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American River Common Features 2016 Flood Risk Management Project, Sacramento, California

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U.S. Army Corps of Engineers
Sacramento District

Central Valley Flood Protection Board

Sacramento Area Flood Control Agency

January 2025

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January 2025

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LIST OF ACRONYMS

Acronym	Definition
ACE	Annual Chance Exceedance
AEP	Annual Exceedance Probability
AOP	Annual Overtopping Probability
ARCF16	American River Common Features 2016
ARMs	American River Mitigation Site
ARPP	American River Parkway Plan
BO	Biological Opinion
CVHS	Central Valley Hydrology Study
cfs	Cubic Feet Per Second
DBH	Diameter at Breast Height
DWR	Department Of Water Resources
EOE	Expert Opinion Elicitation
ER	Engineering Regulation
FDA	Flood Damage Reduction Analysis
FRM	Flood Risk Management
Grr	General Reevaluation Report
HEC	Hydrologic Engineering Center
IWM	Instream-Woody Material
JFP	Joint Federal Project
lar	Lower American River
LDB	Left Descending Bank
LiDAR	Light Detection and Ranging
LMA	Local Maintaining Agency
MCP	Magpie Creek Project
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
MNFS	National Marine Fisheries Service
NPS	National Park Service
OMRR&R	Operations, Maintenance, Repair, Replacement, And Rehabilitation
PDT	Project Delivery Team
PFM	Probable Failure Mode
RM	River Mileage
RTK-GPS	Real-Time Kinematic Global Positioning System

Acronym	Definition
Seir	Supplemental Environmental Impact Report
SEIS	Supplemental Environmental Impact Statement
SPT	Standard Penetration Test
SRFCP	Sacramento River Flood Control Project
SRMS	Sacramento River Mitigation Site
TRAC	Technical Resource Advisory Committee
TOC	Top of Conservation
UNET	Unsteady NETwork Hydraulic Model Program
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
VDD	Vegetation Design Deviation
WRDA	Water Resources Development Act
WRSA	Wild And Scenic Rivers Act

1 INTRODUCTION

1.1 Overview

This engineering appendix provides a summary of engineering investigations, analyses, and design efforts completed to-date to support project components of the American River Common Features 2016 (ARCF16) Project analyzed in this Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR). The SEIS/SEIR is a supplement to the original 2016 ARCF General Re-evaluation Report Final EIS/EIR (2016 ARCF GRR FEIS/EIR).

The ARCF16 Project was originally authorized by Section 101(a)(1)(A) of the Water Resources Development Act (WRDA) 1996, Pub. L. No. 104-303 § 101(a) (1), as amended by Section 366 of WRDA of 1999, Pub. L. No. 106-53, § 366. Additional authority was provided following the interim general reevaluation study in Section 1322(b) of WRDA 2016, Pub. L. No. 114-322 § 1322.

The SEIS/SEIR analyzes design refinements to the authorized Project, including engineering design modifications, footprint expansions, and compensatory habitat mitigation approaches. The design refinements include actions within eight major project components: American River Erosion Contracts 3B, 4A, and 4B; Sacramento River Erosion Contract 3; Magpie Creek Project (MCP), American River Mitigation Site (ARMS); Sacramento River Mitigation Site (SRMS), and installation of a Piezometer Network.

Although the SEIS/SEIR analyzes all the above project features, this appendix will focus on describing and detailing the analyses and efforts specific to the planned erosion protection along both the Lower American River (LAR)[1] and Sacramento River, and the piezometer network proposed to be installed throughout the entirety of the ARCF16 project footprint. The LAR and Sacramento River erosion contracts are described and evaluated at a project-level of detail, except for LAR Contract 4B. LAR Contract 4B and the piezometer network are described and analyzed at a programmatic level of detail because the selected sites for these actions are still early in the planning phase and substantial information is not currently available to accurately describe impacts at a project level of analysis. The engineering analyses required to support the design and construction of these projects varies by project type, project setting, and available existing information and new information acquired during design development. The following sections summarize the engineering analyses developed based on project type and location. These sections include a summary of key sources of information used in the design as well as new studies completed as part of the design process.

1.2 Report Organization

Section 1 of this report provides a summary of information that is consistent between the erosion protection efforts on the Sacramento River and LAR. Section 2 provides a summary of erosion protection efforts on the LAR including additional design criteria to comply with the Wild and Scenic Rivers Act

[1] The Lower American River is the reach of the American River located downstream of Nimbus Dam (River Miles 0-23).

(WSRA), a summary of data used in the site selection and design process, and a review of current designs. Section 3 provides a similar summary of erosion protection efforts on the Sacramento River. Section 4 provides a description of the Piezometer network, while Section 5 includes all references referred to in this appendix.

1.3 ARCF16 Project Background

The Sacramento metropolitan area is one of the most at risk areas for flooding in the United States. There is a high probability that flows in either the American or Sacramento Rivers will stress the network of federal levees protecting the study area to the point that levees could fail. The consequences of such a levee failure would be catastrophic because the inundated area is highly urbanized, and the flooding could be up to 20 feet deep. This section describes the problems addressed by the GRR to reduce flood risk in the Sacramento metropolitan area. The following sections include a description of the flood risk in terms of the probability of flooding and the resulting consequences.

The Sacramento metropolitan area has a high probability of flooding because of its location within the floodplain at the confluence of two major rivers: the Sacramento and Lower American Rivers. Both rivers have large watersheds with very high potential runoff that has overwhelmed the existing flood management system in the past. The existing federal levee system was designed and built many years ago, before modern construction methods were employed. These levees were constructed close to the river to increase velocities in order to flush out hydraulic mining debris. This mining debris has mostly been flushed out of the main river channel by floods over the past several decades, but it remains present in much of the overbank areas of LAR. The high velocities experienced during flood flows easily erode into this mining debris and can quickly put the levee at risk of failure.

1.4 Flood Risk Management System History

Evaluations of storms and floods of record indicate that critical flood-producing conditions in the project area will likely occur during the winter season when there is a wet snowpack and a prolonged series of general storms occurring over the entire basin. Usually, storm precipitation amounts are distributed in the same general pattern as normal annual precipitation amounts. However, major departures from this pattern do occur. Generally, a storm series will last from 2 to 5 days; however, some series have been longer (the 1986 storm lasted 10 days). During such periods, groundwater levels rise, infiltration capacities decline, and the natural and artificial storage within the basin is progressively filled.

Flood flows in the American River basin are rather frequent and of two general types: winter rain-on-snow floods and spring snowmelt floods. Historically, only flood flows resulting from intense winter rainfall over the foothills and mountains have caused serious flooding. Outside the winter season, storms are less severe, cover smaller portions of the basin at a time, and are so widely separated in time that existing basin flood control facilities are usually easily capable of controlling the runoff.

Prior to the construction of levees, the Sacramento River annually would overflow its banks flooding the primarily riparian and wetland habitats of the valley. After levee construction began under the Sacramento Flood Control Project (SRFCP), flows were confined to the river in most areas. Before the bypass system was constructed, levee failures occurred frequently, flooding the previously “reclaimed” areas. After completion of the SRFCP system, which included the bypasses, levee failures still occurred, but only on the more severe flood events.

The SRFCP was designed to pass the known flood of record, which at the time of Congressional authorization, was the 1909 flood. During construction of the system, a new flood of record for a portion of the system occurred in 1927, which was incorporated into the overall system design. After completion of the Federal system in the 1950s, a new flood of record occurred in 1986, followed by the slightly smaller flood of January 1997. The flood of 1986 delivered more water to the leveed reaches than they were designed to carry. On the American River, the four biggest floods occurred after completion of Folsom Dam and the SRFCP. In general, throughout the Sacramento Valley, climatology following the completion of the Federal system has been much wetter with more precipitation than the period that the original design of the system was based upon, and more flow is being delivered to the levee system than it was intended to safely carry.

1.4.1 Past Flood Events

Newspaper accounts and anecdotal evidence mention at least nine major floods prior to 1900, which prompted the construction of spoil bank levees, or non-engineered levees constructed by whatever material was readily available in the immediate vicinity of the construction, across the floodplain. The modern flood control system originated with the Sacramento River Flood Control Project (SRFCP) levees authorized in 1917, the Central Valley Project (including Shasta Dam), the completion of Folsom Dam in 1956, and the completion of Oroville Dam in 1967. In the time since Folsom Dam began operations, large floods on LAR have occurred in 1955, 1964, 1969, 1970, 1982, 1986, 1997, 2006 and 2017. The 1986 flood is the flood of record since the LAR federal levees were completed to their current extents in 1957. Prior to the completion of the LAR federal levees and Folsom Dam, larger floods did pass through the system (e.g., 1951 flood saw 180,000 cfs pass through LAR) since there was no dam on the American River[2] regulating the volume of flood waters on LAR. In these large flood events prior to Folsom Dam construction and the LAR federal levees being fully completed, the flood waters were able to expand further onto the historic floodplains, which reduced flood volumes, river stages, and velocities in the main river channel, and thus there was a lower erosion risk to the communities near the American River than under current conditions. However, the Sacramento area communities were frequently subjected to flooding, prior to the completion of the federal levee system. The federal levee system and dam construction reduced the frequency of flooding, but considering the current levee alignments, which have significantly constrained the rivers and eliminated the ability for flood volumes to spread out over a larger floodplain, has concentrated erosive forces on the river banks and levees, putting the levees at a higher risk of erosion induced failure.

1.4.1.1 February 1986 Flood

In February 1986, a series of storms led to severe flooding in central and northern California. In many areas, precipitation from this 10-day storm delivered more than half of the normal annual precipitation

[2] Use of the term "American River" in this report without the term "Lower" preceding it refers to the American River as whole, both upstream and downstream of Nimbus Dam.

for the area. The Sacramento River flood control system was overloaded and one reservoir in the system (Folsom Dam) was filled beyond its design capacity. Record flow releases from the reservoirs combined with flow from numerous unregulated tributaries to the Sacramento Valley produced river flows that exceeded the design capacity of downstream levees: water encroached into the design freeboard risking overtopping levees throughout the system including those protecting Sacramento. The timely cessation of the storm event prevented overtopping of the American River levees. At the runoff peak, approximately 134,000 cfs was released from Folsom Dam with a combined estimated flow greater than 600,000 cfs passing the Sacramento metropolitan area through the Sacramento River and Yolo Bypass out toward the Sacramento Delta.

Emergency levee work and flood fighting prevented catastrophic flooding. The extended high water caused boils, slips, sloughing, seepage, flood flow erosion, and wave erosion that required emergency work to minimize or prevent further damage during the flood. Several levees upstream from Sacramento failed during this flood. At the conclusion of the storm, the Governor declared emergencies in 39 counties, with damages totaling more than $500 million. Sacramento County had damages estimated at $49 million (1986 dollars): ~$140 million in 2024 dollars.

1.4.1.2 January 1997 Flood

In mid- to late-December 1996, heavy snow fell in the Sierra Nevada Mountains. This was followed by heavy precipitation on the western slope of the mountains. The rain began to fall on December 26, and from December 31 to January 3, an atmospheric river (locally known as a "Pineapple Express") brought approximately 30 inches of rain on the western slopes of the Sierra Nevada, in the process dumping more than half a year's worth of rain on Northern California in 10 days. In addition to the local rainfall, 50°F temperatures and rain in the Sierra Nevada melted the snowpack below 6,000 feet. The combination of record snowfall and record rain resulted in high stream flows around Sacramento. The Sacramento River peaked within half a foot of the 1986 record level. During the 1997 flood event, LAR experienced a peak flow of 117,000 cfs and the Sacramento River experienced a peak flow of 115,000 cfs. Upstream from Sacramento, outside of the study area, levees on the Feather River at Olivehurst and on the Sutter Bypass breached.

1.5 Definitions and Nomenclature

The levees and banks are referred to as *left* and *right* based on an observer looking downstream along the river. On LAR, the *right* bank or levee is also commonly referred to as the *north* levee, while the *left* bank or levee is commonly referred to as the *south* levee. On the Sacramento River, the *left* levee is commonly referred to as the *East* levee. Figure 1-1 shows the terms used to describe the various components of the levee, overbank bench (also referred as just 'overbank' or bench'), and riverbank (or just 'bank') along a typical cross section of the river. *Scour* refers to the lowering of the bed surface by erosive forces, while *erosion* refers to the detachment, entrainment, and transport of bank and levee material.

Overbank bench widths are quantified; however, are referred to qualitatively as "*narrow"* and "*wide"* throughout the document. *Narrow* overbank benches are typically those where the levee template is less than 100 feet from bank toe. *Wide* overbank benches generally refer to locations where the levee template is more than 100 feet from the bank toe.

Levee Template refers to the downward projected levee embankment slopes. When erosion encroaches upon the levee template, there is a higher risk of slope instabilities, which can lead to mass slope failure of the overbank and levee embankment.

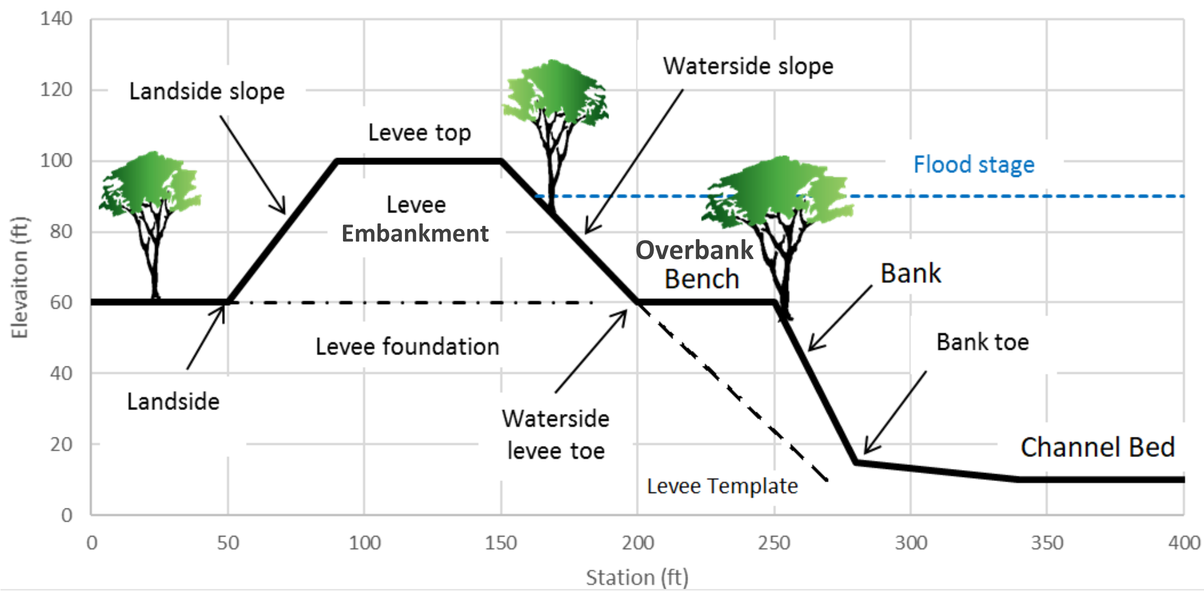

Figure 1-1. Nomenclature for banks and levees.

The analyses used to identify the proposed sites discussed in this document delineated the right and left backlines into river segments. *River Segments* (also referred as just Segments) refer to continuous sections of left or right riverbanks and overbank benches with similar hydraulic conditions, revetment designs, vegetation, as well as riverbank, overbank bench, and levee geometry. Each segment was evaluated for the need for erosion protection and conceptual designs. Adjacent segments that were recommended for erosion protection design that will require common haul routes, staging areas, and design transitions were combined to form design *Sites. Sites* are design or project locations that represent one or more continuous segments that are intended to be designed under a single set of design documents (plans and specifications) and construction contracts. While segments were used to evaluate potential for erosion during the erosion analyses and risk assessment, *Sites* refer to locations where erosion protection is required to address. Sites can include all or parts of individual segments and include adjustments in length for transitioning designs to existing Bankline and/or adjacent revetment designs. The layout of Sites is therefore not always consistent with the extents of segments used in the analysis. Design Sites were further combined into *Contracts,* which were assigned to specific Project Delivery Teams (PDT) within USACE to advance designs to construction.

All elevations referenced in the text are relative to the North American Vertical Datum of 1988 (NAVD88). Data referenced from older reports using the National Geodetic Vertical Datum (NGVD29) were converted to NAVD88 by adding 2.3 feet (NHC, 2013).

1.5.1 Risk and Risk Reduction

Risk is determined by evaluating the probability of a given event occurring in comparison to the consequences caused by that event. Consequences are determined by evaluating economic impacts, life loss, and other factors. High probability storm events that are high consequences are often classified as high risk, and low probability storm events that cause low consequences are generally classified as low risk. Risk Assessments are a process by which these risks are identified and quantified. For the ARCF16 Project, the risks identified pertain specifically to probability of a levee failure occurring and the consequences of a levee failure on the surrounding structures and inhabitants protected by the levee. Along LAR and the Sacramento River, within the ARCF16 Project extents, the consequences of a levee breach would be catastrophic. The flooding would rapidly inundate a highly urbanized area with minimal warning or evacuation time, and these flood waters would be cold, which decreases survivability. The population at risk is upwards of 500,000 people and over 140,000 structures.

The objective of risk reduction efforts is to reduce the likelihood of an identified risk being realized, in a manner which is commensurate with the consequences and is economically and socially acceptable. For the ARCF16 Project, the risk reduction objective is to reduce the likelihood of a levee failure due to overtopping, seepage, stability, and erosion risks. For the content covered in this Engineering Appendix, the specific risks evaluated pertain to erosion induced levee failures. Please refer to Section 1.6 for more information on these identified erosion risks.

1.5.2 Erosion Protection Features

The four key erosion protection features proposed for placement along LAR and the Sacramento River, all forms of rock revetment, are bank protection, launchable trench, launchable (rock) toe, and tiebacks. The definitions and typical applications for each of those four features are provided Table 1-1.

Table 1-1. Types of Erosion Protection Features

Name	Definition	Types seen
Bank Protection	Revetment placed on riverbank or levee embankment/slope.	Soil-filled revetment: Includes soil between and above revetment to establish vegetation on the surface. Soil-filled levee embankment revetment: soil filled revetment placed on the levee embankment. Soil filled riverbank revetment: placed on or near the riverbank. Bank protection without soil fill is typically seen in areas where construction of soil filled revetment would not be feasible, such as in the water.
Launchable Trench	Revetment buried underground that launches to provide flood protection during flood condition where erosion occurs.	Buried, near the levee embankment toe. Buried, on the river overbank typically above the typical wetted channel.

Name	Definition	Types seen
Launchable (Rock) Toe	Revetment placed at waterward face of planting bench or along riverbank that launches when riverbank erodes away during flood conditions.	Launchable toe with planting bench- Placed at the waterward face of a planting bench. Launchable toe- Placed along the riverbank near the riverbank toe. When at riverbank toe, can be included with or without a planting bench.
Tiebacks	Revetment placed perpendicular to the river that impedes erosion from progressing.	Tie-back features are typically incorporated element with erosion features listed above as necessary to meet flood risk measures. Buried Rock Tieback- Placed on its own and installed under the ground. Planting Bench Rock Tie Backs- Placed within planting benches and spaced intermittently.

1.5.3 Design Service Life

The design service life for the improvements implemented as a part of the ARCF16 Project and described in this Engineering Appendix is 50-years. Design service life is the length of time a project will remain in use to provide its intended function. After the design service life expires it is expected the features will require repair or rehabilitation. The 50-year design service life is based on the life cycle established within the 2016 GRR feasibility report.

1.6 Levee Erosion Failure Processes

Levees can fail due to overtopping, erosion, seepage, and under-seepage. The mechanisms by which failure can occur are identified as probable failure modes (PFM's) and developed as part of USACE's risk assessment process. The ARCF16 Project's proposed erosion protection improvement addresses the risk to levee failure due to erosion. On LAR, seepage PFMs were addressed via previous authorizations over the past 25-years; on the Sacramento River, seepage PFMs are being addressed under the ARCF16 Project authorization but are not subject to the scope and content of the SEIS/SEIR and this appendix. "Erosion" in this document refers to the interactive processes causing lateral bank retreat. These processes can include fluvial erosion and soil destabilization. Fluvial erosion refers to dislodgement and removal of soil material by the hydraulic forces exerted by flowing water and/or waves. Soil destabilization has many names, including slope instability, slope stability failure, or mass slope failure. Fluvial erosion can lead to steepening of the riverbank, leading to soil destabilization. Therefore, both fluvial erosion and soil destabilization contribute to the overall erosion process.

Table 1-2 provides a description of several types of fluvial bank erosion mechanisms adapted from the USACE channel rehabilitation manual (U.S. Army Corps of Engineers, 1999).

Table 1-2. Description of fluvial bank erosion processes

Fluvial Process	Typical Conditions or Evidence of Erosion
Parallel flow	Observation of high flow velocities close to the bank; near bank scouring of the bed; under-cutting of the toe/lower bank relative to the bank top; a fresh ragged appearance to the bank face; absence of bank vegetation.
Impinging flow	Observation of high flow velocities approaching the bank at an acute angle; bars directing flow toward the bank; tight meander bends; strong eddying adjacent to the bank; near-bank scouring of the bed; under-cutting of the lower bank; ragged appearance to the face; absence of vegetation.
Scour	Local riverbed lowering near the bank and/or levee toe due to local scour processes or channel incision. Scour may cause translational sliding of the upper bank, particularly when revetment has been placed, leaving scars on the bank. Local bed scour occurs around obstructions and scour holes are often visible where flow dives over or around spurs, intakes, or other bank features.
Wind-generated waves	Large channel width or long, straight channel with an acute angle between eroding bank and long stream direction; a wave-cut notch just above normal lower water plane; a wave-cut platform or run-up beach around normal low-water plane.
Vessel-generated waves	Use of river for navigation; large vessels moving close to the bank; high speeds and observation of significant vessel-induced waves and surges; a wave-cut notch just above the normal low-water plane; a wave-cut platform or "spending" beach around normal low-water plane.

Table 1-3 provides descriptions of soil destabilization adapted from the USACE channel rehabilitation manual (U.S. Army Corps of Engineers, 1999).

Table 1-3. Description of soil destabilization

Failure Process	Typical Conditions or Evidence of Failure
Rotational Slips	Banks formed in cohesive soils; high, but not especially steep banks; deep seated, curved failure scars; back-tilting of the top of failure blocks toward intact banks; arcuate shape to intact bank line behind failure mass; tension cracks or openings in soil behind mass.
Planar Slips	Weakly cohesive bank materials; thin slide layers relative to their area; planar failure surface; no rotation or toppling of failure mass; ragged edge at detachment point.
Cantilever failure	Composite or layered bank stratigraphy; cohesive layer underlain by less resistant layer; under-mining; overhanging bank blocks; failed blocks on the lower bank and at the toe.
Slab type block failures	Cohesive bank materials; steep bank angles; deep seated failure surface with a planar lower slope and nearly vertical upper slope; deep tension cracks behind the bank-line; forward tilting failure mass into channel; planar shape to intact bank-line behind failure mass.
Piping failures	Pronounced seep lines, especially along sand layers or lenses in the bank as indicated by vegetation; pipe shaped cavities in the bank; notches in the bank associated with seepage zones; run-out deposits of eroded material on the lower bank.

For the purposes of this report, levee overtopping is identified as PFM 1. When evaluating the risk posed by other PFMs (such as erosion and seepage), they are all evaluated in comparison to PFM 1. The rationale behind this is that there should be a high degree of certainty that the levees will not fail prior to them being overtopped (i.e., levee breach prior to overtopping). Essentially, the risk reduction objective when addressing PFMs for a levee breach prior to overtopping is to ensure that the probability of a levee breach occurring prior to the levee being overtopped is significantly lower than the probability of the levee being overtopped. Also, the measures implemented to address PFMs for breach prior to overtopping must not increase the probability of the levee being overtopped.

Fluvial erosion risks are captured by PFM 2 and PFM 3, which are defined below:

PFM 2: Erosion of the levee leading to a levee breach. If the velocity and duration of flows are higher than the predicted resistance of the soils and vegetation, then erosion of the levee is expected. Erosion can narrow the width of the levee until a breach occurs. The total width of levee lost can be predicted based on soil type, applied hydraulic force, and flood duration.

PFM 3: Erosion of the levee foundation (typically from bank erosion at the bank or bank toe) resulting in soil destabilization affecting the levee. If the velocity and duration of flows are higher than the predicted resistance of the soils and vegetation, then erosion of the levee foundation is expected. Erosion of the levee foundation generally occurs at the riverbank toe where fluvial forces are highest. During long duration floods, this riverbank toe erosion can progress closer to, and eventually into/below, the levee embankment, which can ultimately lead to failure of the levee. PFM 3 erosion doesn't need erode into/below the levee embankment to induce a failure, either; in instances where the erosion progresses into the levee template (also referred as the levee prism) (see Figure 1-1), it can lead to instability of the bank. This bank instability can result in a slope failure that eliminates a significant portion of the levee embankment that ultimately leads to a levee breach.

Scour (the process of water removing soil to create a vertical depression) may occur in the channel and/or along bank toes, steepening banks and increasing bank heights. Plant roots typically do not extend more than a few inches to a few feet into the soil column and are highly affected by river water levels. If soils beneath the vegetation are lost, the vegetation above can be destabilized. For example, grass on a steep slope of sand will easily be lost if the sand beneath it is washed away. The design team assessed the potential for slope instability by collecting topographic and soil data to create slope stability computer models. These models were peer reviewed and checked by multiple engineers and geologists as part of USACE's technical review process.

1.7 Design Criteria and Standards

For both LAR and the Sacramento River, there are common design criteria and standards applicable to both river systems. These common criteria and standards are described below. However, LAR has a unique subset of criteria and standards the proposed designs must adhere to. These unique LAR criteria and standards are described Section 2.2.

1.7.1 Public Safety Objectives

USACE is responsible for managing a portfolio of dams and levees across the nation. USACE uses risk assessments and risk-informed design to ensure risk to public safety is minimized, (commonly referred to as risk reduction). Risk assessments identify risk drivers, which are events and processes that result in life loss and/or economic loss. The primary (and approximately equal) risk drivers for flooding from the American and Sacramento Rivers into areas protected by the federal levee system are levee breach prior to levee overtopping due to erosion (i.e., PFM 2 and 3) and overtopping of the levees (i.e., PFM 1). The overarching objective of the ARCF 2016 erosion protection improvements is to reduce the probability of PFM 2 and 3 induced levee failures for flows up to the discharge of 160,000 cubic feet per second (cfs) on the LAR and up to 117,000 cfs on the Sacramento River without increasing the risk of PFM 1, which could occur if the river is overly constricted by additions of engineered structures within the channel. The design team consistently balances these objectives by ensuring that engineered structures within the channel will not overly constrict the channel but still adequately address the erosion risks and meet habitat mitigation requirements. Engineered structures include erosion protection features such as elements defined in Section 1.5.1 above and on-site habitat mitigation features such as planting benches, in-stream woody material and a replanting plan.

1.7.2 Design Standards

Analyses and designs were completed in accordance with USACE-prescribed standards and guidelines. Table 1-4 summarizes some of the pertinent USACE Engineering Manuals and Reports that were referenced during the design process.

Table 1-4. USACE engineering manuals and reports referenced for design development.

Manual	Date	Title
EM 1110-2-1601	June 30, 1994	Hydraulic Design of Flood Control Channels
EM 1110-2-1418	October 31, 1994	Channel Stability Assessment for Flood Control Projects
EM 1110-2-1913	April 30, 2000	Design and Construction of Levees
EM 1110-2-1614	June 30, 1995	Design of Coastal Revetments, Seawalls and Bulkheads
EM 1110-2-2302	October 24, 1990	Construction with Large Stone
ER 1110-2-1405	September 30, 1982	Hydraulic Design for Local Flood Protection Projects
EP 1110-2-18	May 1, 2019	Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures
ECB 2022-7	October 20, 2022	Interim Approach for Risk-Informed Designs for Dam and Levee Projects.

Table 1-5 summarizes other manuals and documents that were considered during the design process. These documents, plus other technical documents referred to in the text, such as State and Local requirements, were used to supplement USACE criteria. Several documents listed were considered to aid avoiding and minimizing impacts to sensitive environmental conditions to the greatest extent possible. General operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) criteria for the project are set forth in the Standard Operations and Maintenance Manual for the Sacramento River Flood Control Project (U.S. Army Corps of Engineers, 1955); and each levee unit's respective Supplement to the Standard Manual.

Table 1-5. Other manuals and documents referenced for design development.

Source	Year	Title
California Central Valley Flood Protection Board	2017	Central Valley Flood Protection Plan's Conservation Strategy
California Department of Water Resources	2012	Urban Levee Design Criteria
California Legislature	1972	State WSRA (PRC Section 5093.50-5093.70)
Federal Highway Administration National Highway Institute Countermeasures	2009	Hydraulic Engineering Circular No. 23: Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition
Federal Highway Administration National Highway Institute Countermeasures	2012	Hydraulic Engineering Circular No. 18: Evaluating Scour at Bridges-Fifth Edition
NOAA National Marine Fisheries Service	2021 (Amended the 2015)	Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and management Act Essential Fish Habitat Response, for the American River Common Features General Re-evaluation Report
Public Law 90-542; 16 U.S.C. 1271	1968	Federal WSRA
Sacramento Area Flood Control Agency	2010	Instream Woody Material Installation and Monitoring Guidance Manual
Sacramento County	2008	American River Parkway Plan
US Fish and Wildlife Service	2021 (Amended the 2015)	American River Common Features Project Biological Opinion
USACE, Sacramento District	2015	American River Common Features General Revaluation Report
USACE, Sacramento District	2007	American River Common Features American River Levee Raising Sacramento County, California Top of Levee Profile and Design Documentation Report
USACE, Sacramento District	2008	Geotechnical Levee Practice REFP10L0
USACE, Sacramento District	2007	Geotechnical Levee Practice SOP-EDG03

1.7.3 Biological Opinions

In the biological assessment for consultation under Section 7 of the Endangered Species Act, USACE proposed minimization measures, including mitigation, to minimize and offset effects of the Proposed Action on federally listed fish species The United States Fish and Wildlife Service (USFWS) issued a 2021 Biological Opinion (BO) for the American River Common Features Project including Incidental Take for Delta Smelt (*Hypomesus transpacificus*) (on the Sacramento River), the Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) and the Western Yellow-billed Cuckoo (*Coccyzus americanus*). The National Marine Fisheries Service (NMFS) issued a 2021 BO for Sacramento River winter-run and Central Valley spring-run Chinook Salmon (*Oncorhynchus tshawytscha*), Green Sturgeon (*Acipenser medirostris*) (on the Sacramento River), and Steelhead (*O. mykiss*). The USFWS BO established Conservation Measures and Terms and Conditions for the Project, while the NMFS BO established numerous Conservation and Avoidance Actions, Reasonable and Prudent Measures, Terms and Conditions, and Conservation Recommendations. Key to selection of sites and designs, one of the Terms and Conditions of the NMFS BO required USACE to work with an interagency working group to coordinate stakeholder input to deliberate proposed bank protection designs including intent, purpose, and proposed designs with emphasis on fish friendly designs.

Consultation under Section 7 of the Endangered Species Act for new impacts to special status species, since the Amended 2021 BO's, is ongoing between USACE and the resource agencies at the time of drafting this appendix. New BO's will be issued to USACE from USFWS and NMFS for incorporation into the Final SEIS/SEIR and are expected in early 2025.

1.7.4 Erosion Protection Design Alternatives

During the feasibility study documented in the GRR (U.S. Army Corps of Engineers, 2015 (Revised 2016)), a number of design alternatives for addressing the erosion risks, such as waterside armoring of the levees, launchable rock trenches, bioengineering solutions, grade control structures (i.e., a structure that reduces flow velocities), along both LAR and the Sacramento River were considered. Setback levees, (realignment of levees further from the river channel) were not considered during feasibility due to the heavy residential and commercial development, which exists immediately adjacent to the levees along both rivers. The impacts to the surrounding communities by setback levees would be too great for setback levees to be considered a viable alternative.

The GRR determined waterside armoring of the levees (bank protection), launchable rock trenches, and bioengineering solutions could all be effective methods of reducing erosion potential on the levees. However, bioengineering solutions were only considered viable in areas where a wide natural bank exists on the river, but it could not be used on levee slopes. Grade control structures were determined not to be a viable alternative because analyses of the erosion potential of the riverbeds determined this erosion potential was not a significant risk during the 50-year design life period of analysis. The GRR's final alternatives array for erosion protection measures included bank protection, launchable rock trenches, and bioengineering solutions. These three alternatives were the alternative measures carried forward into the design development phase following authorization of the ARCF16 Project in 2016.

1.7.4.1 Application of Bioengineering Alternatives

Bioengineering erosion protection measures provide an alternative erosion protection solution to traditional bank protection measures, the latter of which typically use substantial amounts of rock revetment. Per USACE's Engineering Research and Development Center (ERDC):

> "*Bioengineering is the combination of biological, mechanical, and ecological concepts to control erosion and stabilize soil through the use of vegetation or a combination of it and construction materials. Both living and nonliving plants can be used. Nonliving plants are used as construction materials, similar to engineered materials.*" (U.S. Army Corps of Engineers, 1997).

For LAR, during the conceptual erosion protection design development phase, bioengineering solutions were considered for use in appropriate locations where the overbank is wide enough to support and justify use of such measures. For example, in LAR Contract 2, which was constructed in 2022 and 2023, bioengineering solutions were considered at a site immediately downstream of Howe Avenue; however, during consultation with resources agencies on the use of these bioengineering solutions there were significant concerns about the longevity of the bioengineering solutions and the impacts repair and replacement of these solutions would have on the on-site mitigation plants and habitat. For these reasons, bioengineering erosion protection solutions were not used on any of the constructed sites to-date, nor are they being proposed in any of the erosion protection measures subject to the contents of this Engineering Appendix (see Section 2.5).

For the Sacramento River, bioengineering erosion protection measures have been incorporated into Sacramento River Erosion Contract 4 (constructed in 2024). However, because of the lack of sufficient overbank width for most of the Sacramento River in the ARCF16 Project area and because of the nature of the erosion being addressed, bioengineering solutions were determined not to be viable for use in the proposed Sacramento River Erosion Contract 3 subject to the contents of this Engineering Appendix (see Section 3.4).

1.7.5 General Design Approach

USACE's general design approach is focused on balancing multiple project objectives (e.g., achieving public safety requirements and minimizing environmental impacts). Design concepts (i.e. 10% designs) developed since late 2019 have been further refined and reviewed incrementally with formal review from multiple disciplines, project partners, and stakeholders occurring at the 35%, 65%, 95% design phases to date for LAR and the Sacramento River (as further described in Sections 2 and 3, respectively).

A sequential overview of the design process to meet design objectives is laid out below.

a) Incorporating a panel of local, regional, and national experts to identify erosion hazards and drivers for sections of the river that share common site characteristics.
b) Incorporating a panel of local, regional, and national experts to identify habitat, cultural and recreational resources, mitigation requirements and compliance needs both on a program and project level.

c) Through a consortium of ecologists, biologists, landscape architects, geomorphologists, hydraulic and geotechnical engineers across local, state, and federal agencies, developed, weighed, and selected a preferred concept alternative on a local river segment level for the design team to advance.
d) Developed comprehensive design criteria to guide and control design outcomes.
e) Developed a suite of analysis tools across design disciplines to support design layout, assess associated impacts and provide design justification.
f) Collected data to support analysis tools needed.
g) Collaborated and engaged with project partners on a local, state, and national level and included subject matter experts across all design phases.
h) Included a robust review charge for the design team to follow. Reviews included local, regional, and national experts internal and external to USACE to identify fatal flaws or recommendations for design refinement.
i) Design review included risk informed design process to arrive at the minimal design footprint to meet flood risk objectives.
j) Each design phase included a detailed assessment of habitat impacts.
k) CAD layout of proposed features included direct use of collected habitat, recreational and cultural datasets to minimize impacts.
l) During design phases, proposed erosion footprints were assessed in the field and modified where plausible to avoid sensitive habitat, recreational and cultural amenities.
m) Each design phase included documentation of supporting design analysis, proposed design layout and impact assessment.
n) Addressed review comments in subsequent design phase.

1.7.6 Summary of Design Criteria

Erosion protection is targeted to locations where there is an unacceptably high risk of erosion induced levee failure during the life of the project. Below list provides critical criteria each design must adhere to.

- Erosion protection designs cannot increase water surface levels during high flow events such that they may increase the potential for levee overtopping (i.e., PFM 1).
- Erosion protection designs must limit the footprint and impact to only what is necessary to meet public safety objectives.
- Erosion protection projects must be developed in consultation with inter-agency working groups.
- Erosion protection projects must incorporate as much on-site habitat and recreational mitigation as feasible to offset impacts caused by construction and installation of the erosion protection.

1.8 Site Evaluations and Selection

The 2016 ARCF GRR deferred erosion protection site selection to the design development phase, as additional analysis was needed to identify and prioritize sites needing erosion countermeasures. To meet the project needs, a two-phase site selection process was adopted to ensure that critical erosion countermeasures were identified, designed, and constructed quickly to provide additional protection to Sacramento while ensuring that areas needing erosion countermeasures are not overlooked or that unnecessary erosion countermeasure construction is avoided.

The Phase I analysis included an expert opinion elicitation (EOE) based on existing data and preliminary analysis to develop initial recommendations for sites to include erosion countermeasures. This analysis looked at a range of high flow events up to the design flow and provided recommendations for additional erosion protection on the expected performance of the site. The Phase I evaluation identified key sites where erosion protection was immediately required to convey the design flow, locations where erosion protection may be required in the future to convey the design flow, and locations where erosion protection was unlikely to be required either now or in the future.

The Phase II analysis included additional studies to expand on the preliminary studies used in the Phase I analysis. These studies included detailed assessments of existing revetment on both rivers and ongoing improvements to the hydraulic models on both rivers. On the LAR, the Phase II analysis also included field investigations to gather additional geologic information, and detailed model studies to improve estimates of potential lateral bank retreat. The Phase II analysis culminated with a baseline risk assessment to identify a probability of failure at each segment following USACE criteria. The results of the Phase I and Phase II evaluations were used in the final decision by USACE Sacramento District to determine where erosion protection was needed to meet overall project objectives. The evaluations and ultimate final selection of where erosion improvements were determined necessary resulted in a total of 6 miles erosion improvements along LAR, reduced from 11 miles estimated in the GRR, and a total of 6.5 miles of erosion improvements along the Sacramento River, reduced from 10 miles estimated in the GRR.

1.8.1 Phase I Site Evaluations –Identification of Initial Sites

A consultant contracted by the Project Partners, facilitated an EOE to estimate probability of levee failure because of erosion. The EOE panel consisted of local experts with experience working on the LAR and Sacramento River systems, representatives from the California Department of Water Resources (DWR), as well as national experts from USACE. The panel included hydraulic engineers, geotechnical engineers, geo-scientists, and ecologists. The panel evaluated individual segments that were identified in previous erosion assessments. The erosion assessments included a summary of existing data for each segment. After discussion of segment conditions and assignment of a probability of failure, the expert panel then designated each segment as Tier 1, Tier 2, or Tier 3, which were defined as:

- Tier 1—Segments that have the highest risk of erosion and are subject to an immediate threat to the levees during high flows.
- Tier 2—Segments that are not subject to an immediate threat to the levee but are anticipated to reach that condition after one or more high flow events (during the 50-year design life of the project).
- Tier 3—Remaining segments that are not considered subject to an erosion threat that could lead to levee breach (during the 50-year design life of the project).

Results of the EOE and resulting segment rankings can be found in Section 2.4.1 for LAR and Section 3.3.1 for the Sacramento River.

1.8.2 Phase II Site Evaluations - Identification of Remaining Sites

The Phase II site evaluations built upon the Phase I evaluations by incorporating new data and analysis, which reduced uncertainty in the evaluation process. New data and analysis included:

1) A new 2D hydraulic model using the USACE HEC-RAS software (see Sections 2.3.3 and 3.2.3).
2) New project-specific soil sampling and testing (see Sections 2.3.4 and 3.2.4).
3) An existing revetment condition assessment (see Sections 2.3.7and 3.2.5).
4) New probabilistic bank retreat estimates using the new project-specific soil properties at segments deemed as moderate to high overall erosion potential was completed on the LAR (see Section 2.3.10).
5) Evaluating erosion induced levee breach risk for each levee segment by a risk assessment team.

Consistent with USACE Engineering Regulation (ER) 1105-2-101, risk assessment teams, composed of a USACE Risk Cadre, Sacramento District PDT members, and SAFCA and DWR representatives (experts who also participated in the Phase I evaluations), re-evaluated the risk of erosion failure at each segment under baseline (pre-project) conditions using the new data and analysis. Risk Cadre teams are multi-disciplinary teams within USACE with special training in risk assessments that assess USACE infrastructure across the nation. The Risk Cadre team completing the baseline risk assessment had previously completed a risk assessment of the LAR and Sacramento River systems to support the GRR and had foundational knowledge of both river systems.

The team used event trees[3] for PFM 2 and 3, previously defined during the baseline risk assessment, that would lead to levee failure. This included an assumption that if a flaw exists it would result in exposure of erodible soils (This could result from either failure of vegetal cover due to excessive hydraulic force, mass slope failure based on instability of the riverbank or levee embankment toe, tree-fall, or other site specific conditions), erosion of bank soils (erosion initiation), erosion extending into the levee template (erosion progression), the potential for intervention such as flood fighting to arrest the erosion, and finally a levee breach occurring in an eroded condition. The risk assessment teams evaluated PFM 2 fluvial erosion of the levee and PFM 3 fluvial erosion of the levee foundation event trees (see section 1.6) at each segment defined in the erosion assessments to determine the likelihood of levee failure during a single large storm event. Segments with unacceptably high risk for failure due to erosion were recommended for repair. Key risk driving attributes at individual segments that led to high-risk ratings were identified to be addressed during design.

[3] An event tree is an analytical technique for modeling a system or sequence of events. It is a sequence of nodes and branches that describe the possible outcomes of an initiating event. Each unique pathway through the tree describes a unique sequence of events that could result from the initiating event.

1.9 Long-Term Levee System Monitoring

Long-term Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) of the levee systems and their flood risk management features (i.e., within the ARCF16 Project) is the responsibility of the project partners (CVFPB, DWR, & SAFCA). This responsibility is delegated by the project partners to Local Maintaining Agencies (LMA). Within the ARCF16 Project footprint, these LMAs include the American River Flood Control District, the City of Sacramento, and DWR Maintenance Area 9. The LMAs are charged with regularly inspecting the flood risk management (FRM) features throughout a given year, patrolling and monitoring the levees within their area of responsibility during high water events, and implementing repairs to the levee system as determined necessary based on the LMAs regular inspections and periodic inspections performed by USACE Sacramento District.

Patrolling and monitoring of the levees during high water events is triggered based on river elevations, or stages, as read at key stream gages throughout the levee system. These stream gages are a critical piece of infrastructure owned and operated by the DWR, which provides real-time data on current river stage and flow conditions of rivers and streams throughout the State. When a given river stream gage reaches a predesignated “Monitoring” elevation, the LMA for that levee system is required to begin regular, daily patrols of the levees along that river. The information these gages provide is critical not only for annual monitoring performed by the LMAs, but it also provides a record of river conditions, which hydraulic engineers can utilize to calibrate their analytical models and ensure their model’s outputs provide reasonable and accurate results.

1.9.1 Piezometer Network

Similar to the stream gage network described above, the planned ARCF16 piezometer network would provide critical, real-time information on groundwater conditions in and around a given levee. The information from these piezometers can be used by LMAs to monitor current performance of the levees during high water conditions and can be used by engineers in future analysis efforts to calibrate additional analytical models, such as seepage analysis models. The data gathered by the piezometers would be a vital tool in evaluating future risks to the levee system and allow engineers to better refine and minimize future projects that may become necessary if, based on future needs, performance of the current levees is determined to be inadequate. For more information on the planned piezometer network, please refer to Section 4 of this document.

2 LOWER AMERICAN RIVER EROSION PROTECTION

2.1 Background

The LAR federal levees were originally intended to convey a release from Folsom Dam of 115,000 cubic feet per second (cfs). During several events since the construction of Folsom Dam, flows have equaled or exceeded the design capacity and caused significant erosion distress. All four significant flood events since the completion of the Federal flood control system in the mid 1950s (1955, 1966, 1986, and 1997) caused considerable damage to the LAR levee system due to erosion. The 1986 event had an imminent threat of levee failure. In addition, all four events required extensive repair after the event so the LAR levee system could perform for the next major event. Based on past performance and recent investigations, erosion is a serious threat to the LAR levees that must be addressed considering the consequences of a levee failure along LAR.

Section 2 of this section provides a summary of past performance of the levees along LAR and a detailed summary the proposed erosion protection design efforts on LAR under the ARCF16 Project. LAR is designated as a Wild and Scenic River under the federal and state of California WSRAs. Section 2.2 summarizes the LAR specific design criteria used to identify the sites for repair and develop designs. Section 2.3 includes a summary of key data sources relied on in the site identification and design, as well as a summary of tools developed for analysis. Section 2.4 provides a summary of how sites requiring improvements were identified. Section 2.5 summarizes the design process and designs at each location in LAR Contracts 3B, 4A, and 4B. Section 2.6 summarizes the implementation process for the proposed projects.

2.1.1 Historical Performance

The history of the American River has been significantly impacted by human activity. During the California Gold Rush of 1849 to 1864, the foothills upstream of the river were mined hydraulically, resulting in millions of cubic yards of mining debris being sent down LAR. The hydraulic mining caused approximately 15 to 20 ft of aggradation in the project reach. Dredge mining for gold caused alignment changes to the floodplain and in-channel bars and significantly altered the topography. Subsequent sand and gravel mining in the river and floodplain resulted in the development of split flow reaches. In 1864, a rechanneling project moved the downstream end of LAR to its present location from an alignment, which ran roughly through the Union Pacific rail yard. In the 1950's, the construction of Folsom Dam (RM 30) and Nimbus Dam (RM 23) essentially eliminated the sediment supply from the upper watershed, causing the lower reaches of LAR to become sediment starved and a lowering, or down cutting, of the river channel invert.

Construction of the south levee of LAR started around 1850 and was completed in the 1910's. Construction of the north levee of LAR, located between the Sacramento River and about RM 5 (near Cal Expo), occurred in the 1910's. Construction of the remainder of the north levee, upstream of Cal Expo extending to RM 14, occurred between 1955 and 1957.

In 1955, the American River experienced the flood of record. This is an important flood event in that of the 1 million acre-feet reservoir at Folsom Dam (only 400,000 acre-feet of reservoir capacity is allocated to flood control) was filled in a single event. The peak release from this flood event was 115,000 cfs. Soon after this flood event, the flood magnitude was factored into the hydrology for Folsom Dam operations, which led to the level of protection provided by Folsom Dam being considerably lowered.

Sacramento experienced significant flood events again in 1964, 1986, 1997 and 2017. The 1964 flood event was the first time the complete LAR levee system was tested with a flow of 115,000 cfs. The 1964 flood event showed considerable stress on the levee system for a flow of 115,000 cfs. An emergency flood-fight along the left bank of LAR near H Street was required to pass the flood event.

The 1986 flood event is significant in that it required a peak release from Folsom Dam of 134,000 cfs in order to avoid a dam failure. The peak flow was passed without a levee failure, but two locations were in the process of failing as flows were receding. Figure 2-1 shows one of these erosion sites located just upstream of the Capital City Freeway. Had the discharge sustained longer, the levee would have likely failed from erosion.

Figure 2-1. Left bank levee and riverbank erosion from 1986 flood event (134,000 cfs) upstream of Capital City Freeway

In 1997, the Sacramento and San Joaquin River systems experienced record flooding and a number of levee breaks. However, in the American River watershed, Folsom Lake experienced a peak inflow of 255,000 cfs and was able to control it to slightly above the 115,000 cfs objective release at a flow of 117,000 cfs down LAR, with 28 percent of the flood management storage available at the peak of the storm. Nonetheless, significant erosion occurred at five sites along LAR, which required immediate repair following the flood event. These repairs were accomplished under the SRBPP.

All four significant flood events since completion of the federal flood control system in the mid 1950's (1955, 1964, 1986, and 1997) caused considerable damage to the levee system because of erosion. After each of these four flood events extensive erosion repairs were necessary so the system was ready for the next major flood event. In addition, erosion also occurred during a flood event in 2006 with a peak flow of just 37,000 cfs. For example, on the left (south) bank upstream of Watt Avenue erosion sites developed at RM 10.0 and 10.6 that were repaired under the SRBPP in 2011. The extensive number of erosion repairs constructed prior to the ARCF16 project's authorization are depicted in Figure 2-4.

2.1.2 Folsom Dam Historical Performance

Folsom Dam is located along the American River, approximately 26 miles upstream from the confluence with the Sacramento River. Folsom Lake is the largest reservoir in the American River watershed with a gross pool capacity of 967,000 acre-feet. In conjunction with levees on LAR and the Sacramento River and other system improvements, Folsom Dam and Lake provides FRM for the greater Sacramento area. Construction of the Folsom Dam and Lake project was completed by the Corps in 1956. The project was transferred to the Bureau of Reclamation (Reclamation) for operation and maintenance as part of the Central Valley Project. Reclamation operates Folsom Dam for FRM with criteria established by USACE, along with other authorized purposes such as hydropower, recreation, and water supply.

A flood of record on the American River watershed in 1986 seriously taxed both the control of Folsom Dam and the downstream LAR levee system and showed that there was a much greater flood risk to the Sacramento area than previously estimated based on observed inflows during the 1986 flood event. Because of that flood, USACE conducted several studies under the authority of the Flood Control Act of 1962 (Pub. L. 87-874). These hydrologic studies demonstrated that relative to the size of the American River watershed and the watershed's flood potential, Folsom Dam was too small to adequately accommodate potential flood inflows and protect the downstream communities. Based on that understanding, it was determined improvements to the Folsom Reservoir's storage capacity and Folsom Dam's outlet works were required.

2.1.3 Folsom Dam Operation Improvements

The existing configuration of Folsom Dam is such that the lower-level outlets are at elevation 280 feet; the spillway sill is at elevation 418 feet, and the bottom of the 400,000 acre-feet permanent flood control pool is at elevation 427 feet. Because of this configuration, only 30,000 cfs can be released until the stage in the reservoir reaches the spillway. The objective release for Folsom Dam is 115,000 cfs. However, prior to construction of the auxiliary spillway, this amount of flow could not be released until the stage was sufficiently high enough above the spillway to force it through the spillway. With this configuration and with the levees downstream of Folsom Dam only able to reliably convey 115,000 cfs, the level of flood protection was relatively low as compared to other similar sized cities throughout the country.

The Folsom Dam flood pool is the portion of reservoir space to be reserved (kept empty) for the purpose of maintaining a target level of downstream flood protection. It is bounded on the bottom by the top of the conservation (TOC) pool, which can vary by date or as a function of watershed state. When water is stored above TOC, the reservoir is said to be encroached. When encroached, water is released as rapidly as possible subject to operational and physical constraints. Under "normal" flood operations, releases are made for the purpose of providing downstream flood protection by safely conveying releases in the downstream leveed channel. The maximum release that can be made under routine flood operations is the normal objective release of 115,000 cfs, and the maximum allowable pool elevation for normal flood operations is the top of flood pool (bottom of surcharge pool) at 468.34 feet NAVD88. Once the objective release is being made, if the combination of current inflow and pool elevation are sufficiently great, the Emergency Spillway Release can require releases greater than 115,000 cfs. When under an emergency spillway release condition, “emergency” flood operations are in effect and releases are made to prevent the dam from overtopping. The greatest release that can be made without overtopping downstream levees is the emergency objective release of 160,000 cfs; however, emergency spillway releases can greatly exceed the emergency objective release if necessary to prevent a dam failure.

Because of the downstream constraint imposed by the inability of the LAR levees to safely convey the 160,000 cfs flow release, benefits provided by the Folsom Dam improvements cannot be fully realized. Furthermore, until the LAR levees are able to safely convey 160,000 cfs, Folsom Dam will remain at a greater risk of overtopping and overtopping induced failure, as evidenced by the 1986 flood event and subsequent hydrological studies, which determined the 115,000 cfs release capacity to be inadequate to manage the flood potential within the American River watershed. For this reason, the design flow along LAR is the emergency objective release from Folsom Dam of 160,000 cfs.

To help illustrate the critical benefits provided by releasing 160,000 cfs from Folsom Dam we can compare the storage capacity maintained by releasing the additional 45,000 cfs above 115,000 cfs to the benefits provided by the Folsom Dam Raise project. The Dam Raise improvements currently under design and construction will decrease downstream flood risk by adding approximately 45,000 acre-feet of surcharge storage. Over a one-day period the ability to release the emergency objective release of 160,000 cfs, rather than the normal objective release of 115,000 cfs, evacuates approximately 90,000 acre-feet of water from Folsom reservoir, double the additional storage provided by the Dam Raise improvements. In other words, every single 24-hour period that the Dam releases 160,000 cfs releases an equivalent of two Dam Raise storage capacities more than the 115,000 cfs release. Together, the Dam Raise improvements and ability to release 160,000 cfs will combine to significantly reduces downstream flood risk and increase the reliability of the overall American River flood control system.

2.1.4 LAR River Mileage

River mileage (RM) is measured from the mouth of LAR along its centerline, with mile zero located at the junction with the Sacramento River. The reference mile markers used in this study are from the USACE Comprehensive Study Unsteady NETwork (UNET) model. They have also been used in other studies recently prepared for USACE and are considered the most consistent set of markers. River mileage is used to bound subreaches and sites, but the references are not intended to be precise.

Mileage markers shown on United State Geologic Survey (USGS) quadrangle maps (1:24,000) differ from those prepared by USACE. The USGS markers match the USACE markers near the mouth but fall short of the USACE markers further upstream. This shift results in USGS RM 16 marker being about 2,000 feet (0.4 miles) downstream of USACE RM 16. Mileage references in older reports do not always refer to the current USACE or USGS mile markers. Care is required when using mileage references in older documents to locate sites relative to the current USACE markers.

2.1.5 LAR Definition and Nomenclature

LAR was divided into four planning subreaches as shown in Figure 2-2. Design or Project sites (e.g., Site 3-1) are referred to by the Subreach they are predominately located in (e.g., Site 3-1 is in Subreach 3). Subreaches were initially evaluated individually, and segments were numbered sequentially in each subreach (e.g., each subreach has a Segment 1). As the study progressed, design sites were evaluated comprehensively requiring discussion of segments in different subreaches to be discussed. Segments are now often referred to with similar nomenclature as design sites by referring to the subreach and then the segment number (Segment 3-9 refers to Segment 9 in Subreach 3).

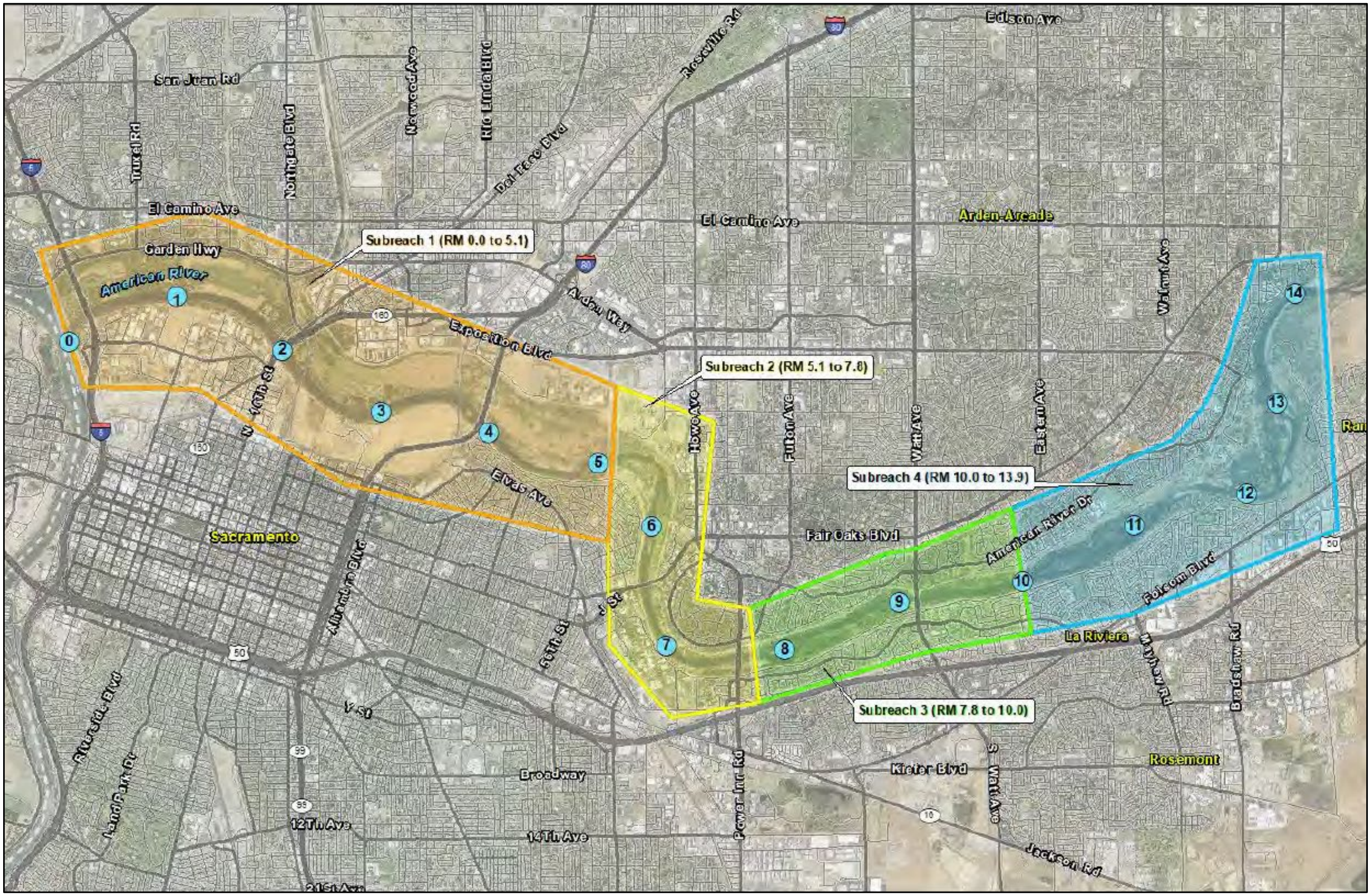

Figure 2-2. LAR Subreach locations

2.1.6 LAR Contracts 1 and 2

The designs developed for LAR Contracts 1 and 2 (see location map shown in Figure 2-3) were unique and necessary to address the high erosion risk specific to that location along LAR. Site evaluations of LAR determined the left bank along this reach (Subreach 2) of the river between Paradise Beach and Guy West Bridge had the highest erosion risk along the entirety of the leveed portion of LAR. Conditions that contributed to this determination included highest flow velocities along the entire leveed portion of LAR, narrowest section along LAR between the two levees (approximately only 750-feet wide), proximity of the main river channel to the levee (i.e., little to no overbank on the left side of the channel), and poor soil composition of the levee and overbank. For more information on the site evaluation and selection process, please refer to Section 2.4.

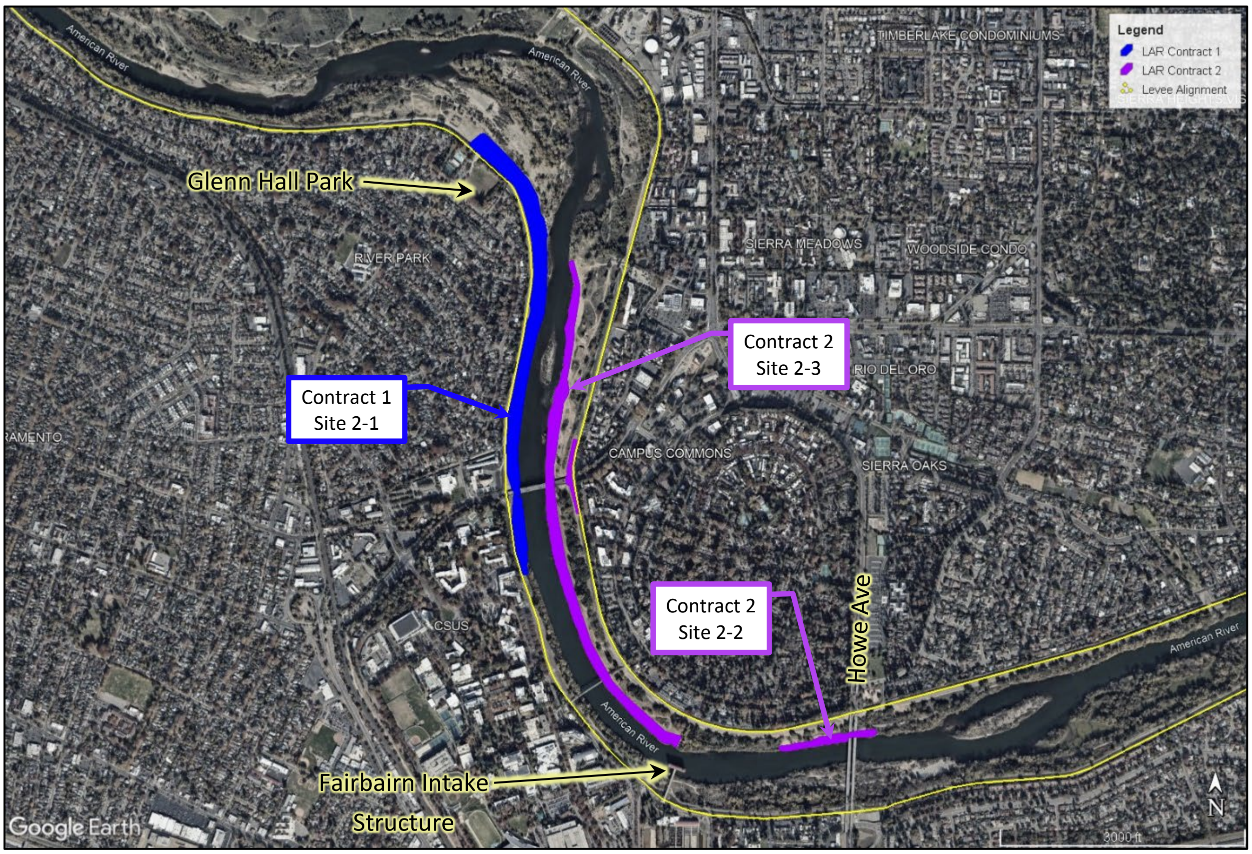

Figure 2-3. LAR Contracts 1 and 2 Location Map

At both Site 2-1 and 2-3, the high velocities resulting from the already constrained (narrow) floodplain at this location created a rise in water surface elevation for fill placed within the channel. The Technical Resource Advisory Committee (TRAC) considered various design alternatives for Subreach 2. Although the Site 2-3 design had significant short-term impacts (due to the removal of all trees from the footprint), the long-term benefits of the site were expected to offset the short-term impacts. The increased conveyance form Site 2-3 also offset the hydraulic impacts of the planting bench at Site 2-1 and allowed for vegetation to be re-established on the Site 2-1 bank line. The hydraulic improvements of Site 2-3 also extended upstream, allowing less impactful designs to be incorporated in the Contract 3B footprint. ***The expansiveness of the impacts within these two sites is unique to these two sites as no other site has the height (bank toe to edge of water) and length of Site 2-1 requiring repair, and no***

other site is proposing cutting banks back similar to Site 2-3. Please refer to Sections 2.1.6.1 and 2.1.6.2 for details on the designs included in Contracts 1 and 2.

Site 2-2 within Contract 2 serves as a better example of what most of proposed bank protection included in Contract 3B will look like, and how much less impactful the Contract 3B improvements will be to the parkway's resources when compared to Sites 2-1 and 2-3. For more information on Site 2-2's design, please refer to Section 2.1.6.2. For more information on the proposed designs for Contract 3B, please refer to Section 2.5.2.

2.1.6.1 LAR Contract 1

LAR Contract 1 was constructed in 2022 and early into 2023. To adequately address the identified erosion risks within Subreach 2 (see Figure 2-2 above), a significant bank protection footprint was required along the left bank starting approximately 1,000 feet upstream of H-Street bridge and continuing downstream into Paradise Beach and terminating near Glenn Hall Park. In this segment, referred to as Site 2-1, river velocities are high from down in the bottom of the river channel all the way up on to near the levee crown, so stone bank protection was required from near the levee crown down to the riverbank toe. Because stone bank protection was necessary for the entire height of the bank, all existing vegetation within Site 2-1 had to be removed to permit construction of the bank protection. Preserving trees in place by placing rock around existing trees rather than fully removing all trees was considered earlier in the design development phase. Evaluations of older erosion repairs along the LAR where existing trees were preserved in that manner showed those trees did not fare well or eventually died post construction. Based on those observations and to reduce the need for potential future impacts and costs were a preserved tree to die as a result of the constructed features, the Technical Resource Advisory Committee (TRAC) recommended all the trees within the footprint be removed and the design include features, which would allow for better establishment of planned on-site mitigation plantings following construction of the erosion protection features.

To offset as much of the habitat impacts as possible within Site 2-1 itself, this design included construction of planting benches at summer mean/low water level elevations to increase habitat for vegetation, recreation, and wildlife (see Figure 2-4). To accommodate these mitigation features, the planting bench had to extend well into the river channel, which, along with the vertical extents of rock installed, significantly constricted the already narrowest section of the river to a degree which, if not offset or mitigated, would cause unacceptable hydraulic impacts. To address this design induced impact, Contract 2, Site 2-3 was developed alongside Contract 1 to excavate the right-side bank opposite of Site 2-1 and offset the hydraulic impacts caused by Site 2-1, the river channel. See Section 2.1.6.2.2 for more details on the design of Contract 2, Site 2-3. Figure 2-5 below shows the changes in channel cross section pre- (red linework) and post construction (green linework) of LAR Contracts 1 and 2 (note: the scale of this cross section is vertically exaggerated).

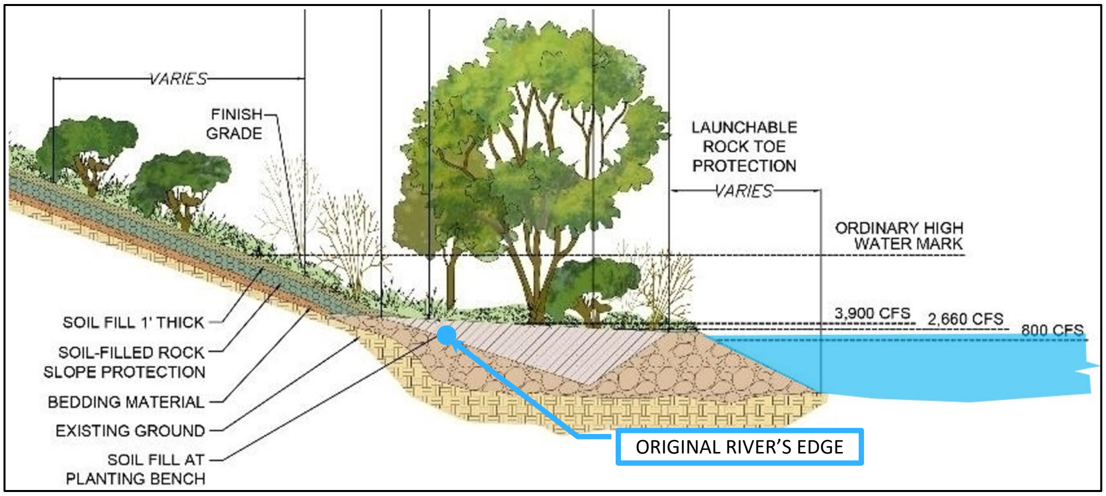

Figure 2-4. Contract 1 Site 2-1 planting bench conceptual cross section

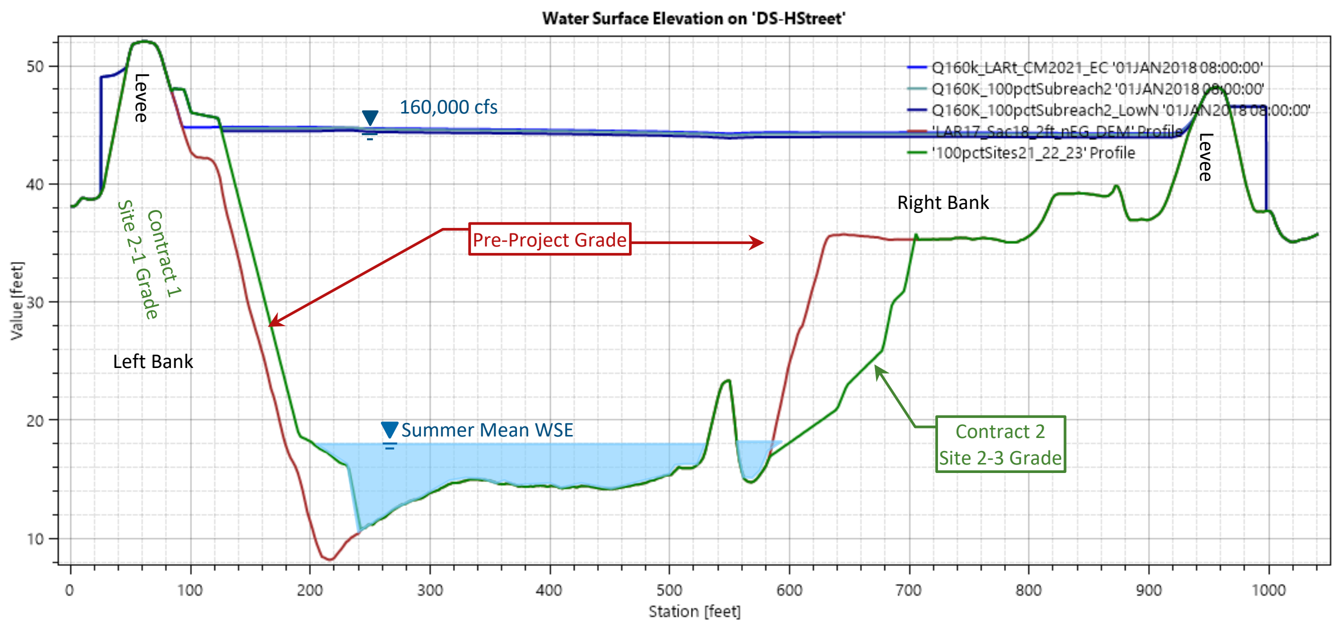

Figure 2-5. Cross Section showing Contract 1 and 2 modifications to LAR channel

2.1.6.2 LAR Contract 2

LAR Contract 2 was constructed over a two-year period between 2022 and 2023. Contract 2 encompassed construction of two separate sites, Sites 2-2 and 2-3, on the right (north) bank of LAR starting just upstream of Howe and extending downstream to Cadillac Drive approximately 2,700 feet downstream of the H Street Bridge. As mentioned above, Site 2-3 was intended to offset the hydraulic impacts caused by construction of Contract 1, Site 2-1 across the river, while site 2-2 was focused on addressing erosion that threatened to undermine the levee embankment near Howe Avenue. Please refer back to Figure 2-3 above to see the location and extents of Sites 2-2 and 2-3.

Both Sites 2-2 and 2-3 are good examples of erosion protection efforts, which provided an opportunity to not only reduce flood risk to the community but also improve habitat within the American River Parkway. Through rigorous coordination with environmental resource agencies, the National Park

Service, and Sacramento County Parks, the designs were optimized to maximize on-site habitat improvements to the Parkway while simultaneously minimizing the impacts caused by construction of the erosion protection measures. More details on the designs for Sites 2-2 and 2-3 are provided below.

2.1.6.2.1 Site 2-2

Contract 2, Site 2-2 is located on the right bank starting just upstream of Howe Avenue and continuing approximately 1,100 feet downstream of Howe Avenue. This site was much less impactful to parkway resources compared to Site's 2-1 and 2-3. Like Site 2-3, prior to construction the riverbank within Site 2-2 had very steep slopes, which were gradually being undermined and were retreating landward. Fortunately, because this site is located in a wider section of the river, there was opportunity to extend the bankline waterward, and similar to Site 2-3, expand habitat areas by providing a gentler slope from the top of overbank down to the river's edge. To construct this site, impacts to existing habitat were limited only to vegetation on the riverbank and some of the existing trees further up on the riverbank were able to be preserved in place (see area shown in Figure 2-6).

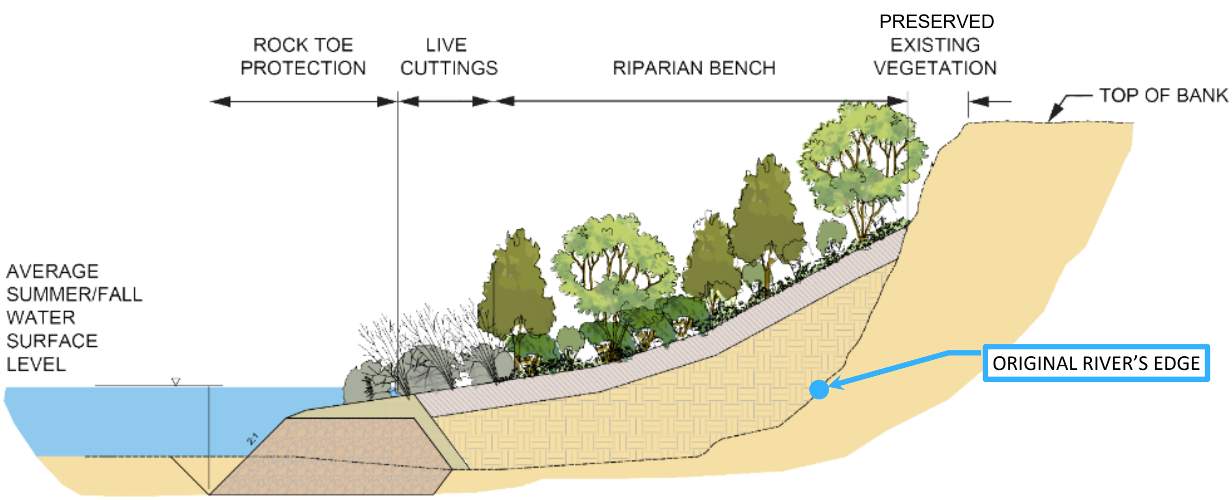

Figure 2-6. Site 2-2 Conceptual Cross Section

2.1.6.2.2 Site 2-3

Site 2-3 extends from the Fairbairn water intake structure at the upstream end downstream to Cadillac Drive (see Figure 2-5) The overbank in segment of the river is mostly composed of hydraulic mining debris that is highly erodible. Prior to construction of Contract 2 the riverbank was very steep, if not vertical, which prevented easy recreational access to the shoreline. Also, due to the steepness of the riverbank and erodibility of the overbank material, the river was gradually undermining the riverbank leading to collapse of sections of the bank and bankline retreat over time. The existing vegetation on the riverbank was gradually being lost to this bank retreat.

The design for Site 2-3 included excavation of the overbank approximately 120-feet landward (see Figure 2-3 above) and gently transitioning the grade from the river's edge upward to the landward extent of the excavation to remove the steep unstable slopes susceptible to ongoing bank toe erosion followed by mass failure, and provide planting benches at elevation near the bank toe where native species of riparian species would establish and naturally armor the bank toe. The planting benches provide elevations of floodplain closer to natural (pre hydraulic mining debris deposition) elevations, which are more frequently inundated to provide habitat, as well as a more pedestrian friendly grade for access to the river's edge. This excavation provided an opportunity to not only stabilize bank retreat and offset the hydraulic impacts caused by Contract 1, but also improve habitat values in Subreach 2 and increase recreation access to the river's edge. Additionally, the conveyance improvements provided by Site 2-3 have far reaching benefits upstream by reducing river stage as far as upstream of Watt Avenue. This improved conveyance has afforded more flexibility for the design of LAR Contract 3B upstream of Howe Avenue, has been a significant factor in minimizing the overall Contract 3B design footprint, and has minimized the impacts to parkway resources caused by Contract 3B. For more information on Contract 3B, please refer to Section 2.5.2.

2.1.6.3 Revegetation of Contracts 1 and 2

Revegetation of Contracts 1 and 2 began with plantings installed along all of Contract 1 in 2023 and the portion of Contract 2 downstream of the H Street Bridge. The remainder of Contract 2 was revegetated in 2024. Although the impacts to the parkway's resources was significant due to required vegetation removal to support construction of these two contracts these impacts are temporary, and once the revegetation plantings have had a few years to establish the Parkway will benefit from overall improved habitat and recreation opportunities. There is strong evidence to support this will be the case based on observation of previous bank protection projects constructed in the late 1990's. A great example of what can be expected for the plantings installed in Contracts 1 and 2 can be seen immediately upstream of Contract 1 on the left bank, adjacent to Sacramento State University. Old Site 4 was constructed just upstream of H Street Bridge and supports a significant strand of riparian habitat on top of the bank protection and planting bench installed at this site. A timeline between 2000 and 2015 showing the establishment and progress of the plantings installed on Old Site 4 is provided in Section 2.6.4, Figure 2-43. Likewise, the bankline immediately downstream from Site 2-2 is a rock bank protection project that was vegetated in the early 2000s and provides an example of potential for vegetation establishment on Site 2-2. Immediately upstream from Site 2-3 provides an example of the expected condition of Site 2-3. The low bench elevation that exists near the water level was uncovered by erosion in 1986, with vegetation re-establishing on similar elevations as those excavated on Site 2-3.

2.2 LAR Design Criteria and Standards

2.2.1 Wild and Scenic River Considerations

The Lower American River Parkway (23 miles) from below Nimbus Dam to the confluence with the Sacramento River is recognized as a Wild and Scenic River under both the California WSRA and the Federal WSRA. LAR was designated as a "Recreational River" in 1972 when the California WSRA was signed into law (Public Resources Code Section 5093.50-5093.70, Chapter 1.4, California WSRA). In 1980, California Governor Edmund G. (Jerry) Brown Jr. petitioned the Secretary of Interior, Cecil Andrus, to include LAR in the National Wild and Scenic River System under Section 2(a)(ii) (16 U.S.C. 1273(a)(ii)); FR August 7, 1980, p 52549). LAR was, added to the National Wild and Scenic Rivers System in 1981 (FR Vol 46. No. 14, Friday, Jan. 23, 1981, p 7484) based upon its recreational and anadromous fisheries Outstandingly Remarkable Values. The State wild and scenic river management plan was completed in 1977 and incorporated the American River Parkway Plan (ARPP) (County of Sacramento, 2008). The current ARPP was completed in 2008 and adopted by the State Legislature in 2009 (AB-889, Jones). The

ARPP establishes boundaries for the Parkway, including for the purposes of WSRA. Its recreational resources were recognized as “extraordinary values” by the State of California.

Under its obligations to manage the LAR as a 2(a)(ii) Federal WSR, the State, through the ARPP, has a non-degradation obligation. This includes limiting resource management actions that degrade the resource values for which the river was originally designated, as well as those conditions that support those resource values, and developing strategies for returning degraded resource conditions to their status at the time of federal designation (1981) where practical. The WSRA values addressed include free-flowing characteristics (i.e., as existing or flowing in natural conditions without impoundments, diversion, straightening and other modification of the waterway), water quality, cultural resources, and recreation and anadromous fisheries (along with those resource attributes that support those values, such as visual, aquatic habitat needs, and bankline structure and riparian vegetation as may be needed for fish habitat, wildlife habitat, and recreational uses and access.)

The ARPP includes specific flood control policies for implementing flood control measures on the LAR. Specifically, Flood Control Policy 4.16 states:

> “*Bank scour and erosion shall be proactively managed to protect public levees and infrastructure, such as bridges, piers, powerlines, habitat, and recreational resources. These erosion control projects, which may include efforts to anchor berms and banks with rock revetment, shall be designed to minimize damage to riparian vegetation and wildlife habitat, and should include a revegetation program that screens the project from public view, provides for a naturalistic appearance to the site, and restores affected habitat areas.*”

To be compliant with the ARPP, designs must minimize damage to riparian vegetation and wildlife habitat and include a revegetation program that screens the project from public view, provides for a naturalistic appearance to the site, and restores affected habitat values.

NPS as the Administrator for the Federal WSRA, will make Consistency Determinations only once 95% level of design is available. Once each design reaches its 95% design milestone, USACE completes a Consistency Analyses per the format specified by NPS for the ARCF16 Project and transmits it to the NPS with a request for their review and consistency Determination. Typically, a draft Consistency Analysis is provided to NPS for comment prior to completing and formally transmitting the document. Consistency Determinations have been received for LAR Contracts 1, 2, and 3A. Consistency Analyses are in development for LAR Contracts 3B, 4A, and 4B.

2.3 Background Data and Ancillary Studies

From the onset of the project, the site selection and design teams used existing data to identify data gaps, and the analyses needed to evaluate the risk and uncertainties within the LAR system. This section summarizes the various data, investigations, tools, and analyses USACE and its partners utilized throughout the site selection and design development process.

The information used to evaluate sites and develop designs was continuously updated throughout the project. Information developed for Phase II risk assessments were informed by discussions and analyses performed in the Phase I evaluations to address uncertainty and improve estimates. Likewise, the design phase (i.e., 10% through 100%) of the project worked to collect additional data and refine analyses tools to ensure design performance while minimizing design footprints. Design work and data development happened simultaneously through an iterative process. This involved defining data requirements while actively gathering and analyzing additional data. As data was developed to better inform site selection or enable a reduction in project footprint, this information was incorporated into the designs. Subsequently, the risk assessment team revisited the designs at each design review step to ensure the design footprints remained minimal while still meeting life-safety objectives.

The following sections include a summary of the best available information collected and applied to-date. Reference reports include dates of the most recent report, which may not necessarily align with the dates when the information was applied (e.g., the final erosion assessment reports included some revisions to address comments generated during the EOE assessments and have final report dates after the EOE assessments).

2.3.1 Bathymetric and Topographic Surveys

Topography and bathymetry were collected for the entire LAR study area in October 2017 using a combination of topo-bathymetric Light Detection and Ranging (LiDAR) data, single beam sonar, and Real-Time Kinematic Global Positioning Systems (RTK-GPS). At Contract 3B (Sites 3-1, 4-1, and 4-2) additional detailed topographic and bathymetric data was collected in 2019 and 2020 using a combination of conventional, GPS, LiDAR, and bathymetric survey methods. At the Contract 4A site, detailed topographic information was collected in 2021 and 2023 with RTK-GPS and total stations.

2.3.2 Hydrology

The hydrology of the LAR system is defined in the Central Valley Hydrology Study (CVHS) and includes the boundary conditions used to assess the hydraulic impacts of Contract 3B (C3B) design features. The CVHS was a multi-year study conducted by USACE and DWR that produced annual exceedance probabilities (AEP) hydrographs centered at Fair Oaks (AMR-14) (U.S. Army Corps of Engineers, 2019a), as well as a 73-year period of record of hourly flow data. The study evaluated historic hydrologic events as if they occurred with the existing reservoirs and operations requirements in place. The AEP events were used in the hydraulic model to assess impacts to water levels, calculate scour depths, and complete lateral bank erosion assessments related to the LAR project areas and design features.

Habitat and erosion control features were designed considering a wide range of flows and recurrence intervals. Habitat features are generally designed for inundation characteristics associated with lower flow stages (e.g., 2,660-cfs), while erosion control features designed to meet public safety criteria are generally focused on the larger, less frequent flow events. Revetment used for erosion protection is designed to remain stable (i.e., not transported downstream) for the 160,000 cfs flow event. The 160,000 cfs flow is the design flow from Folsom Dam based on the latest update to the water control manual completed in 2019 that accounts for the new auxiliary spillway completed under the Joint Federal Project (JFP). This design flow was used to evaluate the stability of erosion protection features associated with the flood risk management project criteria. However, lower discharges were also modeled to ensure that they do not present a more erosive condition than the 160,000 cfs discharge. While rare, the lower flows may have higher velocities at some locations because flow patterns change as the discharge increases, resulting in some locations experiencing higher velocities for lower discharges then 160,000 cfs (U.S. Army Corps of Engineers, 2019b).

Flows associated with the design of on-site resource/habitat features represent a wider range (800 to 115,000 cfs) of flows. The appropriate design flow for the resource features is a function of inundation and flow characteristics for the specific targeted species and habitats (e.g., salmonids, riparian vegetation). However, the higher design flows (i.e., 115,000 cfs) are evaluated to understand operation and maintenance needs associated with the potential erosion of habitat features.

2.3.3 Hydraulic Model Analysis

2.3.3.1 Model Selection

The project required a tool that could predict the hydraulic conditions through a full range of flow events up to the design flow event of 160,000 cfs to inform site selection and design. The spatial mapping of hydraulic forces (e.g., shear stress) during these events and designs resulting in changes to water surface elevation and velocities were fundamental elements that needed to be understood and addressed. Numerical models have been widely applied to address these concerns since the 1980s with advances in computing allowing for increased understanding and computing capabilities. Numerical models rely on the conservation of mass and momentum to provide numerical approximations to physical processes. Relative to physical models, which develop scaled models where hydraulic conditions can be directly measured, numerical models take less physical space and allow many different hydraulic and proposed physical conditions to be evaluated more efficiently.

With few exceptions, all numerical models of hydraulic processes solve the Navier-Stokes equation for the conservation of mass and momentum. The Navier-Stokes equations are a non-linear set of partial differential equations - meaning there are multiple solutions that can satisfy the results and there is no true solution to the results. Numerical models can vary in their assumptions and numerical approaches (e.g., finite element vs finite volume) used in developing solutions. All numerical models are based on some inherent assumptions and are calibrated to measured data to ensure results are within an acceptable margin of error.

Numerical models are generally defined as one-dimensional, two-dimensional, and three-dimensional models. One-dimensional models assume all flow is in streamwise direction and solve for average velocity and water surface elevation at cross-sections located along the channel. Two-dimensional models solve for a depth-averaged velocity flowing both streamwise and transverse directions as well as water depth at points on a computational grid. Three-dimensional models solve for flow velocity in all three directions- streamwise, transverse, and vertical at points within a three-dimensional computational grid. Not all three-dimensional models solve for depth as some models require a “fixed lid” condition where the top layer of the computational grid follows the water surface. The selection of the appropriate numerical model depends on the dominant processes needed to be understood in the design. One-dimensional models are ideal tools for estimating impacts to water surface elevation but are limited to spatially averaged output through a cross-section rather than mapping hydraulic forces over an existing surface. Two dimensional models provide spatially varied information over a computational grid. Three-dimensional models can add further detail where vertical velocity components are dominant processes, where significant stratification occurs in the flow between the channel bed and surface, or otherwise. High fidelity three-dimensional models such as Large Eddy Simulations, can further resolve temporal fluctuations in shear stresses induced by turbulence within the flow.

A two-dimensional model was selected for this project based on: (1) most empirical data used in the assessment of soil erodibility, erosion rates, and threshold values for vegetation to resist erosion are based on time-averaged and depth-averaged flows consistent with those provided in two-dimensional models, and (2) the two-dimensional models can accurately estimate the effects of vegetation on flow and provide spatially varied hydraulic output that can be validated by field-measured data. Hydraulic outputs from the model, including water surface elevations, velocity, and shear stress, were spatially mapped onto the existing channel banks, benches, and levees to inform erosion assessments of the bank and levee materials, as well as understand impacts of project components on the water surface elevation. The model used a typical mesh spacing of 20 feet across the 300-foot to 400-foot-wide channel and overbanks, with more refined meshes used along banklines of interest. Sensitivity analyses showed additional refinement of the mesh did not significantly change hydraulic model results, and the mesh resolution resolved impacts to hydraulics from changes in topography and vegetation.

2.3.3.2 Model Development

USACE staff with support from Project Partner consultants developed the project hydraulic models using the two-dimensional HEC-RAS model platform (cbec, 2021a). Models were incrementally and frequently peer reviewed and involved subject matter experts' direct input on model development and design application from the USACE Hydrologic Engineering Center (HEC). The model domain was developed using topo-bathymetric data collected in October of 2017 (see Section2.3.1). The height of vegetation was measured from the LiDAR data used to develop the topo-bathymetric data and was coupled with information from CDFW (2013) to assign increased roughness to locations where vegetation was present. Roughness values were determined based on vegetation height and type. The roughness values were adjusted to calibrate the model to match the high-water mark elevations observed during the 1997 event. The calibrated model was then validated at four additional flow events: 20,500 cfs (2017), 60,300 cfs (2017), 82,200 cfs (2017), and 134,000 cfs (1986). These validation runs demonstrated the model matched hydraulic conditions observed and measured during these events within a reasonable level of accuracy. Model sensitivity was tested for size separate variables including mesh sizing and orientation, computational timestep, eddy viscosity, and roughness parameters with findings consulted with HEC for further refinement. The final model is run on a computational grid with a 20-foot spacing between grid points with 10 foot-spacing along banklines and near project features and the typical channel width, not including overbank, is approximately 300-ft to 400-ft.

Specific for LAR C3B, the final suite of model runs was completed using a 30-ft curvilinear mesh (e.g. mesh orientation curves to match the meandering of the river) in areas outside of the 50,000 cfs floodplain and project footprint; a 20-ft curvilinear mesh was used for the entirety of the LAR main channel; and a 10-ft curvilinear mesh was used within the C3B project footprint and C3B overbank. The model sensitivity tests showed that the model was not sensitive (i.e., results did not significantly change) to further refinement of these user inputted assumptions.

2.3.3.3 Model Application

Design teams used the calibrated model to simulate existing and design conditions to understand relative impacts of the designs. Proposed designs were evaluated for: (1) post-construction conditions to ensure high flows would not lead to design failure before any vegetation would establish, and (2) long-term fully revegetated conditions to ensure hydraulic capacity would not be impacted. Model simulations included other ARCF16 project improvements and planned work within LAR (e.g., Sacramento Weir, LAR C1 100% design) to ensure the various erosion protection design sites will function collectively and not increase risk at off-site locations. Incorporation of the Sacramento Weir improvements and the recently constructed Site 2-3 within Contract 2 on the LAR into the hydraulic model resulted in lower water surface elevations upstream of Howe Avenue relative to the pre-ARCF16 Project existing conditions. These water surface elevation reductions allowed the Contract 3B design elements to have the minor negative impacts to channel conveyance be offset by the improvements provided by these downstream sites. A direct result of the flexibility provided by the conveyance improvements was the ability to further reduce the Contract 3B design footprint and significant reduction in impacts to vegetation and recreation features upstream of Howe Avenue. For more details on Contract 3B design refinements, please refer to Section 2.5.2.

2.3.3.4 Cumulative Impact Analysis

Overall cumulative impacts to the river system were analyzed in addition to the hydraulic modeling done for each individual site. This analysis was evaluated from two different aspects: (1) understanding the cumulative impact of building multiple projects to the entire river system, and (2) to understand if the project was maintaining or reducing the potential risk of levee overtopping. The cumulative impact analysis reports are provided in Attachment A.

2.3.3.4.1 Cumulative Impacts Hydraulic Modeling

A two-dimensional HEC-RAS model covering the entire area of the LAR, and 15 miles of the Sacramento River was developed containing all of the repair sites and habitat restoration sites, including changes to the Sacramento Weir. These models were run for multiple large flows and compared to modeling efforts of the current system (without repair sites or weir widening) to ensure that the addition of the repairs and habitat restoration did not cause significant (increase greater than 0.1 ft[4]) increases to water surface elevations throughout the entire modeled river system. If results demonstrated an increase in water surface elevations greater than 0.1 ft, a risk assessment would be required to determine the impacts to the system; however, as noted below the model results showed there was a reduction in water surface elevations, so a risk assessment was never required to address that issue.

This modeling effort demonstrated that the implementation of the Sacramento Weir Widening reduced the peak water surface elevations by approximately 1.2 to 1.8 ft within the Sacramento and LAR confluence. This reduction extends to approximately the Watt Avenue bridge on LAR, where reductions of 0.1 ft were seen. These reductions in water surface elevations allowed for installation of critical erosion protection design and habitat restoration in sections of the system that were identified as the highest erosion risk. With the combination of the weir widening, proposed erosion protection, and habitat restoration, the cumulative impacts hydraulic modeling showed that there was an overall reduction in water surface elevations ranging from 0.01 to 0.7-feet.

[4] 0.1 ft is considered significant because it is a measurable increase; changes less than 0.1 ft are considered within the margin of error of the hydraulic models.

2.3.3.4.2 Cumulative Impacts Probability Information

While the hydraulic modeling showed that the overall project would not result in an increase in water surface elevation for the large flood events, the project also checked that the project would be either maintaining the existing overtopping probability or reducing the overtopping probability (AOP – Annual Overtopping Probability – not accounting for geotechnical failures) and levee performance (AEP – Annual Exceedance Probability – accounting for geotechnical failures). Probability for failure was analyzed using the USACE Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA) model.

HEC-FDA was used to compute the expected AOP at six critical index locations assuming the levee does not fail prior to overtopping. This data represents the probability of levee failure outcome solely dependent on the effects of changes in conveyance capacity for a given scenario against the current levee height. The AOP results show a slight reduction in the probability of overtopping, meaning the ARCF16 Project was maintaining or reducing the probability of flooding potential to the area behind the levees.

HEC-FDA was also used to compute the expected AEP at four index locations to demonstrate how the assumed levee fragility affects levee system performance. In addition to failure due to overtopping, the AEP incorporates information on the levee's susceptibility to failure prior to overtopping due to erosion, seepage, and slope instability probabilities at a given index location based on levee specific characteristic (such as soil type, hydraulic loading, river velocities, etc.). This data provides a more realistic representation of the overall levee system performance as it can account for both changes in conveyance capacity and the levee improvements proposed under the ARCF16 Project. The AEP results show that the project improvements provide significantly reduce the probability of a levee failure to LAR system.

2.3.4 Geology

The current project geologic model was created using Leapfrog three-dimensional modeling software. The current model utilized the URS-GEI (2013) three-dimensional stratigraphic model of LAR that was developed as part of the 2016 GRR as a base point. The three-dimensional stratigraphic model was developed using geotechnical boring logs, laboratory testing of soil samples, direct current soil resistivity data collected by the USGS (2008) and geologic field mapping data. The objective of the stratigraphic model was to provide the three-dimensional visualization and coordinates of different geologic layers that were then used to inform design and risk assessments related to the potential for erosion on the site. The model focused on identifying locations of highly erodible post-1850 alluvium (e.g., loose deposits of silty sand material generated from historic hydraulic mining in the watershed) as well as the erosion resistant material (ERM), also referred to as the Pleistocene Fair Oaks Formation at LAR C3B. The current geologic model included additional geologic data from LAR borings completed by USACE after the GRR and by DWR as part of the Urban Levee Evaluation program in 2019 in addition to the original stratigraphic modeling from the GRR. Figure 2-7 shows an example of the stratigraphic model.

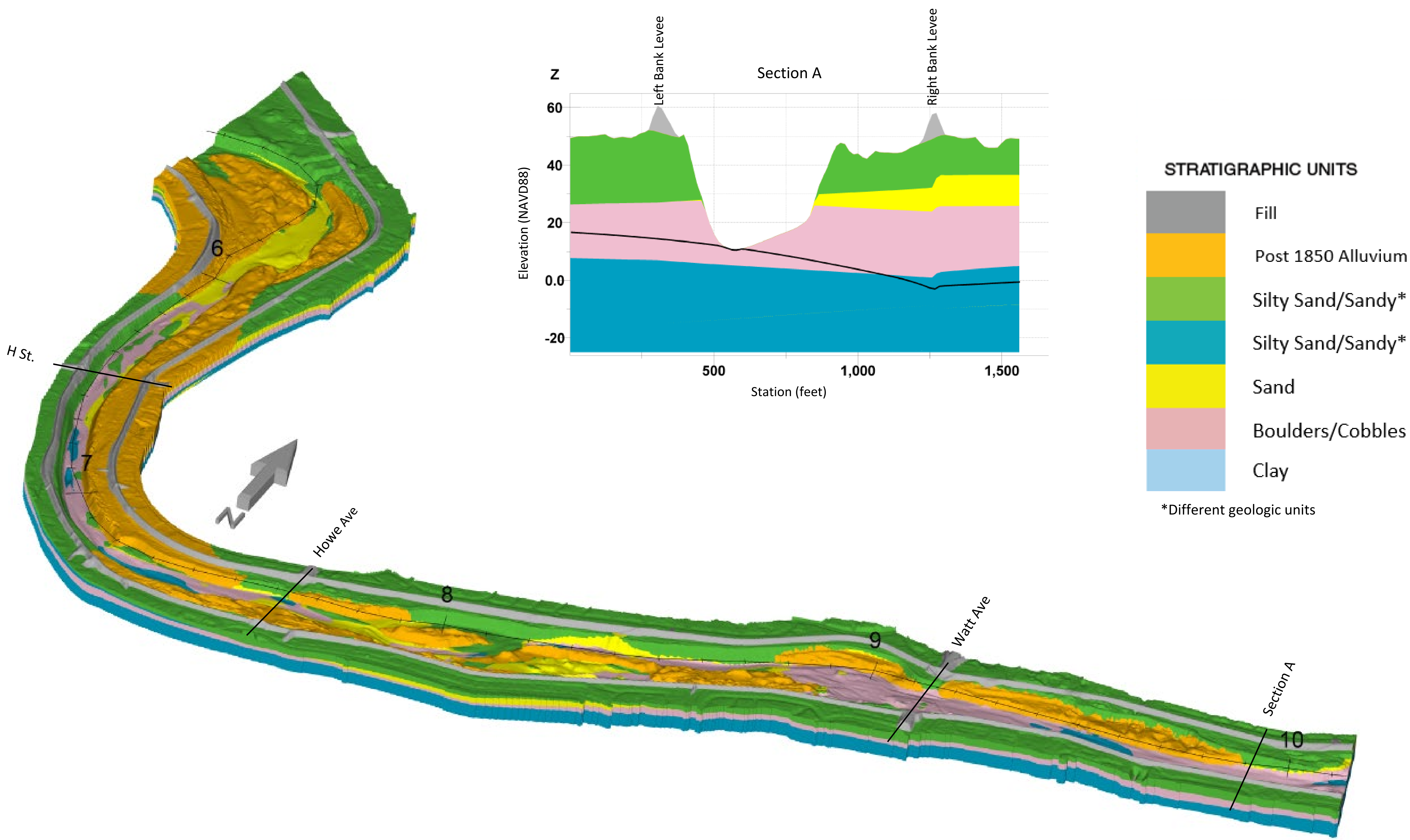

Figure 2-7. Output from URS-GEI (2013) 3D stratigraphic model of LAR extending from Paradise Beach downstream of RM6 and terminating upstream of Watt Avenue at RM 10.1

A supplemental exploration and testing program was completed for the LAR C3B project area in May and June of 2021. Twenty-one pilot borings and 6 companion undisturbed borings were completed in the foundation of the LAR C-3B project to further characterize the sub-surface in Site 3-1 and 4-1 for geotechnical analysis. Borings were collected approximately every 500 to 800-ft within the C3B study area. These borings were terminated after five feet of ERM was observed in each boring. The borings included collection of Standard Penetration Test (SPT) data, disturbed soil samples for classification testing, and undisturbed samples for strength testing and sedimentology logging. The main point of this exploration was to classify the ERM surface, which led to updated stratigraphic modeling by subject matter experts. The ERM surface was updated in 2022 as a result of additional borings collected and refined using ERM outcrop mapping completed during the low water levels in fall 2021. In Fall 2023, a geophysical data collection effort for a portion of Site 4-1 was conducted. The 2023 study used multiple forms of geophysics to map the ERM surface along the river margins and overbank for an isolated section, Segment 3-8.

Additional field sampling of geologic conditions was completed in 2018 and 2019 as part of lateral bank retreat analysis (See Section 2.3.9). This effort focused on classifying soils and measuring the erodibility for the soil material. A variety of collection and testing efforts were pursued to reduce epistemic uncertainty (i.e., uncertainty from limited data and knowledge) inherent in data collection efforts, test methodologies, and lateral bank retreat estimate methods. Additional data for the lateral bank retreat analysis was collected by a variety of agencies. The United States Department of Agriculture (USDA) Agricultural Research Service (ARS) collected information in the fall of 2018 on soil stratigraphy, site topography, unit weight, soil gradation, and bank erosion resistance parameters using the mini-Jet Erosion Test (JET). The USDA effort focused on observed soil near the surface along the main channel riverbank. Conventional drilling was completed on the American and Sacramento rivers near the riverbanks to help categorize soil stratigraphy and obtain bank erosion resistance parameters from project specific samples. The drilling effort was conducted by the U.S. Geological Survey (USGS) in the spring/summer of 2019. The U.S. Army Corps of Engineers assisted in the drilling effort to help categorize soil stratigraphy, collect soil samples, and distribute the collected soil samples. Testing of soil samples from the drilling effort was completed by a U.S. Army Corps soil laboratory at Prado Dam and a soil laboratory at Texas A&M University (TAMU). These efforts are documented in USGS (2020), TAMU (2020), and USDA (2020a).

2.3.5 Documentation of Past Performance

DWR's Urban Levee Evaluation (ULE) was cited for past performance along the levees. URS-GEI (2010) completed a geotechnical evaluation report of the LAR study area, which included approximate locations and year of boils, slides/slumps, cracking, erosion, and seepage. The information compiled in this report included interviews with local levee maintainers and review maintenance records to identify areas, which may have experienced distress between 1986 and 2006. This data was considered in both the Phase I (Section 2.4.1) and Phase II (Section 2.4.2) site evaluations. The DWR Urban Levee Evaluation was completed separately from the ARCF16 Project but provides valuable summary for considering past performance of levees when identifying sites that need erosion countermeasures.

2.3.6 Geomorphic Assessment

A geomorphic assessment was completed in 2018 of LAR to provide an initial broad, long-term perspective on fluvial geomorphic processes in the LAR and identify future channel adjustments over the next 50 to 100 years (Northwest Hydraulic Consultants, 2018). The assessment relied on previous reports prepared for USACE since 1991, academic theses, topographic and bathymetric surveys collected in 1997 and 2008, geologic maps, annual bank erosion assessments, as well as historic and current aerial imagery. The assessment discussed the existing geology, human impacts to the geomorphic process, historical response to those human impacts, as well as direct human impacts on the LAR including instream mining, levee construction, and bank protection. The geomorphic assessment considered both qualitative assessments following the approach of Schumm (1977) and quantitative assessments based on regime-type assessments using approaches provided in U.S. Army Corps of Engineers (1994) as well as additional analysis of sediment transport conditions within the channel to evaluate potential changes to the morphology of LAR over the next 50-100 years.

The contents of this report were utilized in the Phase I Site Evaluations. This geomorphic assessment is provided in Attachment B.

2.3.7 Existing Bank Revetment Condition Assessment

A revetment condition assessment was completed of all existing revetment sites on the LAR (cbec, 2021b). Figure 2-8 shows the locations of all revetments which existed prior to implementation the ARCF16 Project improvements. Historic revetment refers to revetment installed prior to the 1990s and was typically just bare rock and often used rounded cobble stone as revetment. Cobble revetment is more susceptible to failure, or unraveling, and is more easily mobilized during flood events. Modern revetment refers to erosion repair sites that utilized angular quarry stone and included more nature-friendly features such as planting benches, soil-filled quarry stone, soil cover, and ultimately plantings of native vegetation.

The study was broken out into three phases and included reviews of as-built drawings, field investigations, as well has hydraulic modelling and rock size calculations. The intent of the assessment was to verify existing projects, which were designed prior to the current project would remain stable during a 160,000 cfs flood event. Field investigations measured actual rock size that was placed at the project site, as well as measured rock thickness and verified rock extents. Hydraulic information developed from the baseline hydraulic model (see Section 2.3.3) run for 160,000 cfs was used to evaluate if the existing rock would remain stable during the 160,000 cfs event. Reporting was completed in April 2022.

2.3.8 Erosion Assessment

In 2020, erosion assessments were completed to help quantify the risk to the levee (Northwest Hydraulic Consultants, 2020a) (Northwest Hydraulic Consultants, 2020b). Whereas the Geomorphic Assessment delineated the river into subreaches based on river processes, the erosion assessment delineated the right and left riverbanks into segments based on bank and levee conditions. Segments were defined as continuous lengths of bankline with similar soil conditions, revetment designs, vegetation covering, hydraulic conditions, and geometry (bank slope, bench width, etc.). Subreach 3 was delineated into 14 segments, which varied in length from about 0.1 miles to 0.5 miles. Subreach 4 was delineated into 11 segments varying in length from about 0.1 miles to 0.8 miles.

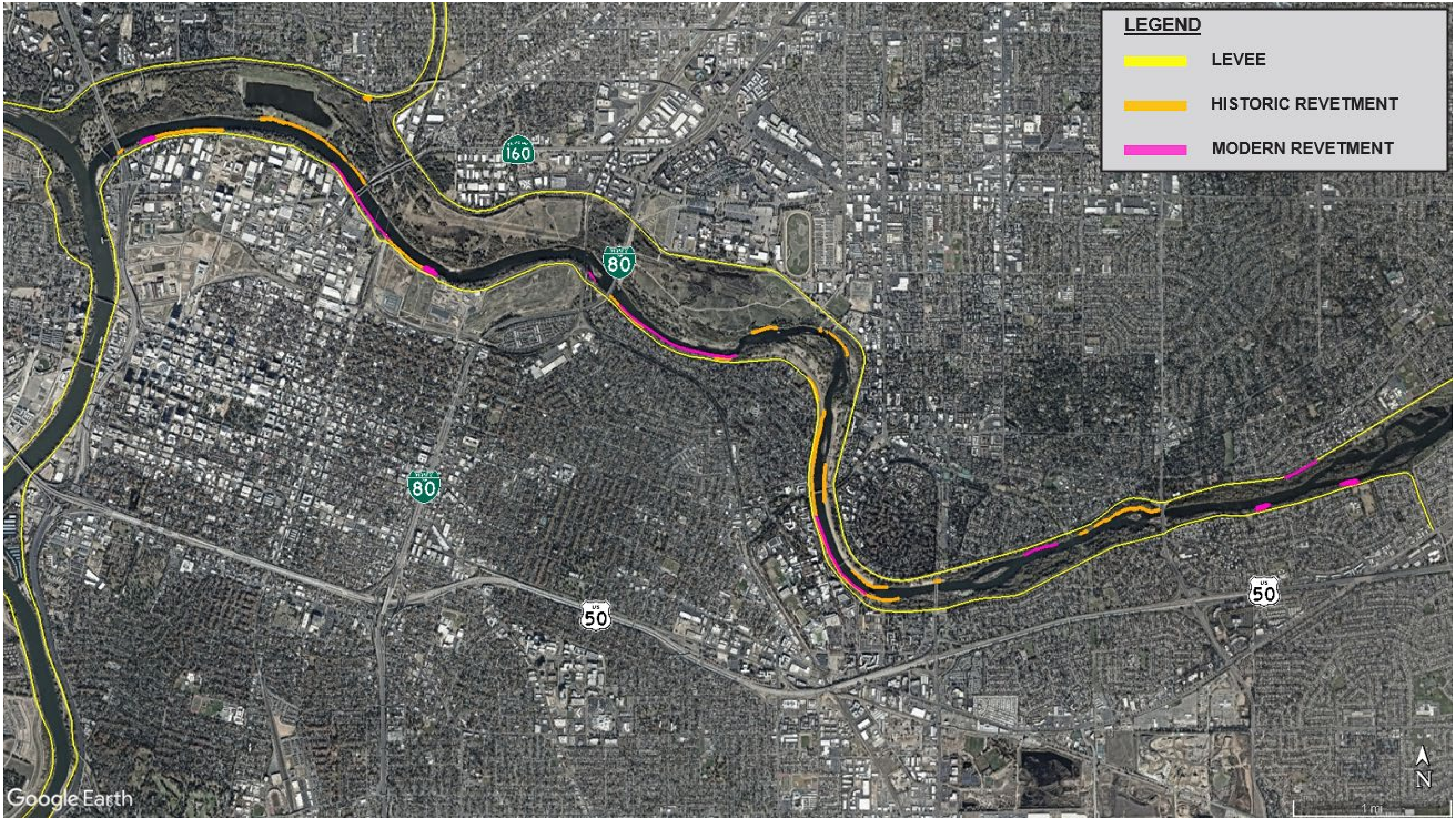

Figure 2-8. Inventory of Existing Revetment

The erosion assessment referred to channel processes identified in the geomorphic assessment and expanded on their potential impacts to individual segments. The evaluation of river processes suggest it is unlikely that long-term river processes will result in significant channel change (e.g., channel width and depth, bar migration, large scale planform changes). However, there is an imbalance between concentrated hydraulic force caused by confining levees and weak channel bank soils that are highly dependent on vegetation for erosion protection. Localized bank erosion could occur during high flow events if vegetation were to fail. The erosion assessment evaluated the potential for these localized failures to occur based on site conditions at each segment.

The erosion assessment focused on individual segments to compare erosive forces to resisting forces during four discrete flow events: 40,000 cfs, 80,000 cfs, 115,000 cfs, and 160,000 cfs. The lower flow events are expected to occur more frequently than the design event and were used to determine if the levee may be susceptible to erosion at more frequent flow events. Information summarized in Section 2.3 were detailed on a segment-by-segment basis to evaluate the erosion potential at each segment. Site visits to each segment were conducted to catalog current conditions, Hydraulic erosive forces were quantified at each segment for each flow of interest and estimated maximum erosion extents for a condition where vegetative cover had failed and bare soil was exposed to a given flow for a duration of three days (The bank erosion modeling described in Section 2.3.9 was completed after the completion of the erosion assessment and provided additional context to the conservative assumptions of the erosion assessment). quantified a Potential scour depth at each segment was also quantified (although long-term incision of the channel is unlikely to occur, general scour-the localized lowering of the channel bed due to channel bends or fluctuating channel geometry- could occur during high flow events). Scour depths were coupled with measured bank slopes to evaluate the potential for slope instability. The erosion assessment evaluated conditions at both the levee face and at the bank toe (see Section 2.1.5 for description of levee and bank).

The erosion analyses generally found most channel banks were subject to some erosion occurring, which is consistent with present day field and historical observations. The erosion analysis for Subreach 1 identified three locations with high risk of erosion and potential to impinge into the levee: RM 2.3 to 2.6 and RM 3.8 to 3.9 on the left (south levee) are at risk to scour and lateral erosion while RM 0.0 to RM 1.3 on the right (north) levee was at risk. For Subreach 3, predicted maximum lateral erosion extents were shown impinge into the levee foundation between RM 8.5 to 10.0 on the left (south) bank, and RM 7.8 to 8.2 on the right bank. In Subreach 4, it was found in several locations that erosion could threaten levee stability between RM 10.0 to 10.5. Installation of bank protection at RM 10.3 to 10.4 in response to mass bank failure demonstrates the vulnerability of this reach. Projected erosion into the levee template occurs in flows as low as 40,000 cfs.

The contents of these reports were utilized in the Phase I Site Evaluations. The Erosion Assessments for is LAR Subreach (i.e., Subreaches 1, 2, 3, & 4) are provided in Attachment C.

2.3.9 Biological Resource Surveys and Assessments

Environmental Science Associates (2020), on behalf of the Project Partners, completed reconnaissance-level field surveys to observe and document the potential occurrence of special status species, aquatic resources, and assess terrestrial and riparian habitats. Field surveys included aquatic resource delineation (documenting wetlands), mapping elderberry shrubs, mapping potential special status bird habitats, protocol level rare plant surveys, tree surveys (documenting species, locations, and size)

Standard Assessment Methodology, and Shaded Riverine Aquatic (SRA) Cover assessments. Environmental Science Associates data was also compiled with the 2019 and 2020 topographic survey for LAR C3B, where that effort also surveyed tree location and tree size. Both of these datasets were used to inform the LAR C3B design development as described in Section 2.5. Similar surveys were also conducted to support LAR C4A. This biological resource survey and assessment report is provided as Attachment D.

2.3.10 Bank Retreat Estimates

Lateral bank retreat estimates are a way to assess the extent of lateral erosion during a high flow event and whether the erosion threatens the integrity of the levee. The erosion assessments (Section 2.3.7) used in the Phase I Site Evaluations (see section 2.4.1) included a conservative analysis of the potential lateral bank retreat using an event-based erosion assessment methodology. This methodology includes potential for slope failure of the bank due to scour at the bank toe, erosion of the bank, slope failure of the levee due to scour, and erosion of the levee. The potential erosion extents were quantified for each flow rate at each segment as a function of the underlying soil types and applied hydraulic shear stresses. The vertical extents of scour are estimated at both the bank and levee toe. Fluvial erosion was quantified as a lateral extent into the bank or levee face. This estimate used an initial project 2D hydraulic model and the best available data at the time including published values of soil properties (e.g., soil critical shear stress and erodibility coefficient).

For Phase II Site Evaluations (see section 2.4.2), additional probabilistic lateral bank retreat estimates were developed for segments deemed as moderate to high-risk overall erosion potential to refine the bank retreat estimate for site-specific project conditions. The probabilistic bank retreat estimates for Phase II Erosion Analysis used:

1. Project-specific soil properties collected as part of this study (Section 2.3.4).
2. Vegetation cover effects on soil erodibility.
3. BSTEM (Bank Stability and Toe Erosion Model), a bank retreat estimating tool developed by USDA-ARS that can provide probabilistic bank retreat estimates.
4. Soil erosion parameters based on calibration to observed erosion (Section 2.3.4).

The previously discussed sampling and testing program (Section 2.3.4) was developed along the American and Sacramento Rivers to inform development of inputs to bank retreat estimates in partnership with the USGS, USDA-ARS, and Texas A&M University. See Rivas et al. (2021a) and Rivas et. al. (2021b) for additional details on the soil sampling and testing and development of soil erosion parameters for lateral bank retreat estimates. The lateral bank retreat analysis also included the effects of vegetation on the bank by using a vegetation cover factor. See Rivas et. al. (2021c) for additional details on application of the cover factor for bank retreat estimates.

BSTEM is a model produced by the USDA-ARSARS (Simon, Pollen-Bankhead, & and Thomas, 2011), (Klavon, et al., 2017)). The BSTEM model includes both erosion of the soil by flowing water (fluvial erosion) and slope stability failures to estimate total bank retreat. BSTEM was used to estimate the bank retreat at sites on the LAR for a number of different scenarios. BSTEM has the capability of incorporating different bank geometries and hydraulic conditions and therefore is a useful tool for determining locations in need of erosion countermeasures and informing designs of erosion countermeasures. The application of BSTEM for this project includes assessing the amount of bank retreat resulting from different Annual Chance Exceedance (ACE) events for existing bank conditions and proposed design conditions. A benefit of using BSTEM is the ability to model conditions that do not currently exist and ACE events that have not occurred and to account for the uncertainty of model inputs.

USDA-ARS developed the stochastic (i.e., “probabilistic”) version of BSTEM and has adapted BSTEM for the purposes of this project (Rivas, et al., 2019). The BSTEM model was calibrated at sites with measured erosion during the 2017 flood event using an objective and repeatable calibration and validation procedure. BSTEM calibration is achieved using a constrained calibration technique at areas of measured erosion. The application of the resulting calibrated parameters to other sites within the study area with similar soil properties was successfully validated. See Rivas et. al. (2021c) for additional details. The calibration effort reduced the uncertainty of key lateral bank retreat soil properties (USDA (2021)), providing greater confidence in the results.

BSTEM has Monte-Carlo type (stochastic) model capabilities important for accounting for uncertainty of key bank retreat estimate inputs. The BSTEM stochastic version as applied to this project uses a probability distribution of the critical shear stress and erodibility coefficient developed from project specific soil sampling and testing and model calibration at sites with observed erosion. BSTEM randomly samples values of the critical shear stress and erodibility coefficient from the probability distribution to develop 500 unique model runs. The results of the 500 model runs produce estimated bank retreat profiles for different non-exceedance percentiles. For simplification, the non-exceedance percentiles will be referred to simply as percentiles. For example, the 50th percentile represents the median amount of bank retreat expected to occur while the 99th percentile represents more expected erosion where only 1% of the modeled profiles exceed this profile and most of the 500 model runs (99%) are less than this profile. The results of the BSTEM stochastic models were provided to a risk cadre during Phase II site evaluation to inform their baseline levee risk assessments (as explained in Section 2.4.2). The BSTEM results are one tool aiding in development of a final minimum erosion protection footprint.

2.4 Site Evaluations and Selection

As discussed in Section 1.8, site selection was completed in a two-phase process. Phase I included an EOE based on existing data and preliminary analysis to develop initial recommendations for sites to be repaired. The Phase II analysis included baseline risk assessments completed at each segment using additional information acquired and developed via new investigations and analyses to expand on the preliminary studies used in the Phase I analysis.

2.4.1 Phase I Site Evaluations – Relative Risk Tier Rankings

Phase I Site Evaluations were developed via an inter-agency working group referred to as the Technical Resource Advisory Committee (TRAC). The TRAC included members from USACE, NMFS, USFWS, Sacramento County Parks, NPS, DWR, SAFCA, and their consultants. The TRAC is a multi-disciplinary group, which includes water resource engineers, geotechnical engineers, geoscientists, biologists, and ecologists. The TRAC developed analysis to support the Phase I Site Evaluations including the Geomorphic Assessment, Erosion Assessment, and initial bank retreat estimates. USACE has successfully worked with similar groups on the LAR on past projects to develop bank protection designs, which reduced habitat impacts and replaced impacted habitat within the designs.

Two EOE’s were conducted for LAR to help identify relative risks between levee segments and identify priority segments for erosion countermeasures. The first EOE focused solely on segments in Subreach 2 and was completed in 2017. The second EOE included all segments from Subreaches 1, 3, and 4 and was completed in 2019. Both EOE panels included the same five local experts with extensive experience working on LAR and flood control projects. USACE incorporated additional national experts onto the Subreach 1, 3, and 4 EOE. Both EOE assessments were largely based on the information presented in Appendix A of the erosion assessments developed for each subreach (Section 2.3.7), as well as additional information on past performance (Section 2.3.5), and individual experts experience and observations. After completion of the formal EOE process, the TRAC assigned a Tier ranking to each segment. Figure 2-9 shows all of the segments within the LAR with their corresponding tier ranking. As already discussed in Section 1.8, Tier 1 includes segments that have the highest risk of erosion and are subject to an immediate threat to the levees during high flows. Tier 2 includes segments that are not subject to an immediate threat to the levee but are anticipated to reach that condition after one or more high flow events (during the 50-year design service life of the project). Tier 3 includes the remaining segments that are not considered subject to an erosion threat that could lead to levee breach (during the 50-year design service life[5] of the project).

2.4.2 Phase II Site Evaluations – Risk-informed Site Selection

Baseline risk assessments were completed for all the segments in subreaches 1, 2, 3, and 4 between November 2019 and December 2020. Baseline risk assessments determine the levee breach flood risk without any new construction of erosion countermeasures. The baseline risk assessments relied on similar information as the Phase I Site Evaluations, but included additional information developed after the Phase I Site Evaluations. This information included additional geologic information on soil erodibility (Sections 2.3.4 and 2.3.6), probabilistic bank retreat estimates (Section 2.3.10), further assessments of the existing revetment (Section 2.3.7), and continued refinements to the hydraulic model (Section 2.3.3). The baseline risk assessments assigned annual probability of failure due to erosion to each levee segment. Uncertainty associated with risk estimates along the LAR was generally higher because the performance of the system at design flood levels has not been proven, whereas on the Sacramento River the levees have experienced design flood flows on several occasions. After reviewing all available information from the Phase I and Phase II site evaluations, USACE identified segments for erosion protection where the probability of failure exceeded project objectives.

The findings of the baseline risk assessment completed during the Phase II Site Evaluations confirmed the recommendations of Tier 1 segments identified by the Phase I Site Evaluations. The baseline risk assessment also identified three additional locations that did not meet risk objectives. The additional sites identified in the baseline risk assessment were identified after more detailed modeling was completed for sites after completion of the Phase I Site Evaluations.

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[5] The 50-year design service life is based on the life cycle established within the GRR feasibility report.

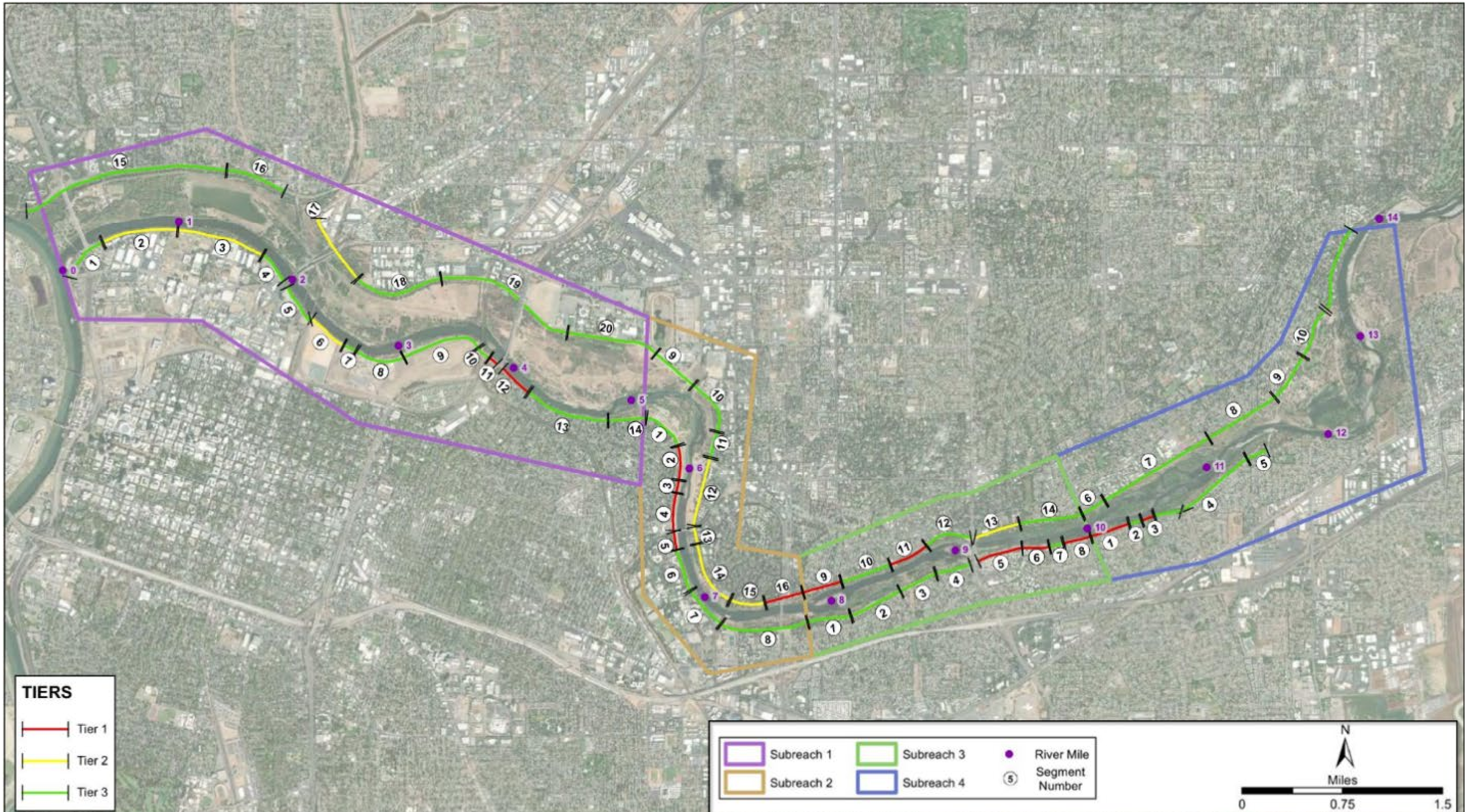


Figure 2-9. LAR segment ranking result

2.4.3 Summary of Site Selection

Based on the results of both the Phase I and Phase II Site Evaluations, USACE Sacramento District identified which segments required erosion protection improvements and developed its implementation strategy for design and construction of erosion protection at those locations along LAR. The overall strategy was to construct improvements at the highest risk sites first. Table 2-1 summarizes the segments that were identified for erosion protection and their corresponding repair site and contract. Figure 2-10 identifies the locations of erosion protection improvement contracts. All the LAR erosion protection projects, including those constructed (Contract 1 and Contract 2) and under construction (Contract 3A), will result in 6 of the 11 authorized miles being improved along LAR. The remaining 5 miles authorized for improvement were determined to meet project risk objectives as they currently exist.

Table 2-1. Final site selection

Contract	Site	Segment
LAR C1[1]	Site 2-1	Subreach 2, Segment 2 (a.k.a. Segment 2-2)
	Site 2-1	Subreach 2, Segment 3 (a.k.a. Segment 2-3)
	Site 2-1	Subreach 2, Segment 4 (a.k.a. Segment 2-4)
	Site 2-1	Subreach 2, Segment 5 (a.k.a. Segment 2-5)
LAR C2[1]	Site 2-3	Subreach 2, Segment 12 (a.k.a. Segment 2-12)
	Site 2-3	Subreach 2, Segment 13 (a.k.a. Segment 2-13)
	Site 2-3	Subreach 2, Segment 14 (a.k.a. Segment 2-14)
	Site 2-3	Subreach 2, Segment 15 (a.k.a. Segment 2-15)
	Site 2-2	Subreach 2, Segment 16 (a.k.a. Segment 2-16)
LAR C3A[2]	Site 1-1	Subreach 1, Segment 11 (a.k.a. Segment 1-11)
	Site 1-1	Subreach 1, Segment 12 (a.k.a. Segment 1-12)
LAR C3B	Site 3-1	Subreach 3, Segment 9 (a.k.a. Segment 3-9)
	Site 3-1	Subreach 3, Segment 11 (a.k.a. Segment 3-11)
	Site 4-1	Subreach 3, Segment 5 (a.k.a. Segment 3-5)
	Site 4-1	Subreach 3, Segment 6 (a.k.a. Segment 3-6)
	Site 4-1	Subreach 3, Segment 8 (a.k.a. Segment 3-8)
	Site 4-1	Subreach 4, Segment 1 (a.k.a. Segment 4-1)
	Site 4-1	Subreach 4, Segment 3 (a.k.a. Segment 4-3)
	Site 4-2	Subreach 3, Segment 14 (a.k.a. Segment 3-14)
	Site 4-2	Subreach 4, Segment 6 (a.k.a. Segment 4-6)
	Site 4-2	Subreach 4, Segment 7 (a.k.a. Segment 4-7)

Contract	Site	Segment
LAR C4A	RM 2.0	Subreach 1, Segment 17b (a.k.a. Segment 1-17b)
LAR C4B[3]	Site 3-1 and Site 4-1	Subreach 3, Segment 8 (a.k.a. Segment 3-8)
	Site 3-1 and Site 4-1	Subreach 3, Segment 11 (a.k.a. Segment 3-11)
	Site 3-1 and Site 4-1	Subreach 4, Segment 1 (a.k.a. Segment 4-1)

[1]LAR C1 and C2 have already been constructed and are not subject to the contents of this SEIS/SEIR
[2]LAR C3A is currently under construction and is not subject to the contents of this SEIS/SEIR.
[3]LAR C4B considers similar segments to those in LAR C3B but focuses on protecting trees within the USACE designated Vegetation Free Zone which requires additional review from USACE Headquarters as discussed in Section 2.5.4.

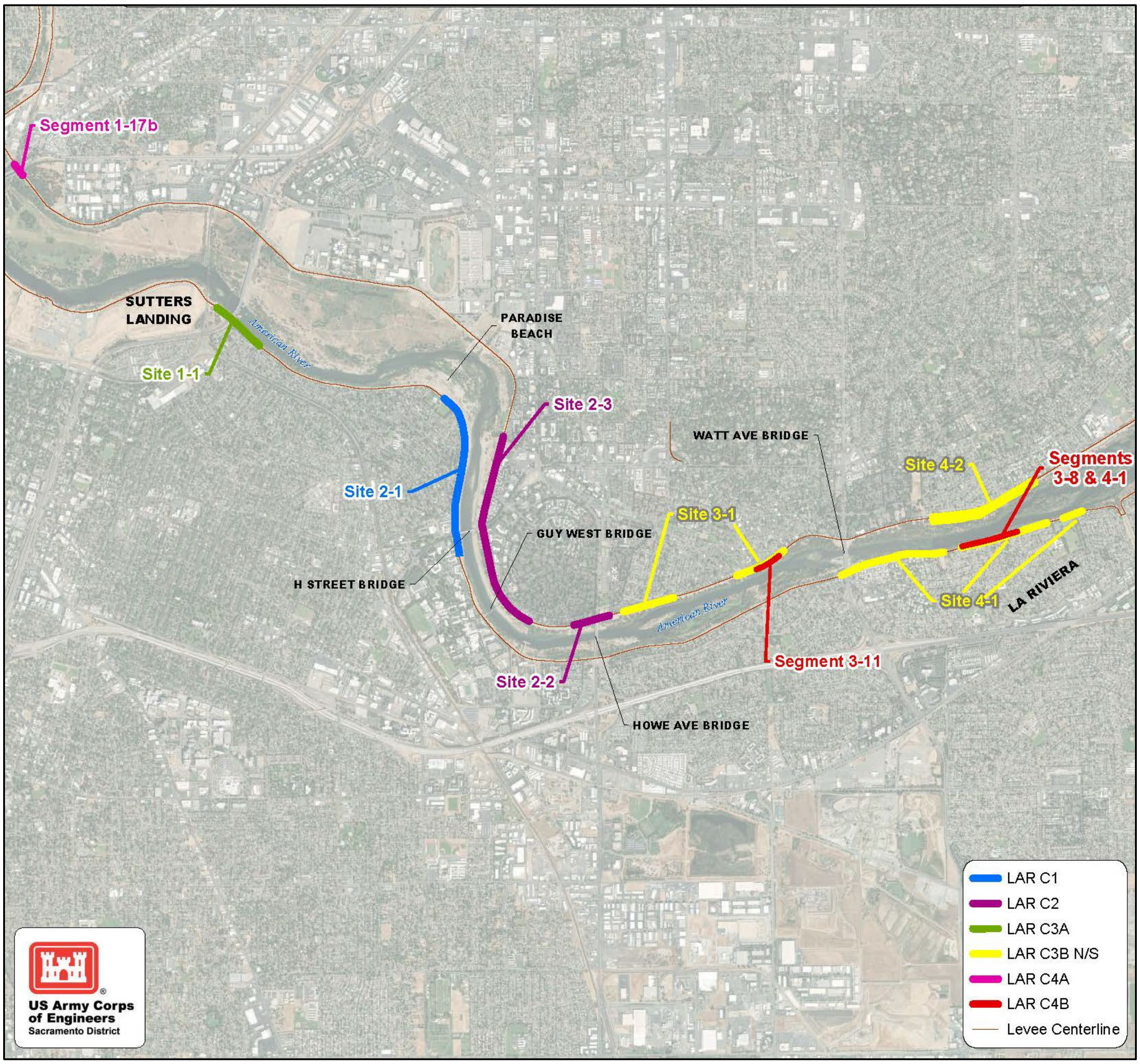


Figure 2-10. Summary of ARCF 2016 erosion projects on LAR

The identified sites include some locations that are not currently experiencing bank failure or accelerated erosion. Rather these sites have local conditions where the risk of erosion occurring and compromising levee stability during a high flow event are unacceptably high given the potential public safety risk if the levee were to fail. Some of these sites appear well vegetated under existing conditions and it was recognized by the expert panel and Risk Cadre that trees and other vegetation do reduce risk to bank erosion. However, failure of vegetation during high flow events can expose underlying erodible soils to erosion, and the affects of vegetation often does not extend much below summer water levels. Both the expert panel and the Risk Cadre considered the potential for vegetation to remain in place during high flow events, the potential for vegetation to fail due to being undercut on steep banks, toppled by high velocities or otherwise. This information was coupled with the potential for erosion to progress to a point where it compromised levee stability to determine where erosion protection is required. Section 2.5 provides a summary of the design process, and further details the risk drivers identified at each segment and the approach to address these conditions.

2.5 Design Development

2.5.1 Overview and Process

Erosion protection designs were developed incrementally with key milestones at the 10%, 35%, 65%, 95%, and 100% plans. The intent of each milestone was to provide the project partners with an opportunity to review and comment on the design. Each subsequent submittal adds additional detail to the design, in addition to addressing comments from previous submittals. Both LAR C3B and LAR 4A were developed from the initial alternative selection to their current design working with multi-disciplinary and multi-agency stakeholder groups. The entities involved in these reviews and design development are discussed further with each contract, below. In addition to these groups, the designs were also reviewed by the Risk Cadre to ensure proposed design conditions met project risk reduction objectives, internal USACE reviews for consistency with design standards (Section 1.7.2) and regulatory requirements (Section 1.7.3 and 2.2.1). Since LAR C4B is still refining the footprint, outreach to discuss development has not yet occurred but will begin in 2025 as site specific information is developed.

2.5.2 Contract 3B

Erosion protection and on-site habitat mitigation designs for LAR C3B were initially developed via the TRAC, advanced by a multi-disciplinary USACE design team, and subsequently reviewed by TRAC members and other multi-agency review staff at design milestones. The TRAC provided initial recommendations for design approaches and provided review and comment throughout the design process.

The TRAC developed initial recommendations for LAR C3B in 2019 based on a comprehensive subreach approach to address erosion concern at each Tier 1 and Tier 2 river segment). Initial concepts were developed for Tier 1 and Tier 2 segments and their hydraulic and resource impacts were quantified. The

TRAC evaluated which combination of conceptual designs or alternatives would limit short-term impacts and provide the best long-term resource conditions without having impacts to the conveyance capacity of the LAR (e.g., not increase the likelihood of overtopping). The final recommended design approach for each segment within LAR C3B was provided by the TRAC as 10% designs. All designs included rock protection.

The hydraulic benefits from other project features including the Sacramento Weir improvements and Site 2-3 (designed under Contract 2 of this project) were still being quantified at the 10% design completion for LAR C3B. These two projects feature lower water surface elevations upstream and at the LAR C3B Contract sites. This reduction in water surface allowed designs from the start of the 65% design phase in LAR C3B to have additional flexibility to incorporate design features that created minor increases in water surface elevations (e.g., wider planting benches, etc.)) that were not considered originally by the TRAC at the 10% milestone. This hydraulic assessment was completed in part by the cumulative hydraulic modeling efforts discussed in Section 2.3.3.

Between the 10% and 35% design, the LAR C3B design footprint increased to account for site access (e.g., haul routes for constructability) and included review feedback from Risk Cadre elicitation. This increase in footprint was primarily at segments where a buried launchable trench feature was proposed in the overbank. A part of the LAR C3B 35% submittal and every subsequent design submittal included assessing the habitat impacts for that design proposal. Several TRAC member representatives and SAFCA, DWR, and USACE Project Delivery Team (PDT) members held a LAR C3B design Charrette with representatives of DWR, NPS, NMFS, USFWS, and Sacramento County Parks after completion of the 35% designs to revisit the assumptions of the 10% design, account for updated program design criteria, and identify if alternative design concepts would reduce short term habitat impacts. Ultimately, LAR C3B designs at Site 3-1, and in Site 4-1 were adjusted at the 65% design phase to reduce habitat and resource impacts. These improvements are discussed in Section 2.5.2.4 below.

The placement of revetment and project features was limited to locations needed to address the primary risk drivers at each segment based on local site features and attributes. The PDT presented information to the review teams, TRAC, and Risk Cadre for input and evaluation as more detailed information of design conditions and refinement of analysis tools (e.g., hydraulic modeling, slope stability modeling, bank retreat estimates, vertical scour analysis, ERM stratigraphic modeling, etc.) at critical and nominally spaced sections of the project sites were developed. This allowed for a further reduction in the design footprint throughout the design development phases, while ensuring the design would meet the life-safety objectives of the project (Section 1.7.1). Effectively the Risk Informed Design is included and was utilized to find the minimum erosion protection footprint to meet flood risk objectives.

In additional to the design accounting for erosion protection features, on-site habitat design features are also included and leverage assessment of past erosion protection projects within the basin. LAR C3B on-site habitat features include planting benches designed for ecological based flow conditions and include in-stream woody material, soil filled revetment, placing a topsoil lift above the soil filled revetment, a replanting plan. The rock-based bank protection will not only protect the levee from erosion, but it will also protect existing vegetation left undisturbed by construction from erosion, too, and will also expand the bankline waterward and provide more space for vegetation to establish than previously existed. Gravel will also fill in gaps of larger angular launchable toe on the waterside face of planting benches. The surface of the planting bench above the summer water levels will include coir fabric in place of cobble while vegetation is established. This change in design from cobble to coir fabric was based on review comments received from Sacramento County Regional Parks at the 95% design phase.

2.5.2.1 Design Coordination and Collaboration

The LAR erosion protection improvements are being designed and implemented in stages (i.e., multiple construction contracts). To ensure that the design contracts are developed consistent with the requirements of the Federal and State WSRA's, the Endangered Species Act, and other requirements, the C3B design team coordinated with NPS, Sacramento County Parks, NMFS, USFWS, and other regulatory agencies throughout the design process and when designs reached 10%, 35%, 65%, and 95% levels. This collaboration and coordination results in an iterative conversation between the design team and the other agencies – presentation of design, receipt of suggestions and other feedback from reviewing agencies, design adjustments and additional engineering analysis, followed by a new agency review of the refined design. Table 2-2 highlights concerns raised by reviewing agencies and strategies adopted by the design teams to address the concerns.

Table 2-2. Influence of collaboration on the Lower American River Designs

Concern	Strategy
Habitat loss	• Minimized footprint • Replant habitat onsite - Revegetate with native species • Replant habitat offsite • NMFS collaboration to ensure design meets requirements for anadromous fish and fishery • Establish planting benches with variable elevation to enhance fish habitat • Instream Woody Material for aquatic habitat • Selection of native plants to be used for revegetation • Native plant selection to restore habitat and aesthetics (consistent with American River Parkway Plan)
Recreation short term impacts	• Design user friendly pedestrian and bike detours • Consistent with American River Parkway Plan for recreation
Aesthetic impacts	• Design buried erosion control features to minimize exposed rock • Cover rock with topsoil and revegetate with native species
Tree removal	• Selective, minimal tree removal • Preservation of most heritage oaks by footprint adjustments • Replant with native species
Noise/Vibration Dust & Traffic impacts	• Temporary construction impacts mitigated through various contractor controls and protocols

2.5.2.2 Tying into Existing Modern Revetment

The LAR C3B project footprints tie-in to four modern revetment sites that were constructed to stabilize active erosion occurring on the stream banks. These existing, modern revetment sites include are found in Segment 3-10 (called site 8.7R in historic documentation), Segment 3-7 (called Site 10.0L in historic documentation), Segment 4-2 (called Site 10.6L in historic documentation) and Segment 4-6 within Project Site 4-2. These revetment sites were constructed between the years 1999 and 2011.

- Segment 3-10 is located approximately between RM 8.1 and 8.5 on the north bank and includes an existing revetment feature (also called Site 5 or 8.7R). The existing revetment was installed in 1999 due to the 1997 flood event, which had a peak flow of 117,000 cfs. This segment includes the existing cobble lined bank with an angular riprap toe.
- Segment 3-7 is located approximately between RM 9.7 to 9.8 on the south bank and is an existing revetment site (also referred as 10.0L). The existing revetment site includes soil-filled riverbank revetment and a planting bench with launchable rock toe installed in 2011.
- Segment 4-2 is located approximately between RM 10.3 and 10.4 and is an existing revetment site (also referred as 10.6L). The existing revetment site includes soil-filled riverbank revetment and a planting bench with launchable rock toe installed in 2011.
- Segment 4-6 is located approximately between RM 10.0 and 10.2 on the north bank.

2.5.2.3 Contract 3B Site 3-1

Contract 3B Site 3-1 is located on the right (north) bank upstream of Howe Avenue. Figure 2-11 shows the location of Site 3-1 and the proposed bank protection footprint based on the 95% designs.

2.5.2.3.1 Identified Risk Drivers

As discussed in Section 1.6, the probable failure modes related to erosion with the ARCF16 Project include: PFM2 (Erosion of the levee leading to a levee breach),) and PFM3 (Erosion of the levee foundation). At Site 3-1, the primary risk driver is PFM3 erosion into the levee foundation. The existing site, approximately 1,200-ft upstream of the Howe Avenue Bridge, has a narrow bench that is less than 100 feet in areas with steep banks 30 feet in height. Vegetation being undercut along the toe of the bank, and vegetation toppling on the bank were observed in the field. The levee prism is located within 50 feet to 100 feet of the bank toe along much of the site. Hydraulic conditions at 160,000-cfs are sufficient to initiate erosion of the silty sand riverbank and levee foundation material.

At the downstream extent of Contract 3B Site 3-1, the risk driver includes both PFM3 and PFM2.

2.5.2.3.2 Design Alternatives

For each river segment within Site 3-1, the genesis of designs included TRAC developing 10% design concepts for the USACE design team to advance, and 35% review by the TRAC, partners, and review teams. Based on input from the TRAC and other reviewers on the 35% design, the 35% design footprint was determined to be too expansive and would cause an unacceptable level of impacts to habitat and recreational features within the parkway. To address this problem, the PDT worked with members of the TRAC, project partners, and Risk Cadre to adapt designs at the start of the 65% design phase to meet risk objectives but minimize habitat impacts. A design charette was held with engineers and resource managers at USACE, SAFCA, DWR, NMFS, USFW and Sacramento Regional Parks to discuss, evaluate and select a preferred type of erosion protection treatment for each river segment to minimize habitat impacts and meet erosion risk objectives. In general, resource managers evaluated that a feature constructed along the riverbank would preserve or protect the bench/overbank and parkway amenities and the constructed erosion protection feature would include on-site habitat mitigation and a robust revegetation plan. The outcomes of the design charette at the start of the 65% design phase were also briefed at TRAC and Bank Protection Working Group forums to identify fatal flaws and gain additional input before 65% designs were advanced. During the 65% and 95% design phases, a variety of field visits with partner inclusion were held to refine design layout to minimize local impacts. Subsequently each design phase included assessing habitat impacts and completing formal review from multiple review

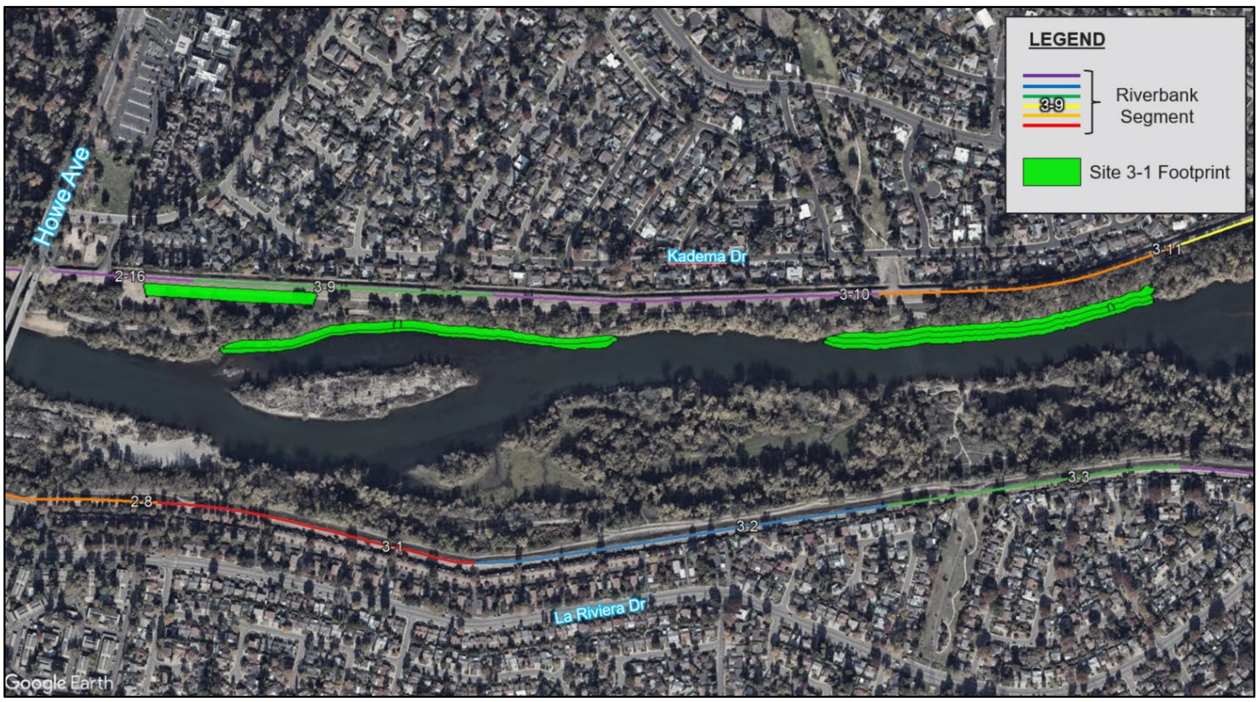


Figure 2-11. Site 3-1 overview map

teams and agencies. Incrementally from the 10%, 35%, 65%, 95% to 100% design phase, design features and analysis tools were evaluated and refined to arrive at the minimally sized erosion protection feature to meet flood risk objectives and minimize impacts. A more detailed discussion of design alternatives considered and advanced for each river segment is discussed below.

At segment 3-9, three alternatives were originally considered by the TRAC at the 10% concept phase: (1) buried launchable trench at the levee toe, (2) launchable toe with planting bench and soil filled riverbank revetment along the riverbank, and (3) excavating the existing in-channel island and placing cut material to widen the existing bench while moving the river further away. The initial TRAC recommendation was to remove the island (i.e., Alternative 3) and widen the existing bench as this provided some hydraulic relief to the project and could reduce the need for rock along the edge of river. Due to the high impacts of removing the island, the additional channel conveyance from downstream

Site 2-3 allowing some hydraulic impacts at the site, and the inclusion of rock protection in the 35% design, the USACE design team adjusted the design concept at Segment 3-9 at the start of the 65% design phase to include a planting bench and soil filled revetment along the riverbank (e.g., TRAC option 2 above). This design adjustment was vetted at the 65% design charette and subsequent briefings to the TRAC and Risk Cadre.

At Segment 3-11, the TRAC only considered two alternatives at the 10% concept phase: (1) buried launchable trench at the levee toe, and (2) launchable toe with planting bench and soil filled riverbank revetment along the riverbank. The TRAC recommended Alternative 2, the launchable toe with planting bench and soil filled riverbank revetment, for the design team to advance.

At both Segment 3-9 and Segment 3-11, the footprint for the buried launchable trench feature at the levee toe would require the removal of most, if not all, vegetation on the bench/overbank and was not preferred at this location due to the high short-term impacts and lack of long-term resource benefits. TRAC members considered and evaluated that for the buried launchable trench feature placed away from the riverbank, the overbank bench and parkway amenities could still be lost after a high flow event and the end state would be a rock bankline.

2.5.2.3.3 Proposed Design

Segment 3-9 includes a soil-filled levee embankment revetment feature for the most downstream portion of the levee embankment slope within this segment. The feature is similar to the proposed revetment in Site 4-2 and illustrated in Figure 2-29 below in Section 2.5.2.5.3. This feature will protect the levee embankment from PFM 2 erosion into the levee face. Soil-filled rock will be placed on the levee face and toe, be covered with one-foot of topsoil and be re-seeded with native grasses. The layout of this erosion protection feature limits removal of existing trees.

In Segment 3-9 and in Segment 3-11 the design also includes bank protection focused features, specifically a launchable toe with planting along the river margins and soil filled riverbank revetment extending up for a portion of the existing riverbank height. The soil-filled revetment includes a 12-inch soil lift and will be replanted. These designs are similar to the intent and layout of the 10% designs developed by the TRAC. The planting bench and revetment will be vegetated via a separate greening contract. The revetment is designed to remain stable during large events and prevent erosion of the bank toe from compromising the upper bank or extending into the levee foundation and the levee embankment itself. The top elevation of the rock was limited to what was needed to meet the flood risk objective and minimize resource impacts. Although erosion could occur above the top of rock, the erosion would be unlikely to extend into the levee and induce levee failure per Risk Cadre assessments and output from analysis products. Reducing the revetment height limits project impacts to the existing resources. The planting bench extends down to typical summer water levels and replaces vegetation that must be removed to implement the project. Planting bench rock tiebacks will be placed periodically on the planting benches to minimize longitudinal erosion or scalloping between the tiebacks if it occurs and allow for variability in the top elevation of the planting benches. Instream woody material (IWM) will be installed on top of the planting benches to provide habitat for salmonids until planted vegetation establishes.

Figure 2-12 to Figure 2-15 provide example renderings of bank protection designs on the riverbank within Site 3-1, showing the launchable toe with planting bench and soil filled riverbank reverent feature, and maturation of the revegetation effort. It also depicts protected vegetation and recreational amenities above the proposed bank protection feature. This rendering does not show the proposed 925-ft section of work along the levee embankment closer to Howe Avenue discussed earlier in this Section. In the plan view graphic for each segment, the existing trees that are to be preserved in place are depicted as green circles.

Figure 2-12. Layout of Segment 3-9 erosion protection features and cross section location

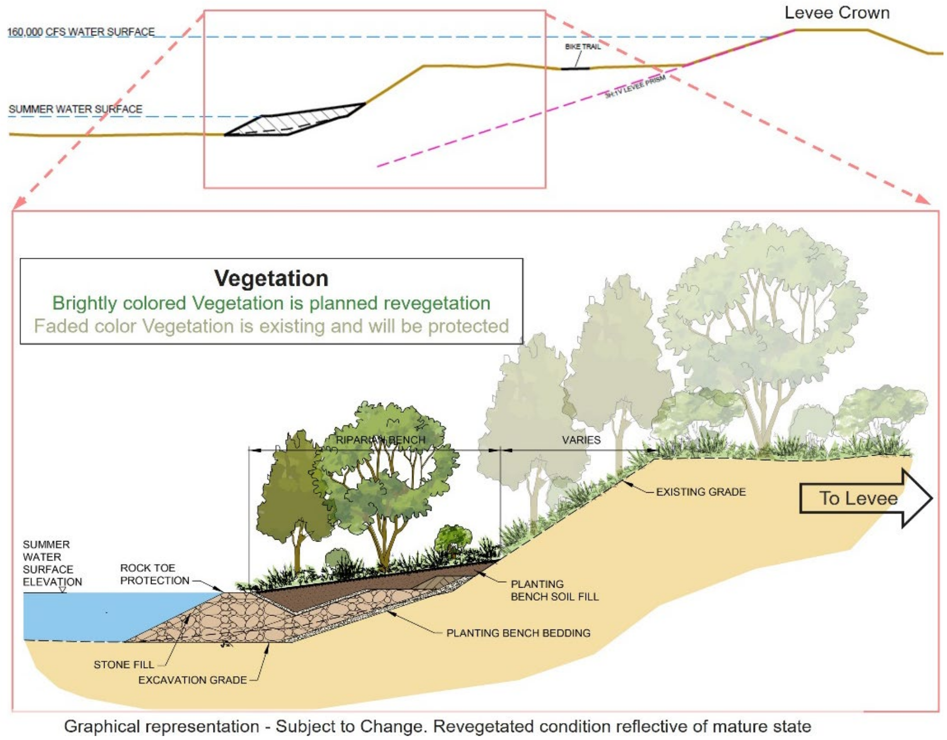
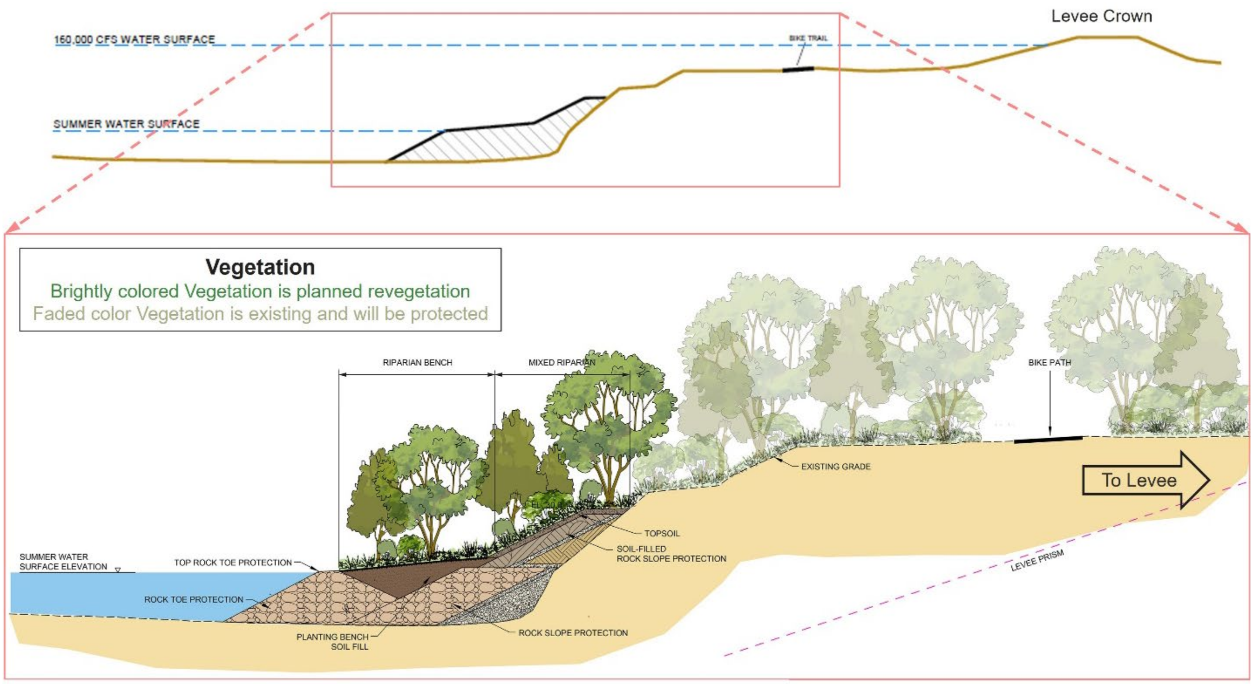


Figure 2-13. Segment 3-9 rendering of erosion protection feature

Figure 2-14. Partial Layout of Segment 3-11 erosion protection feature and cross section location



Graphical representation - Subject to Change. Revegetated condition reflective of mature state

Figure 2-15. Segment 3-11 rendering of erosion protection feature

2.5.2.4 Contract 3B Site 4-1

Contract 3B Site 4-1 is located on the left (south) bank upstream of Watt Avenue. Figure 2-16 shows the location of Site 4-1 and the proposed bank protection footprint based on the 95% designs.

2.5.2.4.1 Identified Risk Drivers

Site 4-1 includes five separate river segments for repair. The segments each have different site conditions resulting in unique risk drivers and erosion mitigation approaches. At Segment 3-5, both PFM 2 and PFM 3 (erosion of the levee embankment and embankment foundation, respectively) were identified as erosion risk drivers because high velocities concentrate along the waterside levee toe exacerbated by bridge constriction effects. At Segment 3-6, both PFM 2 and PFM 3 were identified with high velocities in the channel reaching the levee with a narrow overbank bench between 50 feet to 100 feet wide. Segment 3-7 was previously repaired in 2011, found to meet flood risk objectives for this program and is not included in the design. Segment 3-8 was found to be at risk for PFM 3 due to the steep bank, narrow overbank bench, and high in-channel velocities. Segment 4-1 has an outcropping of erosion resistant material (ERM), also referred to as the Pleistocene Fair Oaks Formation. At Site 4-1, the distance between the river toe and levee embankment toe is wider than immediate upstream or downstream river segments. However geologic inspection suggests erodible materials underly the material behind the riverbank toe resulting in potential for PFM 3 erosion into the levee foundation to occur. Segment 4-2 was previously repaired, in 2011, found to meet flood risk objectives for this program and is not included in this design. Segment 4-3 is at risk of PFM 3 erosion into the levee foundation due to the steep and high banks, narrow overbank bench width, and impinging flows from the river.

2.5.2.4.2 Design Alternatives

For each river segment within Site 4-1, the genesis of designs included TRAC developing 10% design concepts for the USACE design team to advance, and 35% review by the TRAC, partners, and review teams. Based on input from the TRAC and other reviewers on the 35% design, the 35% design footprint was determined to be too expansive and would cause an unacceptable level of impacts to habitat and recreational features within the parkway. To address this problem, the PDT worked with members of the TRAC, project partners, and Risk Cadre to adapt designs at the start of the 65% design phase to meet risk objectives but minimize habitat impacts. A design charette was held with engineers and resource managers at USACE, SAFCA, DWR, NMFS, USFW and Sacramento Regional Parks to discuss, evaluate and select a preferred type of erosion protection treatment for each river segment to minimize habitat impacts and meet erosion risk objectives. In general, resource managers evaluated that a feature constructed along the riverbank would preserve or protect the bench/overbank and parkway amenities and the constructed erosion protection feature would include on-site habitat mitigation and a robust revegetation plan. The outcomes of the design charette at the start of the 65% design phase were also briefed at TRAC and Bank Protection Working Group forums to identify fatal flaws and gain additional input before 65% designs were advanced. During the 65% and 95% design phases, a variety of field visits with partner inclusion were held to refine design layout to minimize local impacts. Subsequently each design phase included assessing habitat impacts and completing formal review from multiple review teams and agencies. Incrementally from the 10%, 35%, 65%, 95% to 100% design phase, design features

Figure 2-16. Site 4-1 overview map

and analysis tools were evaluated and refined to arrive at the minimally sized erosion protection feature to meet flood risk objectives and minimize impacts. A more detailed discussion of design alternatives considered and advanced for each river segment is discussed below.

On Segment 3-5, the TRAC at the 10% design considered two alternatives: (1) buried launchable trench at the levee toe, and (2) launchable toe with planting bench at the riverbank. Alternative 1, the buried launchable trench, was preferred as the revetment could be placed below the existing parking lot and road and minimize impacts to the existing channel and riverbank. The wide bench at this segment and PFM 2 and PFM 3 both being risk drivers would also require revetment at along the riverbank and levee embankment, whereas the buried launchable trench at the levee toe only required revetment to be placed at a single location, minimizing impacts. The TRAC based design (i.e., Alternative 1) was advanced to final design.

On Segment 3-6, the TRAC considered three alternatives at the 10% design phase: (1) buried launchable trench at the levee toe, (2) launchable toe with a planting bench and soil filled riverbank revetment along the riverbank, or (3) launchable toe with a planting bench and soil filled riverbank revetment bench that would excavate back into the existing riverbank. Alternative 1, buried launchable trench at the levee toe, was eliminated because of the amount of existing vegetation removal required to construct this feature. Alternative 2, launchable toe with a planting bench and soil filled riverbank revetment along the riverbank, was initially eliminated because of the associated hydraulic stage impacts this feature caused. Alternative 3, launchable toe with planting bench and soil filled riverbank revetment along the riverbank that would excavate back into the existing bank, reduce hydraulic impacts and result in less fill placed into the river system, but had increased impacts to existing vegetation and habitat on the bench. The TRAC ultimately recommended Alternative 3 at the 10% phase for the design team to advance. However, during the 35% design phase, the hydraulic stage restrictions or concerns were lessened as channel capacity from Site 2-3 (a part of LAR Contract 2) and the Sacramento Weir were accounted for. The Segment 3-6 design was revised at the start of the 65% design phase based on the outcome of the design charette held with partners to include a launchable toe with a planting bench and soil filled riverbank revetment along the riverbank; aligning closer to Alternative 2 evaluated during the 10% TRAC phase. Segment 3-6 designs vary along its longitudinal length where narrower overbank locations with high velocities require soil filled revetment along the riverbank and levee embankment. In areas with a wider overbank, designs that address PFM 3 and 2 are being advanced that includes partial revetment along the riverbank and revetment with scour protection volumes placed near the levee toe.

At Segment 3-8, the TRAC at the 10% design phase considered two alternatives: (1) launchable toe with a planting bench, soil filled riverbank revetment along the riverbank and a buried launchable trench feature at the levee toe, and (2) launchable toe with a planting bench, soil filled riverbank revetment along the riverbank that would excavate back into the existing riverbank, and a buried launchable trench feature at the levee toe. The amount of revetment needed to create a buried launchable trench feature at the levee toe and the associated impacts to existing vegetation in this immediate area in the overbank was not strongly considered by the TRAC. The intent of the buried launchable trench feature at the levee toe was to allow some existing vegetation to remain on the bench and not carry continuous rock from the riverbank toe up to the levee toe. The TRAC selected the design that did not excavate into the existing bank to avoid additional impacts to existing vegetation, Alternative 1 described above. This design solution (i.e., bank protection feature placed along the river toe and riverbank) also was evaluated and selected during the design charette at the start of the 65% design phase. However, via additional analysis and review, the buried launchable trench feature placed near the levee toe was eliminated and in isolated locations in the overbank replaced with a buried rock tie-back features field fit to minimize habitat impacts.

At Segment 4-1, the TRAC considered three alternatives at the 10% design: (1) launchable toe with a planting bench, soil filled riverbank revetment along the riverbank and a buried launchable trench feature at the levee toe, (2) launchable toe with a planting bench, soil filled riverbank revetment along the riverbank that would excavate back into the existing riverbank, and a buried launchable trench feature at the levee toe, or (3) soil filled riverbank revetment without a planting bench and a buried launchable trench at the levee toe. Since the existing riverbank toe is an outcropping of erosion resistant material (ERM) at this location, the TRAC preferred a design that would not impact this existing feature and selected Alternative 3, soil filled riverbank revetment without a planting bench and a buried launchable trench for design advancement. Furthermore, the armored riverbank feature was to be limited to localized areas where the bank slopes are steep. Design options of placing the erosion protection feature in the overbank (i.e., between the levee toe and riverbank) were evaluated and selected at the start of the 65% design phase via a design charette with partners considering this segment's overbank is wider than other river segments in the immediate area. During the 65% design phase, the PDT worked with Sacramento Regional County Parks, NMFS and USFWS to discuss erosion protection layout options in this overbank section and conducted field visits with partners to refine the location of this feature in an effort to minimize habitat impacts. Options were vetted by the Risk Cadre to confirm design meets flood risk objectives.

At Segment 4-3, the TRAC at the 10% design considered three alternatives: (1) launchable toe with a planting bench, soil filled riverbank revetment along the riverbank and a buried launchable trench feature at the levee toe, (2)) launchable toe with a planting bench, soil filled riverbank revetment along the riverbank that would excavate back into the existing riverbank, and a buried launchable trench feature at the levee toe, and (3) buried launchable trench at the levee toe. The TRAC selected Alternative 1, launchable toe with a planting bench, soil filled riverbank revetment along the riverbank and a buried launchable trench feature at the levee toe for design advancement. The PDT worked with the TRAC members at the start of the 65% design phase to re-evaluate the preferred concept. Based on the design charette and additional analysis and review, the 10% feature of a buried launchable trench at the levee toe was eliminated. The proposed design includes a launchable toe with a planting bench and soil filled riverbank revetment along a portion of the riverbank to minimize habitat impacts for high quality vegetation in the overbank. Effectively the footprint was reduced over the course of design phases and designs still meet minimum flood risk objectives.

2.5.2.4.3 Proposed Design

The proposed design at Site 4-1 varies through the site as site conditions and resource values change. Considerable attention was applied to Site 4-1 design based on the habitat quality and identification of high flood risk and risk drivers based on this constrained section of LAR. Design accounted for the presence of and characteristics of ERM that is a predominant geologic feature in this section of the river. Multiple ERM forums with a subset of members of the TRAC, project partners, and local and national subject matter experts were held by USACE staff for design application. The presence of and characteristics of ERM was accounted for in the design layout primarily for Site 4-1. ERM is a key design variable in this section of the river where ERM outcrops are identified along the river and river margins. The presence of ERM was also accounted for in vertical scour analysis.

The downstream section of the site (i.e., Segment 3-5) incudes a buried launchable trench below the existing parking lot and road to avoid most impacts to existing vegetation. The feature mitigates PFM 3 concerns. Further upstream where the overbank narrows and high-quality riparian habitat exists, the design shifts to focus erosion protection features to be placed along the riverbank to avoid impacts to the overbank and the presence of heritage oaks. The launchable toe placed near the shoreline and soil filled revetment along the riverbank will prevent significant erosion and overbank loss that could threaten the levee foundation. Planting benches will include soil-filled tiebacks, Instream-Woody Material (IWM), and will be planted with native species to replace habitat lost. In addition, 12 inches of soil will be placed on top of the soil filled revetment to allow areas outside the vegetation free zone to be replanted with woody species. Revegetation of native grasses are included for C3B work within the vegetation free zone. Erosion protection features were designed based on lessons learned from successful reestablishment sites built for LAR erosion projects over the last few decades.

The erosion protection feature is limited to locations where erosion could impair levee stability and targets local site concerns. In locations the soil filled revetment extends only a portion of the riverbank height where the design avoids additional impacts to existing vegetation. In isolated section, such as in Segment 3-6, erosion protection features are included along both the riverbank and levee embankment based on site characteristics. Design layout was based on collecting field data, identification of erosion risk drivers at each location and included an array of refined analysis tools, field visits and incremental review and engagement with partners for design refinement.

In Segments 4-1 and 3-8 buried rock tie-back features (aka, spurs made up of revetment) that extend from the riverbank bank protection features landward to the levee toe are included to account for flanking concerns during high flow events, are based on localized hydraulic conditions and Risk Cadre input. Careful attention was applied to the locations and layout of these buried rock tie-back features. Tree survey data (i.e., location, specie type, tree size) was reviewed coupled with field visits attended by Sacramento County Regional Parks staff to minimize habitat impacts.

Figure 2-17 to Figure 2-26 provide plan view and cross-sectional example renderings of each Site 4-1 segment's proposed erosion protection and on-site habitat mitigation design features. The renderings illustrate the general location of the feature (e.g., riverbank vs overbank), inclusion of on-site habitat mitigation elements such as planting benches, soil filled revetment with soil a lift and maturation condition of the revegetation effort. It also depicts protected vegetation and recreational amenities above or below the proposed bank protection feature. Existing trees that are to be preserved in place are depicted as green circles in the plan view figures.

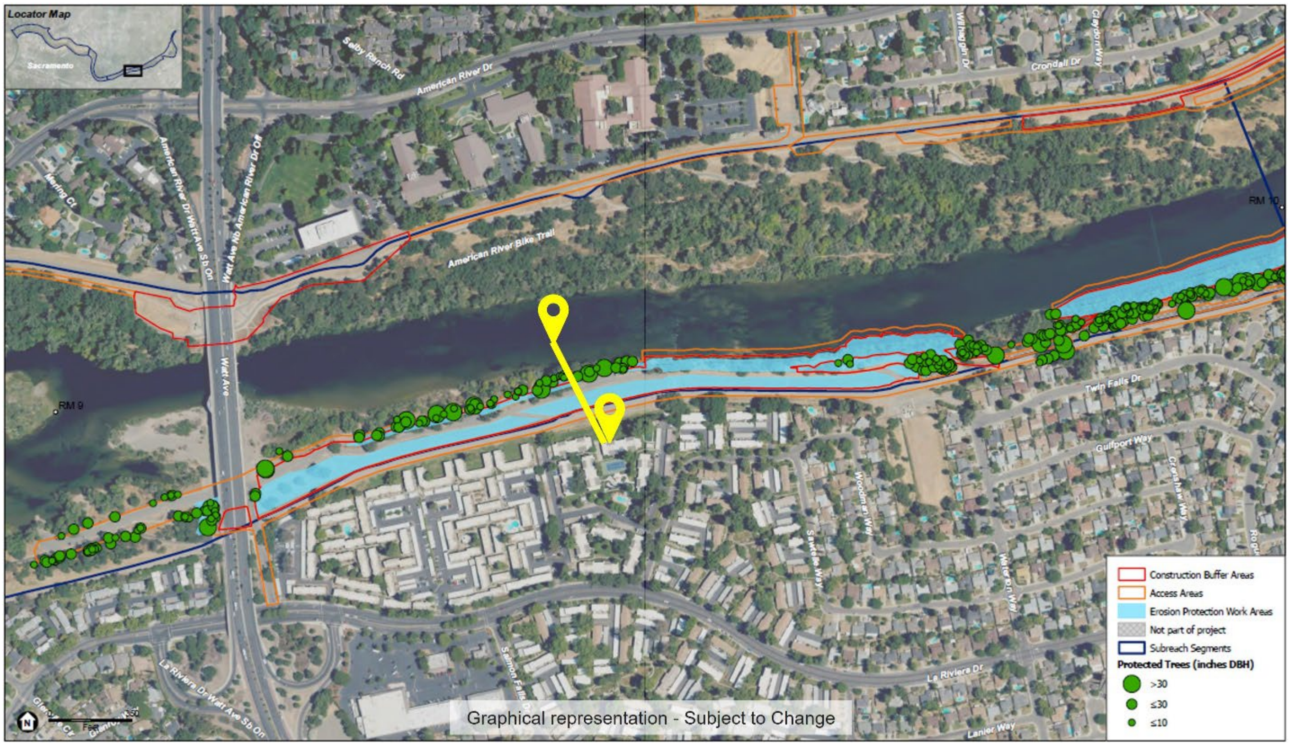
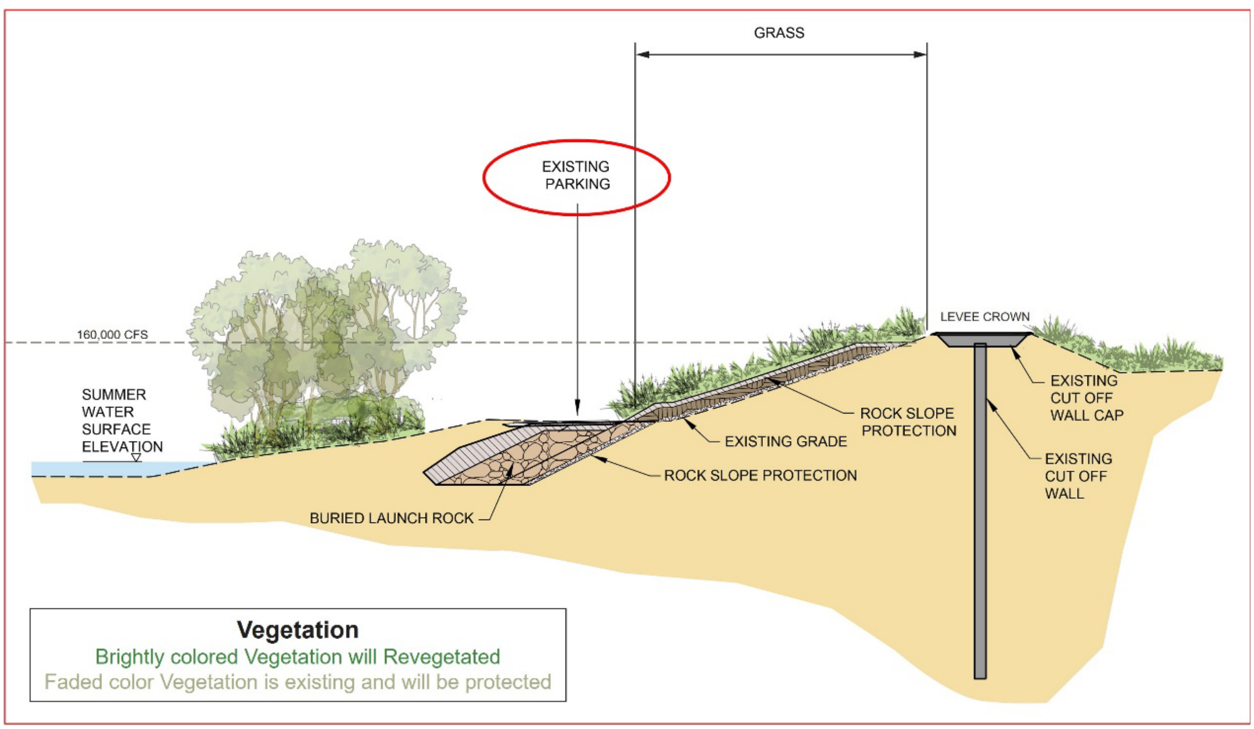


Figure 2-17. Layout of Segment 3-5 erosion protection feature and cross section location



Graphical representation - Subject to Change. Revegetated condition reflective of mature state

Figure 2-18. Segment 3-5 rendering of erosion protection feature

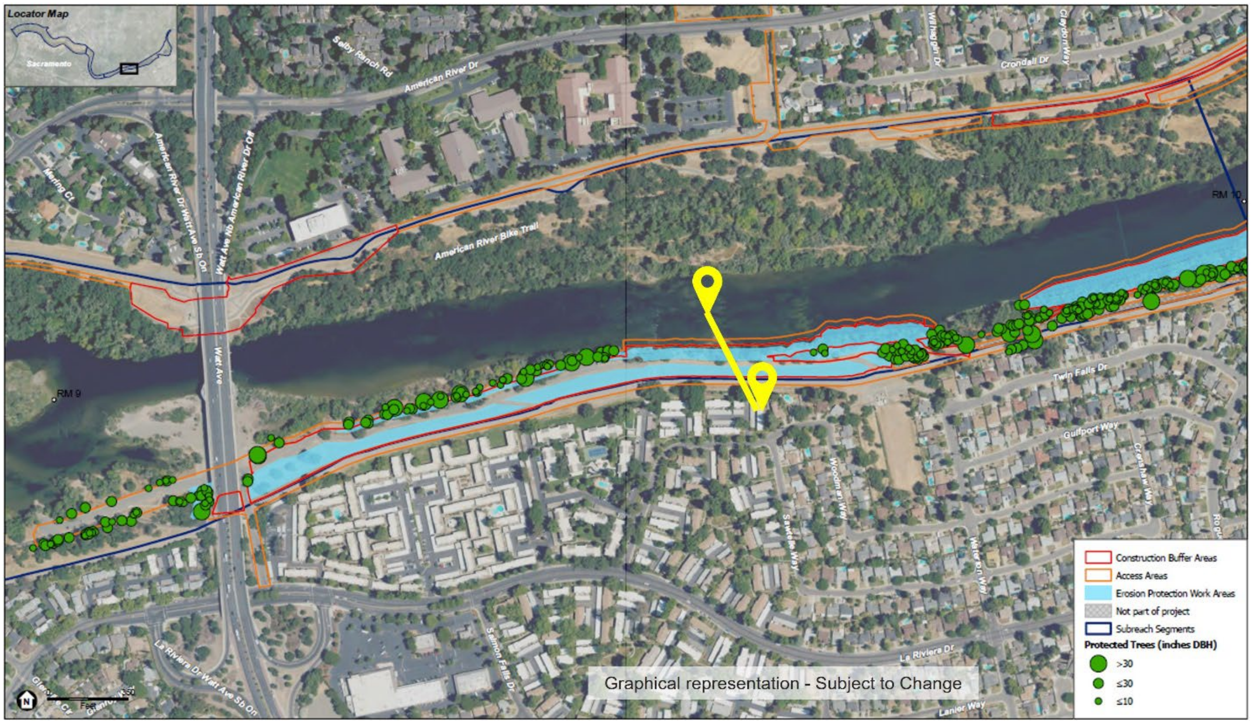
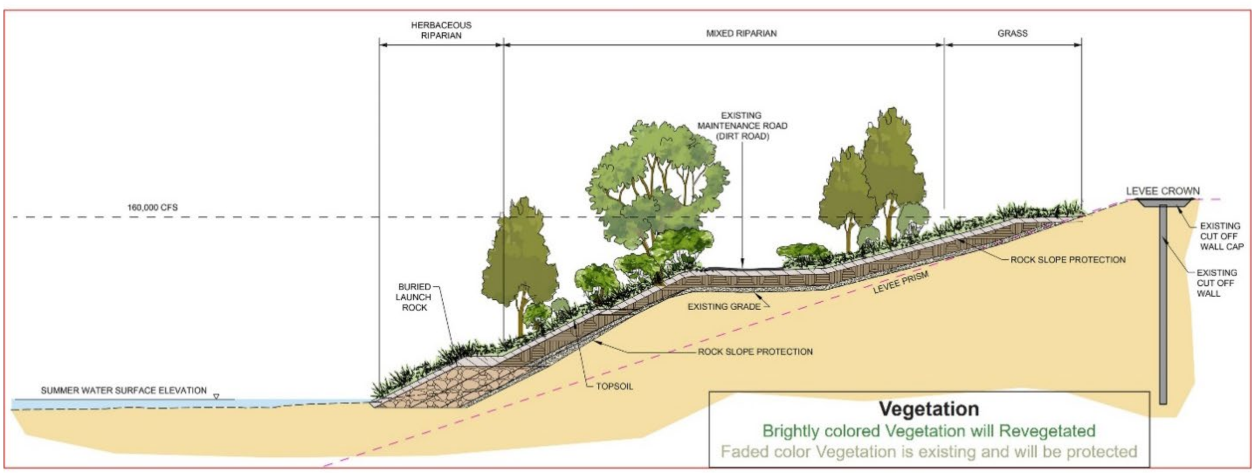


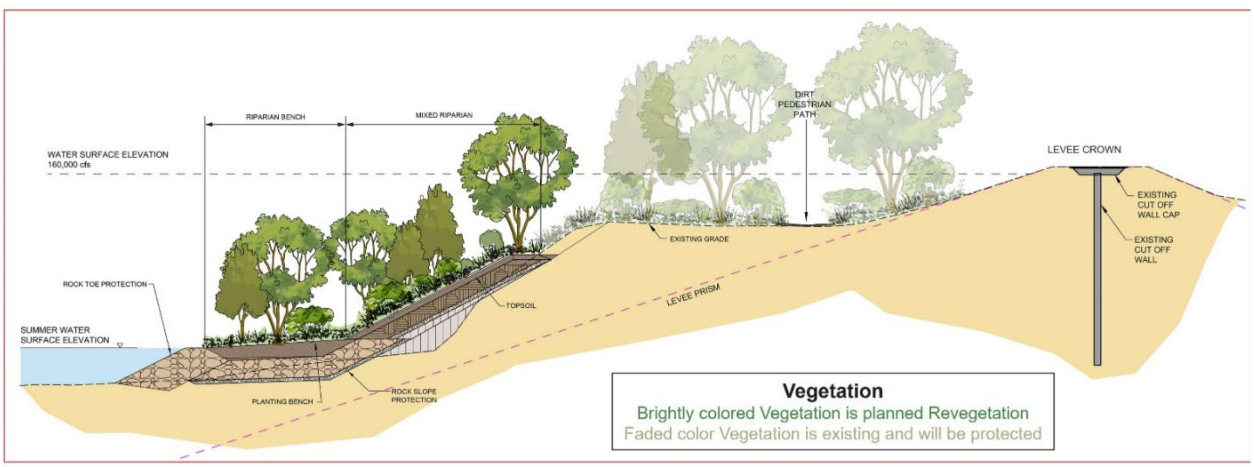
Figure 2-19. Layout of Segment 3-6 erosion protection feature and cross section location



Graphical representation - Subject to Change. Revegetated condition reflective of mature state

Figure 2-20. Segment 3-6 rendering of erosion protection feature

Figure 2-21. Partial Layout of Segment 3-8 erosion protection feature and cross section location



Graphical representation - Subject to Change. Revegetated condition reflective of mature state

Figure 2-22. Segment 3-8 rendering of erosion protection feature

Figure 2-23. Layout of Segment 4-1 erosion protection feature and cross section location

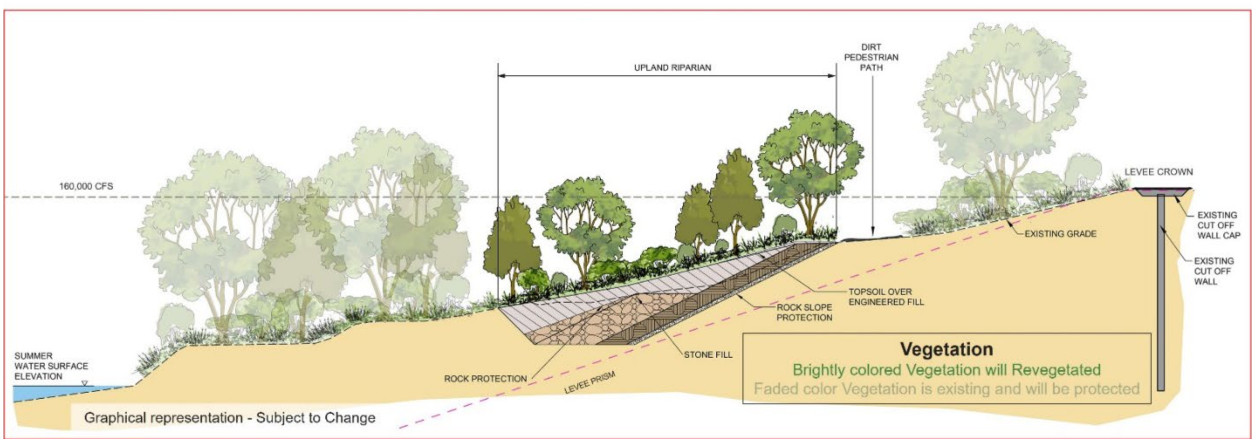


Figure 2-24. Segment 4-1 rendering of erosion protection feature

Figure 2-25. Layout of Segment 4-3 erosion protection feature and cross section location

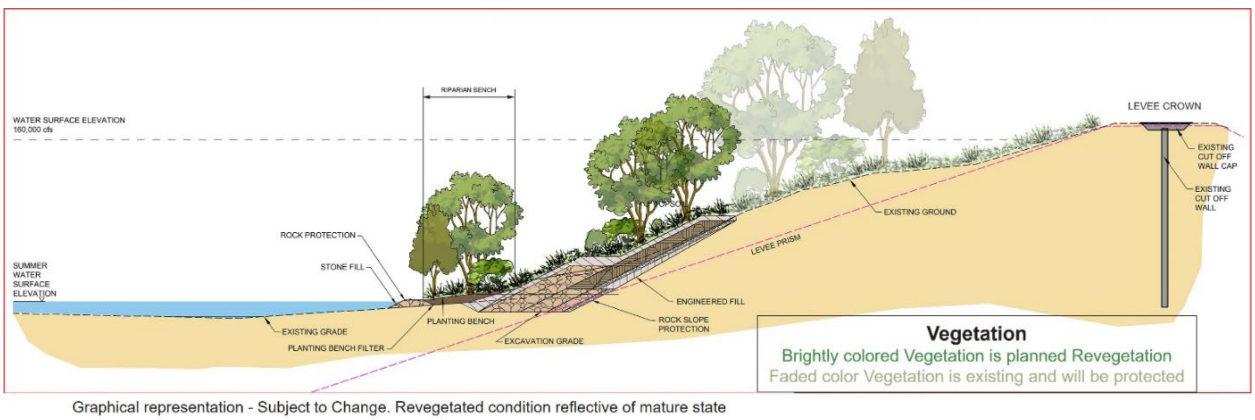


Figure 2-26. Segment 4-3 rendering of erosion protection feature

2.5.2.5 Contract 3B Site 4-2

Contract 3B Site 4-2 is located on the right (north) bank upstream of Watt Avenue. Figure 2-27 shows the location of Site 4-2 and the proposed erosion protection footprint.

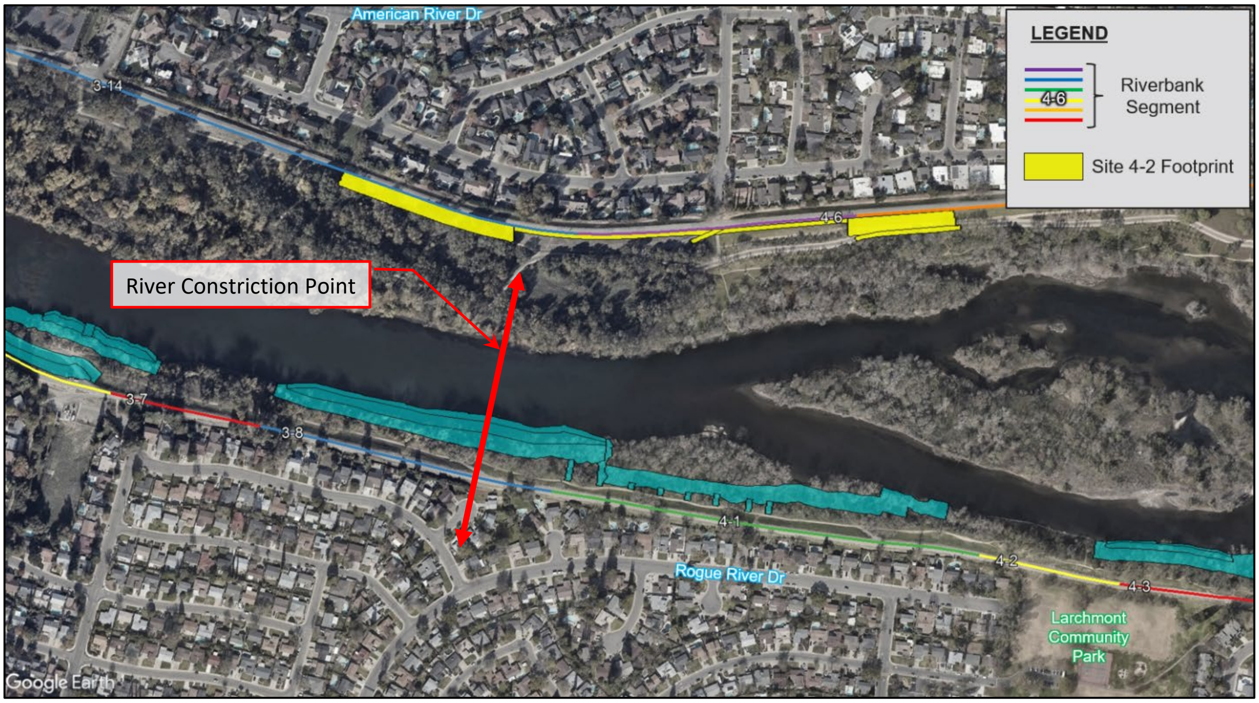


Figure 2-27. Site 4-2 overview map

2.5.2.5.1 Identified Risk Drivers

Site 4-2 expands a previous design that was installed at this site in 2004. The primary risk driver at the site is PFM 2 due to high velocities located along the levee embankment and toe. The American River makes a mild right bend at the project location, and the width of flow area between the north and south levee decreases at this location relative to upstream and downstream. This constriction, depicted in Figure 2-27 above, causes a localized increase in velocities on the levees where velocities may exceed the shear strength of the grass covered levee and induce erosion. The levee at this location is constructed to minimum required dimensions, and progression of erosion will remove material critical to levee stability.

2.5.2.5.2 Design Alternatives

This site was originally identified as a Tier 3 site by the Phase I Site Evaluation and was not evaluated by the TRAC for a recommended approach at the 10% C3B design. However, after acquiring more site-specific data and performing additional hydraulic analysis, the Phase II baseline assessments evaluations determined this segment did not meet project erosion risk objectives based on hydraulic conditions; specifically, the increased velocities induced along the north levee by the constriction point described above. Thus, USACE Sacramento District determined erosion protection was necessary at this site and added it to the scope of LAR C3B in July 2021. The PDT developed an initial design concept that was reviewed by the TRAC with additional discussions and refinement options discussed with Sacramento County Regional Parks staff. Design alternatives were developed and weighed with the PDT and Sacramento County Regional Parks participation to minimize impacts to recreational and habitat amenities. The design includes increasing the revetment height of the existing revetment features to account for the design objective flow condition (i.e., 160,000 cfs). In addition, the design extends levee embankment protection both upstream and downstream of the existing revetment features based on hydraulic conditions for the design objective flow.

2.5.2.5.3 Proposed Design

The proposed design installs soil-filled revetment on the levee embankment and will cover the soil-filled rock with one foot of topsoil to be reseeded with native grasses. The revetment is sized to resist erosion during the design event. Covering the revetment with topsoil and reseeding the topsoil will screen the project from public view and provide a naturalistic view to the project. The levee embankment is currently vegetated with grasses and will be replanted with native grasses. Design for the sections upstream and downstream of the existing revetment feature also include a volume of buried launchable trench at the levee toe to address scour potential. The layout of the buried launchable trench was designed to minimize impacts to the recreational trail in proximity as well as minimize impacts to existing vegetation. Figure 2-28 and Figure 2-29 provide an example rendering of erosion protection design within Site 4-2. The plan view also depicts vegetation to be protected as green circles.

Figure 2-28. Layout of Site 4-2 erosion protection feature and cross section location

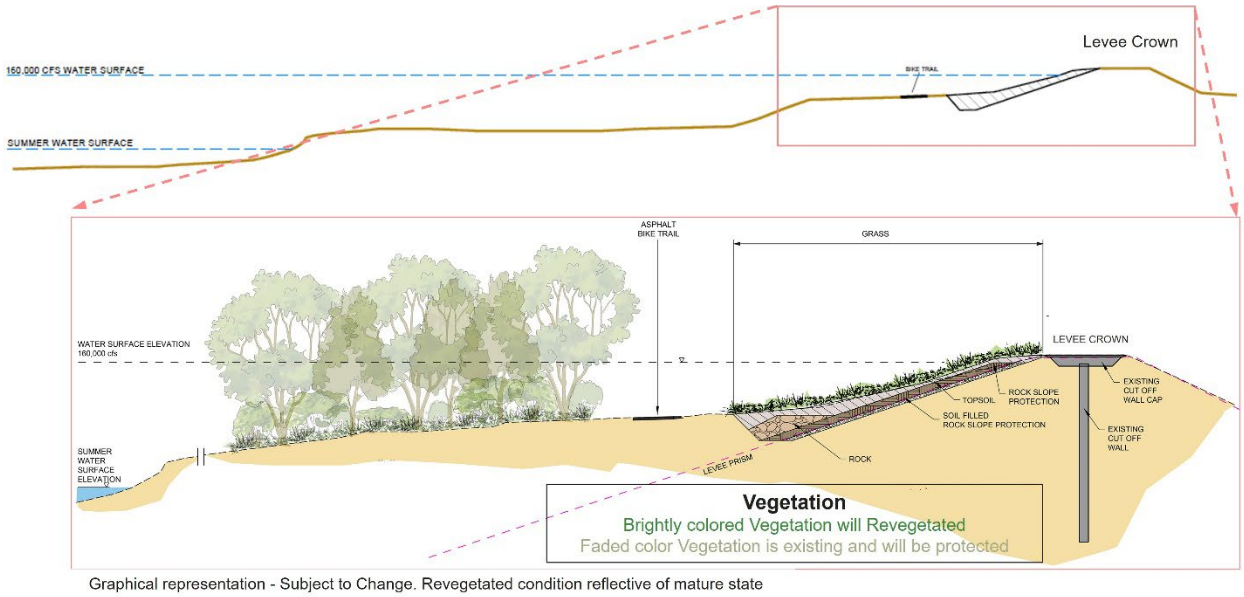


Figure 2-29. Site 4-2 rendering of erosion protection feature

2.5.3 Contract 4A

Contract 4A includes one site located on the right (north) levee at the Highway 160 bridge. Figure 2-30 shows the location of Contract 4A and the proposed erosion protection footprint. This location was identified initially as a Tier 2 segment by the Phase I Site Evaluation with a concern for localized high velocities under the bridge. It was not originally recommended for repair by the TRAC. However, the Phase II Site Evaluation baseline risk assessment quantified the risk of erosion levee failure to exceed the project objectives. The concerns documented in the risk assessment include:

1) High velocities along the levee (up to 5.0 fps).
2) Erodible soils within the levee embankment (sands, silts, and clays).
3) No erosion countermeasures to protect the levee with areas of exposed, unvegetated soil beneath the bridges.
4) Potential for debris blockage on the railroad bridge bents causing isolated higher velocity flows against the levee.

Figure 2-30. LAR C4A project overview map

This levee is about 1,800 feet from the American River main channel. There are three bridges crossing the American River at this location; State Highway 160 West Bound, State Highway 160 East Bound, and a UPRR bridge. Embankments constructed on the floodplain for these bridges partially block floodplain flows, forcing more flow into the main channel and into a narrower opening between the bridge embankments and the levee. This results in accelerated flow between the bridge embankments and the levee with higher velocities near the ARN levee as shown in Figure 2-31.

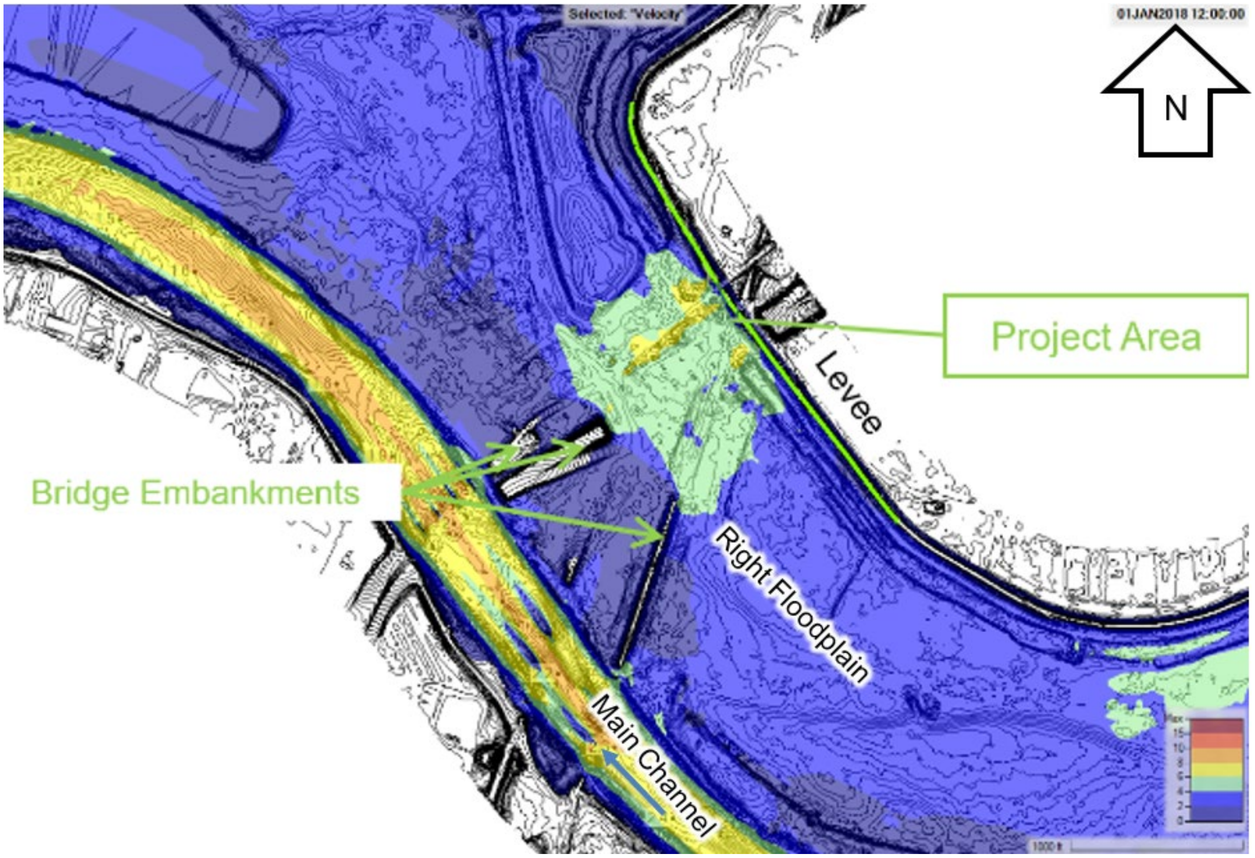


Figure 2-31. Plot showing velocities increase in the floodplain near LAR Contract 4a levee

The flow around the bridge columns and posts creates turbulent vortices. These turbulent vortices increase the erosive forces on the soil locally adjacent to these features and impact the levee. The embankment along the levee supporting the UPRR bridge abutment projects into the flow, locally contracting and accelerating the flow while creating turbulent vortices. This is illustrated in Figure 2-32. Velocity tracers are shown as purple lines around the UPRR bridge abutment for the design flow. The higher local velocity and turbulence can lead to local abutment scour in addition to the local pier scour previously described.

The relatively close spacing of the UPRR bridge bents, their angled orientation relative to the flow of the water, and the relatively low elevation of the lowest elevation of the superstructure (i.e., "low chord") below the top of levee contribute to the potential for debris to accumulate around the bridges. The debris can block flow, creating higher velocities through the remaining openings, possibly including higher velocities on the levee itself. The debris can also re-direct flow toward the levee and contribute to erosion of the levee. Therefore, debris can increase the likelihood of erosion of the levee.

The soils immediately below the levee are mostly clays and silts that are susceptible to scour and erosion from the high velocities and turbulence. Erosion testing of soil samples indicate that soils in

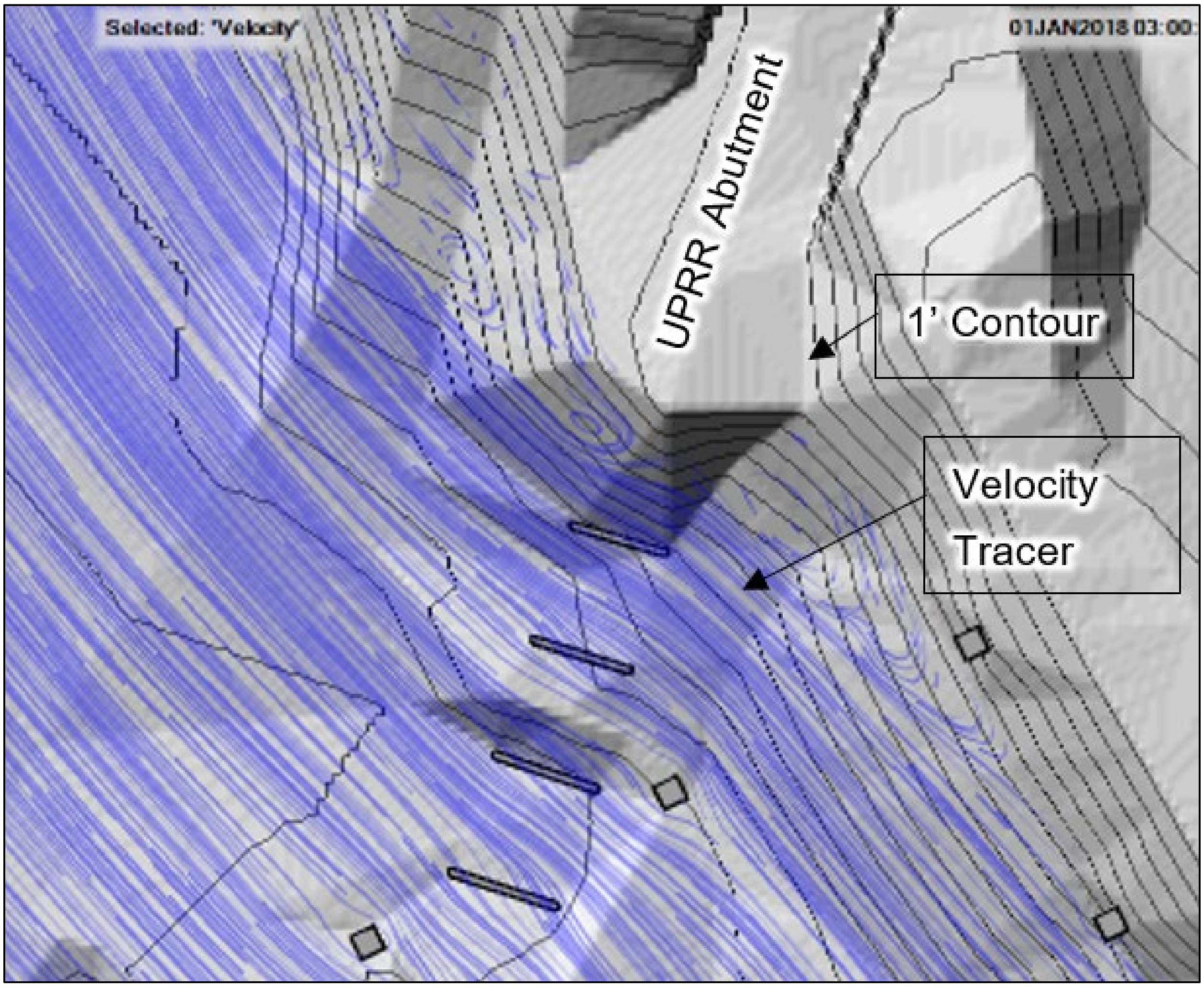


Figure 2-32. Plot showing flow contracting around UPRR bridge abutment

erosion category II (High Erodibility) to category I (Very High Erodibility). See Figure 2-33 for example soil test results showing high erodibility for a silty clay soil sample collected within the levee at the project site. While clay soils typically classify in the moderate or even low erodibility category, the levee soils at LAR C4a were tested and almost all tests found the soils in the project area to be near the boundary between very high erodibility and high erodibility, categories typically associated with sand. This confirms the risk cadre's concern about the presence of erodible soils at this site.

Because of the high and potentially turbulent velocities against the levee and the presence of erodible soils, the Sacramento District determined erosion protection was necessary at this location.

USACE began the repair design by hosting design charrettes with a multi-disciplinary group from various agencies with a similar but not completely consistent membership to the TRAC to discuss design alternatives. USACE has continued to work with this group during design development The designs at each milestone have been reviewed by TRAC members and other review staff. The design development is discussed further in the following sections.

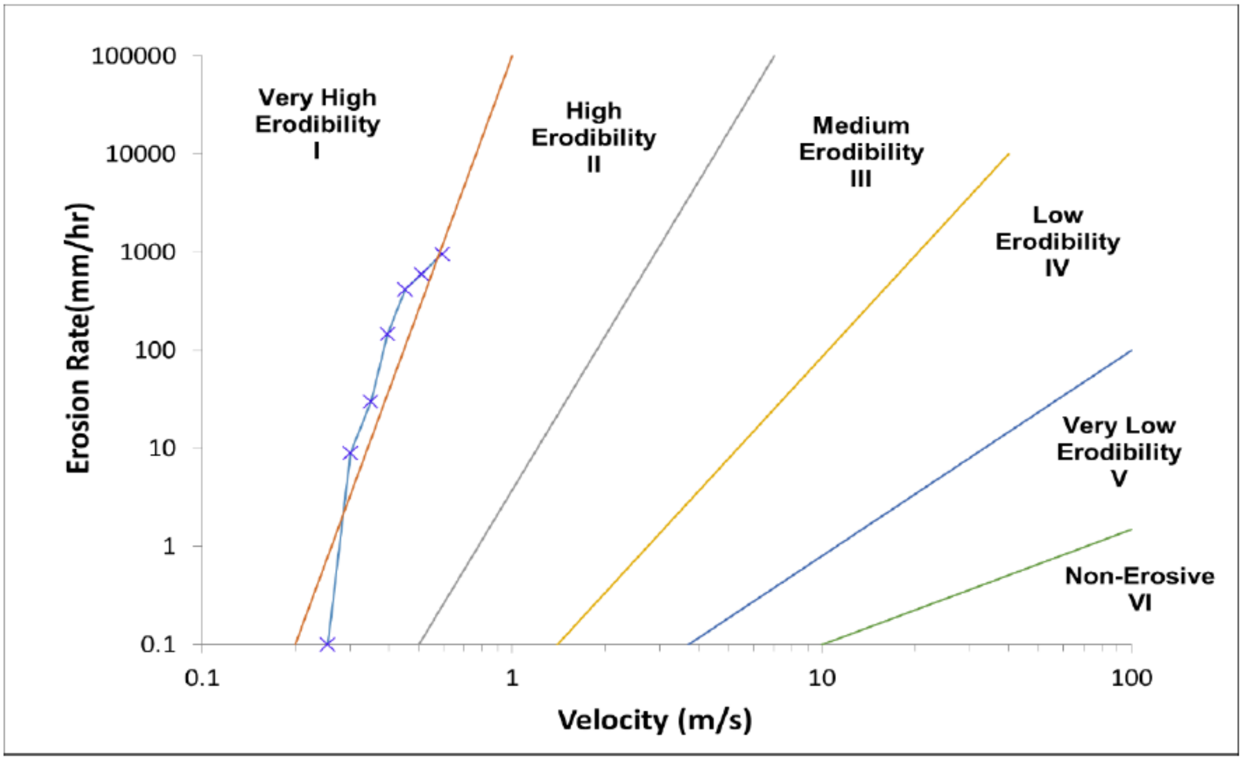


Figure 2-33. Example soil test results

2.5.3.1 Identified Risk Drivers

Contract 4A at RM 2.0 is located on the right levee under the highway 160 bridge. The primary risk driver at the site is PFM 2 erosion into the levee caused by high velocities impinging into the levee, and the presence of the Highway 160 bridge and Union Pacific Railroad bridge piers inducing local scour near the levee. Velocity is increased at the site by the large railroad and highway 160 encroachments in the floodway locally constricting flow.

2.5.3.2 Design Alternatives

The PDT worked with representatives from USFWS, NMFS, NPS, Sacramento County Regional Parks, DWR, and SAFCA to evaluate alternative designs at the site at two design charettes. The initial design charette identified alternatives to be considered including:

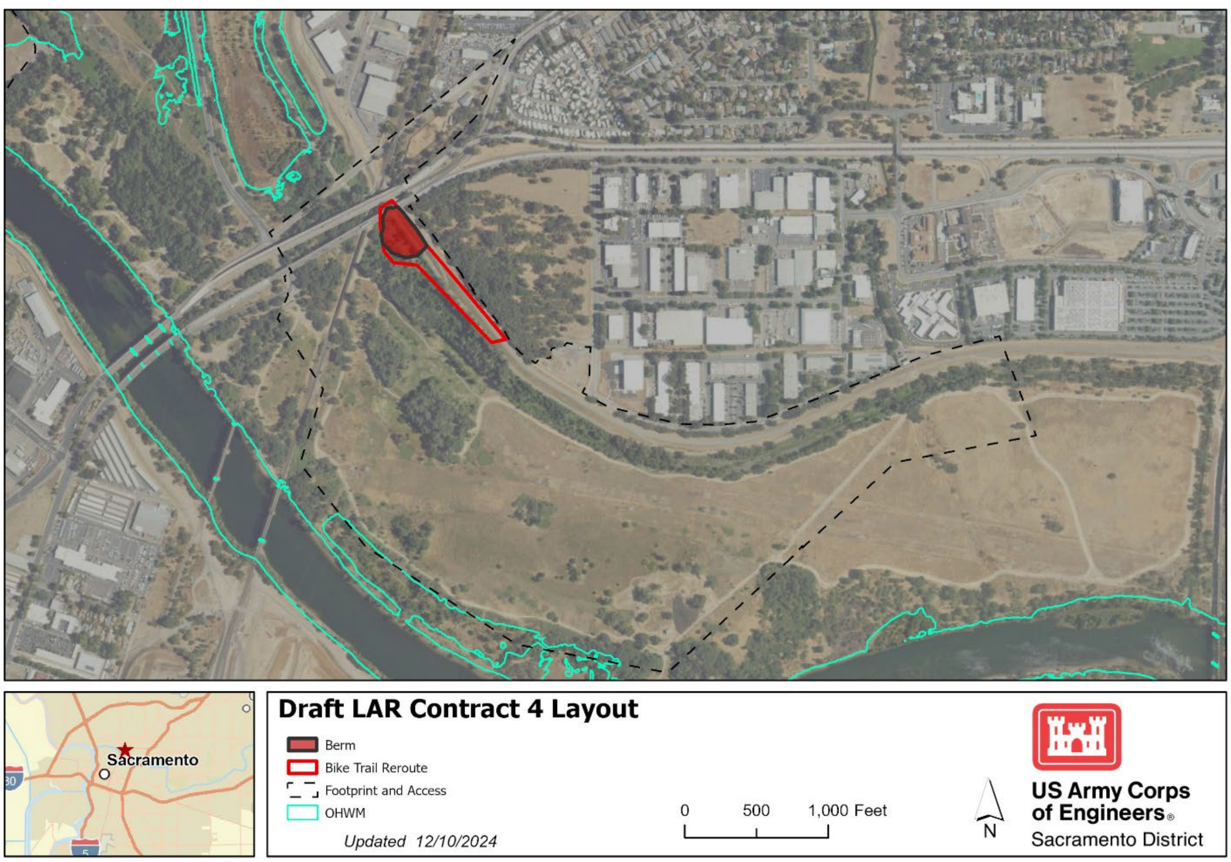
1. Groin (deflector spur or berm) or jetty system upstream of bridges or under bridges to deflect flow away from the levee.
2. Rock blanket on ground surface near levee and on levee and at piers.
3. Buried rock layer within levee prism and into levee toe; rebuild to existing lines/grades.
4. Launch rock under bike path; Build soil filled rock at bike path alignment and relocate bike path on top or in another location.
5. Select rock revetment at high velocity areas/piers but not along entire levee slope.

6. Grouted rock or concrete lined riprap on levee slope/toe.
7. Articulated concrete blocks.
8. Pave the levee slope and toe up to the bike path.

After the initial design Charette, the PDT further analyzed and developed these alternatives prior to a second design charette to discuss the alternatives in detail. The group ultimately identified a preferred alternative to construct a large deflector spur (berm) upstream of the Highway 160 bridge to deflect flow away from the levee. This alternative required the relocation of the bike trail as the berm blocks the existing bike path location. An alternative bike path alignment was identified working with Sacramento County Regional Parks including a third design Charette.

2.5.3.3 Proposed Design

The features of the proposed design for LAR C4A include construction of a deflector berm, relocation of a portion of the existing Jedediah Smith Memorial Bike Trail, and relocation of part of a 12-inch waterline. These features are shown on the overview map (Figure 2-30).



The proposed design will construct a berm upstream of the Highway 160 bridge that will deflect flow away from the levee preventing the flow from impinging on the levee and reducing velocity on the levee face to reduce erosion risk. The berm will be constructed of soil-filled quarry stone, covered with 1-foot of topsoil, and seeded with native grasses. Adjustment of the berm was considered to avoid more trees, but no additional modifications could be done to the berm that wouldn't have either increased flood risk, increase the project footprint, or encroach into adjacent properties. In addition, to avoid wetland impacts, the design minimizes the project footprint as much as possible while still meeting flood risk objectives.

The berm will block the alignment of the existing bike trail. Therefore, the bike trail alignment will be moved to a location around the berm. that bypasses the deflector berm. This bike trail alignment was agreeable to Sacramento Regional County Parks.

The berm is also located above an existing City of Sacramento 12-inch waterline. As a result, approximately 210 feet of waterline will be relocated around the berm to allow for simpler maintenance and remove the risk of a waterline break beneath the berm.

Soil filled quarry stone fill will be placed in part of an old abandoned borrow pit (which has been delineated as a wetland) running approximately parallel with the existing bike path to support construction of the berm and parts of the bike path and waterline relocations. This soil-filled quarry stone also provides erosion and scour protection to the berm and bike path foundations and the relocated waterline. The soil-filled quarry stone will be topped with 1-foot of topsoil and seeded with native grasses.

Construction of the project will occur in phases so that at least one lane of the bike path will be open to the public during construction at all times to reduce impacts of bikeway closure to the public.

2.5.4 Contract 4B

Lower American River (LAR) Contract 4B is located on the right (north) bank upstream of Howe Avenue and on the left (south) bank upstream of Watt Avenue. Contract 4B is located immediately adjacent to Contract 3B; specifically, in between the footprint of Contract 3B and the levee crown. Figure 2-34 shows the location of Contract 4B in relation to the locations of the other American River Common Features (ARCF16) Project erosion protection improvements along the LAR. Contract 4B is focused on addressing two key erosion risks along the Lower American River, specifically in river Segment 3-11 on the north bank upstream of Howe Avenue and Segments 3-8 and 4-1 on the south bank upstream of Watt Avenue. The first erosion risk being addressed by Contract 4B pertains to lone tree scour, which is detailed in Section 2.5.4.1 below. The second erosion risk Contract 4B is addressing is the potential for erosion to outflank the Contract 3B design is Segment 4-1 on the south bank of the river; this second erosion risk is detailed in Section 2.5.4.2 below.

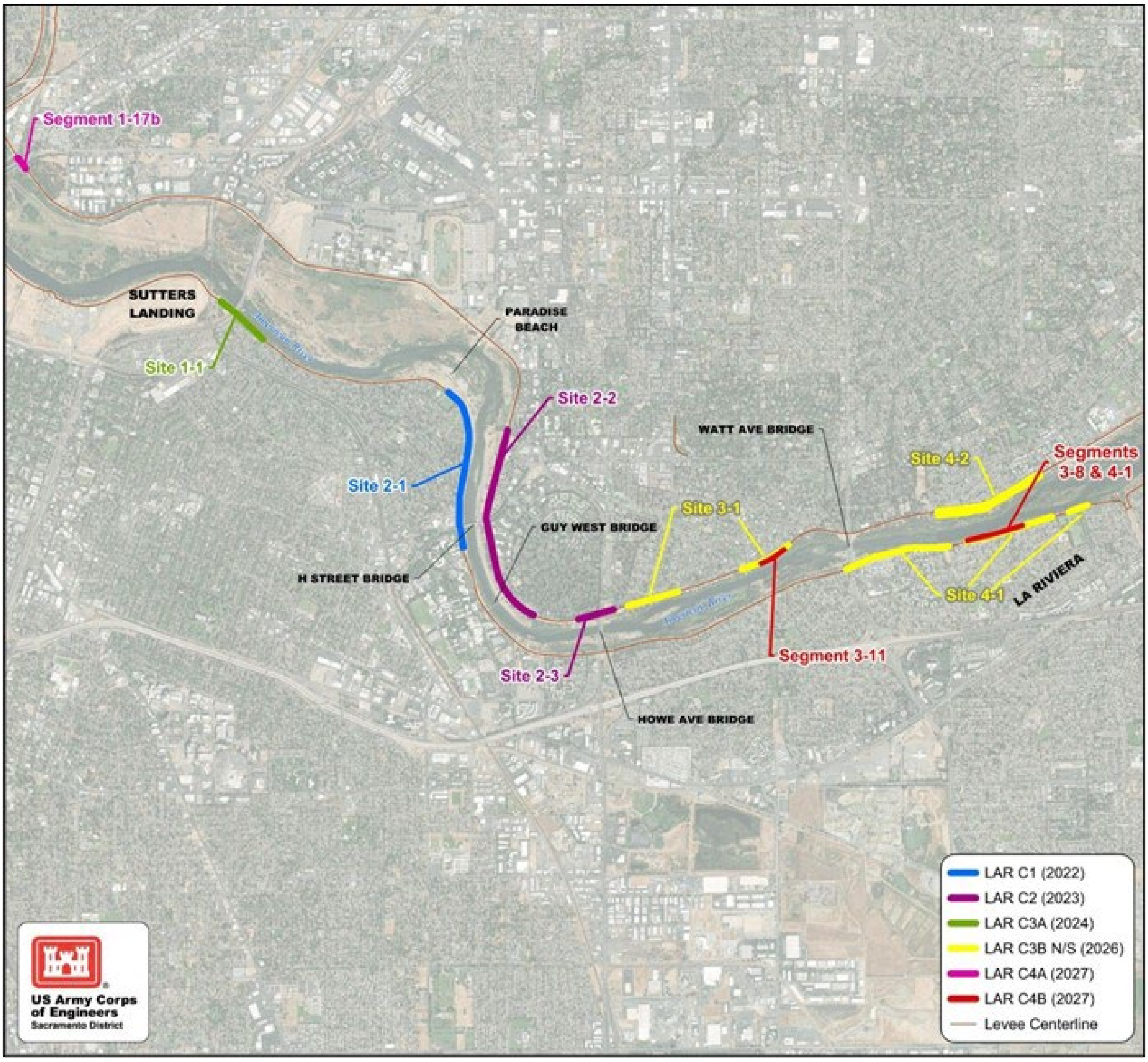


Figure 2-34. ARCF 2016 Project erosion protection improvements on LAR

2.5.4.1 Lone Tree Scour

A risk assessment completed in 2022 determined certain trees on or near the levee embankment adjacent to the Contract 3B erosion protection footprint pose an unacceptable risk to the levee's integrity. The purpose of Contract 4B is to address this risk to the levee while protecting these trees in place by installing erosion protection around the base of the trees. However, if engineering analyses demonstrate that a design solution to protect a given tree in place is not achievable, or if based on input from landscape architects and arborists a design solution would likely result in a given tree's death, tree removal may be required.

The risk assessment identified trees within Segments 3-8, 3-11, and 4-1 which pose a risk of riverside erosion above the levee toe in the levee embankment (PFM 2). Tree trunks are obstructions in the middle of incoming flow, which could cause flow acceleration around these tree trunks and lead to localized scour similar to bridge piers (U.S. Army Corps of Engineers, 2016). Figure 2-35 shows an example of this tree scour that occurred in the 1986 flood event while Figure 2-36 shows an example of lone tree scour, which occurred on the Big Sioux River, a Missouri River tributary, in 2024. Observed lone tree scour hole depth and extent varies widely. And more detailed analysis is needed to isolate the impact of lone tree scour effect as outline in 2.5.4.1.1. The scour excavates a depression around a given tree that, for trees located near or on the levee embankment, can extend into the levee embankment and narrow the levee inducing levee failure. The magnitude of scour is directly related to the diameter of the tree, the depth of flow, the erodibility of the soil, and the flow velocity. Trees of concern are large diameter trees (greater than 18-inch diameter at breast height (DBH)) located on or immediately adjacent to the levee at locations where the levee is not overbuilt, and at locations with relatively deep flow depths and higher velocities. With Contract 3B's Sites 3-1 and 4-1 designs optimized to address erosion of the riverbank, not lone tree scour, and the lone tree scour risk being identified late in the C3B design process, the lone tree scour risk potential is being addressed as a separate contract to allow for a more selective approach to address this unique risk driver.

Figure 2-35. 1986 Lower American River flood event aftermath - localized lone tree scour

Figure 2-36. 2024 Big Sioux River flood aftermath. Example - localized lone tree scour

2.5.4.1.1 Lone Tree Scour Risk Scope

The intent of lone tree scour evaluations and remediation is to address the risk of erosion jeopardizing the levee while protecting all native tree species in place. Non-native tree species which pose a threat will be reviewed on a per tree basis with the Technical Resource Advisory Committee (TRAC) to determine preference for removal or protection. The TRAC is a multi-disciplinary group, that includes water resource engineers, geotechnical engineers, geoscientists, biologists, and ecologists, along with local stakeholders (county parks & others), regulating agencies and Subject Matter Experts (SME) who advise on design decisions.

USACE is working through a four-step process to identify individual trees which pose a risk to the levee and to develop approaches to reduce the erosion risk. Steps two and three focus on minimizing the footprint of the project to ensure only trees that are immediate threats to levee safety during a high flow event are included in Contract 4B. USACE will complete this process following the following four steps:

Step 1: Identify individual trees in close proximity to the levee which may threaten the levee if scour were to occur. USACE completed an initial assessment and identified 81 trees for study. These trees include all trees located on the waterside slope of the levee and within 25 feet of the waterside levee toe. Figure 2-37 and Figure 2-38 show the locations of these 81 trees.

Step 2: Estimate maximum scour expected to occur around each tree during a design event and determine which trees could create scour that could extend into the levee or levee foundation. USACE completed an initial analysis of the 81 trees identified in Step 1 and identified 31 trees did not need further action due to limited scour depths and/or the potential scour not extending into the levee.

Step 3: Evaluate the scoured condition to determine the effect on levee stability. The remaining 50 of 81 trees will be further evaluated to understand if the scoured condition around the tree could threaten the integrity of the levee. The evaluations will include geotechnical studies of seepage and stability and detailed risk assessments to verify which trees pose an immediate threat to levee safety. Trees determined to not pose an immediate threat to the levee's integrity during a single high flow event will be considered safe and will be removed from further evaluation. USACE is currently working on this step to finalize the scope of Contract 4B and determine exactly which trees require action to mitigate the erosion risk. It is anticipated this step will be completed in late 2025.

Figure 2-37. Contract 4B trees under evaluation within Segment 3-11

Figure 2-38. Contract 4B trees under evaluation within Segments 3-8 and 4-1

Step 4: Develop solutions to mitigate erosion risk working with certified arborists and the TRAC. Only trees determined to pose an immediate threat to the levee's integrity will be considered. USACE will work with the TRAC to develop design criteria for addressing the erosion risk for these trees, develop a range of treatments for each tree, and select the final preferred treatment. The final array of design solutions will need to demonstrate that USACE flood risk reduction objectives are met. USACE will continue to consult with the TRAC throughout the design development cycle and comply with requirements for arborist determinations regarding tree preservation, trimming, and removal.

2.5.4.1.2 Potential Actions

The intent of the Contract 4B design is to protect all native species inside the vegetation free zone in place; however, if the engineering analyses demonstrate that a given tree poses an unacceptable erosion risk to the levee and a design solution which can protect the tree in place is not achievable, its removal may be required. Non-native species will be reviewed on a per tree basis with the TRAC to determine preference for removal or protection. For each tree, the considered potential actions to mitigate the erosion risk will include:

- No Action. Detailed engineering analyses concludes that the tree is not a risk to the levee.
- Erosion Protection. This action would place erosion resistant material around the tree to prevent, or limit, the local scour from occurring similar to scour countermeasures placed near bridge piers. Unlike bridge piers, the health of trees can be impaired if the tree roots are damaged thereby limiting excavation to place materials and total fill depth that can be placed over roots to prevent erosion. Unique treatments for different tree types and loadings will be developed for each tree type and loading condition.
- Tree Removal. This action carefully considers the types of trees (native versus non-native), the size of scour depth, and the potential impact of the scour to the levee prism above the levee

toe. Removal of trees is not preferred due to the short and long-term loss of riparian habitat and would likely be limited to non-native invasive vegetation or trees of poor health.

2.5.4.1.3 Vegetation Design Deviation

The trees within Contract 4B's scope are located within the Vegetation Free Zone (VFZ) established in ETL 1110-2-583 (U.S. Army Corps of Engineers, 2014). Design solutions which propose anything other than removal of woody vegetation within the VFZ require a Vegetation Design Deviation (VDD) be approved by USACE Headquarters (USACEHQ). The approval process is expected to take approximately 2-years to complete once the final scope of Contract 4B is finalized. As the native oak and walnut trees in the project footprint are important to the visual aesthetic, habitat values, and natural setting of the American River Parkway, design solutions will be developed to protect the trees as well as the levee from erosion in consultation with Non-Federal sponsors and TRAC. The PDT is working toward an approval from USACE Headquarters by completing additional analyses considering the soil profile, vegetation type, and local three-dimensional hydraulics developed with site specific three-dimensional hydraulic models.

2.5.4.2 Tieback Extensions

Within Contract 3B Segment 4-1 on the south bank of LAR, upstream of Watt Avenue, part of the erosion protection planned includes installation of rock tiebacks which serve to prevent erosion from outflanking the revetment installed at the riverbank's edge (i.e., eroding the bank/levee landward of the riverbank's edge revetment). These tiebacks can be seen in Figure 2-39 below. It is anticipated this step will be completed by late 2025 or early into 2026. 2.5.4.1.3⍰2.5.4.1⍰.

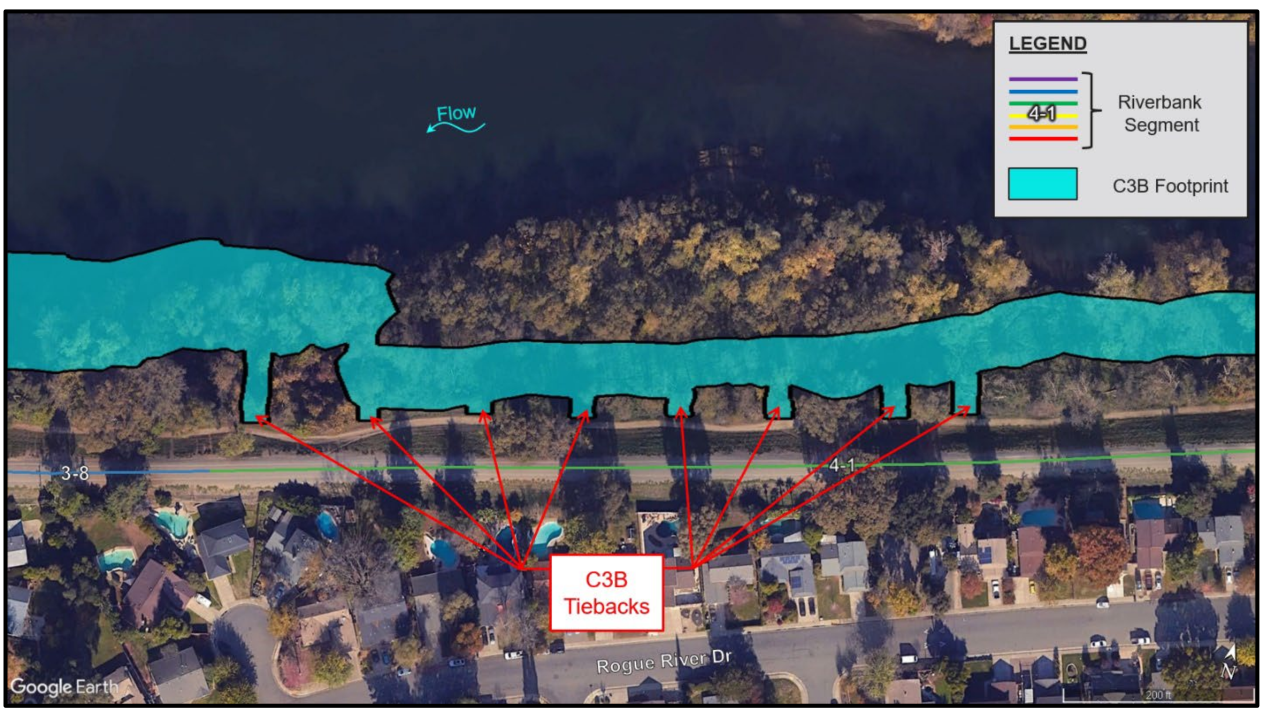


Figure 2-39. Contract 3B Tiebacks

2.5.4.2.1 Tieback Extension Scope

The Contract 3B tiebacks are fully buried and constructed using soil filled rock. For Contract 4B, the eight tiebacks depicted in Figure 2-39 above will be extended further landward and be constructed in the same manner as Contract 3B. The exact length of each tieback extension is still being determined but the tiebacks will extend into the VFZ and into the levee embankment. A typical cross section of the tiebacks is shown in Figure 2-40 below. A rough estimation of the extended tieback footprints is shown in Figure 2-41 below.

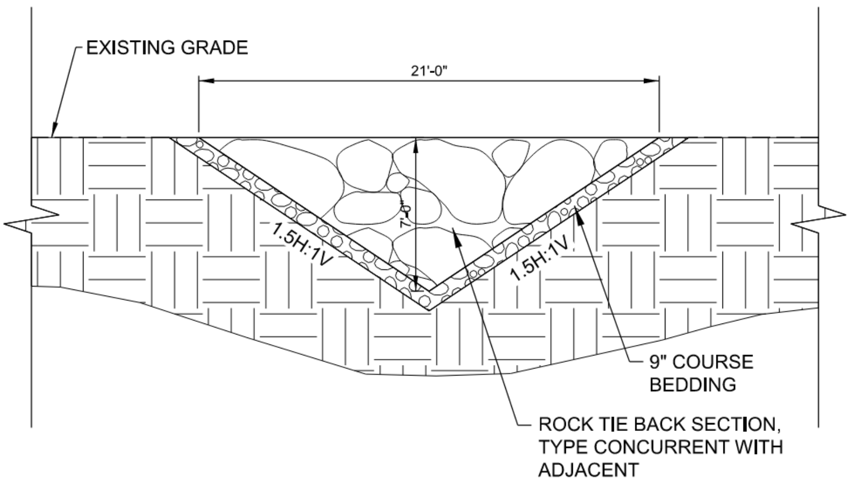


Figure 2-40. Rock Tieback Typical Cross Section

Figure 2-41. Estimated maximum footprint of tieback extensions

2.6 Design Implementation

2.6.1 General Schedule and Overview

Table 2-3 below provides a summary of planned implementation activities for each contract. The Projects are generally implemented in three phases further described below: Vegetation Clearing and Elderberry Transplant, Civil Construction, Revegetation. Separating the project components into phases better facilitates working within regulatory windows, avoiding project delays, and using the best available contractors for each type of work. The overall schedule is generally based on completing construction during the in-water work window specified in the NMFS BO. Site 3-1 and Site 4-1 are to be constructed over two years to ensure completion of in-water work during the in-water work window. Some civil construction activities for features that are above the ordinary high-water mark may start as early as April 16 each year.

Table 2-3. Schedule for Implementation

Contract / Site	Vegetation Clearing/ Transplant	Target Construction Year	Revegetation
LAR C3B	Y1: Fall/ Winter 2025/2026 Y2: Fall/Winter 2026/2027	Y1: Summer 2026 – Fall 2026 Y2: Summer 2027 – Fall 2027	Y1: Spring 2026 Y2: Spring 2027
LAR C4A	Fall/Winter Preceding Construction	Spring – Fall 2027 or 2028	N/A
LAR C4B	Fall/Winter Preceding Construction	Spring – Fall 2028	Spring 2029

2.6.2 Vegetation Clearing and Elderberry Transplant

Large vegetation will be removed from the project footprint the fall and winter ahead of construction to avoid nesting bird season. For contracts expected to be constructed over multiple construction seasons, such as LAR C3B, vegetation removal in the preceding fall/winter will be limited to areas where construction will occur in each construction season. Vegetation is removed from above ground, and roots are left in place to provide erosion protection for the winter and spring months. Vegetation is removed during this period to facilitate transplanting elderberry shrubs within the footprint as USFWS BO requires the relocation of elderberry shrubs between November 1 and February 15. Generally, relocation of elderberry shrubs requires some clearing of other vegetation for access. Clearing of vegetation during the winter months also helps reduce the potential for impacts to nesting birds and construction delays from nesting birds. Vegetation clearing will be completed by a pre-qualified contractor under a contract which also includes the establishment of the elderberry shrubs at the transplant locations.

2.6.3 General Civil Construction

The general civil construction work includes all excavation, grading activities, rock and soil placement for both levee erosion protection and on-site habitat mitigation efforts. The general civil contractor will be a prequalified contractor with experience working near rivers and with required worker education on the environmental and cultural permit requirements at the site. Construction monitoring for sensitive biological and cultural resources may be required and is site dependent. At the conclusion of the work, the contractor will install temporary erosion control and seed the footprint with native grasses and sedges.

2.6.4 Revegetation of Sites

Once the general civil contractor has completed on-site work, a revegetation contractor will start work the following year to revegetate the site with native plants. The revegetation contractor will be required to install plants per the revegetation plans, and to irrigate and maintain plants through an establishment period. The establishment period is a performance-based requirement that will likely vary in duration from three to five years based on plant survival rates. During this time, the revegetation contractor will remove and replace failed vegetation, remove any invasive species from the site, and maintain any temporary erosion control features at the site. Once plant establishment requirements have been met, the contractor will remove temporary features (such as irrigation piping).

The vegetation being replanted at the site are species reviewed by project partners and includes native trees, shrubs, sages, and grasses. Table 2-4 below provides a list of Container Plants and Cuttings Species which will be included in the revegetation plantings. Table 2-5 provide a list of Seed Mix Species which will be used on the sites following construction completion.

Once established, the vegetation will continue to grow and mature. Figure 2-42 and Figure 2-43 provides examples of similar bank protection projects completed on the LAR since the late 1990s. Planting pallets and plant densities have been revised based on lessons learned from these previous projects as summarized by (GEI, 2019). These lessons learned have included reduced plant densities relative to previous designs which tended to overplant the site, and the inclusion of more shade tolerant ground cover. The designs are intended to provide natural regeneration once the site is established.

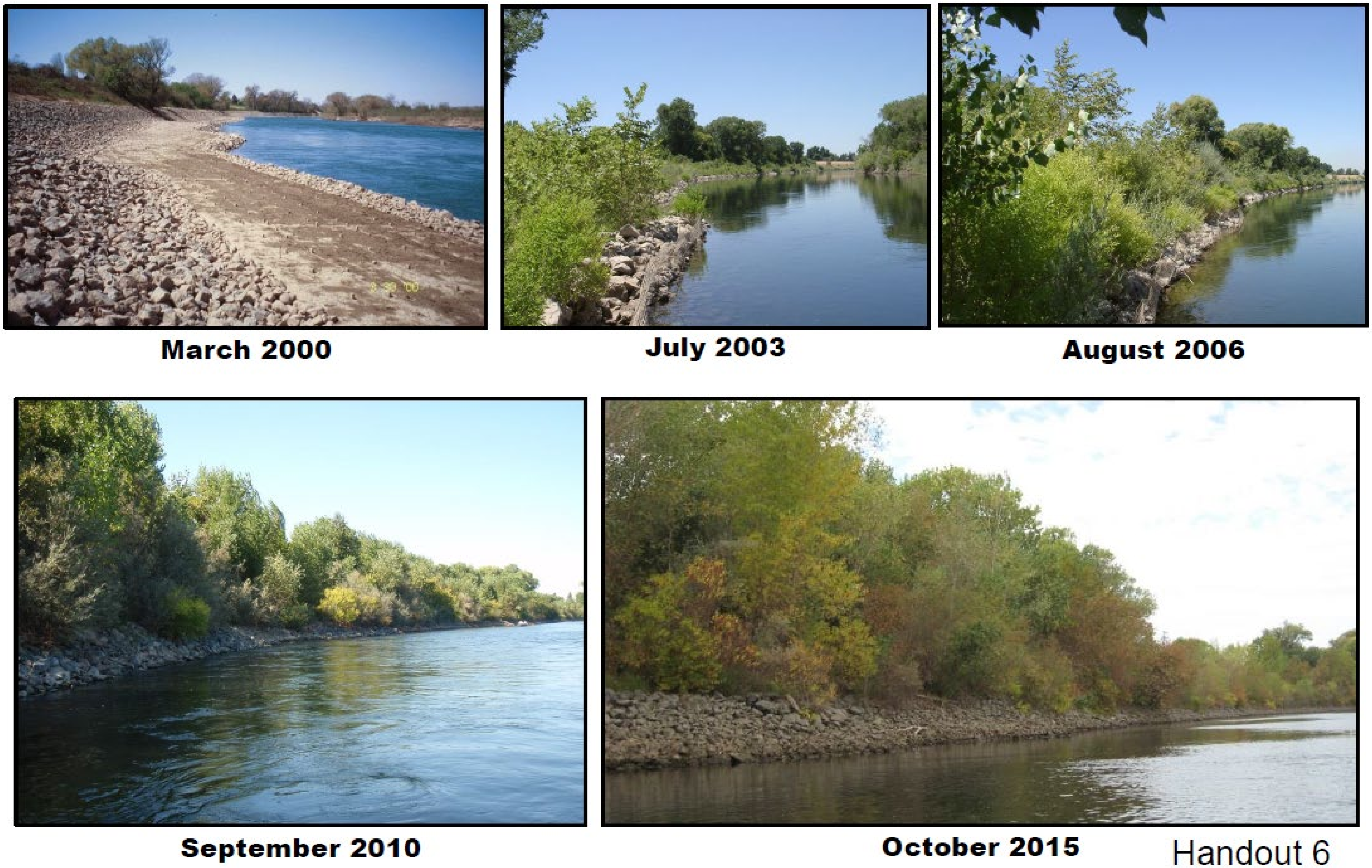
Table 2-4. Container Plants and Cuttings Species

Botanical Name	**Common Name**
Acer negundo	boxelder
Achillea millifolium	Yarrow
Alnus rhombifolia	white alder
Aristilochia californica	Pipevine
Artemesia douglasiana	mugwort
Baccharis pilularis	coyote brush
Baccharis salicifolia	mulefat
Carex barbarae	Santa Barbara sedge
Cephalanthus occidentalis	button bush
Cercis occidentalis	western redbud
Clematis lingustifolia	clematis
Dicheolostemma capitatum	blue dicks
Equisetum hyemale ssp. Affine	horsetail
Euthamia occidentalis	western goldenrod
Frangula calilfornica	coffeeberry
Fraxinus latifolia	Oregon ash
Grindelia camphorum	gum plant
Heteromeles arbutifolia	toyon

Botanical Name	Common Name
Isolepis cernua	low bulrush
Juglans hindsii	California walnut
Juncus balticus	Baltic rush
Juncus effusus	common bog rush
Leymus triticoides	creeping wildrye
Lupinus albifrons	silver bush lupine
Mara macrocarpa	wild cucumber
Muhlenbergia rigens	deergrass
Oenothera hookerii	evening primrose
Platanus racemosa	western sycamore
Populus fremontii	Fremont cottonwood
Quercus lobata	valley oak
Quercus wislizeni	interior live oak
Rosa Californica	western wild rose
Rubus ursinus	California blackberry
Salix lasiolepis	arroyo willow
Salix exigua	sandbar willow
Salix exigua	Sandbar willow
Salix gooddingii	black willow
Salix Laevigata	red willow
Salix lasiandra	pacific willow
Salix lasiolepis	arroyo willow
Sambucus mexicana	blue elderberry
Schoenoplectus acutus var. occidentalis	tule
Schoenoplectus californicus	california bulrush
Solidago velutina spp. Californica	california goldenrod
Stipa Pulchra	purple needlegrass
Symphoricarpos albus var. laevigatus	common snowberrry
Vitis californica	California wild grape

Table 2-5. Seed Mix Species

Botanical Name	**Common Name**
Achillea millifolium	Yarrow
Agrostis exarta	spike bentgrass
Ambrosia psilostachya	western ragweed
Artemisia douglasiana	California mugwort
Bromus carinatus	California Brome
Clarkia purpurea	purple clarkia
Clarkia unquiculata	elegant clarkia
Croton setigerus	turkey mullein
Elymus glaucus	blue wildrye
Eschscholzia californica	California poppy
Euthamia occidentalis	western goldenrod
Festuca microstachys	six weeks fescue
Grindelia camporum	gum plant
Hordeum brachyantherum	meadow barley
Hordeum brachyantherum ssp. californicum	California barley
Koeleria macrantha	june grass
Leymus triticoides	creeping wild rye
Lupinus bicolor	minature lupine
Lupinus microcarpus	chick lupine
Madia elegans	common madia
Poa secunda spp. Secunda	one sided bluegrass
Stipa Pulchra	purple needlegrass
Trifolium wildenovii	tomcat clover



Handout 6

Figure 2-42. Establishment of vegetation at RM 4.4L bank protection site after planting in 2000

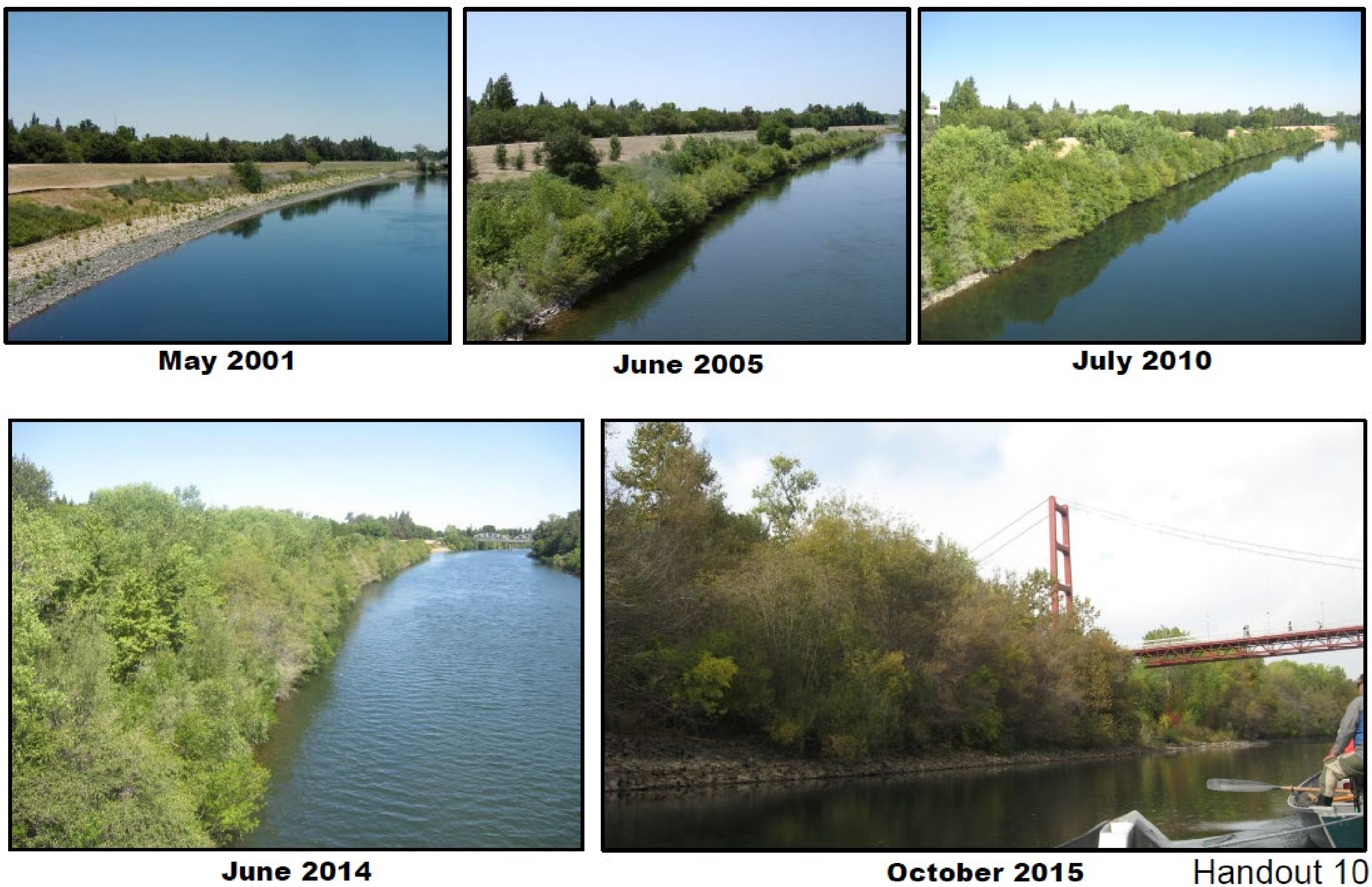


Figure 2-43. Vegetation establishment at RM 6.4 L bank protection site after planting in 2001

3 SACRAMENTO RIVER EROSION PROTECTION

3.1 Background

The Sacramento River downstream of LAR has tight levees and is tidally influenced. The location of the channel has been relatively stable for the past 150 years (although local scour and erosion can still be an issue). A large percentage of this reach has already been armored with riprap. This area has heavy wave action from recreational boats and wind, and the banks are heavily used by the general public since the banks are heavily occupied by private residences and commercial structures that limits public access along the levees. The general public use in this reach often creates local erosion by walking directly on the levee and banks. Many of the levees are constructed of dredged soils from the bottom of the channel. This reach does not have significant waterside structures such as private and commercial buildings but has some sections of heavy vegetation and many boat docks. The causes of erosion in this reach are boat wake, wind-wave, mass failure, fluvial processes, and public use.

This section provides detailed information about past performance of the levee, the selection of sites for repair, and the design process to develop designs for Contract 3 on the Sacramento River. Section 3.3 includes a summary of key data sources relied on in the site identification and design, as well as a summary of tools developed for analysis. Section 3.4 provides a summary of how sites requiring improvements were identified. Section 3.2 summarizes the design process and designs at each location in the Sacramento River Erosion Contract 3. Section 3.5 summarizes the implementation process for the proposed projects.

3.1.1 Historical Performance

The history of the Sacramento River has been greatly impacted by the influx of people into the Central Valley. Prior to 1800's the Sacramento River had insufficient capacity to carry large winter and spring flows, resulting in floodplains that extended for miles beyond the channel banks. The overbank velocities were low and much of the sediment eroded from the mountain and foothill areas would drop out, resulting in floodplain deposition (vertical accretion) and the development of natural levees through the rapid deposition of coarse particles as flow velocities decreased. Hydraulic mining, particularly in the Yuba and Bear Rivers, resulted in an excess of sediment load being washed into the Sacramento River and resulted in reduced channel flow and increased flooding in the low elevation areas.

In addition to the hydraulic mining, increased agriculture in the area resulted in landowners building low levees along the river to protect their cultivated fields. The levees were built in piecemeal fashion, without coordination between landowners, which led to competition between landowners to continually raise and strengthen their section of the levee to induce flooding on someone else's land.

During the time of hydraulic mining and agricultural development (1850 to 1900), the Sacramento River saw 13 large flood events. The flood of 1862 flooded the city of Sacramento and resulted in loss of life and destruction of property. The levees protecting the city of Sacramento were subsequently raised following this flood. The floods of 1881 resulted in numerous levee breaks on both sides of the Sacramento River, downstream of the city of Sacramento. After the 1800's, significant floods occurred in 1904, 1907, 1909, and 1928 on the Sacramento River.

Following the floods of the 1800's and early 1900's, early planning for the modern Sacramento River flood protection system started and consisted of dams, bypasses, channel widening and deepening, and levee enlargement. Construction of the Sacramento River Flood Control Project began in 1918 and was completed in 1953. The major features that were constructed included levees along the Sacramento River channel, leveed bypasses, and weirs.

The levees along the Sacramento River south of the confluence with LAR were constructed by a private mining and dredging company with the purpose of reclaiming and selling thousands of acres of farmland. The levees were constructed using large "clam shell" dredging machines. The work began in 1912 and was completed by the end of 1915. Based on typical construction schematics shown on basin-wide maps and historical literature, the levees along the Sacramento River were constructed in the following manner:

- A dragline was used to excavate a trench about 6 to 12 feet deep along the centerline of the levee alignment. The trench bottom width ranged from about 12 to 28 feet. The excavated material was deposited along both sides of the trench forming two small containment dikes.
- Hydraulic dredging operations placed material from the adjacent Sacramento River bottom into the excavation area between the dikes. This material consisted predominately of sands.
- The final levee configuration was achieved by covering the dredged sand with the adjacent dike materials. These materials consisted predominately of silt, clay, and fine sand.

It should be noted that because of the construction history outlined above, the upper portion of the semi-pervious blanket beneath the center of the levee has been removed and commonly replaced with sand. Typically, the sand core extends to a greater depth beneath the center of the levee than beneath either of the flanks or the surrounding ground. Most of the levee material was hydraulically dredged from the Sacramento River and piled or pushed into place with no mechanical compaction. Some mechanical shaping of the upper and outer portions of the sand core likely occurred during establishment of the general levee geometry.

The levees along the Sacramento River south of the confluence with LAR were constructed by local interests using clamshell dredges excavating material from the Sacramento River in the early 1900's. This method of construction usually resulted in a levee constructed on the channel banks with loose, sandy fill material that is deepest below the center of the levee. The materials within the levee embankment are predominantly sands, silty sands, and cohesionless materials. Since the construction of the original levee embankment in the early 1900's the levee has been remediated and improved several times. Levee remediation and improvements have consisted of embankment reconstruction and or enlargement, floodwalls, waterside rock slope protection, shallow through seepage cutoff wall, deep under seepage cutoff walls, seepage berms, and relief wells.

The 1955 flood was the first test of the new Sacramento River Flood Protection system. At the Sacramento Weir, 30 gates were opened with the peak flow reaching 48,000 cfs sent into the bypass. The peak flow in the Sacramento River at I Street was about 95,000 cfs. During the 1964 flood, the peak flow on the Sacramento River at I Street was about 100,000 cfs, just below the channel capacity of the reach. The flood of 1969 was largely controlled by the reservoirs, flood channels, and bypasses. The flood of 1974 saw a peak of 95,000 cfs at the I Street gage; the Sacramento Weir gates were not opened.

In 1960, Congress authorized the Sacramento River Bank Protection Project (SRBPP) for the construction of bank erosion control works and setback levees within the limits of the existing levee system. This project is intended to maintain the integrity of the levee system to continue the degree of protection for which it was designed.

The flood of 1986 had a peak flow of 117,000 cfs at the Freeport gage, just south of the city of Sacramento. The levees on the Sacramento River were severely stressed from high water and seepage. The levees near the Garden Highway required extensive repairs during the flood and nearly failed. The north bank along Arcade Creek was overtopped and 500 homes were inundated.

Since the completion of the Sacramento River Flood Control Project, significant floods have caused considerable erosion related damage to the levee system. Erosion in the Sacramento River has even occurred during lower flow events, as documented by SRBPP. Numerous emergency bank repairs and repairs done by SRBPP (over 800,000 linear feet) have been constructed in the last 50 years. Erosion continues along the Sacramento River banks and levees and there are currently numerous sites that are in need of repair.

3.1.2 Sacramento River Mileage

River mileage (RM) is measured from the mouth of the Sacramento River along its centerline, with mile zero located at the confluence with the Pacific Ocean. The reference mile markers used in this study are from the USGS quadrangle maps. They have also been used in other studies recently prepared for USACE and were considered to be the most consistent set of markers.

Descriptions of project locations refer to levee stationing (STA) along the centerline of the Sacramento River East Levee (SREL). The stationing refers to lineal feet moved along the centerline and is consistent with other levee improvement projects completed on the Sacramento River. For design and plan sheet creation, a simplified version of the provided levee alignment was created for each site. This simplified site alignment was developed to closely follow the existing alignment with fewer curves and points for the Contractor. Therefore, it should be noted that in some areas there could be up to one foot of error when comparing these two alignment sets; however, that should not hinder comparison between past reference data and proposed designs.

3.2 Background Data and Ancillary Studies

3.2.1 Bathymetric and Topographic Surveys

DWR’s North Central Region Office collected bathymetric surveys between 7/19/2019 and 8/19/2019. They used a multibeam echosounder and used the NAD83 (California State Plane Zone II) horizontal (Epoch 2017.5), NAVD88 vertical datums. Topographic survey and cross sections were collected every 50 feet at each project site in early 2020. The surveys were combined the topographic survey with the bathymetric survey. The combined surveys were Quality Controlled by USACE and were used as the existing surface for civil design work.

3.2.2 Hydrology

Two river stage and discharge gages are located within the project area. DWR operates the gage (#A02100) just upstream of the I-Street Bridge at RM 59.5. USGS operates the gage (#11447650) near Freeport Bridge at RM 46.0. The gages provide historic flow and stage data; however, changes to Folsom Dam operations may impact future releases relative to historic releases, and ongoing improvements to the Sacramento Weir will affect how upstream flows are split between the Yolo Bypass and the Project Reach of the Sacramento River. USACE developed two hydraulic models to support the project (See Section 3.2.3) – ARCF 16 1D SPK Release 6.2 and WCM 1D Model – to help assess the impacts these changes had on the period of record data and full datasets.

The Freeport gage was analyzed to develop typical daily flows through the reach throughout the year. These flows were used to help inform appropriate elevations of resource features to be included in the design such as planting benches and instream woody material where the added resources would be available during migratory windows when juvenile salmonid were present. The gage analysis also identified a range of typical flow conditions when vessel generated traffic was most frequent to inform designs. Historic gage information was compared with hydrology from the updated Folsom Water Control Manual routed through the WCM 1D model (See Section 3.2.3.1) to evaluate potential changes in future conditions relative to historic observations. The gage record was also used to develop a flow rating curve to be used as a downstream boundary condition for hydraulic modelling analysis (see Section 3.2.3.2).

Initial hydrology datasets for this project were adapted from the CVHS which provides a range of hydrographs from the 1/2 AEP event to the 1/500 AEP, including the peak emergency discharge of 160,000 cfs at Folsom Dam. The design discharge for LAR is 160,000 cfs and will be the primary discharge used to evaluate metrics when designing erosion countermeasures, which coincides to a flow of around 117,700 cfs on the Sacramento River.

3.2.3 Hydraulic Model Analysis

Existing one-dimensional (1D) hydraulic models were used to route combined Sacramento River and American River flows into the Project reach to support the hydrologic analysis. The 1D model was used to assess the impacts of water surface of the entire ARCF project. See Section 3.2.3.1.1 for more detail on the 1D model.

Two-dimensional depth averaged models (2D) were used to evaluate more detailed hydraulic conditions such as water velocities, and scour estimations through the reach under baseline and project conditions. These values were used to estimate the required rock size and bank protection thickness. Hydrologic Engineering Center's River Analysis System (HEC-RAS), version 5.0.7, was chosen for all detailed hydraulic analyses initially. However, the more recent release of HEC-RAS, version 6.1 resulted in quicker run times of high definition two-dimensional (2D) models. Therefore, the existing 2D model and rise analysis was run through version 6.1 to reduce the time for analysis. See Section 3.2.3.2 for more detail about the 2D model.

3.2.3.1 1D HEC-RAS Model

3.2.3.1.1 ARCF 16 1D SPK Release 6.2 Model

This 1D unsteady model was developed in HEC- RAS version 5.0.7 to determine design water surface profiles using the best available data, tools, and engineering methods. The model expands upon the model developed for the GRR by including updated basin hydrology, improved modeling resolution near levees, known basin changes and levee improvements, and is consistent with requirements in the State of California Urban Levee Design Criteria. The model also accounts for sea level change, super-elevation, debris blockages, and the 65% design of the Sacramento Weir expansion (there were no Sacramento Weir expansion design changes between 65% and 100% design that needed to be captured in this hydraulic model). Coverage for this model includes planned erosion protection project sites on both LAR and Sacramento River. The model evaluates flows developed by CVHS (See Section 3.2.2).

3.2.3.1.2 WCM 1D Model

The Folsom Dam Water Control Manual (WCM) HEC-RAS model extended from Nimbus Dam on LAR and Verona on the Sacramento River, downstream to river mile (RM) 40 on the Sacramento River. This model did not include the proposed widened Sacramento Weir; however, the model was used to evaluate lower magnitude flows where the weir would be less effective (Northwest Hydraulic Consultants, 2019). The general intent of this model is to support the design of habitat-based features. The model provided hourly outflows from Folsom Dam for a 73-year period of record (1929-2002) and can compare previous records to new operations of the Folsom Dam. Additionally, NHC used this model to evaluate and compare the 0.5 AEP discharge relative to the value used in the ARCF 16 1D SPK Release 6.2 Model and to evaluate stream power and effective discharge on the Sacramento River for sediment transport estimates and relative changes to bank erosion from changing operations of Folsom Dam.

3.2.3.2 2D HEC-RAS Model

Contractors, on behalf of SAFCA and the U.S. Army Corps of Engineers, A 2D HEC-RAS hydraulic model of the Sacramento River from the Sacramento Weir downstream through Freeport was developed and calibrated to further design of the Sacramento River erosion protection (cbec, 2020). The report covers the development, calibration, and validation of the 2D hydraulic model.

The model begins at approximately RM 61.5 on the Sacramento River and RM 0.75 on the Lower American River (LAR) and extends 17 miles downstream near the Freeport gage. This allows the Freeport stage data to drive the downstream boundary conditions while the upstream hydrographs can be routed from the two 1D models.

The 2D mesh consists of mostly square elements in a curvilinear 20-feet grid that follows flow paths and includes banklines along steep gradients, bridge piers, and topographic high points. The mesh was further refined with smaller cell sizes along the levee crest, levee toes, channel banks, and bridge pier banklines. Lastly, a refinement region was included along the entire left bank of the Sacramento River from below the LAR to the end of the model domain. This region spans from the channel edge to the levee crest and uses and increased model resolution of 5-feet grid spacing to support high resolution bank protection design projects. The average channel width of the Sacramento River within the ARCF16 Project extents is approximately 800-ft.

Manning's n-values for five land cover classes were calibrated to high water marks (HWM) of the 2006 event (Peak Flow: 65,000 cfs). The model was then validated to the 1997 event (115,000 cfs). A velocity distribution validation test at the I-St Bridge shows reasonable agreement of modeled velocities based on the selected eddy viscosity.

3.2.3.3 Cumulative Impact Analysis

In addition to the hydraulic modeling done for each individual site, overall cumulative impacts to the river system were analyzed. This analysis was looked at from two different aspects, the first being understanding the cumulative impact of building multiple projects to the entire river system. The second aspect was to understand if the project was maintaining or reducing the potential risk of overtopping.

3.2.3.3.1 Cumulative Impacts Hydraulic Modeling

A Two-Dimensional HEC-RAS model covering 17 miles of the Sacramento River, from River Mile (RM) 61.74 to RM 44.49 and 0.75 miles of the Lower American River were simulated containing all the repair sites and habitat restoration sites, including changes to the Sacramento Weir. These models were run for multiple large flows and compared to modeling efforts of the current system (without repair sites or weir widening) to ensure that the addition of the repairs and habitat restoration did not cause significant (increase greater than 0.1 ft[6]) increases to water surface elevations throughout the entire modeled river system. If results demonstrated an increase in water surface elevations greater than 0.1 ft, a risk assessment would be required to determine the impacts to the system; however, as noted below the model results showed there was a reduction in water surface elevations, so a risk assessment was never required to address that issue.

This modeling effort showed that the implementation of the Sacramento Weir Widening reduced the peak water surface elevations by approximately 0.5 ft or more within all the repair sites on the Sacramento River for the 0.5% AEP event. The only significant change in inundation is a ponding area adjacent to the Marina Way River Access in West Sacramento. This area, which is located within the leveed portion of the system, was typically flushed with fresh water from a 1 in 2-year event, the overall stage reduction from the project means the pond area will not experience as frequent of flooding. This area will likely still fill from rain events, but the inflow of water into the pond from the river will be less frequent.

3.2.3.3.2 Cumulative Impacts Probability Information

While the hydraulic modeling showed that the overall project would not result in an increase in water surface elevation for the large events, the project also checked that the project would be either maintaining the existing overtopping probability or reducing the overtopping probability (AOP – Annual Overtopping Probability – not accounting for geotechnical failures) and levee performance (AEP – Annual Exceedance Probability – accounting for geotechnical failures). Probability for failure was analyzed using the HEC-FDA (Flood Damage Reduction Analysis) model.

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[6] 0.1 ft is considered significant because it is a measurable increase; changes less than 0.1 ft are considered within the margin of error of the hydraulic models.

The HEC-FDA program was used to compute the expected AOP, at six critical index locations, assuming the levee does not fail prior to overtopping. This data represents the probability of levee failure outcome solely dependent on the effects of changes in conveyance capacity for a given scenario against the current levee height. The AOP results show a slight reduction in some locations to a larger reduction in other areas for the probability of overtopping, meaning the ARCF16 Project was maintaining or improving the flooding potential to the area behind the levees.

The HEC-FDA program was also used to compute the expected AEP, at four index locations, to demonstrate how the assumed levee fragility affects levee system performance. In addition to failure due to overtopping, the AEP incorporates information on the levee's susceptibility to failure prior to overtopping due to erosion, seepage, and slope instability probabilities at a given index location based on levee specific characteristic (such as soil type, hydraulic loading, river velocities, etc.). This data provides a more realistic representation of the overall levee system performance as it can account for both changes in conveyance capacity and the levee improvements proposed under the ARCF16 Project. The AEP results show that the project improvements provide an overall reduced probability of levee failure to the Sacramento River east levee system.

3.2.4 Geology

The study area has been mapped by a number of geologists on a regional scale, most recently, the study area was mapped by Fugro William Lettis & Associates (FWLA, 2010) for DWR's ULE project. FWLA mapped surficial geologic units at a scale of 1:20,000 and developed the most detailed geologic mapping available for the study area.

The geomorphic processes and stratigraphic distribution of the soils in the study area are described in detail by FWLA. Their mapping was based on data and findings from past published works in conjunction with review of aerial photographs and topographic, surficial geologic, and soil maps, but was not correlated to explorations performed for the ULE project. GEI/HDR reviewed the FWLA geomorphology together with subsurface data from borings and CPTs to develop an interpretation of subsurface conditions. In general, the FWLA geomorphology was found to be reasonably consistent with foundation conditions.

3.2.5 Existing Bank Revetment Assessment

A revetment condition assessment of all existing revetment sites on the east levee between Freeport and the LAR confluence, see Figure 3-1, was completed in 2021. The study included reviews of as-built drawings, field investigations, as well has hydraulic modelling and rock size calculations. The intent of the assessment was to verify existing projects which were designed prior to the current project would remain stable during a 117,000 cfs flood event. Field investigations measured actual rock size that was placed at the project site, as well as measured rock thickness and verified rock extents. Hydraulic information developed from the baseline hydraulic model (see Section 3.2.3.2) run for 117,000 cfs was used to evaluate if the existing rock would remain stable during the design event.

3.2.6 Biological Resource Surveys and Assessments

Data collection, analysis, and reporting in support of the ARCF16 project along the 15-mile-long section of the east bank of the Sacramento River, from the confluence with LAR south to Cliff's Marina, near

Freeport (AECOM, 2020). Surveys to support this report included collecting data and mapping vegetation communities, elderberry shrubs, and SRA cover across the entire reach. These surveys were collected from December 2019 to April 2020. This survey was used to create the vegetation removal plan for trees to be removed or trimmed and elderberry shrubs to protect in place as part of Contract 2 and Contract 3 construction. Additionally, environmental staff used the canopy analysis to calculate impacts and mitigation requirements.

3.2.7 Geomorphic Assessment

A geomorphic assessment was completed in 2019 of the Sacramento River Sacramento River from the confluence with LAR (River Mile (RM) 60.1) to Freeport (RM 46) (Northwest Hydraulic Consultants, 2019). The intent of the report was to support engineering analyses of erosion and stability by identifying key geomorphic processes affecting channel stability. The report documented the geologic setting and historic anthropogenic impacts to the study reach, historic anthropogenic impacts to the reach, identified historical trends in channel forming processes up to the present, and assessed the potential for geomorphic change. Overall, the geomorphic assessment identified the study reach to be generally both vertically and laterally stable. The elevation of the sand bed channel is likely to continue to fluctuate several feet in elevation into the future as sediment is conveyed through the reach and ephemeral scour holes develop in high flow events and fill; however, the long-term trend is for the reach to continue to be a conveyance. The Geomorphic Assessment for the Sacramento River is provided in Attachment B.

3.2.8 Erosion Assessment

An erosion assessment of the Sacramento River east bank was completed in 2019 to help quantify the risk of erosion to the levee (Northwest Hydraulic Consultants, 2019). Whereas the Geomorphic Assessment (discussed in previous section and included in the document) evaluated the historic and long-term trends of the channel and noted that the channel is generally stable, the assessment also noted the historic and ongoing efforts to address erosion. The levees through this reach are generally constructed on or in close proximity to the riverbank with relatively steep waterside slopes. Development of ephemeral scour holes during high flow events can undercut the levee foundation, ongoing wind wave erosion induces erosion along summer water levels, while the potential for velocities to erode the levees continues to exist.

The assessment delineated the study reach into 33 river segments based on geomorphic, structural, or other physical features. Each river segment was characterized and evaluated for erosion potential. The erosion assessment set the stage for future evaluation and prioritization of potential erosion countermeasures. The Erosion Assessment for the Sacramento River is provided in Attachment C.

3.2.9 Existing Bank Revetment Condition Assessment

A revetment condition assessment of all existing revetment sites was completed in 2021 on the Sacramento River (cbec, 2021). Figure 3-1 shows the locations of all revetments which existed prior to implementation the ARCF16 Project improvements. Historic revetment refers revetment installed prior to the 1990s and was typically just bare rock and often used rounded cobble stone as revetment, which is more susceptible to slope failure and more easily mobilized during flood events.

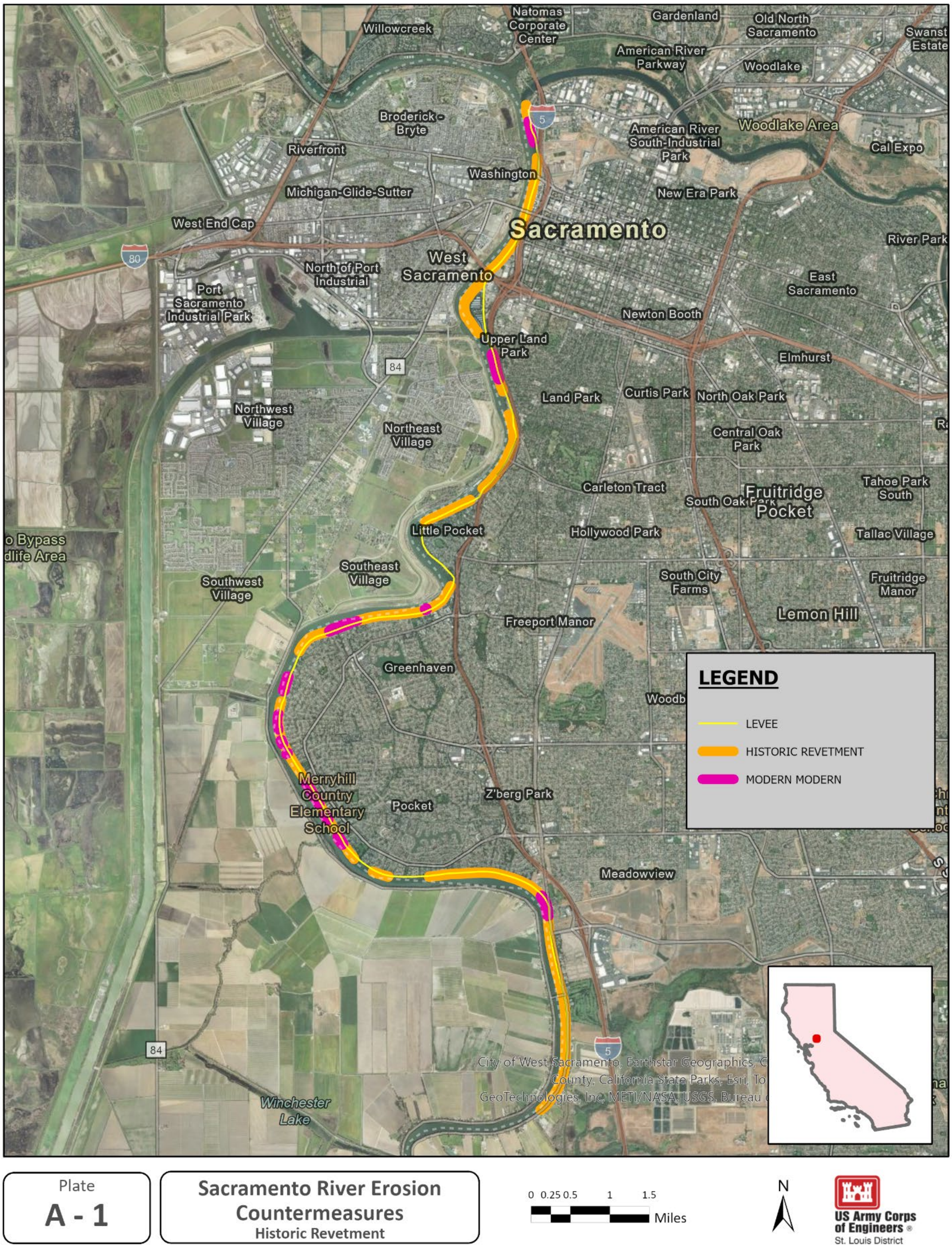


Figure 3-1. Existing revetment along the Sacramento River

Modern revetment refers erosion repair sites which utilized angular quarry stone and included more nature-based features such as planting benches, soil-filled quarry stone, soil cover, and ultimately plantings of native vegetation.

The study was broken out into three phases and included reviews of as-built drawings, field investigations, as well has hydraulic modelling and rock size calculations. The intent of the assessment was to verify existing projects which were designed prior to the current project would remain stable during a 160,000 cfs flood event. Field investigations measured actual rock size that was placed at the project site, as well as measured rock thickness and verified rock extents. Hydraulic information developed from the baseline hydraulic model (see Section 2.3.3) run for 160,000 cfs was used to evaluate if the existing rock would remain stable during the 160,000 cfs event. Reporting was completed in April 2022.

3.3 Site Evaluation and Selection

As discussed in Section 1.8, site selection was complete in a two-phase process. Phase I included an EOE based on existing data and preliminary analysis to develop initial recommendations for sites to be repaired. The Phase II analysis included baseline risk assessments completed at each segment using additional information acquired and developed via new investigations and analyses to expand on the preliminary studies used in the Phase I analysis.

3.3.1 Phase I Site Evaluations- Expert Opinion Elicitation

An EOE was completed for the Sacramento River in August 2020 through November 2020. The EOE panels included four local experts with extensive experience working on the Sacramento River and adjacent flood control projects. USACE incorporated additional national experts onto the team. The EOE assessments were largely based on the information presented in Appendix A of the erosion assessment, as well as additional information on past performance, and individual experts experience and observations. After completion of the formal EOE process, the EOE panel assigned a Tier ranking to each segment.

3.3.2 Phase II Site Evaluations - Baseline Risk Assessments

Consistent with USACE Engineering Regulation (ER) 1105-2-101, Risk Cadre teams re-evaluated the risk of erosion failure at each segment under baseline (pre-project) conditions. Segments were evaluated for both PFM 2 erosion into the levee, and PFM 3 erosion into the levee foundation (see Section 1.6). Segments with unacceptably high risk for failure due to erosion were recommended for repair. Key risk drivers- attributes at individual segments that led to high-risk ratings- were identified to be addressed during design.

Risk Cadre teams are multi-disciplinary teams within USACE with special training in risk assessments that assess USACE infrastructure across the nation. The Risk Cadre team completing the baseline assessment had previously completed a risk assessment of the Sacramento River to support the GRR and had foundational knowledge of the river system. The Risk Cadre teams were augmented with local experts from the Non-Federal sponsors with experience working on the Sacramento River that also participated in the EOE. The Risk Cadre based their evaluations on information in the Erosion Assessment and other background information included in Section 3.2.

The Risk Cadre evaluated the potential for PFM 2 fluvial erosion of the levee and PFM 3 fluvial erosion of the levee foundation (see Section 1.6) at each segment defined in the erosion assessment during a single large storm event to determine the likelihood of levee failure. The Risk Cadre defined an event tree for each PFM that would need to occur for levee failure to occur including a flaw occurs exposing erodible soils (by either failure of vegetal cover due to excessive hydraulic force, mass slope failure, tree-fall, or other site specific conditions), erosion of bank soils, erosion extending into the levee template, the potential for intervention such as flood fighting to arrest the erosion, and finally a levee breach occurring in an eroded condition.

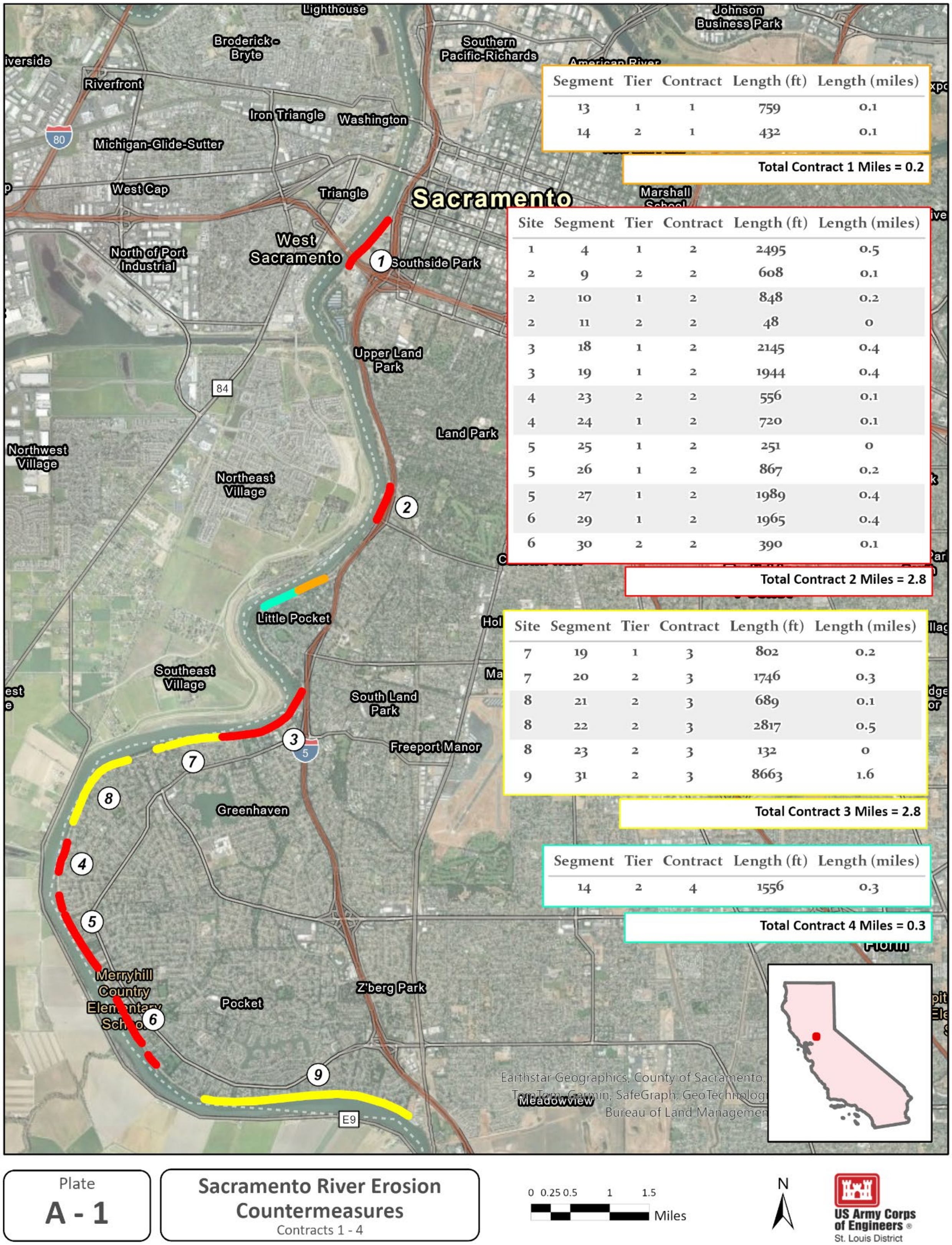
Baseline risk assessments were completed for all the segments in early spring 2020. The baseline risk assessments relied on similar information as the EOE assessments, but included additional information developed after the EOE study to inform the assessment. This information included continued refinements to the hydraulic model (Section 3.2.3.2). The baseline risk assessments assigned annual probability of failure due to erosion to each levee segment. Where the probability of failure exceeded project objectives, USACE identified the segments for erosion protection.

3.3.3 Summary of Site Selection

The findings of the baseline risk assessment confirmed the recommendations of Tier 1 segments identified by the EOE and Tier 3 segments identified by the EOE. Of the Tier 2 segments, the baseline risk assessment identified five of the nine Tier 2 segments as needing repairs to meet project risk reduction objectives. The baseline risk assessment also identified three additional locations for erosion protection would be needed to meet risk objectives. The additional sites identified in the baseline risk assessment were identified after more detailed modeling was completed of sites after completion of the EOE assessment.

Based on the results of both the EOE and Baseline Risk Assessments, USACE developed its implementation strategy for design and construction of erosion protection sites along the Sacramento River. The overall strategy was to construct the worst sites first. The Sacramento River erosion protection work was broken down into four main construction contracts, see Figure 3-2. Sacramento River Contract 1 included one Tier 1 segment, a total of 0.1 miles of bank protection. Sacramento River Contract 2 included solely Tier 1 segments for a total of 2.8 miles of bank protection. Sacramento River Erosion Contract 3 included the five Tier 2 segments identified as needing action, and an additional Tier 1 segment, which totaled approximately 2.8 miles of bank protection features on the Sacramento River and is divided into 3 separate sites. Sacramento River Contract 4 included one Tier 2 segment for a total of 0.3 miles of bank protection. Table 3-1 below provides a breakdown of the sites and segments included in the four construction contracts.

All of the Sacramento River erosion protection projects, including those already constructed (Contracts 1, 2, and 4 covered under a previous environmental document), will result in 6.1 miles of the 12 authorized miles being improved. The remaining 5.9 miles authorized for improvement were determined to meet project risk objectives as they currently exist.



Segment	Tier	Contract	Length (ft)	Length (miles)
13	1	1	759	0.1
14	2	1	432	0.1

Site	Segment	Tier	Contract	Length (ft)	Length (miles)
1	4	1	2	2495	0.5
2	9	2	2	608	0.1
2	10	1	2	848	0.2
2	11	2	2	48	0
3	18	1	2	2145	0.4
3	19	1	2	1944	0.4
4	23	2	2	556	0.1
4	24	1	2	720	0.1
5	25	1	2	251	0
5	26	1	2	867	0.2
5	27	1	2	1989	0.4
6	29	1	2	1965	0.4
6	30	2	2	390	0.1

Site	Segment	Tier	Contract	Length (ft)	Length (miles)
7	19	1	3	802	0.2
7	20	2	3	1746	0.3
8	21	2	3	689	0.1
8	22	2	3	2817	0.5
8	23	2	3	132	0
9	31	2	3	8663	1.6

Segment	Tier	Contract	Length (ft)	Length (miles)
14	2	4	1556	0.3

Figure 3-2. Sacramento River erosion protection contracts and sites

Table 3-1. Summary of site selection for all Sacramento River East Levee

Contract	Site	Segment
SAC C1[1]	RM 55.2L	Segment 13
SAC C2[1]	Site 1	4
	Site 2	9, 10, 11
	Site 3	18, 19
	Site 4	23, 24
	Site 5	25, 26, 27
	Site 6	29, 30
SAC C3	Site 7	Segments 19, 20
	Site 8	Segments 21, 22, 23
	Site 9	Segment 31
SAC C4[1]	RM 2.0	Segment 14

[1]SAC C1, C2 and C4 have already been constructed or are currently under construction and are not subject to the contents of this SEIS/SEIR.

3.4 Design Development

Sacramento River Contracts 1, 2, and 4 have already been constructed, or will complete construction in 2024 and none of which are subject to the contents of the SEIS/SEIR. To be clear, the only Sacramento River Erosion contract subject to the contents of the SEIS is Contract 3. Thus, this design development section will focus solely on the contents of Sacramento River Erosion Contract 3, which is planned to be constructed in 2026.

3.4.1 Overview and Process

The two main design objectives of the designs are to prevent bank erosion and provide resistance against wave wash. Designs also include a launchable rock toe to provide resilience against river-bed scour. A secondary objective is to reduce impacts to habitat, as well as provide habitat mitigation wherever possible.

Bank protection designs were developed with an inter-agency working group referred to as the Technical Resource Advisory Committee (TRAC). The TRAC included members from USACE, NMFS, USFWS, DWR, SAFCA, and their consultants. The TRAC is a multi-disciplinary group which includes water resource engineers, geotechnical engineers, geoscientists, biologists, and ecologists. The TRAC provided initial recommendations for design approaches and provided review and comment throughout the design process. USACE has successfully worked with similar groups on the LAR on past projects to develop bank protection designs which reduced habitat impacts and replaced impacted habitat within the designs.

The TRAC developed an initial recommendation in 2020 and provided 10% designs to the U.S. Army Corps of Engineers. The TRAC discussions in the development of the 10% designs focused on developing designs that would optimize long-term habitat conditions at the site. Although construction of planting benches along the edge of the summer water level replaces impacted riparian vegetation and improves habitat for out-migrating juvenile salmonids, the increase in footprint to the design further impacts green sturgeon. Likewise, benches constructed below summer water levels may be more accessible to fish (especially during drought or low flow years), but more susceptible to wave wash erosion or less prone to establish wood riparian species. PDT participated in the TRAC during the development of the design, and the TRAC was briefed with each design submittal and provided an opportunity to review and comment on the project.

The PDT developed designs using established engineering design standards (summarized in Section 1.7.2). While the TRAC provided input in design decisions about resource impacts and technical review of project components, the Risk Cadre evaluated the design at each intermediate submittal to verify risk drivers were being adequately addressed to lowered to meet overall project objectives. Cadre review at each design milestone was also proceeded by or concurrent review by district quality control staff and agency technical review to ensure established engineering design standards were being applied; safety assurance review teams to ensure projects would not create unintended safety hazards; consistency review by program staff; and review by DWR and SAFCA staff. Review from the comprehensive review team includes subject matter experts across engineering disciplines, ecologist, biologists and landscape architects.

3.4.2 Sacramento River Erosion Contract 3

Sacramento River Erosion Contract 3 is composed of erosion protection on Sites 7, 8, and 9. Sites 7 and 8 are located on the north side of the big pocket are of Sacramento. Site 9 is located on the south side of the big pocket of Sacramento.

3.4.2.1 Contract 3 Site 7

Site 7 consists of Segments 19 (after Sump 63) and 20 and extends along the Left Descending Bank (LDB) of the Sacramento River from STA 1341+00 to 1389+00 (Figure 3-3). Segment 19 is classified as Tier 1; whereas Segment 20 is classified as Tier 2. The site begins downstream of the reconstructed Sump 63 and moves through a river crossing where a majority of the thalweg is aligned on the right descending bank (RDB). There is minimal to no berm width throughout the site. The levee on the opposite bank was recently set back which could reduce the hydraulic forces on the LDB.

3.4.2.1.1 Risk Drivers

At Site 7, the primary risk is PFM 3 erosion into the levee foundation. The toe of the riverbank is silty sands which is expected to be erodible at the 115,000 cfs flow event. The steep bank may allow trees to be undercut, and narrow bench width could allow erosion to undercut the levee foundation.

3.4.2.1.2 Proposed Design

The proposed design for Site 7 will include a rock toe being placed along the riverbank in the channel. The rock toe includes adequate rock volume to allow some material to launch (fall) into any channel scour, while still maintaining a stable slope to support the levee foundation. The rock will generally be placed up to about the lowest typical summer water level. Above the lowest typical summer water level, the design will vary along the site to accommodate available bankline and footprint, and limit impacts to existing infrastructure. Some of the site will typically include the rock toe, with a narrow soil-filled rock bench above it extending to the top of the typically highest summer water levels to protect against vessel induced wave wash. These sections are used to reduce impact area into the channel and to assist in providing a smooth transition between the design and its upstream and downstream extents, and existing infrastructure within the footprint. Along about 600 lineal feet of the site, a planting bench will be constructed between typical low and high summer water levels to support revegetation of riparian vegetation and provide armor against vessel-induced wave wash. IWM will be placed just below typical annual low water levels along much of the site, with the exception of design locations near existing boat docks. Figure 3-4 and Figure 3-5 show typical sections with and without planting benches respectively

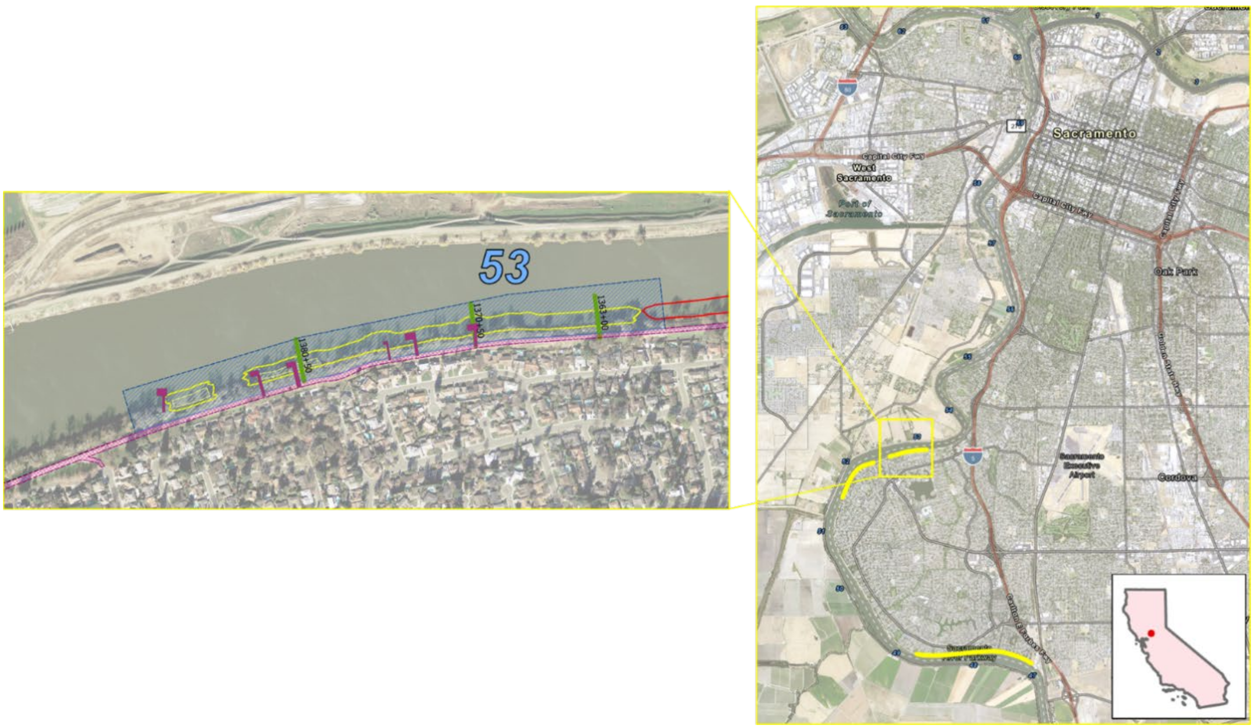


Figure 3-3. Site 7 location map

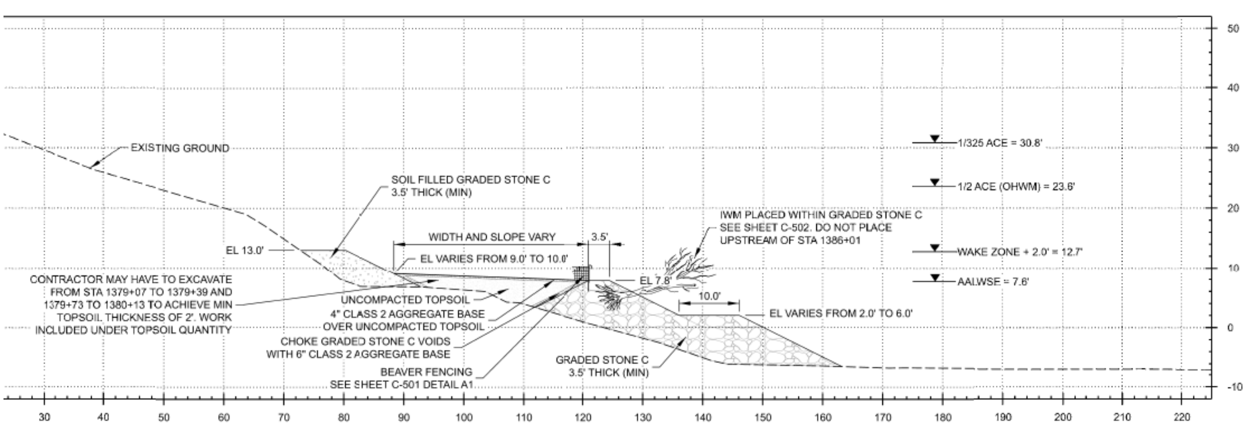


Figure 3-4. Site 7 typical section with planting bench

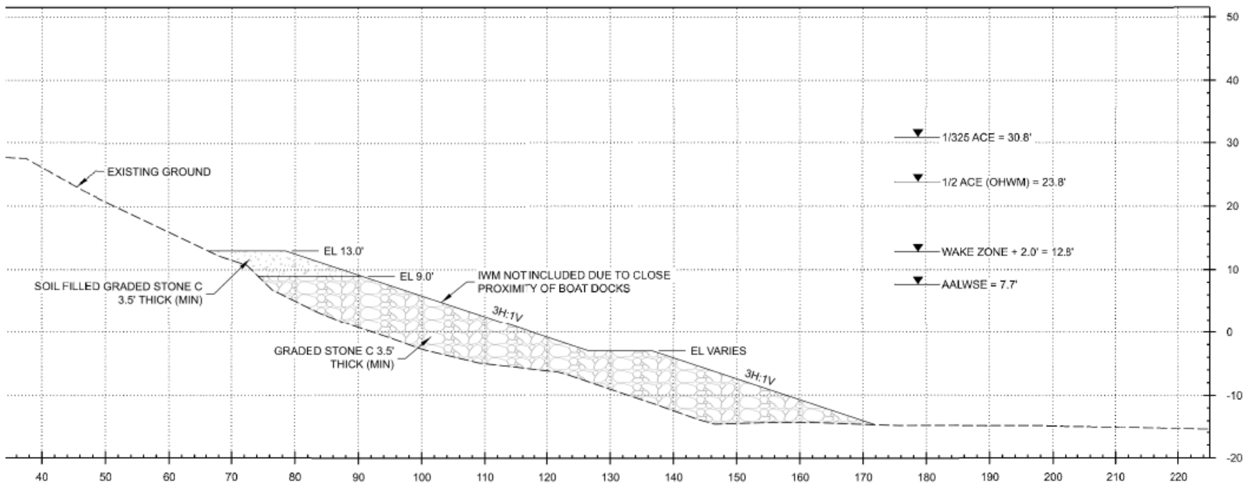


Figure 3-5. Site 7 typical section without planting bench

3.4.2.2 Contract 3 Site 8

Site 8 consists of Segments 21, 22, and 23 (Figure 3-6). Segments 21 and 22 extend along the LDB of the Sacramento River from STA 1401+00 to 1438+00, and Segment 23 extends along the LDB of the Sacramento River from STA 1446+00 to 1452+00. Segments 21, 22, and 23 are all classified as Tier 2, and there are 2006 era repairs in each of the segments. Segment 22 is located along the inside of a sharp bend, and Segment 21 is located just upstream of this bend (with the thalweg aligned along the west bank). Segment 23 is located on a straight section downstream of the bend. The berm is non-existent through Segment 21 and is less than 50 ft through Segments 22 and 23.

3.4.2.2.1 Risk Drivers

At Site 8, the primary risk is PFM 3 erosion into the levee foundation. The toe of the riverbank is silty sands which is expected to be erodible at the 115,000 cfs flow event. The existing bank is relatively steep, and the channel thalweg creates a tall bank with much of the area below where vegetation can establish to provide natural erosion resistance. The berm is narrow to non-existent allowing erosion to quickly undercut the levee. Intermittent placement of dumped rock riprap along the site suggests the site has experienced erosion during past events with hasty repairs to stabilize.

3.4.2.2.2 Proposed Design

The Site 8 design includes a rock toe being placed up to the lowest typical summer water level. The rock has adequate protection to allow some material to launch (fall) into any channel scour, while still maintaining a stable slope to support the levee foundation. Three typical designs are used on the site: a minimal rock design that reduces benthic impacts and reduces impacts to adjacent boat docks located along the site, a bench designs which install a planting bench above the summer water level, and transition sections which transition between these two locations. Instream woody material will be placed along the entire site. Figure 3-7 and Figure 3-8 show typical sections with and without planting benches respectively.

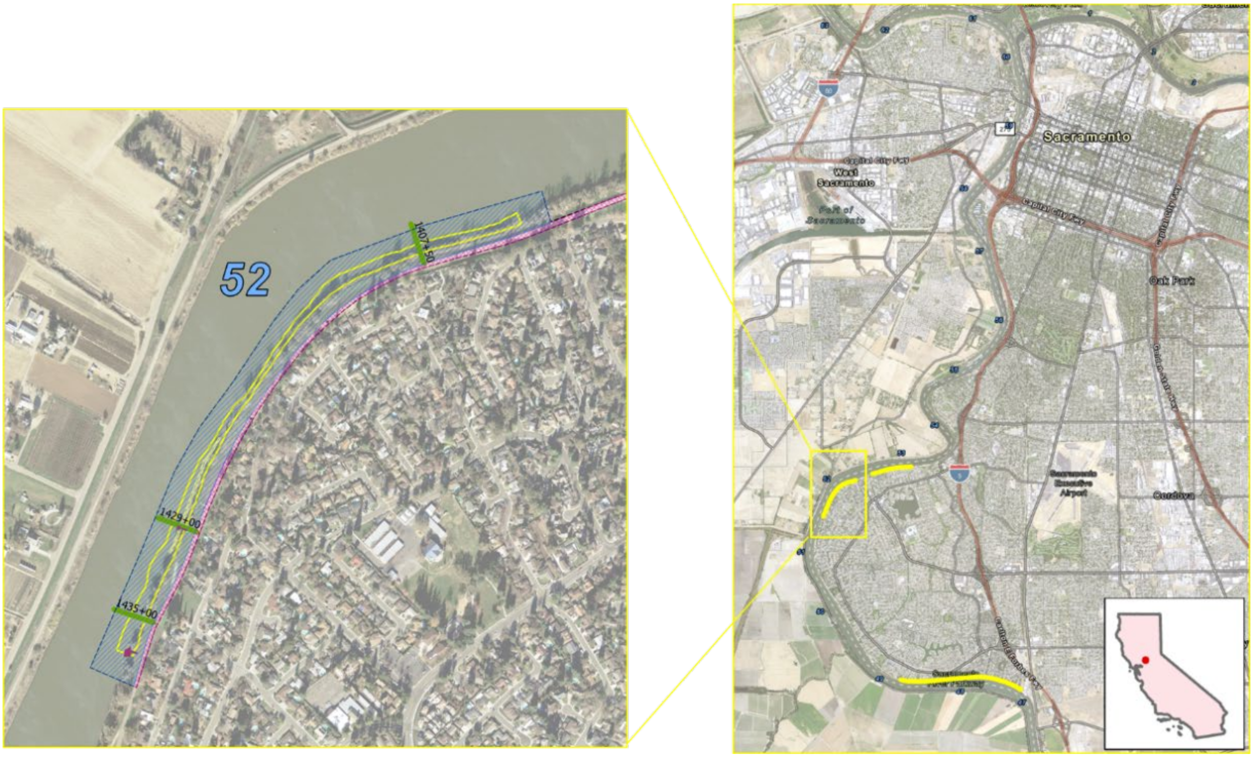


Figure 3-6. Site 8 location map

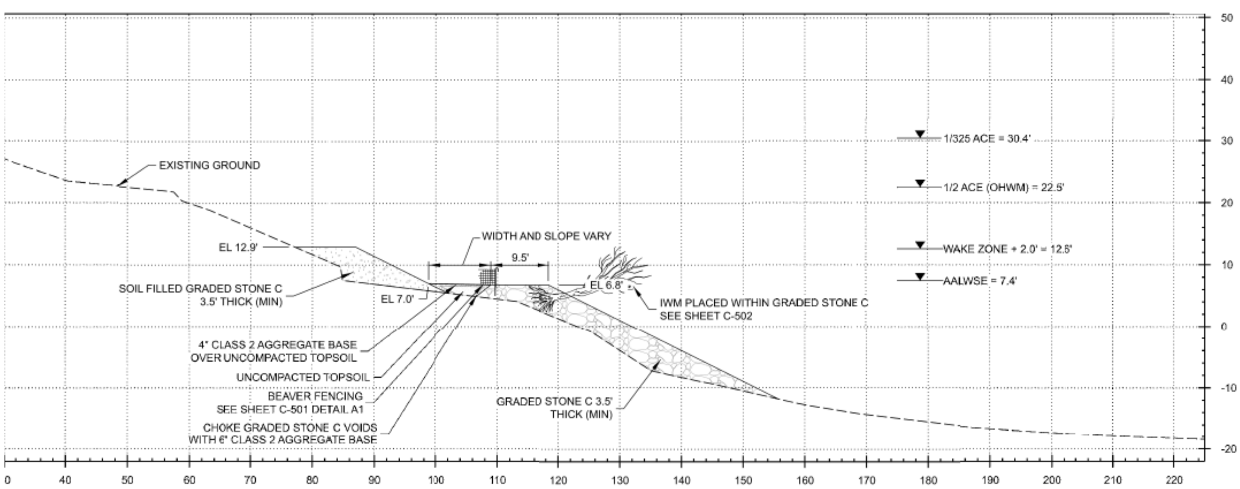


Figure 3-7. Site 8 typical section with planting bench

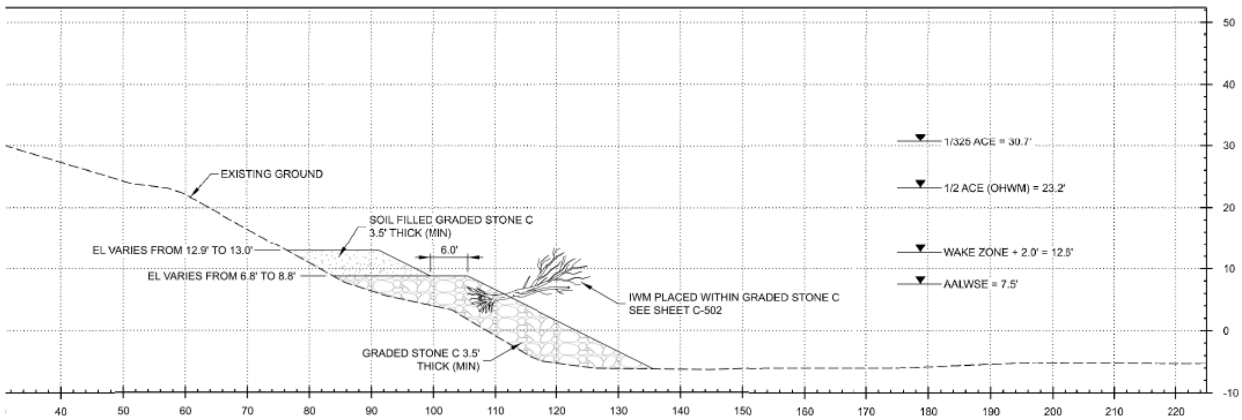


Figure 3-8. Site 8 typical section without planting bench

3.4.2.3 Contract 3 Site 9

Site 9 consists of Segment 31, which extends along the LDB of the Sacramento River from STA 1575+00 to 1662+00 (Figure 3-9). There is minimal to no berm width throughout the site, and there were extensive rip rap installations in the 1970s. Since the installations, many large trees have been lost and gaps have been filled in with rip rap. This segment has several areas with old or no bank protection and ongoing erosion.

3.4.2.3.1 Risk Drivers

At Site 9, the primary risk is PFM 3 erosion into the levee foundation. The toe of the riverbank is silty sands which is expected to be erodible at the 115,000 cfs flow event. The existing bank is relatively steep, and the channel thalweg creates a tall bank with much of the area below where vegetation can establish to provide natural erosion resistance. The berm is narrow to non-existent allowing erosion to quickly undercut the levee. Placement of dumped rock riprap along the site suggests the site has experience erosion in past events with hasty repairs to stabilize.

3.4.2.3.2 Proposed Design

The Site 9 design provides a continuous stretch of protection with quite a few changes in the actual design in between. The design transitions into existing modern revetment on the upstream of the site and into the Freeport Regional Water Facility on the downstream end. The design for Site 9 varies to follow the existing ground. Where room to accommodate a planting bench exists, planting benches are proposed. At locations where the existing levee does not have a bench, a minimal footprint of rock extending from about typical summer water levels will be installed. Similar to upstream designs, the rock toe will provide adequate rock volume to adjust to future scour within the channel, and a soil filled rock cap will be placed to the top of the high typical summer water levels to prevent wave wash and erosion. Figure 3-10 and Figure 3-11 show typical sections with and without planting benches respectively.

Figure 3-9. Site 9 location map

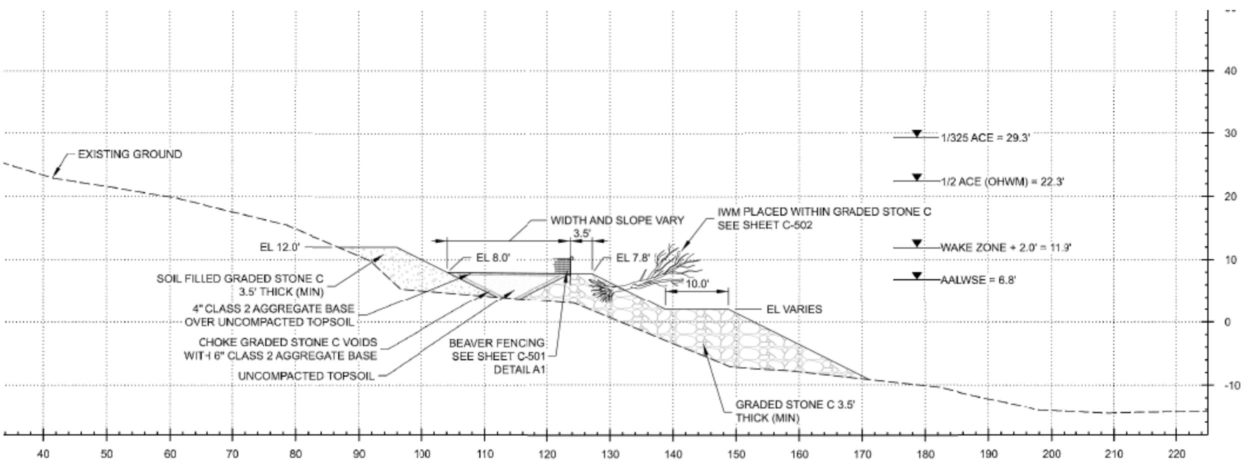


Figure 3-10. Site 9 typical section with planting bench

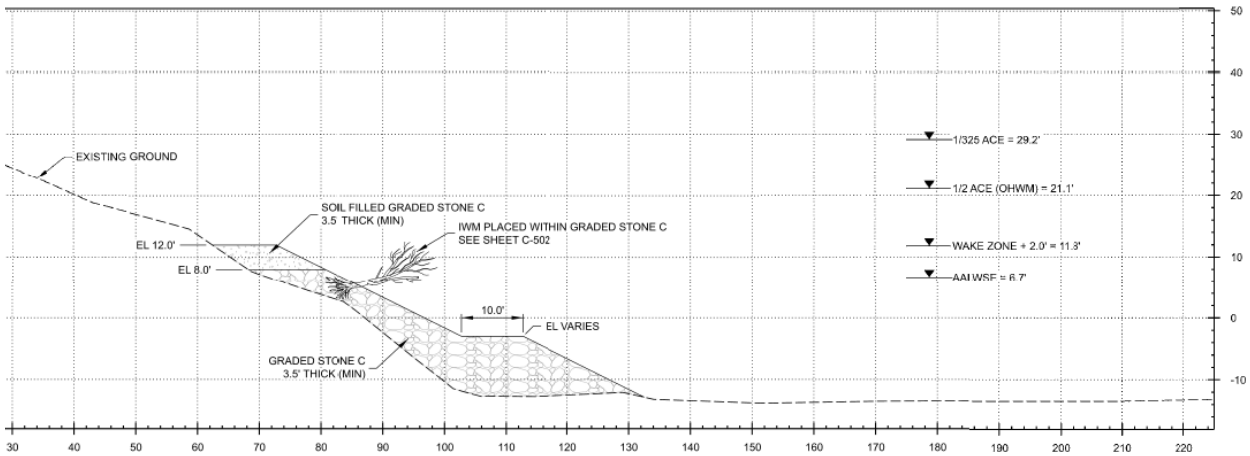


Figure 3-11. Site 9- typical section without planting bench

3.5 Project Implementation

3.5.1 General Schedule and Overview

Table 3-2 below provides a summary of planned implementation activities for each contract. The Projects are generally implemented in three phases further described below: Vegetation Clearing and Elderberry Transplant, Civil Construction, Revegetation. Separating the project components into phases better facilitates working within regulatory windows, avoiding project delays, and using the best available contractors for each type of work. The overall schedule is generally based on completing construction during the in-water work window specified in the NMFS BO. Sacramento River Erosion Contract 3 will be constructed over two years to ensure completion of in-water work during the in-water work window.

Table 3-2. Implementation Schedule

Site	Vegetation Clearing/ Transplant	Target Construction Year	Revegetation
Site 7	Fall/Winter Preceding Construction	Summer-Fall 2026	Spring 2027
Site 8	Fall/Winter Preceding Construction	Summer-Fall 2026	Spring 2027
Site 9	Fall/Winter Preceding Construction	Summer-Fall 2027	Spring 2028

3.5.2 Vegetation Clearing and Elderberry Transplant

Large vegetation will be removed from the project footprint the winter ahead of construction. Vegetation is removed from above ground, and roots are left in place to provide erosion protection for the winter and spring months. SAFCA contracted with AECOM to conduct data collection, analysis, and reporting in support of the ARCF project along the 15-mile-long section of the east bank of the Sacramento River, from the confluence with LAR south to Cliff's Marina, near Freeport. Surveys conducted by AECOM to support this report included collecting data and mapping vegetation communities, elderberry shrubs, and shaded riparian aquatic (SRA) cover across the entire reach. These surveys were collected from December 2019 to April 2020. This survey was used to create the vegetation removal plan for trees to be removed or trimmed and elderberry bushes to protect in place as part Contract 3 construction. According to the survey, Contract 3 does not have any elderberry shrubs within the construction footprint. If an elderberry bush is determined to be present by preconstruction surveys, special care and consideration is required in accordance with the USFWS BO.

Clearing of vegetation during the winter months also helps reduce the potential for impacts to nesting birds and construction delays from nesting birds. Vegetation clearing will be completed by a pre-qualified contractor under a contract which also includes the establishment of the elderberry shrubs at the transplant locations.

3.5.3 General Civil Construction

The general civil construction work includes all excavation, grading activities, rock and soil placement for both levee erosion protection and on-site habitat mitigation efforts. The general civil contractor will be a prequalified contractor with experience working near rivers and with required worker education on the environmental and cultural permit requirements at the site. Construction monitors for sensitive biological and cultural resources may be required on a site-dependent basis. The contractor place rock and soil to install project features. General civil construction will be completed primarily by barge from the Sacramento River. At the conclusion of the work, the contractor will install temporary erosion control and seed the footprint with native grasses and sedges.

3.5.4 Revegetation of Sites

Once the general civil contractor has completed on-site work, a revegetation contractor will start work the following year to revegetate the site with native plants. The revegetation contractor will be required to install plants per the revegetation plans, and to irrigate plants through an establishment period. The establishment period is a performance-based requirement that will likely vary in duration from three to five years based on plant survival rates. During this time, the revegetation contractor will remove and replace failed vegetation, remove any invasive species from the site, and maintain any temporary erosion control features at the site. Once plant establishment requirements have been met, the contractor will remove temporary features (such as irrigation piping).

The vegetation being replanted at the sites are species reviewed by project partners and includes native trees, shrubs, sages, and grasses. Planting pallets and plant densities have been revised based on lessons learned from these previous projects as summarized by (GEI, 2018). These lessons learned have included reduced plant densities relative to previous designs which tended to overplant the site, and the inclusion of more shade tolerant ground cover. The designs are intended to provide natural regeneration once the site is established. Table 3-3 below provides a list of Container Plants and Cuttings Species which will be included in the revegetation plantings.

Table 3-4 provides a list of Seed Mix Species which will be used on the sites following construction completion.

Table 3-3. Container Plants and Cuttings Species

Botanical Name	Common Name
Acer negundo	boxelder
Alnus rhombifolia	white alder
Artemesia douglasiana	mugwort
Carex barbarae	Santa Barbara sedge
Cephalanthus occidentalis	button bush
Euthamia occidentalis	western goldenrod
Fraxinus latifolia	Oregon ash
Juncus balticus	Baltic rush
Juncus effusus	common bog rush
Platanus racemosa	western sycamore
Rosa Californica	western wild rose
Salix exigua	sandbar willow
Salix lasiolepis	arroyo willow

Table 3-4. Seed Mix Species

Botanical Name	Common Name
Achillea millifolium	Yarrow
Agrostis exarta	spike bentgrass
Ambrosia psilostachya	western ragweed
Artemisia douglasiana	California mugwort
Carex barbarae	Santa Barbara carex
Deschampsia elongata	slender hairgrass
Elymus trachycaulus	slender wheatgrass
Hordeum brachyantherum ssp. californicum	California barley
Juncus Balticus	Baltic rush
Juncus effusus	Common bog rush
Leymus triticoides	creeping wild rye

4 PIEZOMETER NETWORK

A piezometer is used to measure underground water pressure and piezometers are extensively used to monitor groundwater levels and flow patterns. The purpose of installing a piezometer network is to provide an empirical data collection system to evaluate the performance of the ARCF 2016 Project and to provide real time data to water resource managers, levee maintenance agencies, and project engineers. The piezometer network would allow USACE to evaluate the long-term performance of the flood risk management features (i.e., levee systems) throughout the project following construction of the proposed levee improvements. All sites receiving piezometers were included in the ARCF GRR FEIS/EIR; however, the installation of a piezometer network was not analyzed in the original document and is considered a design refinement.

4.1 Overview

Piezometers are planned to be installed permanently along the existing levees within the authorized footprint of the ARCF GRR FEIS/EIR. These installations could occur along the Sacramento River left bank, Lower American River left and right banks, Magpie Creek left bank, and Sacramento Bypass right bank that are all project areas of the ARCF 2016 Project. The distribution of piezometers will be based on the size of the project area and the local hydrologic conditions. It is anticipated that most, but not all piezometers would be installed within the spatial limits of the construction footprint. All piezometer installation locations would require preconstruction surveys for biological and cultural resources.

Approximately 100 piezometers will be installed at various locations along the levee segments listed above with piezometers on the levee crown and/or near the landside levee toe. Piezometers will be distributed between all ARCF 2016 Project reaches (see Figure 4-1 for reach locations) and some areas may have higher concentrations of piezometers than other areas. On average, between 3 and 15 piezometers will be installed at each ARCF16 Project reach. There is an existing network of previously installed piezometers within the authorized footprint. Some existing piezometers may require abandoning and/or full replacement.

4.2 Piezometer Locations

Piezometers will be located on top of or immediately landward of the levee. At a given location along the levee, there may be as few as one piezometer or as many as three piezometers. Piezometer type and depth of installation would vary upon location and monitoring objectives. Piezometers can sit flush with the ground surface, or stick out above the ground surface, depending on site specific circumstance. A standard piezometer (vibrating wire) installation diagram, which sits flush with the ground surface, is shown in Figure 4-2. Examples of standpipe piezometers, which stick out above the ground surface are provided in Figure 4-3 and Figure 4-4.

Piezometers are recommended to be installed at the top of the aquifer, below the base of the blanket layer, to monitor the following conditions:

- Effectiveness of relief wells.
- Effectiveness of deep cutoff walls.
- Performance monitoring at transitions between deep and shallow cutoff walls.

- Verification of performance in levee segments where no remediation was installed.
- Monitoring near in-ground swimming pools close to the landside levee toe.

Following installation, each piezometer will be equipped with telemetry devices to provide real-time and remote data acquisition, which saves time and money by avoiding the need to take manual readings of each piezometer in the field.

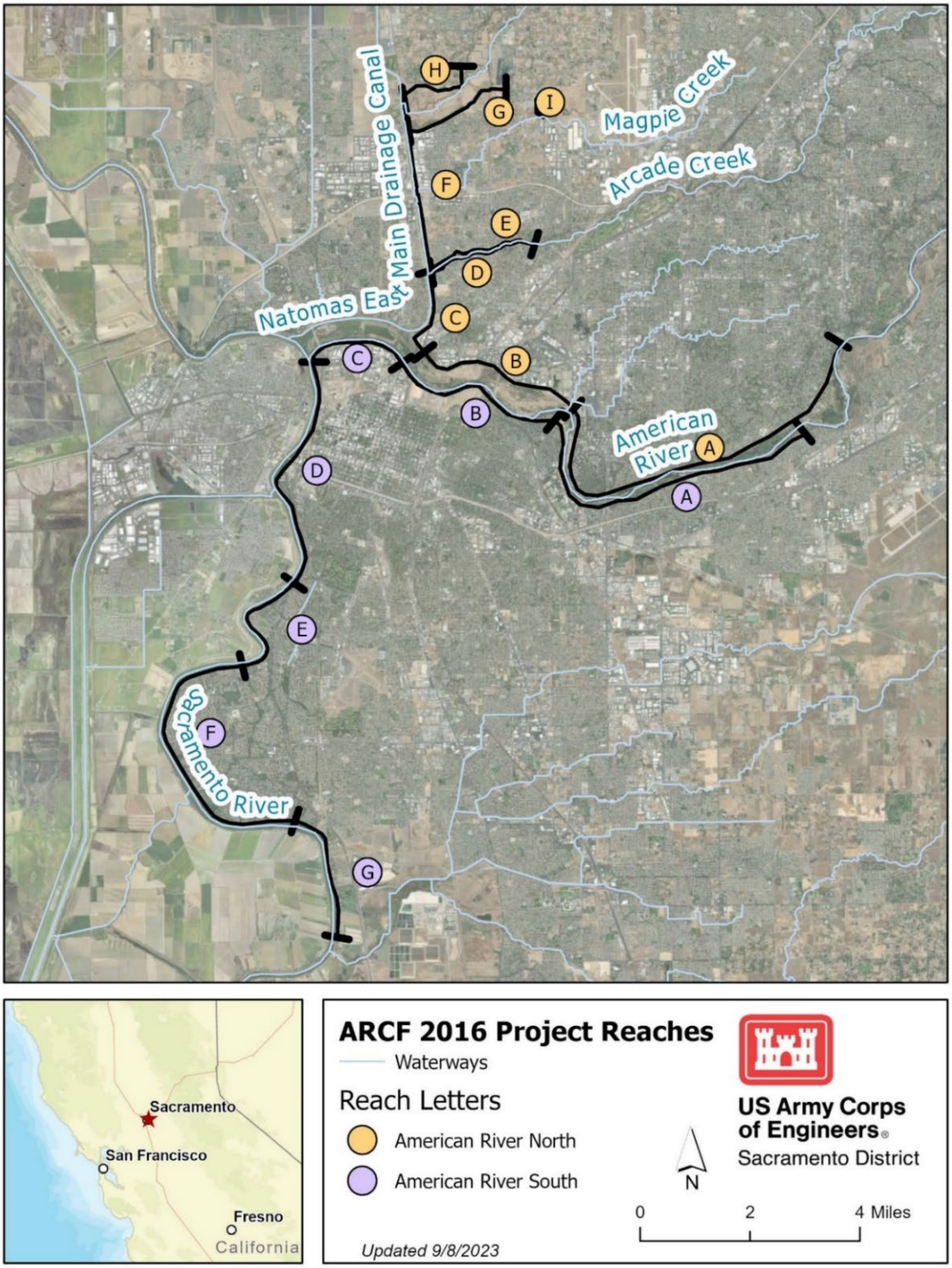


Figure 4-1. ARCF16 Project Reaches

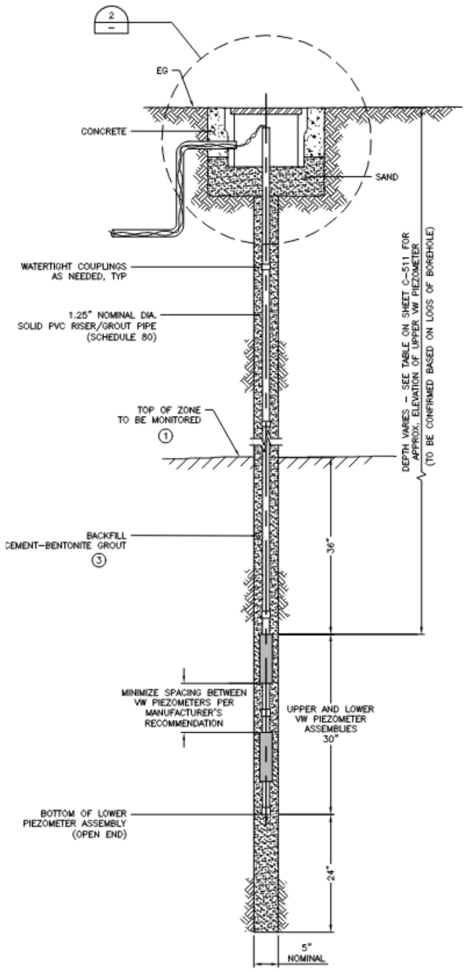


Figure 4-2. Typical Vibrating Wire Piezometer

Figure 4-3. Typical Open-Standpipe Piezometer

Figure 4-4. Dual Standpipe Piezometers

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ATTACHMENTS

ATTACHMENT A: CUMULATIVE IMPACTS ANALYSIS

(Provided as a separate document)

ATTACHMENT B: GEOMORPHIC ASSESSMENTS

(Provided as a separate document)

ATTACHMENT C: EROSION ASSESSMENTS

(Provided as a separate document)

ATTACHMENT D: BIOLOGICAL RESOURCE SURVEYS AND ASSESSMENTS

(Provided as a separate document)

APPENDIX H
WILD AND SCENIC RIVERS ACT COMPLIANCE

1. Collaboration and Coordination

1.1. Introduction

The American River Common Features, Water Resources Development Act 2016 Project (ARCF16 Project) has been, and continues to be, designed in collaboration with Federal, state, and local agencies that have jurisdiction by law or have expertise relevant to project designs. The Project Partners participate in relevant existing coordination and collaboration forums hosted by others. In these forums the Partners present developing designs and receive feedback on those designs. These forums include the Lower American River Task Force, the Lower American River and Sacramento River Technical and Resource Advisory Committees (TRAC), and the Lower American River Bank Protection Working Group. The Task Force and the Bank Protection Working Group are open to the public. The Partners also convene project-specific interagency meetings and working groups to discuss the project and design development. The U.S. Army Corps of Engineers (USACE) hosts an agency Wild and Scenic Rivers Act (WSRA) Discussion Meeting (see Section 1.2 below). General public engagement meetings were also held as part of National Environmental Policy Act (NEPA), including public scoping meetings early in the NEPA process and public engagement meetings following release of the Draft Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR).

1.2. WSRA Interagency Meetings

The first WSRA Discussion Meeting was held between USACE and the National Park Service (NPS) in May 2020. In 2021, these meetings expanded to include NPS, Sacramento County Regional Parks Department (Regional Parks), Sacramento Area Flood Control Agency (SAFCA), California Department of Water Resources (DWR), and USACE. In 2022, participation in these meetings was further expanded to include National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). **Table 1.1** provides a summary of agency participation by year. **Table 1.2** shows participation by agency in each WSRA Discussion Meeting. The purpose of these meetings is to “coordinate and discuss designs, design changes and refinements. Identify any concerns early and collaboratively develop solutions.” At times these meetings were convened monthly. At other times participants agreed to meet as needed when specific topics or designs were ready for review and discussion. In addition to the Discussion Meetings, USACE convened a Federal Agency Technical Meeting on June 5, 2024, among the Project Partners and key Federal regulating agencies (NMFS, NPS, USFWS) to present and discuss some of the engineering evaluations conducted in support of the Lower American River (LAR) project elements.

Table 1-1. WSRA Interagency Discussion Meeting Participants

Agency	2021	2022	2023	2024
Federal Agencies				
National Marine Fisheries Service (NMFS)		X	X	X
National Park Service (NPS)	X	X	X	X
U.S. Army Corps of Engineers (Federal Project Partner)	X	X	X	X
U.S. Fish and Wildlife Service (USFWS)		X	X	X
State Agencies				
Central Valley Flood Protection Board (CVFPB) (State Project Partner)				X
California Department of Water Resources (DWR) (Staff to CVFPB)	X	X	X	X
Local Agencies				
Sacramento Area Flood Control Agency (SAFCA) (Local Project Partner)		X	X	X
Sacramento County Regional Parks Department (Regional Parks)		X	X	X

Table 1-2. Agency Participation in ARCF16 WSRA Discussion Meetings and the June 5, 2024, Federal Agency Technical Meeting

Date	Federal NMFS	Federal NPS	Federal USFWS	State DWR[1]	Local SAFCA	Local Regional Parks
	Attended	Attended	Attended	Attended		Attended
December 2024	X[2]	X	X	X	X	X
August 2024	X	X	X	X	X	X
June 2024	X	X	X	X	X	NI[3]
January 2024	Invited	X	Invited	X	X	Invited
December 2023	X	X	Invited	X	X	X
October 2023	X	X	Invited	X	X	X
August 2023	X	X	Invited	X	X	X
June 2023	X	X	X	X	X	Invited
February 2023	Invited	X	Invited	X	X	Invited
January 2023	X	X	Invited	X	X	Invited
October 2022	Invited	Invited	X	X	X	Invited
August 2022	X	X	Invited	X	X	X
June 2022	Invited	X	Invited	Invited	X	X
May 2022	Invited	X	Invited	X	X	X
April 2022	Invited	X	Invited	X	X	X
March 2022	Invited	X	Invited	X	X	Invited
January 2022	X	X	X	X	X	X
April 2021	NI	X	NI	X	X	X
February 2021	NI	X	NI	X	X	X

[1] DWR provided staff to support the CVFPB. [2] X = attended. [3] NI= not invited

1.3. How Collaboration has Shaped the Designs to Date

The LAR erosion protection improvements are being designed and implemented in stages (i.e., multiple construction contracts). To ensure that the design contracts are developed consistent with the requirements of the Federal and State WSRAs, Endangered Species Act, and other requirements, the design teams coordinated with NPS, Sacramento County Parks, NMFS, USFWS, and other regulatory agencies throughout the design process and when designs reached 10%, 35%, 65%, 95%, and 100% levels. This collaboration and coordination results in an iterative conversation between the USACE design teams and the other agencies – presentation of design, receipt of suggestions and other feedback from reviewing agencies, design adjustments and additional engineering analysis, followed by a new agency review of the refined design. **Table 1.3** highlights concerns raised by reviewing agencies and strategies adopted by the design teams to address the concerns.

Table 1-3. Influence of collaboration on the Lower American River Designs

Concern	Strategy
Habitat loss	• **Minimize erosion protection footprint** • Replant habitat onsite - Revegetate with native species • Replant habitat offsite • Collaboration with NMFS to ensure design meets requirements for anadromous fish and fishery • Establish planting benches with variable elevation to enhance fish habitat • Include **Instream Woody Material** for aquatic habitat • Select native plants for revegetation • Select native plants to restore habitat and aesthetics (consistent with American River Parkway Plan)
Recreation impacts	• **Design user friendly pedestrian and bike detours** • Design **consistent with American River Parkway Plan for recreation** • Provide **easier river access** by i**n-filling exposed rock at the river's edge with gravel** (i.e., "choke stone")
Aesthetic impacts	• Design **buried erosion control features** to minimize exposed rock • Cover rock with topsoil and revegetate with native species
Tree removal	• Use **selective, minimal tree removal** • **Preserve most heritage oaks** by adjusting the construction footprint • Replant with native species
Noise/Vibration Dust & Traffic impacts	• Mitigate temporary construction impacts through various contractor controls and protocols

1.3.1. LAR Contract 3B

Contract 3B's design footprint has changed substantially from earlier iterations. This is largely due to input received from the environmental and parks agencies at the 35% design milestone. The proposed 35% design footprint was significantly larger and more impactful to the parkway and river channel than is currently proposed. When the resource and parks agencies reviewed the 35% design, they strongly objected to the extent of the impacts which would be caused by the design. In response, the Project Partners convened a design charette and a series of intensive coordination efforts beginning in July 2021. The purpose of these engagements was to develop a design solution which addressed the resource and parks agencies' concerns. The result of this intense coordination and collaboration was a Contract 3B design that minimized both the design footprint and the impacts to Parkway resources to the greatest extent possible while also achieving the flood risk management objectives of the Project.

Figure 1.1 below, provides a timeline of the Contract 3B design development process. This timeline shows the overall design development milestones and key coordination meetings. These meetings included the Bank Protection Working Group (BPWG) and TRAC, where the proposed design was presented and shared with key engineering, geological, ecological, and biological technical professionals for review, comment, and advise. Coordination with the resource and parks agencies was not limited to attendance at BPWG and TRAC meetings. Regular and recurring meetings separate from the BPWG and TRAC occurred with those agencies as detailed in Section 1.2.

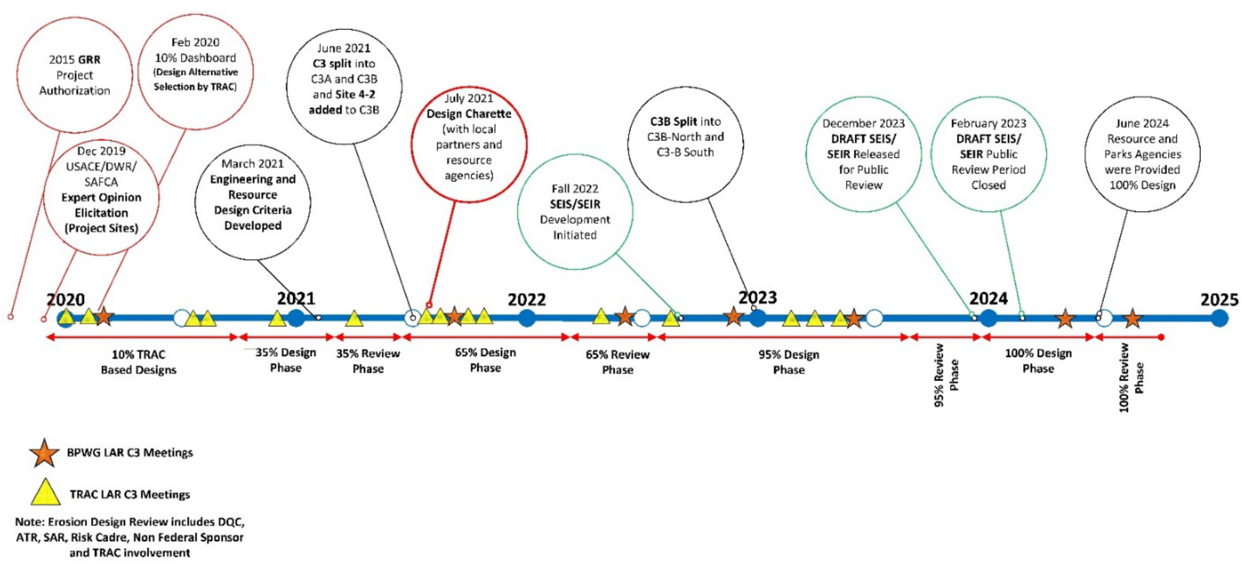

Figure 1-1. Contract 3B Design Development and Coordination and Collaboration Timeline

1.3.2. LAR Contract 4A

The LAR Contract 4A Project Partners reached out and engaged key stakeholders including SAFCA, DWR, Regional Parks, USFWS, NMFS, and NPS early and often throughout the project. Key engagements are shown in **Table 4**. Not all communications and meetings involved in the coordination are shown in **Table 4**. Not all of those invited sent participants. Only those who participated in the meetings are shown in the table. Because no substantial changes to the design were made post 65%, the 95% design and 100% design review milestones are not shown.

Three Design Charettes were convened for LAR Contract 4A. Participants in the first Design Charette shared background information, developed the problem statement, and identified an initial array of repairs to address the problem. Following the first Design Charette, the initial array of repair options was screened, and additional analysis was completed on a select subset of the initial array. This included developing costs and identifying environmental, cultural resource, and hydraulic impacts. During the second Design Charette participants reviewed these results and selected the preferred repair for advancement to the 10% design. A third Design Charette focused on how to manage bike traffic during and after construction. During this Design Charette participants developed an initial array of bike detour alternatives and the Project Partners responded to suggestions and concerns raised by Regional Parks and the NPS.

The 10%, 35%, and 65% designs all included briefings to the TRAC. The briefings included describing any changes to the design made by the design team since the last design submittal along with an explanation for why the changes were made. After the briefings the design team requested comments from the TRAC for inclusion in updated designs for the next submittal.

The preferred repair was changed at 65% design due to complicated and numerous utility relocations and bridge modifications necessary to construct the originally preferred alternative and because the project footprint kept getting larger with increasing impacts (e.g. more elderberry shrubs needed to be transplanted than originally anticipated). The preferred alternative changed from buried rock protection with native grasses seeded on topsoil placed over the buried rock (10% to 35% design) to a berm placed upstream of the area needing protection to deflect flow away from the levee (65% to 100% design). The berm will also be covered with topsoil and seeded with native grasses based on feedback from DWR, SAFCA, Sacramento County Parks, and the NPS. The changed approach resulted from developing and considering another array of potential solutions that were developed closely with DWR, SAFCA, Sacramento County Parks, and the NPS. Costs and impacts were developed for these as well and shared with DWR, SAFCA, Sacramento County Parks, and the NPS before final selection of the berm alternative. The berm was designed to be as minimally invasive to the flowing water as possible to avoid unacceptable hydraulic impacts while also minimizing its erosion protection footprint. This is especially important as part of the wetland needs to be filled in to support the berm's construction and the team made every effort to minimize the footprint in the wetland area.

The selected berm alternative blocked the existing heavily used Jedediah Smith Memorial Bike Trail, requiring it to be permanently re-routed. The design team used the initial array of alternatives and other information gleaned from the third Design Charette to evaluate the cost and impacts of the bike trail realignment alternatives. The results of the analysis and a recommended alternative were shared with the Regional Parks and the NPS. The preferred plan was to permanently re-route the bike path south of an existing wetland along existing unsurfaced utility maintenance roads before following a new path roughly parallel with the Union Pacific Railroad property. This minimized impacts to existing wetlands and vegetation while being a cost-effective solution. Feedback during subsequent design reviews led to the design team modifying the path of the proposed bike path re-route to avoid as many trees as possible.

A design constraint became apparent during the 100% design reviews. This has required the design team to begin evaluating a potential bike trail detour redesign that would reroute the bike trail around the berm instead of into the floodplain. The design team met with County Parks and NPS on November 20, 2024, to discuss the potential redesign effort. A second meeting was held with Regional Parks, NPS, USFWS, and NMFS on December 4, 2024, to provide an update on the possible redesign.

Table 1-4. Key Engagements for Selecting the Alternative to be Designed for LAR Contract 4A

Engagement	Date(s)	Participants
Design Charette 1 (Initial alternatives)	Sept 21 – 23, 2021	SAFCA, DWR, Regional Parks, USFWS, NMFS, USACE
Design Charette 2 (Alternative selection)	Nov 17 & 18, 2021	SAFCA, DWR, Regional Parks, USACE
10% Design Reviews		
10% PDT[1] Review	Feb 10 – Mar 7, 2022	USACE PDT Team
10% Design Management & Sponsor Briefing	Feb 18, 2022	DWR, SAFCA, SPK Section and Branch Chief's
10% Design DQC & Sponsor Review	Mar 10 – 18, 2022	USACE DQC Team, SAFCA, DWR
10% Design TRAC Briefing	Mar 16, 2022	SAFCA, DWR, NPS, Regional Parks, USACE
10% Design Risk Assessment	Mar 17 & 18, 2022	SAFCA, DWR, USACE Risk Cadre
Design Charette 3 (Bike path traffic management)	May 24 – 26, 2022	SAFCA, DWR, NPS, Regional Parks, USACE
35% Design Reviews		
35% PDT Review	Jun 13 – JUN 30, 2022	USACE PDT Team
35% DQC[2] Review	Jun 30 – JUL 15, 2022	USACE DQC Team
35% Design Risk Assessment	Aug 2 & 3, 2022	SAFCA, DWR, USACE Risk Cadre
35% Management Briefing	Aug 10, 2022	Sacramento District, USACE Section and Branch Chief's
35% NFS's[3] & TRAC Briefing	Aug 17, 2022	SAFCA, DWR, NPS, Regional Parks, USACE
LAR C4a Design Workshops	Aug 22 & 24, 2022	SAFCA, DWR, USACE
35% Design Sponsor Review	Oct 3 – 25, 2022	SAFCA, DWR, Technical Advisory Committee
65% Design Reviews		
65% Design Path Forward -SPK Management	Oct 12, 2022	Sacramento District, USACE Section and Branch Chief's
65% Design Path Forward – Sponsor	Oct 20, 2022	SAFCA, DWR, NPS, Regional Parks, USACE
65% Design Path Forward -SPK Management	Nov 14 & 17, 2022	SPK Section and Branch Chief's
65% Design Path Forward – Sponsor	Nov 23, 2022	SAFCA, DWR, NPS, Regional Parks, USACE
Site Baseline Risk Assessment Re-evaluation	Dec 6 – 8, 2022	SAFCA, DWR, USACE
65% Design Path Forward – Decision (PDT Meeting with NFS's and Site Visit)	Jan 25, 2023 & Feb 2, 2023	SAFCA, DWR, Regional Parks, USACE
Bike Trail Reevaluation		
Notification of design constraint and potential need to redesign the bike trail detours.	Nov 20, 2024	Design team, Regional Parks, NPS
Update on the potential redesign	Dec 4, 2024	Design team, Regional Parks, NPS, USFWS, NMFS

[1]PDT = Project Delivery Team
[2]DQC = USACE District Quality Control
[3]NFS = Non-Federal project cost-sharing partner

1.3.3. LAR Contract 4B

LAR Contract 4B includes two main evaluation and design efforts: 1) extension of tiebacks, which will be partially constructed under Contract 3B, and 2) remediation of lone tree scour risk identified on the north bank downstream of Watt Avenue and on the South bank upstream of Watt Avenue. For specifics on these two design elements please refer to the Engineering Appendix, **Appendix G**.

Contract 4B design development is in its infancy as its full scope is still being evaluated via additional hydraulic and geotechnical sensitivity analyses. Once the full scope of Contract 4B is defined by early 2025, Contract 4B will undergo the same thorough coordination and collaboration process utilized by earlier designs such as LAR Contracts 1 and 2 and outlined in the above **Table 1.3**. This coordination and collaboration process will be utilized as design alternatives are developed, as a preferred alternative (or alternatives) is selected, and as final designs are developed, refined, and finalized. Specifically, for Contract 4B it is anticipated this collaboration will mostly influence the designs required to mitigate the lone tree erosion risks identified within the Contract 4B footprint. The proposed tieback extensions included in Contract 4B will be minimally influenced by this collaboration process because the extensions are of tiebacks partially constructed as a part of Contract 3B which has already undergone through the coordination and collaboration process with the appropriate agencies. The 10% design milestone is anticipated in Summer 2025.

1.3.4. ARMS

As with other LAR components of the ARCF16 Project, the American River Mitigation Site (ARMS) designs are being developed in coordination with Regulators, the TRAC, and the American River BPWG. Designs are also shared and discussed in WSRA Discussion Meetings.

In April 2022, five design concepts were presented to the TRAC. Two concepts consisted primarily of terminal backwater channels, two consisted of flowthrough systems with side and backwater channels, and one design consisted of ring channels that created habitat islands. TRAC participants requested the Project Partners develop another design to retain a portion of the existing pond. The goal of this design would be to align with the design contained in the 2008 American River Parkway Plan and to focus on post-project recreation. Participants also recommended avoiding development of habitat islands due to public safety and enforcement concerns.

Using the feedback from the TRAC, USACE narrowed the number of concepts down to three for further development: one terminal backwater only concept, one backwater and flowthrough side channel concept, and a backwater/flowthrough concept with retention of 8-acres of the existing pond. All concepts included the construction of two inlets to the LAR main river channel and achieved the target compensatory mitigation acreages.

In August 2022, these three concepts were presented to USFWS and NMFS. Both agencies favored the flowthrough system for hydraulic performance and because it restored the entire area of the pond to high habitat for Federally protected species, particularly salmonids. These concepts were then shared with Regional Parks; however, the agency declined to provide feedback because SAFCA was conducting site investigations to inform property acquisition, clean-up required, design development, and long-term property management/ownership.

Design development and coordination has continued through 2024 and will continue through 100% design development and review.

2. WSRA Guidance and Criteria

2.1. Introduction

This chapter discusses guidance and criteria used by NPS when conducting their consistency review under the WSRA as applied to the ARCF16 Project. The NPS administers the Federal WSRA-designated portion of the Lower American River. In this role they review proposed actions for consistency with the Federal WSRA. NPS will conduct their consistency review only once a design as reached at least 95%. Each contract within the ARCF16 LAR must receive a Consistency Determination from NPS before it can proceed to implementation. In conducting their consistency review, NPS is guided by the WSRA and supporting policy and guidance documents. In addition to the WSRA itself, NPS is guided in their review by Directors Order 46: Wild and Scenic Rivers (May 2, 2015), NPS Reference Manual 46: Wild and Scenic Rivers (April 12, 2021), the NPS 2006 Management Policies, and 47 Federal Register 39454-39461 (September 7, 1982), National Wild and Scenic Rivers System Final Revised Guidelines for Eligibility, Classification and Management of River Areas.

2.2. NPS Guidance and Best Management Practices

As part of coordination and early consultation, NPS provided a recommended template for the ARCF16 Project WSRA Consistency Analyses. This template includes tables of NPS-recommended best management practices (**Table 2.1**) and universal avoidance and minimization measures (**Table 2.2**). These practices and measures are consistent with the policy and guidance documents identified in Section 2.0. During design development for each of the LAR Contracts, these practices and measures are incorporated to the greatest extent feasible consistent with engineering standards and meeting the Congressionally authorized flood risk management objectives. Each draft or final Consistency Analysis includes tables in Section 3 together with the specific ways the contract design meets the requirement or provides an explanation for why the design is not able to meet the requirement. The design teams also follow a WSRA decision flow chart, which was presented in an NPS-recommended training course (**Figure 2.1**). This is discussed in Section 2.3 below.

Table 2-1. NPS Recommended Best Management Practices

Best Management Practices
Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock.
If necessary, stone fill (riprap) may only be used for abutment scour protection; the use of stone fill to stabilize the riverbanks is prohibited. To stabilize the riverbanks, use approved native boulders, cobble and gravel; loam; vegetation; and bio- engineering techniques such that the banks, when fully restored, have an appearance and function similar to the natural riverbank.
Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed.
Disturbed/exposed banks, staging and project access areas must be properly stabilized (seeded, mulched, or otherwise) with native vegetation to prevent erosion and establishment of invasive plant species. A non-persistent cover crop of annual rye or equivalent temporary seeding may be used to ensure a more rapid establishment of cover while native perennial plantings grow.
Bio-engineering methods must be used or, where deemed necessary by the [insert river managing agency/ contact], clean broken rock riprap of an adequate size specific for bank stabilization.
The use of demolition debris for slope armoring is not allowed.
Avoid unnecessary tree removal within the project work area.
A vegetation plan shall be in place to protect existing vegetation/trees from damage by construction equipment (*e.g.,* provide temporary barriers to protect existing trees, plants, root zone).
Disturbances of the riparian zone must be limited to the indicated access points; prior to the operation of heavy equipment (dozers, cranes, trucks), orange construction fencing must be erected to delineate the dripline of remaining trees to avoid compaction of tree roots.
The fastening of ropes, cables, or fencing to trees is prohibited.
To ensure bank stability, trees removed within fifteen feet of the top of the riverbank shall be cut flush to the ground; stumps and roots shall be left in place; indiscriminate bulldozing of riparian trees is prohibited.
All trees removed from the riparian corridor shall be replaced with a native tree of like species. Replace each mature tree removed (12-inch or greater diameter at breast height [DBH]) with [insert specifications, e.g., replant 3:1 ratio depending on expected survival rate and with trees that are a minimum 3- inches DBH]. Plant only local, native trees/shrubs/grasses, naturally occurring within the [insert river name] riparian zone [insert plant species list and/or to be determined in coordination with appropriate staff].
A qualified individual (arborists, foresters, or trained staff with similar experience) shall plant replacement trees at the appropriate time of year and in a random fashion to avoid a plantation effect. Cultivate and monitor planted tree seedlings/saplings for two years to ensure success; water plantings as necessary. Promptly replace planted stock showing signs of mortality.
Stakes and guide wires shall be properly removed and disposed of once seedlings are established.

Table 2-2. NPS Recommended Universal Avoidance and Minimization Measures

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):
Levee Setbacks	Set back the levees wherever possible to allow the river to move.	Free-Flow
Bioengineering and native plantings throughout the banks and levees	Avoid riprap to the extent possible. Use bioengineering techniques including use of wood (e.g., log crib walls, tree revetments, root revetments; engineered log jams) and deformable techniques (e.g., fabric-encapsulated soil lifts (i.e., geolifts), rock bags, coir rolls (i.e., bio logs), erosion control blankets/fabrics).	Free-Flow, Anadromous Fish
Riprap at the bank toe	Riprap would only be placed at the bank toe of segments where the levee prism and associated planting berms (if included) are at the extent of the Parkway limits.	Free flow
Riprap at the bank toe	Ensure no hydraulic impacts from riprap.	Water quality
Riprap at the bank toe	Ensure no direct and adverse impacts to anadromous fish.	Anadromous Fish
Riprap at the bank toe	Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. If rock is needed utilize cobble to the extent possible.	In-water recreation
Riprap at the bank toe	Cover exposed riprap at the bank with soil and vegetation where cobble is not possible.	Aesthetics
Avoid and Minimize use of riprap on the bank above the toe to the Ordinary High-Water Mark (OHWM) and near the water	Minimize the use and visibility of RCP. RCP should be avoided or minimized to the extent possible. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. Cover any necessary riprap on the bank above the OHWM with planting benches containing sufficient soil and capable of supporting riparian habitat.	Anadromous Fish Recreation Aesthetics
Minimize use of Riprap on the levee slope	Cover revetment on the slope with sufficient soil and native grasses or forbs, as woody vegetation may not be possible due to USACE vegetation on levees policies.	Anadromous Fish Aesthetics

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):
Removal of vegetation	Minimize vegetation removal to the maximum extent practicable. Provide planting benches to reduce the affects for lost habitat on-site. Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed. Provide restoration in the parkway when revegetation cannot be completely restored in the project footprint. Re-vegetate all areas of the repair site above the waterline with native, ecotone appropriate, species. Design sites such that they are indistinguishable from the overall fabric of the Parkway.	Anadromous Fish Aesthetics Water quality
Closure of bike trail	The first priority is to detour the bike trail on the nearest dedicated trail. That is, the trail should not be shared with automobiles. If the bike trail segment being detoured is paved, the detour route should also be completely paved to include all transitions from permanent to temporary trails/detours. In an event due to where the trail cannot be routed near construction boundaries for safety concerns it should be detoured to surface streets with bicycle safety measures for a minimal amount time. Detours to surface streets should be considered the last option and review by all stakeholders. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Minimize the extent of the closure. When feasible use flaggers instead of detours. Minimize the length of time the detours are needed. Detours will carry the same safety standards as a permanent trail and if detours go down to one bicycle lane, caution should be considered and the included use of flaggers with dismount zones in single lane areas. Any permanent re-routing of the bike trail should also include rerouting the equestrian trail. Re-routed trails should provide the same experience as the existing trail including the aesthetics. The new trail should be shaded with riparian vegetation.	Recreation
Closure of levee maintenance road	Detour the route, if normally used as a hiking, horse, or mountain bike trail. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Plant vegetation to provide shading along this road once users return to the extent possible.	Recreation
General Impacts of Work in the Parkway	Reduce work limits to the maximum extent practicable. Close trails and other recreational features only when necessary for safety of the public. Advance notice of work shall be provided at the site of the closures and on the web.	Recreation
General Impacts of Work in the Parkway	Phase work appropriately such that sites do not remain incomplete for excessive periods of time (e.g., bank work completed but planting delayed for years, or tree clearance years ahead of the construction etc.)	Aesthetics

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):
Closure of boat ramp	Avoid closure of boat ramps to the maximum extent practicable. Phase work such that not more than one boat ramp is closed. Provide information at the closure and on the web about the location and duration of the closure and the nearest open boat ramp. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation
Closure of river access points	Avoid closure of river access points to the maximum extent practicable. Phase work such that consecutive river access points are not closed for more than one consecutive mile on account of this project. Provide information at the closure(s) and on the web about the location and duration of the closure and the nearest open river access points. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation
In water work	Abide by the National Pollution Discharge Elimination Systems (NPDES)requirements to ensure there is no adverse effect to water quality.	Water Quality
In water work	Abide by NMFS Biological Opinion to ensure there is no adverse effect to anadromous fish from water quality.	Anadromous Fish
In water work	Provide buoys or other demarcation for closed sections of the channel. The channel shall not be closed such that upstream or downstream navigation is precluded.	In-water recreation

2.3. Decision Flow Chart from the “Bank Stabilization on Wild and Scenic Rivers Solved” Short Course

Although not part of the formal criteria required to be followed by USACE’s erosion design team, the flow chart shown in **Figure 2.1** was used as an additional tool during the development of LAR Contract 3B. The flow chart has not been formally implemented by NPS for bank stabilization efforts on designated Wild and Scenic Rivers but has been discussed and presented in NPS sponsored training seminars. The Figure 2.1 flow chart is anticipated to become formal guidance from the NPS in the near future. The analysis and application of the flow chart is provided purely as an academic exercise to demonstrate that Contract 3B’s designs would comply with potential future Wild and Scenic River design criteria and shares similar logic on developing solutions based on local site conditions and constraints.

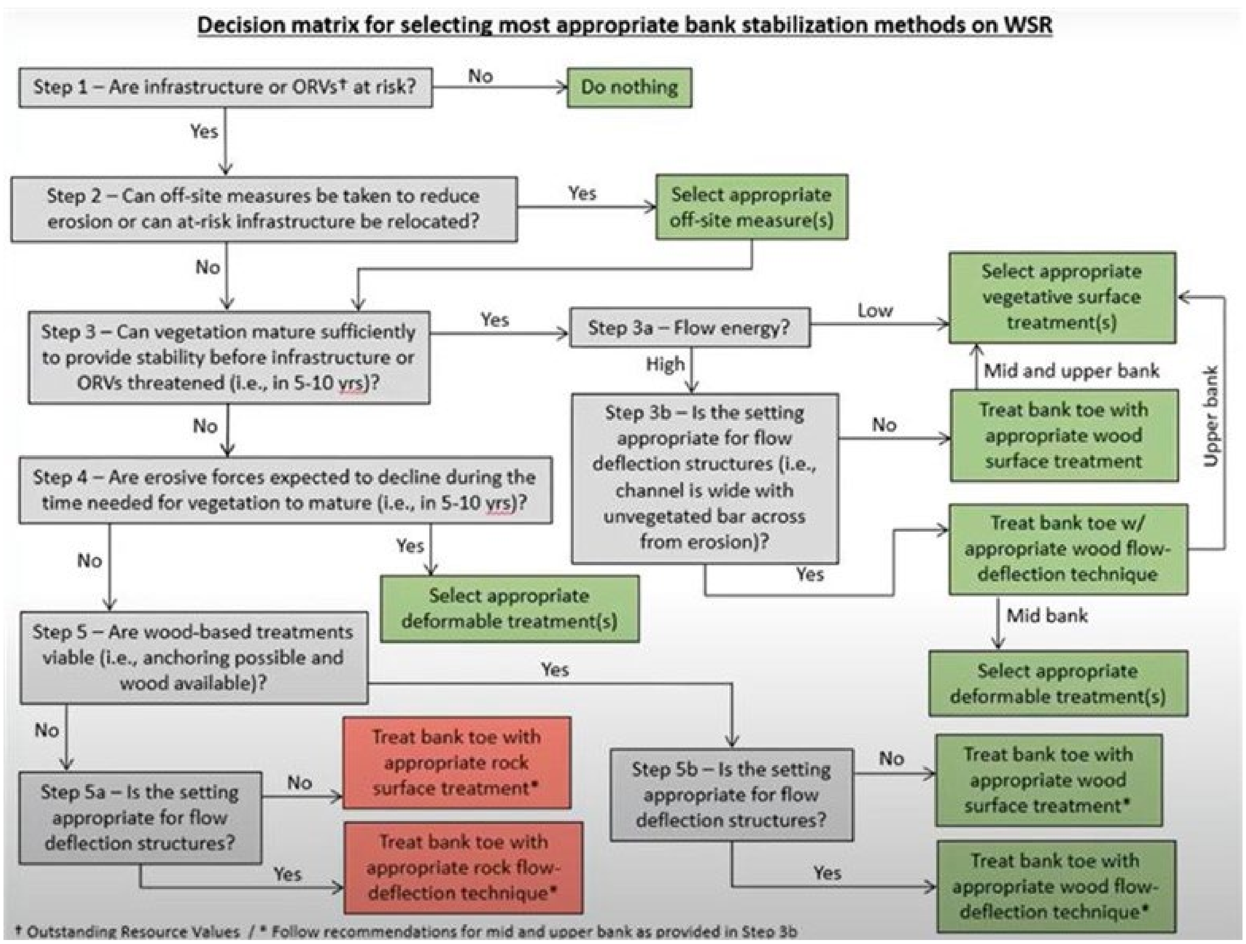

Figure 2-1. Decision matrix for selecting the most appropriate bank stabilization methods on Wild and Scenic Rivers

Step 1: Are infrastructure or Outstandingly Remarkable Values (ORVs) at risk? Yes. The project is being designed to protect critical flood protection infrastructure which reduces flood risk to over 440,000 people and over $1 billion in infrastructure. Should the flood protection infrastructure fail, the life loss estimate is greater than 500 people.

Step 2: Can off-site measures be taken to reduce erosion, or can at-risk infrastructure be relocated? No. USACE evaluated the feasibility of relocating at-risk infrastructure (via levee setbacks) during the feasibility study phase of the ARCF16 Project. The encroachment of adjacent neighborhoods up to the landside toe of the levee make levee setbacks were infeasible due to the high cost of buying up and removing residential neighborhoods. During preliminary analyses of alternative site designs, the TRAC evaluated removal of the upstream berm to allow more flow to the north channel away from the design, however the effects of flow were negligible. Removal of the in-channel island were not evaluated, however, due to the expected high impacts to the parkway and environment.

Step 3: Can vegetation mature sufficiently to provide stability before infrastructure or ORV's are threatened? Unlikely. One of the potential erosion drivers at this site is due to channel scour locally steepening the channel bank causing bank instability and leading to undermining of both overbank vegetation and the levee embankment. Vegetation is not an effective countermeasure against this type of erosion as it occurs below summer water levels (where roots are not predominant). Failure of adjacent well-vegetated banks also demonstrates the inability of vegetation to resist erosion.

Step 4: Are erosive forces expected to decline during the time needed for vegetation to occur? No. The channel planform is generally laterally and vertically stable; meaning the river channel alignment as a whole is unlikely to migrate, or meander, from its current alignment, but that does not mean no erosion is anticipated. The primary driver for erosion is due to local erosion (general scour or localized bank scour/erosion) during high extreme events. Since the channel in planform is unlikely to significantly alter in the immediate future (i.e. migrate further away from the levee), the erosion hazard to the levees in extreme events is unlikely to decrease.

Step 5: Are wood-based treatments viable? No. Wood based treatments were discussed and were not preferred by the TRAC for use on the LAR. The TRAC preferred designs which would 1) limit footprint extents, and 2) provide long-term erosion protection and habitat benefits. The concern with wood-based treatments is that the planting benches could be lost over time as the wood-based treatments decay and become more susceptible to erosion. In addition, if wood-based treatments required future replacement to provide adequate erosion protection due to wood decay, the site would again be subjected to new impacts to replace the wood.

Step 5a: Is the setting appropriate for flow deflection structures? For Contracts 3B the answer is no. This approach was discussed by the TRAC during the initial screening of alternatives. The structures would likely induce erosion and habitat loss elsewhere in the Parkway and create impacts to hydraulic conveyance and increase risk of levee overtopping. For Contract 4A, a deflection berm is actually the proposed design. A deflection berm was determined to be feasible at the Contract 4A location because the overall channel width (levee to levee) in that stretch of the LAR is significantly larger (~2,500-ft) compared to the Contract 3B locations (~900-ft). The wider channel width in the 4A area permits minor flow impacts in the vicinity of the berm to stay within acceptable thresholds.

Step 6: Treat Bank Toe with Appropriate Rock Treatment (and follow recommendations for mid and upper bank provided in slide 3B.) The proposed design places rock at the channel toe and extends rock to an elevation where erosion will no longer threaten the levee embankment or its foundation. Above the placed rock, existing vegetation is being protected in place to continue to provide erosion protection to the bench. The bank toe protection protects not only the levee, but also the existing vegetation on the overbank from erosion. The proposed design includes soil filling the placed rock along the riverbank, placing 12-inches above and revegetating the disturbed surface.

2.4. ARCF16 Project Adoption of BMPS

Table 2.3 shows the NPS recommended best management practices and generally describes how the LAR elements of the ARCF16 Project address these practices. **Table 2.4** shows the NPS' Universal Avoidance and Minimization Measures and generally describes how the ARCF16 Project elements address them. **Attachments 1 through 4** are the USACE Consistency Analyses for each contract and ARMS. Each of the analyses include Tables that contain the same content as Tables 2.3 and 2.4, but which are tailored to the specific contract.

Table 2-3. Summary of Adherence to NPS Best Management Practices

NPS Best Management Practice	Proposed Action
Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock.	The minimum amount of RCP required to meet flood risk management objectives is proposed. Most RCP would be covered with soil and plantings or with choke stone to naturally accrete sediments.
If necessary, stone fill (riprap) may only be used for abutment scour protection; the use of stone fill to stabilize the riverbanks is prohibited. To stabilize the riverbanks, use approved native boulders, cobble and gravel; loam; vegetation; and bio- engineering techniques such that the banks, when fully restored, have an appearance and function similar to the natural riverbank.	Stone riprap would be placed below bridges, existing outfalls, and certain other infrastructure where required to ensure their stability during a large flood event.. Although these areas would not be planted they are currently mostly unvegetated. Therefore, the aesthetics of the area would not be further reduced. Stone riprap would be placed below the water surface at the time of construction. This water surface is assumed to be equivalent to the 2,660 cubic feet per second (cfs) water surface elevation. Buried stone riprap is also part of the buried launchable rock design.
Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed.	Wherever feasible disturbed riparian areas would restored through appropriate plantings. . Immediately following construction, the exposed soil would be hydroseeded with an appropriate native seed mix. Tree saplings and other companion plants would be planted as soon as practicable, but no later than one year following construction.
Disturbed/exposed banks, staging and project access areas must be properly stabilized (seeded, mulched, or otherwise) with native vegetation to prevent erosion and establishment of invasive plant species. A non-persistent cover crop of annual rye or equivalent temporary seeding may be used to ensure a more rapid establishment of cover while native perennial plantings grow.	Immediately following construction, the site would be hydroseeded with an appropriate native seed mix.
Bio-engineering methods must be used or, where deemed necessary by the [insert river managing agency/ contact], clean broken rock riprap of an adequate size specific for bank stabilization.	Bioengineering methods would not sufficiently reduce the flood risk to meet the project flood risk management objectives. Clean, broken riprap from an approved quarry would be used.
The use of demolition debris for slope armoring is not allowed.	No demolition debris would be used for slope protection.
Avoid unnecessary tree removal within the project work area.	Tree removal will be minimized to the extent feasible. Each tree within the project footprint is evaluated by the design team to determine if it can be preserved. Regulators and stakeholders participate in this process during meetings and site visits.

NPS Best Management Practice	Proposed Action
A vegetation plan shall be in place to protect existing vegetation/trees from damage by construction equipment (e.g., provide temporary barriers to protect existing trees, plants, root zone).	Trees outside of the removal zones will be protected in place using orange construction fencing or chain-link fences. Trees with root zones extending into the construction area, and which could be damaged by grading activities, will be removed. Contract Specifications will incorporate requirements to protect trees including that an arborist be present for tree trimming or grading near roots; financial penalties for tree damage; and root protection matting.
Disturbances of the riparian zone must be limited to the indicated access points; prior to the operation of heavy equipment (dozers, cranes, trucks), orange construction fencing must be erected to delineate the dripline of remaining trees to avoid compaction of tree roots.	Orange construction fencing or chain link fences will be used to delineate the site boundaries. No work will occur outside the construction footprint or designated staging areas.
The fastening of ropes, cables, or fencing to trees is prohibited.	No ropes, cables, or fencing will be fastened to trees marked for retention.
To ensure bank stability, trees removed within fifteen feet of the top of the riverbank shall be cut flush to the ground; stumps and roots shall be left in place; indiscriminate bulldozing of riparian trees is prohibited.	Generally, tree removal would occur in two phases. In phase 1, trees would be cut 4 feet above the grade in the fall/winter prior to start of construction. In phase 2, the remaining root mass would be removed. At no point would indiscriminate bulldozing occur.
All trees removed from the riparian corridor shall be replaced with a native tree of like species. Replace each mature tree removed (12-inch or greater diameter at breast height [DBH]) with [insert specifications, e.g., replant 3:1 ratio depending on expected survival rate and with trees that are a minimum 3- inches DBH]. Plant only local, native trees/shrubs/grasses, naturally occurring within the [insert river name] riparian zone [insert plant species list and/or to be determined in coordination with appropriate staff].	Trees and vegetation will be removed from within project footprints. Trees and vegetation on the periphery of the project will be protected from construction activities. Riparian habitat acreage will be replaced by planting riparian trees and shrubs at a ratio of 2:1 (replacement habitat: affected habitat). Riparian habitat within 82 feet of elderberry shrubs, will be replaced at a ratio of 3:1. These two mitigation ratios were established during consultation with the USFWS and are specified in the Biological Opinion for the project. Compensatory mitigation planting will be accomplished on site to the extent possible with the remainder planted within the Parkway in mitigation areas that will be conserved in perpetuity. Overall, there will be greater than 3:1 native plant replacement. Only native plant species appropriate for the sites and approved by the County of Sacramento for planting in the Parkway, will be used. Three-inch DBH and larger trees of the appropriate species are not available locally in sufficient quantities and quality for the project. Therefore, smaller container plantings that adapt more readily to site conditions will be used. An establishment period of 5 years will be used, to include irrigation, to maximize growth and survival.

NPS Best Management Practice	Proposed Action
A qualified individual (arborists, foresters, or trained staff with similar experience) shall plant replacement trees at the appropriate time of year and in a random fashion to avoid a plantation effect. Cultivate and monitor planted tree seedlings/saplings for two years to ensure success; water plantings as necessary. Promptly replace planted stock showing signs of mortality.	Replacement trees will be planted at designated riparian habitat restoration areas according to designs prepared under the supervision of a California licensed USACE landscape architect with experience in developing habitat restoration. The mitigation sites will be managed and monitored according to the ARCF GRR Habitat Mitigation Monitoring and Adaptive Management Plan, which includes success criteria.
Stakes and guide wires shall be properly removed and disposed of once seedlings are established.	All stakes, fencing, and any other construction or mitigation related materials will be removed once construction is completed and once mitigation plants have become established and mature. In most cases, planting stakes and guide wires will not be used.

Table 2-4. Summary of Adherence to Universal Avoidance and Minimization Measures

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Levee Setbacks	Set back the levees wherever possible to allow the river to move.	Free-Flow	Levee setbacks are not feasible in this area due to the existence of homes and businesses, and major roadways immediately behind the levee.
Bioengineering and native plantings throughout the banks and levees	Avoid riprap to the extent possible. Use bioengineering techniques including use of wood (e.g., log crib walls, tree revetments, root revetments; engineered log jams) and deformable techniques (e.g., fabric-encapsulated soil lifts (i.e., geolifts), rock bags, coir rolls (i.e., bio logs), erosion control blankets/fabrics).	Free-Flow, Anadromous Fish	Bioengineered methods to achieve flood risk reduction are not generally feasible along the LAR due to the magnitude of the hydraulic forces. The minimum amount of rock protection will be used to meet the risk reduction objectives. Soil-filled rock, planting benches, and soil placed over riprap would be incorporated where feasible to support revegetation with native species and natural soil accretion and recruitment. IWM will be placed at appropriate water surface elevations to create a naturalistic appearance and restore function.
Riprap at the bank toe	Riprap would only be placed at the bank toe of segments where the levee prism and associated planting berms (if included) are at the extent of the Parkway limits.	Free flow	USACE understands this avoidance measure to mean that when the levee prism is far from the riverbank, Riprap would not be placed at the bank toe. Site designs would be consistent with this measure by placing the erosion protection features to the protect the levee. In some locations rock would be placed at the toe of the riverbank hundreds of feet from the levee. This would occur where the topography of the site and the proximity of the levee prism to the riverbank is at risk of erosion. Rock would not be placed at the riverbank toe unless it is necessary for flood risk reduction.
Riprap at the bank toe	Ensure no hydraulic impacts from riprap.	Water quality	Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Riprap at the bank toe	Ensure no direct and adverse impacts to anadromous fish.	Anadromous Fish	All direct and adverse effects to anadromous fish have been considered in the programmatic biological opinion for the ARCF16 project. Jointly with the NMFS, USACE has devised avoidance and minimization measures to reduce these impacts to the extent practicable. In addition, mitigation ratios of greater than 1:1, as required by the biological opinion, would reduce effects and ensure that any adverse effects are short term.
Riprap at the bank toe	Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. If rock is needed utilize cobble to the extent possible. Cover exposed riprap at the bank with soil and vegetation where cobble is not possible.	In-water recreation Aesthetics	RCP at the bank toe will be reduced to the minimum amount necessary to achieve the flood risk reduction objectives. Riprap along most of the levee and riverbank would be covered with soil and replanted. Some areas would not include soil and plantings but would incorporate choke stone to create a smoother and more aesthetic surface with some natural sediment accretion expected. Riprap would be exposed around bridge footings and outfalls, consistent with the current condition. RCP at the bank toe will be reduced to the minimum amount necessary to achieve the flood risk management objectives. Soil filled riprap would be used for tiebacks. Riprap could protrude through soil and be visible.
Avoid and Minimize use of riprap on the bank above the toe to the OHWM and near the water	Minimize the use and visibility of RCP. RCP should be avoided or minimized to the extent possible. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. Cover any necessary riprap on the bank above the OHWM with planting benches containing sufficient soil and capable of supporting riparian habitat.	Anadromous Fish Recreation Aesthetics	Most riprap would be covered by soil and planting benches, except around outfalls and bridge footings. Exposed slopes will be planted with appropriate materials per the planting plans. Planting benches will be designed to have an adequate depth to support riparian trees and shrubs.
Minimize use of Riprap on the levee slope	Cover revetment on the slope with sufficient soil and native grasses or forbs, as woody vegetation may not be possible due to USACE vegetation on levees policies.	Anadromous Fish Aesthetics	Slopes within the vegetation free zone will be hydroseeded with soil and appropriate native grasses and forbs. Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Removal of vegetation	Minimize vegetation removal to the maximum extent practicable. Provide planting benches to reduce the effects for lost habitat on-site. Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed. Provide restoration in the parkway when revegetation cannot be completely restored in the project footprint. Re-vegetate all areas of the repair site above the waterline with native, ecotone appropriate, species. Design sites such that they are indistinguishable from the overall fabric of the Parkway.	Anadromous Fish Aesthetics Water quality	Only trees within the construction footprint, or designated haul routes will be removed. Haul routes will be placed to avoid trees and elderberry shrubs to the extent feasible. Access ramps will be oriented to minimize the area impacted to the extent practicable. Established roads will be used as haul routes wherever possible. Habitat mitigation that cannot be completed on site will be accomplished at other locations in the Parkway in at least a 1:1 ratio. Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of bike trail	The first priority is to detour the bike trail on the nearest dedicated trail. That is, the trail should not be shared with automobiles. If the bike trail segment being detoured is paved, the detour route should also be completely paved to include all transitions from permanent to temporary trails/detours. In an event due to where the trail cannot be routed near construction boundaries for safety concerns it should be detoured to surface streets with bicycle safety measures for a minimal amount time. Detours to surface streets should be considered the last option and review by all stakeholders. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Minimize the extent of the closure. When feasible use flaggers instead of detours. Minimize the length of time the detours are needed. Detours will carry the same safety standards as a permanent trail and if detours go down to one bicycle lane, caution should be considered and the included use of flaggers with dismount zones in single lane areas. Any permanent re-routing of the bike trail should also include rerouting the equestrian trail. Re-routed trails should provide the same experience as the existing trail including the aesthetics. The new trail should be shaded with riparian vegetation.	Recreation	Bike trail detours will be provided around the active construction. Where feasible, the existing access and trail system within the Parkway will be used for detours. Detours may use the top of the levee and/or public surface streets in some locations. Signage, physical barriers separating riders from other motorized vehicles, and/or in-person flaggers will be present to avoid safety risks to bike riders. Informational signage will be posted at the upstream and downstream ends of the detour as well as at the closure points. Information will also be provided on-line.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of levee maintenance road	Detour the route, if normally used as a hiking, horse, or mountain bike trail. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Plant vegetation to provide shading along this road once users return to the extent possible.	Recreation	Where an affected levee maintenance road is used by hikers, bicycle riders and/or horseback riders, detours will be provided when safe. Information will be provided at the closure points and online. Sites are generally designed to preserve a strip vegetation adjacent to the bike trail. Otherwise, the area will be replanted where the trails are not within the vegetation free zone.
General Impacts of Work in the Parkway	Reduce work limits to the maximum extent practicable. Close trails and other recreational features only when necessary for safety of the public. Advance notice of work shall be provided at the site of the closures and on the web.	Recreation	Every effort will be made to reduce the work area to the extent practicable. Advance notice of the work will be provided on sacleveeupgrades.com.
General Impacts of Work in the Parkway	Phase work appropriately such that sites do not remain incomplete for excessive periods of time (e.g., bank work completed but planting delayed for years, or tree clearance years ahead of the construction etc.)	Aesthetics	Work will be scheduled to progress sequentially. Gaps in the construction sequence would be limited to necessary safety stand downs during the flood season when no work may be conducted in the floodway.
Closure of boat ramp	Avoid closure of boat ramps to the maximum extent practicable. Phase work such that not more than one boat ramp is closed. Provide information at the closure and on the web about the location and duration of the closure and the nearest open boat ramp. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	Where present within the construction footprint, boat launches will be closed during construction. In some areas parking lots will be used for construction staging or transit. When this is the case, the parking lots will not be available to the public.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of river access points	Avoid closure of river access points to the maximum extent practicable. Phase work such that consecutive river access points are not closed for more than one consecutive mile on account of this project. Provide information at the closure(s) and on the web about the location and duration of the closure and the nearest open river access points. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	Where active construction is in progress, public access will be prohibited or restricted. This is necessary to ensure public and construction worker safety. Unofficial, informal access to the river will be restricted from active construction zones and within the project area during vegetation establishment following construction. Portions of the Parkway that are not under construction or in the process of vegetation establishment will remain available for river access.
In water work	Abide by NPDES requirements to ensure there is no adverse effect to water quality.	Water Quality	Site designs are consistent with this measure.
In water work	Abide by NMFS Biological Opinion to ensure there is no adverse effect to anadromous fish from water quality.	Anadromous Fish	Site designs are consistent with this measure.
In water work	Provide buoys or other demarcation for closed sections of the channel. The channel shall not be closed such that upstream or downstream navigation is precluded.	In-water recreation	Buoys or other demarcation would be provided where turbidity curtains are used. At no time would navigation be completely precluded.

3. Consistency Determination Request Packages

3.1. Introduction

Section 3 documents the WSRA compliance status for each of the remaining LAR components (i.e., “contracts”) of the ARCF16 Project. As discussed in Section 2 of this appendix, consistency with the WSRA is considered throughout design development for the LAR elements of the ARCF16 Project. **Attachments 1 through 4** provide the USACE WSRA Consistency Analyses for LAR Contracts 3B (final), 4A (draft), 4B (draft), and ARMS (draft) based upon the current level of design. Each Consistency Analysis will be updated as designs reach 95%, and transmitted to the NPS with a request for their consistency review. Three other LAR Contracts (Contracts 1, 2 and 3A) were the subject of previous NEPA documents and have received Consistency Determinations from NPS (see **Table 3.1**). Before each ARCF16 contract can be constructed it must receive a Consistency Determination from the NPS.

Table 3-1. NPS Consistency Determinations for the ARCF16 Project

Project Contract	USACE Submited Consistency Analysis	NPS Provided Consistency Determination
LAR Contract 1	22-Jun-2021	20-Jul-2021
LAR Contract 2	22-Jun-2021	20-Jul-2021
LAR Contract 3A	4-Nov-2022	30-Nov-2022

3.2. Final Request Packages

3.2.1. LAR Contract 3B

LAR Contract 3B has reached 100% level of design and a final Consistency Analysis has been completed and transmitted to NPS together with a request for their consistency review under the WSRA (**Attachment 1**). Contract 3B cannot be constructed until an NPS Consistency Determination is received.

3.3. Draft Consistency Request Packages

3.3.1. LAR Contract 4A

LAR Contract 4A reached 95% level of design but is reconsidering a portion of the design related to the bike trail alignment. A draft Consistency Analysis has been completed based upon the bike trail alignment that currently appears to be most feasible (**Attachment 2**). Once designs again reach 95%, the Consistency Analysis will be updated and transmitted to NPS for their consistency review and determination. Contract 4A cannot be constructed until an NPS Consistency Determination is received.

3.3.2. LAR Contract 4B

LAR Contract 4B is in early conceptual design stages. Detailed engineering analyses are in development and a request for deviation from USACE levee vegetation standards (ETL 1110-2-583) is anticipated. Decision regarding the variance rests at Headquarters USACE. The best information available at this time was used to develop a draft Consistency Analysis (**Attachment 3**). Once designs reach 95% (at least two years from now), the Consistency Analysis will be updated and transmitted to NPS for their consistency review and determination. Contract 4B cannot be constructed until an NPS Consistency Determination is received.

3.3.3. ARMS

The ARMS designs have reached between 35% and 65%. A draft Consistency Analysis has been developed based upon these designs (**Attachment 4**). Once designs reach 95%, the Consistency Analysis will be updated and transmitted to NPS for their consistency review and determination. ARMS cannot be implemented until an NPS Consistency Determination is received.

American River Common Features 2016 Project Section 7 Wild and Scenic Rivers Act DRAFT Consistency Analysis American River Erosion Contract 4A

Erosion Management Activities on the Lower American River- Sacramento County, California

October 2024

US Army Corps of Engineers®
Sacramento District

Preface

*As discussed in the main body of Appendix H, consistency with the Federal Wild and Scenic Rivers Act is considered throughout design development for the Lower American River (LAR) elements of the American River Common Features (2016) Project. The purpose of this attachment (**Attachment 2**) is to share with the public and decision makers the current Draft USACE Consistency Analysis for LAR Contract 4A. LAR Contract 4A reached 95% level of design but a portion of the contract is undergoing redesign at a 65% design level. This Draft Consistency Analysis evaluates LAR Contract 4A using the best available design information. Once designs have reached 95%, USACE will update this draft Consistency Analysis to provide more project specific details and will transmit it to the National Park Service together with a request that they conduct their consistency review*.

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Acronyms and Abbreviations

Acronym or Abbreviation	Description
AEP	Annual Exceedance Probability
ARCF	American River Common Features 2016
ARMS	American River Mitigation Site
cfs	Cubic feet per second
FEIR	Final Environmental Impact Report (CEQA)
FEIS	Final Environmental Impact Statement (NEPA)
GRR	General Reevaluation Report
IWM	Instream Woody Material
HMA	Hot Mix Asphalt Concrete
LAR	Lower American River
NMFS	National Marine Fisheries Service
No.	Number
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
Parkway	American River Parkway
Proposed Action	American River Erosion Contract 4A
SH	State Highway
Stat.	Statute
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VELB	Valley elderberry longhorn beetle
WRDA	Water Resources Development Act
WSR	Wild and Scenic River
WSRA	Wild and Scenic River Act
XS	Cross section

1. Introduction

The American River Common Features 2016 Project (ARCF Project) is a Congressionally authorized flood risk management project that is being implemented by the project cost-sharing partners the U.S. Army Corps of Engineers (USACE), the Central Valley Flood Protection Board (CVFPB), and the Sacramento Area Flood Control Association (SAFCA). The California Department of Water Resources (DWR) also participates and provides technical staff to support the CVFPB. The full scope of the ARCF Project is described in the 2016 American River Watershed Common Features General Reevaluation Report (GRR) and joint Final Environmental Impact Statement and Environmental Impact Report (FEIS/FEIR), and as revised and supplemented. This consistency analysis addresses Lower American River (LAR) Contract 4A.

1.1. Authority

As part of the larger ARCF Project, LAR Contract 4A (Proposed Action) is authorized by Section 101(a)(1)(A) of the Water Resources Development Act (WRDA) of 1996, Public Law Number (No.) 104303 Section 101(a)(1), 110 Statute (Stat.) 3658, 3662–3663 (1996), as amended by Section 366 of the WRDA of 1999, Public Law No. 106-53, Section 366, 113 Stat. 269, 319-320 (1999). Following the interim general reevaluation study, additional authority was provided in Section 1322(b) of the WRDA of 2016, Public Law No. 114-322, Section 1322, 130 Stat. 1707, also known as the Water Resources Infrastructure Improvements for the Nation Act, and Public Law 115-123 (Bipartisan Budget Act of 2018).

1.2. Need for Consistency Determination

The Lower American River (LAR) has been designated by the Secretary of the Interior as a Wild and Scenic River (WSR) under the Wild and Scenic Rivers Act (WSRA) Section 2(a)(ii). The ARCF Project constitutes an “Other Proposed Federally-Assisted Water Resources Project (Agency Other than the Federal Energy Regulatory Commission)” within the WSR-designated portion of the LAR (Interagency Wild and Scenic Rivers Council 2004). Section 7(a) of the WSRA requires Federal agencies to determine whether water resources projects planned in rivers under the jurisdiction of the act are consistent with WSRA requirements to protect river resources. The responsibility for the Section 7 determination is a Federal responsibility not delegated to the state. Therefore Section 7 determinations are the responsibility of one of the four river administering agencies, Bureau of Land Management, U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service, or the National Park Service (NPS). As the LAR does not run through Federal lands under the jurisdiction of another Federal river-administering agency, the responsibility for the Section 7 determination rests with NPS. Accordingly, the Sacramento District, USACE prepared this analysis for the NPS as agency submitted documentation to support a consistency determination.

1.3. Purpose of this report

The ARCF project was described in the American River Common Features (ARCF) Project 2016 Wild and Scenic Rivers Programmatic Consistency Analysis, dated June 22, 2021, and updated July 19, 2021 (NPS identifier 1.A.2 (PW-NR)). This project-specific consistency analysis focuses on the potential effects of LAR Contract 4A, which is part of the ARCF project and is located on the LAR. This report considers whether the Proposed Action would directly and adversely affect the river values that were present in the LAR in 1981, the year when the LAR was designated as a component of the National Wild and Scenic Rivers System. The actions under LAR Contract 4A are consistent with the purpose and need of the overall ARCF project. They are conducted within the overall location of the ARCF project as described in the programmatic consistency analysis. This report was prepared using the format provided in Appendix A of the programmatic consistency analysis (USACE, 2021).

2. Project Description

2.1. Location

LAR Contract 4A is just upstream of the State Highway (SH) 160 Bridge on the north side of the American River. **Figure 2** shows the location of LAR Contract 4A and **Figure 3** shows the project footprint.

2.1.1. Site Condition in 1981

LAR was listed as a Wild and Scenic River in 1981. Aerials of the project area taken on April 1, 1976, August 10, 1981, and June 29, 1987, collected from the University of California Santa Barbara's Library's FrameFinder Website (UCSB 2024) were used to determine the visible conditions when LAR was listed as a Wild and Scenic River. Refer to Attachment A to see a side-by-side comparison of the proposed erosion protection features with the aerials from these dates. There was far less vegetation in 1981 (Attachment A). There was vegetation where the berm is being proposed. The wetland within the Project Footprint was present as well.

There was some revetment already installed along the LAR when LAR was established as a Wild and Scenic River in 1981 (**Figure 1**). At the LAR Contract 4A site, there was no revetment.

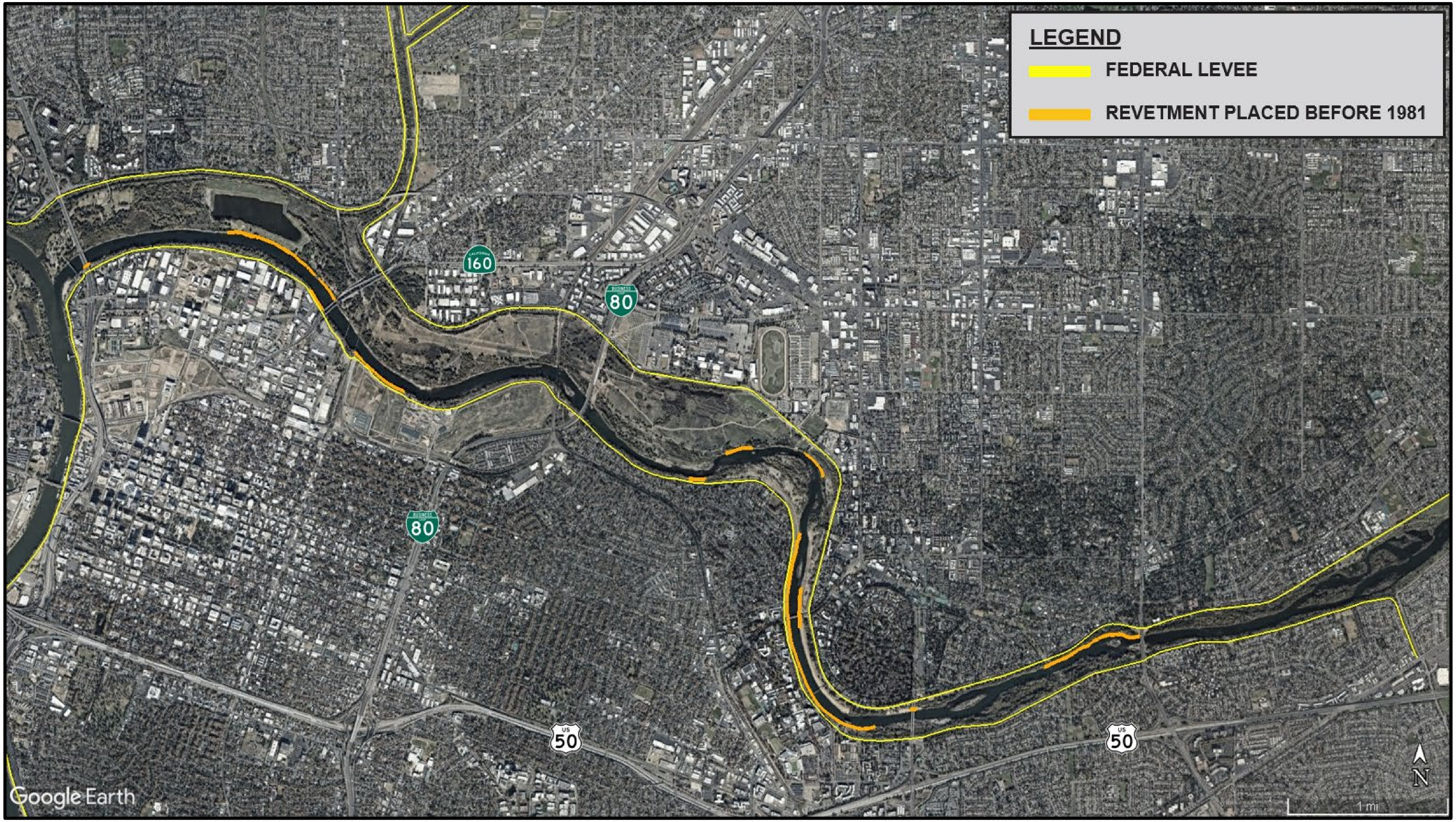

Figure 1. Location of Revetment that was Present Along the LAR in 1981 when it was Designated as a Wild and Scenic River

2.2. Schedule and Duration

LAR Contract 4A construction will proceed in phases beginning in fall 2026 with tree clearing and elderberry transplants, ending with construction and reseeding finishing in fall 2027.

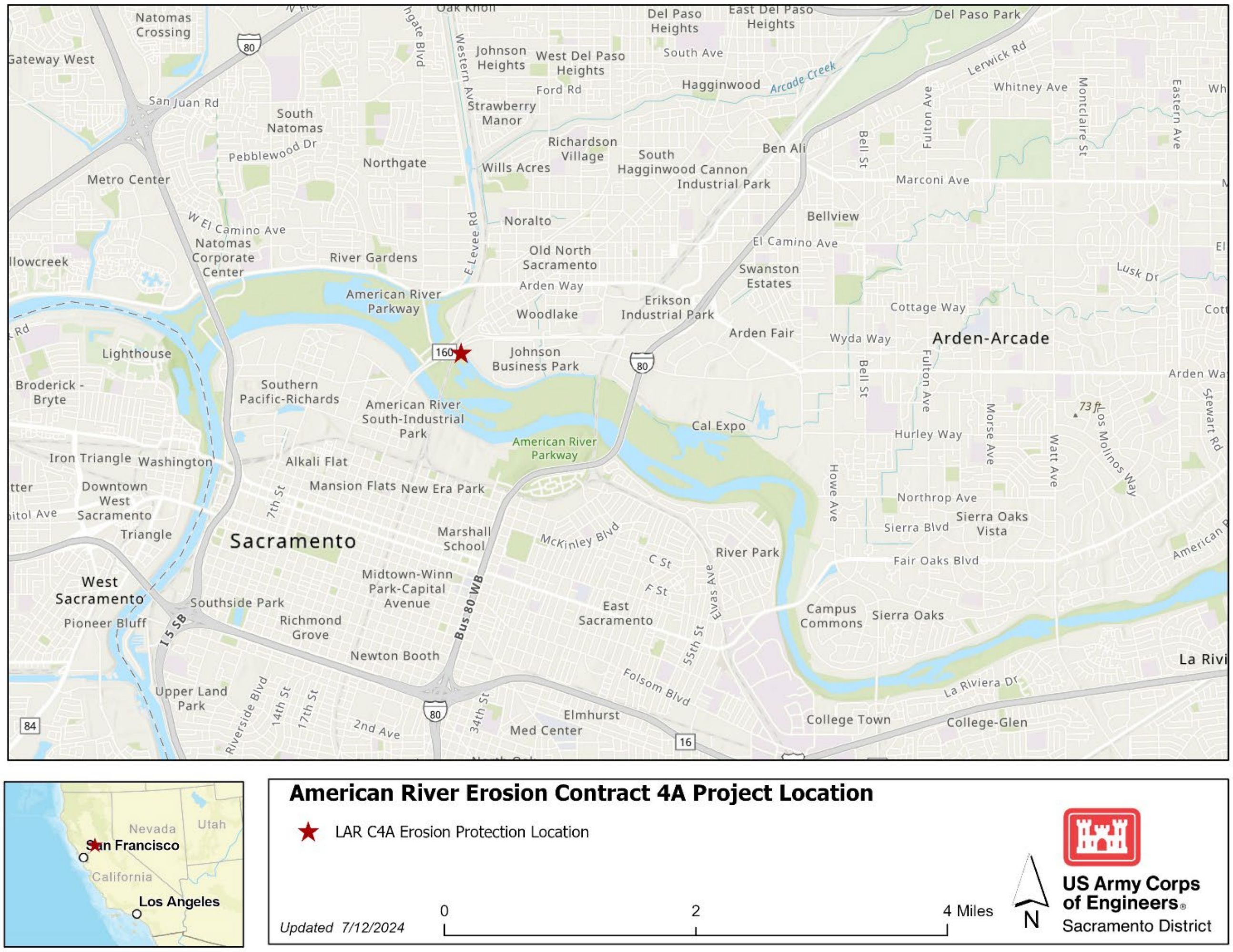

Figure 2. Overall American River Contract 4A Project Location

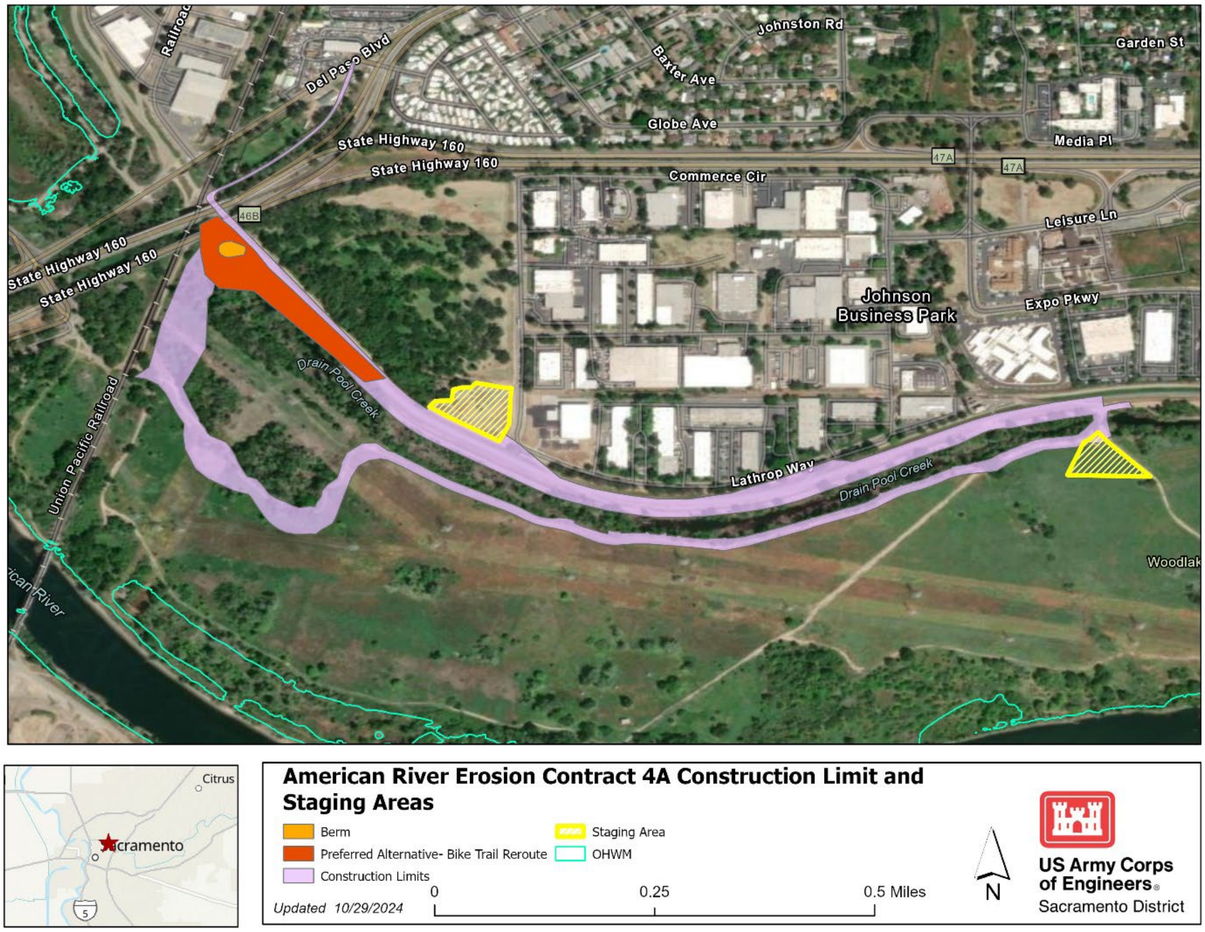

Figure 3. Preliminary LAR Contract 4A Construction Limits and Staging Areas

2.3. General project features

At the LAR Contract 4A site there are three bridge embankments that are partially blocking flood flows in the floodplain, forcing the flow through a narrower area and accelerating the velocity near the levee. Additionally, the presence of the SH 160 bridge bent columns (aka, piers) and Union Pacific Railroad (UPRR) bridge bent posts (aka, piers) near the levee toe creates additional turbulence near the levee, further increasing erosive forces. To reduce the risk of erosion at the project site, a waterside berm will be placed closed to the SH 160 bridges. The berm would divert velocities and flows away from the levee.

This berm will block the existing Jedediah Smith Memorial Trail, which is a heavily used bike path for recreation and commuter use. Therefore, this bike path will need to be permanently relocated as part of the project. Because the top of the levee drops off and becomes flood gates for road and railroad crossings in this area, the bike path also functions as a patrol road for American River Flood Control District to monitor the levee. Consideration for relocation for both recreational use and flood management use was considered when designing the project. Additionally, a 12-inch utility waterline will be relocated.

The location and erosion protection method of LAR Contract 4A were not analyzed in the ARCF GRR Final EIS/FEIR. Only use of riprap in bank protection or launchable trench were considered in the ARCF GRR Final EIS/FEIR. Additionally, the ARCF GRR Final EIS/FEIR did not consider alternatives where the erosion protection features would permanently block the Jedediah Smith Memorial Trail.

2.3.1. Erosion Protection Features

The berm includes a waterside embankment that is adjacent to and joined with the existing levee. **Figure 4** and **Figure 5** shows sketches of the proposed berm. The berm and surrounding scour apron will be constructed of soil-filled quarry stone. The soil-filled quarry stone and scour apron will have 1-foot of topsoil placed on top to support establishment of native grasses for erosion protection and provide a more natural appearance. Since the berm will be constructed where the existing bike path is routed, the bike path will be re-routed south and around the berm.

Figure 4. **Overhead Drawing of Velocity Diverting Berm**

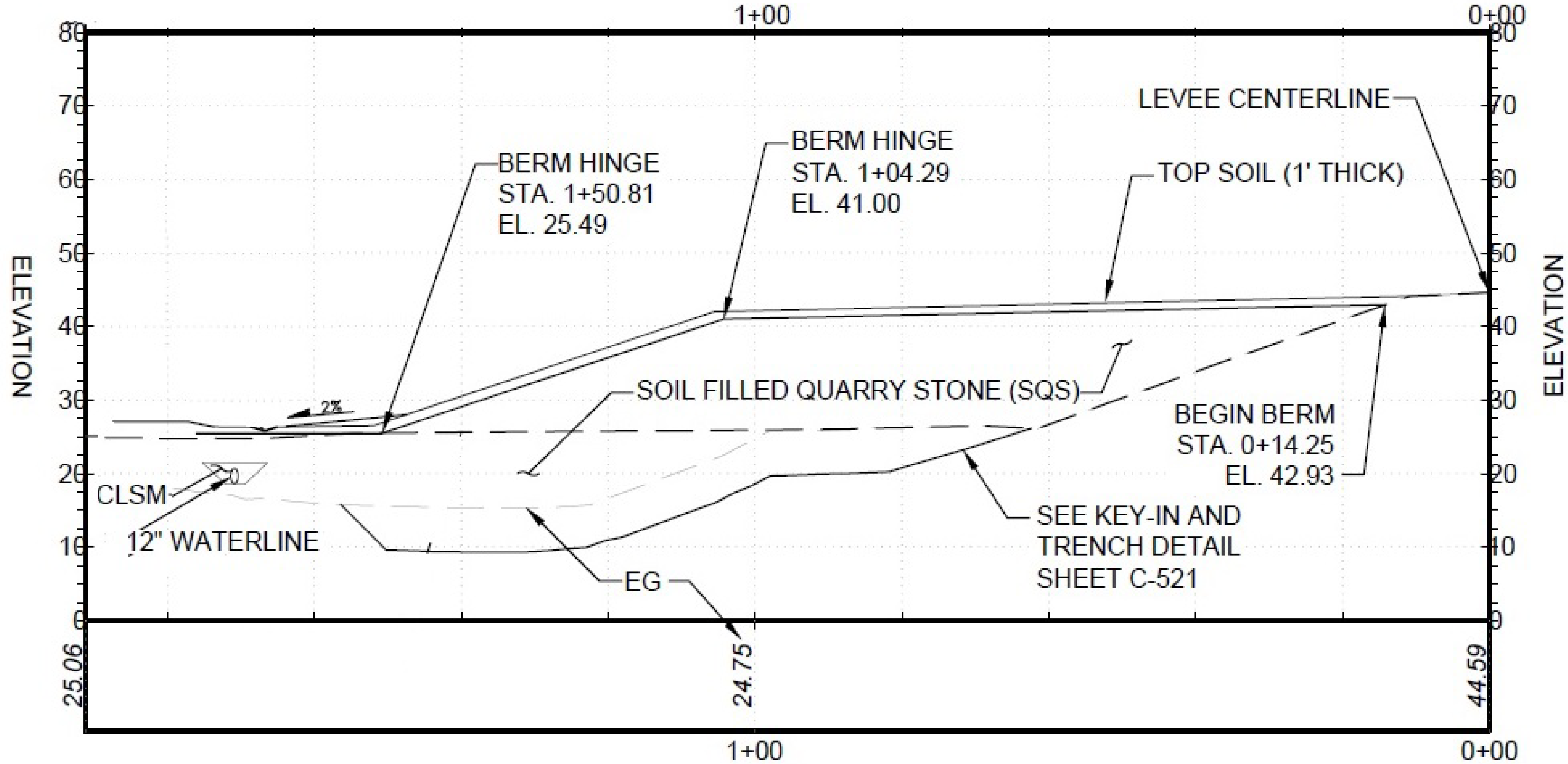

Figure 5. Cross Section of Velocity Diverting Berm

2.3.2. Preliminary Bike Trail (and Patrol Road) Reroute

At this location the top of the levee drops off for the railroad tracks and Del Paso Blvd, so the Jedediah Smith Memorial Trail at this location is also utilized as a patrol road by American River Flood Control District to inspect and maintain the levee. The design team needed to consider detour and rerouting both the recreational trail and the patrol road in this location.

Because the velocity diverting berm will be blocking the Jedediah Smith Memorial Trail, part of the project includes rerouting the Jedediah Smith Memorial Trail. Unfortunately, there is a wetland that follows the Jedediah Smith Memorial Trail in this area for almost a mile, that cannot be fully avoided. The velocity berm cannot be moved without requiring increased footprints, increased habitat impacts and decreased functionality. A bike trail reroute was considered along an existing road south of the wetland along an existing dirt road, but design constraints have prevented this option. Instead, the bike trail will be rerouted directly around the berm. Designs for the bike trail reroute are in early phases, so details are preliminary. Additional fill will be required within the wetland to construct this bike trail reroute. Fill will be reseeded and planted with native grasses. Impacts to wetlands will be mitigated at the American River Mitigation Site (ARMS), which is sometimes referred to as the Urrutia mitigation site, and/or by purchasing credits from an approved mitigation bank. The land that is now the ARMS wasa an old sand and gravel mine before being abandoned. The area will be restored for use as compensatory habitat mitigaon by reshaping the topography, reconnecting the floodplain to the American River, and establishing freshwater emergent/seasonal wetland habiat, riparian woodland, and riverine habitat.

Design of the bike path will use a recent previous design by Sacramento County Regional Parks Department (Regional Parks) and is defined by two 6-foot-wide lanes with 3-foot shoulders. The structural cross section of the bike path is anticipated to be comprised of a 21-inch total depth section (3-inches of Hot Mix Asphalt Concrete (HMA) over 6-inches of Aggregate Base Course founded on 12-inches of compacted subgrade). Shoulders are anticipated to consist of compacted decomposed granite surfacing flush with the HMA. Striping and pavement markings are anticipated to be designed to be consistent with the Caltrans Highway Design Manual.

2.4. Other design features

There is a 12-inch utility waterline that runs approximately along the toe of the levee on the waterside within the project footprint, upstream of the UPRR bridge trestle. The 12-inch waterline also runs approximately perpendicular from the UPRR bridge trestle towards the toe of the levee. Approximately 200 feet of this waterline will be relocated from underneath the berm.

2.5. On-site restoration features

Unlike all of the other LAR Projects associated with the ARCF project, LAR Contract 4A is not anticipated to include on-site habitat mitigation. Generally, the areas impacted by the project will be a part of the Vegetation Free Zone of the Levee or the rerouted Jedediah Smith Memorial Trail. There will likely be very limited areas to plant on-site mitigation. If no on-site mitigation can be included, all mitigation plantings associated with LAR Contract 4A would be planted off-site. The LAR Contract 4A project site will be reseeded with native grasses. Additionally, the berm will be topped with topsoil so the areas can be reseeded with native grasses as well. The seeding mix is anticipated to include the following: California brome (*Bromus carinatus*), California Barley (*Hordeum brachyantherum ssp. californicum*), Blue wildrye (*Elymus glaucus*), Creeping Wild Rye (*Leymus triticoides*), Nodding Needlegrass (*Nassella cernua*), Purple needlegrass (*Nasella pulchra*), Six weeks Fescue (*Festuca microstachys*), and Pine Bluegrass (*Poa secunda*).

2.6. Offsite Mitigation

2.6.1. Rossmoor West Mitigation Site

Offsite mitigation for Contract 4A will be accomplished through elderberry transplants and additional offsite compensatory mitigation. The elderberry shrubs removed from the project limits, will be transplanted the Rossmoor West mitigation site during the appropriate transplant window. Transplanting will occur at the same time and under the same contract as the vegetation removal so that the elderberries are not damaged due to the vegetation removal. In addition to transplanting elderberry shrubs, compensatory mitigation for the loss of habitat for the valley elderberry longhorn beetle (VELB) is required at a 3:1 ratio at the offsite mitigation site(s).

The Rossmoor West mitigation site is within the American River Parkway (Parkway). Additional elderberry shrubs and associated riparian species will be planted to restore habitat within the Parkway beyond what can be achieved with the on-site planting benches alone, in accordance with USFWS and NMFS BiologicalOpinions for the project.

2.6.2. Future Mitigation Sites

Impacts to riparian habitat and wetlands will be achieved via habitat restoration at the American River Mitigation Site ARMS, , and/or through purchase of credits from an approved mitigation/conservation bank. ARMS is within the Parkway and is anticipated to be constructed in four years; 2026, 2027, 2028, and 2029.

2.7. Staging Areas and Haul Routes

Anticipated LAR Contract 4A staging areas are shown in **Figure 3**. Specifically, a parcel already used for staging by the American River Flood Control District along Lathrop Way and a grassy area in the American River Parkway could be used for staging.

Staging areas would be used for material stockpiles, construction office and trailers, construction worker vehicle parking, and equipment staging. Haul traffic may also pass through staging areas.

Materials will be hauled on-site by truck. Access to the LAR Contract 4A site will be along existing public roadways and levee patrol roads (**Figure 6**). The project site is over 1,700 feet from the American River, which is too far to allow use of barges for materials hauling.

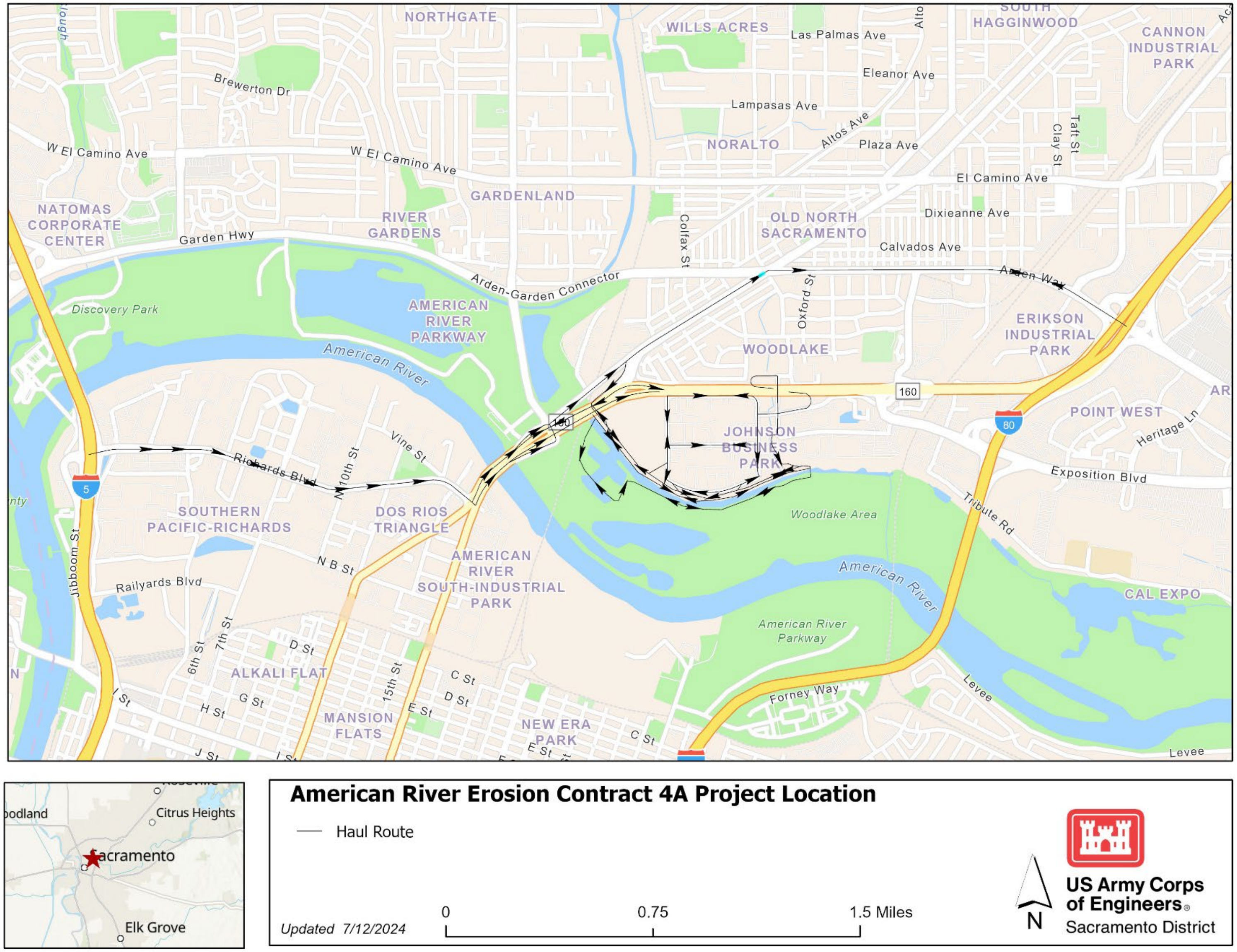

Figure 6. Proposed Haul Route for LAR Contract 4A

3. Effects on Wild and Scenic Values

Table 1 provides a summary of LAR Contract 4A temporal impacts.

3.1. Effects on Free-Flowing Nature of the River

Levees are present on both sides of the American River throughout the LAR Contract 4A reach. When the river was designated, it generally only included the lands within the levees rather than the whole floodplain because development had already occurred immediately behind the levees.

The LAR Contract 4A levees are on the right side of the American River as water flows downstream. Improvements, the proposed berm, are planned just upstream of the SH 160 bridge approximately. The berm itself is almost 1,700 feet from the typical summer surface water of the American River.

The proposed berm is approximately 800 feet away from the ordinary high-water mark (OHWM). Under normal conditions the project site does not contain flows from the American River. Only under high flood conditions would the flow of the American River be obstructed by the proposed project. The berm would not be inundated with water most of the time. Water begins to touch the berm for flood events more frequent than ½ annual exceedance probability (AEP) (commonly known as a 2-year event) because of backwater from the intersection of the Sacramento River, the American River, and Steelhead creek. The wetland area is connected to the American River main channel through an unnamed drainage channel adjacent to the Union Pacific Railroad bridge. For flood events more frequent than the 1/10 AEP (commonly known as a 10-year event) the flow velocity is very slow near the berm. For flood events less frequent than the 1/10 AEP (i.e., larger peak discharge flood events), flood water begins to spill over from the main channel and velocity and flow depth increase on the floodplain and the berm. As mentioned in Section 2.2, the purpose of the project is to divert high velocity flows from reaching the levee at the project site. However, this does not impact the free-flowing nature of the river, as this would only occur at high flood events.

3.2. Effects on Water Quality

The project site is almost 800 feet away from the OHWM, but there is a wetland adjacent to the project site that connects to the American River during high flood events. Water quality impacts for this project will be short-term due the temporary nature of construction. In-water work and/or construction site runoff could increase turbidity in the wetland; however, increases would be limited by following the provisions of the Stormwater Pollution Prevention Plan for the project which is required by the National Pollution Discharge Elimination System (NPDES). Consistent with the Clean Water Act, Section 401 water quality certification (WDID No. 5A34CR00819) for the project, runoff reduction measures will be used where required to minimize impacts to the water quality in the wetland adjacent to the project site. If the wetland is wet during work, the wetland will be monitored to ensure that turbidity increases are limited to the work area. Additionally, if the wetland is wet during construction, the portion of the wetland that resides in the project footprint would be dewatered. Clean Water Act Section 402 would be complied with if the wetland needs to be dewatered. Overall, the wetland only connects with the American River during high flood events and construction is scheduled to be outside of the flood season (April to November), so it is not anticipated that any runoff from construction would directly enter the American River.

In the long term, the area will be reseeded to ensure that excess sediment will not be released into the wetland. No impacts are anticipated to water oxygen levels or nutrient loads, and no permanent impacts are anticipated since the proposed project does not contain any elements which could lead to permanent increases. As a result, this project is anticipated to have a neutral impact to water quality in the long run.

3.3. Effects on the Anadromous Fishery

The project site is overt 800 feet away from the OHWM. Only at high flood events would fish reach the project area. Most of the year, river water remains in the river channel and does not enter the Parkway. In some years (see Section 3.1) during the flood season (November 1st to April 15th in the Sacramento Valley) river water does enter and may cover large parts of the Parkway for a period of time. Stormwater also enters from local runoff drainage systems. The proposed berm would be located in the Parkway and flowing water would be adjacent to or on the berm intermittently as described in Section 3.1. Fish stranding is unlikely as the berm is built on the floodplain (above elevation 26 NAFD88-feet) and outside the low-lying wetland area. In addition, the area around the berm is graded to drain with no low spots. Because the project is not within the OHWM, and any floodwaters entering the project area would drain out and not cause fish stranding, impacts to anadromous fish are not anticipated.

3.4. Effects on Recreation

The bike trail reroute will be designed utilizing a previously approved design by Regional Parks. Additional road striping, and pavement markings will be consistent with the Caltrans Highway Design Manual.

Early designs of the bike trail reroute are being completed to allow for construction to be phased so that the impacts to recreation could be minimized as much as feasible. Early designs indicate that there would not be a need for a full closure of the Jedediah Smith Memorial Trail during construction, though there may need to be one lane closure during construction. Flaggers would ensure bicyclists can safely pass the area during lane closures. If it is determined later that detours are needed, coordination will occur with Regional Parks to ensure an appropriate detour is selected.

Part of the access route for haul trucks is currently used for hiking and equestrian use. During construction the area would be closed to hikers and horses. The maintenance road along the top of levee, which is used for recreation, is expected to be used for construction access and will require closure during construction. The Jedediah Smith Memorial Trail reroute around the berm would be open at this point in time so those walking on the top of the levee will be detoured with Jedediah Smith Memorial Trail along the reroute.

During construction, haul trucks will cross the existing Jedediah Smith Memorial Trail. During construction of the erosion protection features, construction vehicles may also need to cross in this area to reach the construction laydown area. Flaggers will be used to ensure safety of recreationalists. There may also be a need for construction equipment to cross or drive on the bike path to reach the area of the berm for construction work at some phases of the project. This is not anticipated to occur regularly and safety precautions like flaggers will be put in place to minimize safety risks to recreationalists.

At the conclusion of this project, minimal exposed riprap will be visible on the site. The riprap armoring the velocity diverting berm will be soil capped and replanted with native grasses. Though the berm area was riparian vegetation in 1981, the vegetation free zone of the levee adjacent to the berm was grassy. Additionally, the reroute will only slightly take bicyclists off the existing route, so there will be a similar view and experience for bicyclist with the bike trail reroute.

Generally, because the Jedediah Smith Memorial Trail would remain open during construction (or if detours are determined to be needed, they will be coordinated with Regional Parks) and the bike trail reroute will be a similar experience to the existing experience, there would not be significant impacts to recreation.

3.1 Aesthetics

Generally, the area where LAR Contract 4A is being constructed is already developed. The velocity diverting berm is being build adjacent to the existing levee and is less than 75 feet from the SH 160 bridge (See **Figure 4**).The existing levee is already grassy and sloped, the new berm and slopes from the bike trail reroute would have a similar grassy and sloped appearance to the existing levee once grasses establish. The bridges and grassy areas on the existing levee were both present in 1981 when the river was listed as Wild and Scenic (Attachment A).

The overall aesthetic view of those on the trail would only change for approximately 550 feet of the Jedediah Smith Memorial Trail. Since vegetation would need to be removed for installation of the berm and bike trail reroute there would be less vegetation in this area. However, only approximately 550 feet of change would not impact the overall experience of those using the trail. The area would not be replanted with woody vegetation and there would be little acreage outside the trail and berm that have availability to be replanted successfully. The berm would be replanted with native grasses. The general aesthetics of the overall area will not be diminished as there is already development in the area.

3.5. Avoidance and Minimization Measures

Consistent with the guidelines set forth in the programmatic consistency analysis (USACE, 2021), **Table 2** summarizes how Contract 4A will adhere to the Best Practices for designated Wild and Scenic Rivers (NPS, 2020). During discussions held during the formulation of the programmatic consistency analysis, USACE and NPS jointly devised Universal Avoidance and Minimization measures which would be adopted in the remainder of projects on the LAR under the ARCF project. A summary of how the project adheres to the measures is given in **Table 3**.

Table 1. Summary of Temporal Impacts

Contract/Site	Dates	Actions	WSR Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
LAR Contract 4A Phase 1 Vegetation Removal	Fall 2026 - Winter 2027	Vegetation removal and elderberry transplant	**Aesthetics** impacts from tree removal and bare ground. **Water Quality** from increased turbidity in wetland **Recreation** from horse and hiking trail closures/detours.	**Aesthetics:** Use of Best Management Practices (BMP's) to reduce runoff. **Water Quality:** Use of Best Management Practices (BMP's) to reduce runoff. **Recreation:** Hikers will be able to detour onto the Jedediah Smith Memorial Trail. Signs will be placed warning recreationalist of closure. Small amount of tree removal and elderberry should occur over a short timeframe.
Jedediah Smith Memorial Trail Detour Construction and Berm Construction Phase 2 Site Construction	Mid-April – October 2027	Regrading area, laying materials, paving trail, installing signage/striping, reseed trail slopes, dewatering wetland if wet, regrading site, building berm, relocate waterline, reseed berm	**Aesthetics** from tree removal and bare slopes. **Water Quality** effects from increased turbidity and possible dewatering of wetland. **Recreation** effects due to bike, horse, and walking trail closures/detour. **Recreation** due to loss pedestrian use of the top of levee.	**Aesthetics:** Use of Best Management Practices (BMP's) to reseed with native grasses in compliance with NPDES permit. **Water Quality:** Use of Best Management Practices (BMP's) to reduce runoff in compliance with NPDES permit. Turbidity will be constantly monitored if wetland is wet to ensure that increases in turbidity are minor and do not extend beyond the bounds of the repair. **Recreation:** Either construction will be phased so that full closure of the bike trail is not needed or detours would be put in place after coordination with Regional Parks.
LAR Contract 4A Maintenance (1-year)	Fall/Winter 2027/ – Fall/Winter 2028	Prior to closing out the contract and SWPPP, the contractor must have 75% coverage of native grasses in the seeded area	**Aesthetics** - people working on the slopes	None planned.
LAR Contract 4A Long Term Operations & Maintenance	For the life of the site	Mowing, weeding, and other activities as provided in the Parkway Plan	None	N/A

Table 2. Summary of Adherence to NPS Best Practices.

NPS Best Management Practice	Proposed Action
Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock.	The minimum amount of RCP required to meet risk management objectives is proposed. Most RCP would be covered with soil and plantings
If necessary, stone fill (riprap) may only be used for abutment scour protection; the use of stone fill to stabilize the riverbanks is prohibited. To stabilize the riverbanks, use approved native boulders, cobble and gravel; loam; vegetation; and bio- engineering techniques such that the banks, when fully restored, have an appearance and function similar to the natural riverbank.	Stone riprap would armor the velocity diverting berm. Riprap would be topped with soil and reseeded.
Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed.	Generally, most riparian areas impacted will be replaced with the berm or bike trail, there is little room for onsite mitigation, so no woody vegetation would be replanted onsite. All disturbed surfaces would be reseeded with native grasses.
Disturbed/exposed banks, staging and project access areas must be properly stabilized (seeded, mulched, or otherwise) with native vegetation to prevent erosion and establishment of invasive plant species. A non-persistent cover crop of annual rye or equivalent temporary seeding may be used to ensure a more rapid establishment of cover while native perennial plantings grow.	Immediately following construction, the site will be hydroseeded with an appropriate native seed mix (see section 2.3 for details).
Bio-engineering methods must be used or, where deemed necessary by the [insert river managing agency/ contact], clean broken rock riprap of an adequate size specific for bank stabilization.	No bioengineered methods are available which would meet the flood risk management objectives. Clean, broken riprap from an approved quarry would be used.
The use of demolition debris for slope armoring is not allowed.	No demolition debris would be used for slope protection.
Avoid unnecessary tree removal within the project work area.	Tree removal has been minimized to the extent feasible. The design team has looked at each individual tree within the project footprint to determine if it can be saved as designs progress to 100% designs.
A vegetation plan shall be in place to protect existing vegetation/trees from damage by construction equipment (*e.g.,* provide temporary barriers to protect existing trees, plants, root zone).	Contract Specifications require contractor to protect trees: “Protect existing trees that are to remain to ensure they are not injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. Coordinate with the Contracting Officer to determine appropriate action for trees and other landscape features scarred or damaged by equipment operations” Additionally Specifications require a certified arborist present for any tree trimming.

NPS Best Management Practice	Proposed Action
Disturbances of the riparian zone must be limited to the indicated access points; prior to the operation of heavy equipment (dozers, cranes, trucks), orange construction fencing must be erected to delineate the dripline of remaining trees to avoid compaction of tree roots.	The Project has been designed to minimize the need to remove trees to the maximum extent feasible. This included adjusting the project boundary to minimize trees cut down. Fences will be used to delineate the site boundaries. No work will occur outside the construction footprint or designated staging areas.
The fastening of ropes, cables, or fencing to trees is prohibited.	Contract Specifications prohibit ropes, cables, or fencing from being fastened to vegetation marked for retention.
To ensure bank stability, trees removed within fifteen feet of the top of the riverbank shall be cut flush to the ground; stumps and roots shall be left in place; indiscriminate bulldozing of riparian trees is prohibited.	Tree removal would occur in two phases. In phase 1, trees over 6" DBH would be cut 4 feet above the grade the fall/winter prior to start of construction. In phase 2, remaining vegetation and rootmass would be removed, at no point would indiscriminate bulldozing occur.
All trees removed from the riparian corridor shall be replaced with a native tree of like species. Replace each mature tree removed (12-inch or greater diameter at breast height [DBH]) with [insert specifications, e.g., replant 3:1 ratio depending on expected survival rate and with trees that are a minimum 3- inches DBH]. Plant only local, native trees/shrubs/grasses, naturally occurring within the [insert river name] riparian zone [insert plant species list and/or to be determined in coordination with appropriate staff].	Trees and vegetation will be removed from within the project footprint to allow for erosion protection measures and bike trail reroute. Trees and vegetation on the periphery of the project will be protected from construction activities. Riparian habitat acreage will be replaced by planting riparian trees and shrubs at a ratio of 2:1 (replacement habitat: affected habitat), except riparian habitat within 82 feet of elderberry shrubs, will be replaced at a ratio of 3:1. Due to the berm being in the vegetation free zone, there is little area for onsite mitigation, and it is anticipated that it will not feasible to do onsite mitigation for LAR Contract 4A. All mitigation would be planted offsite but will be at least replaced 1:1 within the Parkway in mitigation areas that will be conserved in perpetuity. Only native plant species appropriate for the sites and approved by the County of Sacramento for planting in the Parkway, will be used.
A qualified individual (arborists, foresters, or trained staff with similar experience) shall plant replacement trees at the appropriate time of year and in a random fashion to avoid a plantation effect. Cultivate and monitor planted tree seedlings/saplings for two years to ensure success; water plantings as necessary. Promptly replace planted stock showing signs of mortality.	Replacement trees will be planted at designated riparian habitat restoration areas according to designs prepared under the supervision of a California licensed USACE landscape architect with experience in developing habitat restoration. The mitigation sites will be managed and monitored according to the ARCF GRR Habitat Mitigation Monitoring and Adaptive Management Plan, which includes success criteria.
Stakes and guide wires shall be properly removed and disposed of once seedlings are established.	Contract Specifications State "Conduct a Final Cleaning of all waste, surplus materials, and rubbish removed. Remove all temporary structures, barricades, project signs, and construction facilities from the project area."

Table 3. Summary of Adherence to Universal Avoidance and Minimization Measures.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Levee Setbacks	Set back the levees wherever possible to allow the river to move.	Free-Flow	Levee setbacks are not feasible in this area due to the existence of homes and businesses, and major roadways crossing the river.
Bioengineering and native plantings throughout the banks and levees	Avoid riprap to the extent possible. Use bioengineering techniques including use of wood (e.g., log crib walls, tree revetments, root revetments; engineered log jams) and deformable techniques (e.g., fabric-encapsulated soil lifts (i.e., geolifts), rock bags, coir rolls (i.e., bio logs), erosion control blankets/fabrics).	Free-Flow, Anadromous Fish	Both use of vegetation to increase roughness in the project area to reduce flows, and planting vegetation within the area of erosion concern (which required rock placement around bridge piers and abutments in addition to the vegetation) were both considered at 10% designs for LAR Contract 4A. However, running the HEC-RAS model in the area with increased vegetation in the area showed no substantial reduction of velocities near the levee. Also, use of vegetation in the area of concern was eliminated as an option since the vegetation would be required to be planted under bridges and it would have been difficult to establish vegetation with the shade from the bridges.
Riprap at the bank toe	Riprap would only be placed at the bank toe of segments where the levee prism and associated planting berms (if included) are at the extent of the Parkway limits.	Free flow	The project, and levee at the project site, is far away from the riverbank toe (erosion protection features for the levee would be approximately 1,700 feet from the water's edge). No riprap would be place at the riverbank toe.
Riprap at the bank toe	Ensure no hydraulic impacts from riprap.	Water quality	Site designs are consistent with this measure.
Riprap at the bank toe	Ensure no direct and adverse impacts to anadromous fish.	Anadromous Fish	All direct and adverse effects to anadromous fish have been considered in the programmatic biological opinion for the project, including the risk of anadromous fish stranding. Jointly with the NMFS, USACE has devised avoidance and minimization measures to reduce these impacts to the extent practicable.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Riprap at the bank toe	Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. If rock is needed utilize cobble to the extent possible. Cover exposed riprap at the bank with soil and vegetation where cobble is not possible.	In-water recreation Aesthetics	RCP will not be placed at the riverbank toe. Riprap will be located along the berm (at the levee). Riprap will be covered with soil and reseeded with native grasses.
Avoid and Minimize use of riprap on the bank above the toe to the OHWM and near the water	Minimize the use and visibility of RCP. RCP should be avoided or minimized to the extent possible. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. Cover any necessary riprap on the bank above the OHWM with planting benches containing sufficient soil and capable of supporting riparian habitat.	Anadromous Fish Recreation Aesthetics	No work will be done below the OHWM or near the American River.
Minimize use of Riprap on the levee slope	Cover revetment on the slope with sufficient soil and native grasses or forbs, as woody vegetation may not be possible due to USACE vegetation on levees policies.	Anadromous Fish Aesthetics	Slopes within the vegetation free zone will be hydroseeded with soil and appropriate native grasses and forbs. Site designs are consistent with this measure.
Removal of vegetation	Minimize vegetation removal to the maximum extent practicable. Provide planting benches to reduce the affects for lost habitat on-site. Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed. Provide restoration in the parkway when revegetation cannot be completely restored in the project footprint. Re-vegetate all areas of the repair site above the waterline with native, ecotone appropriate, species. Design sites such that they are indistinguishable from the overall fabric of the Parkway.	Anadromous Fish Aesthetics Water quality	Only trees within the construction footprint, or designated haul routes will be removed. Haul routes have been placed to avoid trees and elderberry shrubs to the extent feasible. Access ramps have been oriented to minimize the impacted area to the extent practicable. Established roads will be used as haul routes wherever possible. Habitat mitigation that cannot be completed on site will be accomplished at other locations in the Parkway in at least a 1:1 ratio. Most areas being disturbed by the project are either in the vegetation free zone or being replaced by the bike trail reroute. All exposed areas will be reseeded with native grasses once work is completed.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of bike trail	The first priority is to detour the bike trail on the nearest dedicated trail. That is, the trail should not be shared with automobiles. If the bike trail segment being detoured is paved, the detour route should also be completely paved to include all transitions from permanent to temporary trails/detours. In an event due to where the trail cannot be routed near construction boundaries for safety concerns it should be detoured to surface streets with bicycle safety measures for a minimal amount time. Detours to surface streets should be considered the last option and review by all stakeholders. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Minimize the extent of the closure. When feasible use flaggers instead of detours. Minimize the length of time the detours are needed. Detours will carry the same safety standards as a permanent trail and if detours go down to one bicycle lane, caution should be considered and the included use of flaggers with dismount zones in single lane areas. Any permanent re-routing of the bike trail should also include rerouting the equestrian trail. Re-routed trails should provide the same experience as the existing trail including the aesthetics. The new trail should be shaded with riparian vegetation.	Recreation	Construction will be phased so that the permanent bike trail reroute will be constructed first so that the bike trail does not need to be closed, though one lane closures will likely be needed during construction. Flaggers will be required in Contract Specifications if there are one lane closures. Preliminary designs indicate that detours will not be required. If design refinements require detours, all detours will be coordinated with Regional Parks to ensure that safety standards are met. Flaggers will be required where construction equipment crosses the bike trail. The permanent bike trail reroute will not effect the nearby equestrian trails. The bike trail reroute is adjacent to the existing bike trail and will provide a similar experience, though vegetation will be removed in this area, so 500 feet will be less vegetated than the current condition. This area will be within the vegetation free zone, so vegetation cannot be planted in the area
Closure of levee maintenance road	Detour the route, if normally used as a hiking, horse, or mountain bike trail. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Plant vegetation to provide shading along this road once users return to the extent possible.	Recreation	Those recreating on the maintenance road of the top of the levee at this location will be able to use the Jedediah Smith Memorial Trail Reroute as a detour during construction.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
General Impacts of Work in the Parkway	Reduce work limits to the maximum extent practicable. Close trails and other recreational features only when necessary for safety of the public. Advance notice of work shall be provided at the site of the closures and on the web.	Recreation	Every effort has been made to reduce the work area to the extent practicable. Advance notice of the work would be provided on sacleveeupgrades.com.
General Impacts of Work in the Parkway	Phase work appropriately such that sites do not remain incomplete for excessive periods of time (e.g., bank work completed but planting delayed for years, or tree clearance years ahead of the construction etc.)	Aesthetics	Work is scheduled to be conducted sequentially.
Closure of boat ramp	Avoid closure of boat ramps to the maximum extent practicable. Phase work such that not more than one boat ramp is closed. Provide information at the closure and on the web about the location and duration of the closure and the nearest open boat ramp. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	There are no boat ramps in the LAR Contract 4A project footprint.
Closure of river access points	Avoid closure of river access points to the maximum extent practicable. Phase work such that consecutive river access points are not closed for more than one consecutive mile on account of this project. Provide information at the closure(s) and on the web about the location and duration of the closure and the nearest open river access points. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	Lathrop Way River Access will be closed during construction. Expo Way River Access and the Woodlake Area Access point will be open during construction. For safety reasons, it is not anticipated that Lathrop Way River Access would be available on weekends. Advance notice of the work would be provided on sacleveeupgrades.com.
In water work	Abide by NPDES requirements to ensure there is no adverse effect to water quality.	Water Quality	Site designs are consistent with this measure.
In water work	Abide by NMFS Biological Opinion to ensure there is no adverse effect to anadromous fish from water quality.	Anadromous Fish	Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
In water work	Provide buoys or other demarcation for closed sections of the channel. The channel shall not be closed such that upstream or downstream navigation is precluded.	In-water recreation	There is no work in the American River for this Project.

4. Conclusion

USACE has determined that the LAR Contract 4A should be considered fconsistent with the mandates of the WSRA because:

a. The project is a part of the authorized ARCF project and fits within the scope of the overall project.

b. The minimization measures proposed for each design specific feature, as outlined in the Universal Minimization Measures, will be used.

c. This project will be conducted under the standing biological opinions for the ARCF project and will be subject to the terms and conditions therein.

d. This project will be conducted under the programmatic 401 certification for the ARCF project and will be bound to the terms therein.

USACE requests concurrence from NPS within 60 days of the date of this document.

5. References

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American River Common Features 2016 Project Section 7 Wild and Scenic Rivers Act DRAFT Consistency Analysis American River Erosion Contract 4B

Erosion Management Activities on the Lower American River- Sacramento County, California

December 2024

US Army Corps of Engineers®
Sacramento District

Preface

As discussed in the main body of Appendix H, consistency with the Federal Wild and Scenic Rivers Act is considered throughout design development for the Lower American River (LAR) elements of the American River Common Features (2016) Project. The purpose of this attachment (Attachment 3) is to share with the public and decision makers the current Draft USACE Consistency Analysis for LAR Contract 4B. This draft is based upon the information currently available and will be updated as designs progress. LAR Contract 4B is at an early conceptual stage, or about 10% level design concepts. Therefore, this Draft Consistency Analysis is very general and includes assumptions about the design. Once designs have reached 95%, USACE will update this draft Consistency Analysis to provide more project specific details and will transmit it to the National Park Service together with a request that they conduct their consistency review.

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Acronyms and Abbreviations

Acronym or Abbreviation	Description
ARCF	American River Common Features 2016
ARMS	American River Mitigation Site
CEQA	California Environmental Quality Act
cfs	Cubic feet per second
FEIR	Final Environmental Impact Report (CEQA)
FEIS	Final Environmental Impact Statement (NEPA)
GRR	General Reevaluation Report
IWM	Instream Woody Material
k-rail	Temporary concrete barrier
LAR	Lower American River
LDPs	Load distribution platforms
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
No.	Number
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
Parkway	American River Parkway
Proposed Action	American River Erosion Contracts 3B North and 3B South
RCP	Rock Channel Protection
Stat.	Statute
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VELB	Valley elderberry longhorn beetle
WRDA	Water Resources Development Act
WSR	Wild and Scenic River
WSRA	Wild and Scenic River Act
XS	Cross section
YBCU	Yellow-billed cuckoo

1. Introduction

The American River Common Features 2016 Project (ARCF Project) is a congressionally authorized flood risk management project that is being implemented by the project cost-sharing partners the U.S. Army Corps of Engineers (USACE), the Central Valley Flood Protection Board (CVFPB), and the Sacramento Area Flood Control Association (SAFCA). The California Department of Water Resources also participates and provides technical staff to support the CVFPB. The full scope of the ARCF Project is described in the 2016 American River Watershed Common Features General Reevaluation Report (GRR) and joint Final Environmental Impact Statement and Environmental Impact Report (FEIS/FEIR), and as revised and supplemented. This consistency analysis addresses American River Erosion Contract 4B, which comprises the Proposed Action. For consistency with other project documents, American River Erosion projects will be referred to as Lower American River (LAR) projects in this document.

1.1. **Authority**

As part of the larger ARCF Project, LAR Contract 4B (Proposed Action) is authorized by Section 101(a)(1)(A) of the Water Resources Development Act (WRDA) of 1996, Public Law Number (No.) 104303 Section 101(a)(1), 110 Statute (Stat.) 3658, 3662–3663 (1996), as amended by Section 366 of the WRDA of 1999, Public Law No. 106-53, Section 366, 113 Stat. 269, 319-320 (1999). Following the interim general reevaluation study, additional authority was provided in Section 1322(b) of the WRDA of 2016, Public Law No. 114-322, Section 1322, 130 Stat. 1707, also known as the Water Resources Infrastructure Improvements for the Nation Act, and Public Law 115-123 (Bipartisan Budget Act of 2018).

1.1.1. Need for Consistency Determination

LAR has been designated by the Secretary of the Interior as a Wild and Scenic River (WSR) under the Wild and Scenic Rivers Act (WSRA) Section 2(a)(ii). The ARCF Project constitutes an “Other Proposed Federally-Assisted Water Resources Project (Agency Other than the Federal Energy Regulatory Commission)” within the WSR-designated portion of the LAR (Interagency Wild and Scenic Rivers Council 2004). Section 7(a) of the WSRA requires Federal agencies to determine whether water resources projects planned in rivers under the jurisdiction of the act are consistent with WSRA requirements to protect river resources. The responsibility for the Section 7 determination is a Federal responsibility not delegated to the state. Therefore Section 7 determinations are the responsibility of one of the four river administering agencies, Bureau of Land Management, U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service, or the National Park Service (NPS). As the LAR does not run through Federal lands under the jurisdiction of another Federal river-administering agency, the responsibility for the Section 7 determination rests with NPS. Accordingly, the

Sacramento District, USACE prepared this analysis for the NPS as agency submitted documentation to support a consistency determination.

1.2. **Purpose of this report**

The ARCF project was described in the American River Common Features (ARCF) Project 2016 Wild and Scenic Rivers Programmatic Consistency Analysis, dated June 22, 2021, and updated July 19, 2021 (NPS identifier 1.A.2 (PW-NR)). This project-specific consistency analysis focuses on the potential effects of LAR Contract 4B, which is part of the ARCF project and is located on the LAR. This report considers whether the Proposed Action would directly and adversely affect the river values that were present in the LAR in 1981 when the LAR was designated as a component of the National Wild and Scenic Rivers System. The actions under LAR Contract 4B are consistent with the purpose and need of the overall ARCF project. They are conducted within the overall location of the ARCF project as described in the programmatic consistency analysis. This report was prepared using the format provided in Appendix A of the programmatic consistency analysis (USACE, 2021).

2. Project Description

2.1. Purpose of Contract 4B

Late in the LAR Contract 3B design process (at 65% designs) a design review by the design Risk Cadre (multi-disciplinary teams within USACE with special training in risk assessments that assess USACE infrastructure across the nation) determined that there was a risk of lone tree scour within the vegetation free zone at certain locations of the LAR Contract 3B site. Trees of concern are large diameter trees (greater than 18-inch diameter at breast height (DBH)) located on or immediately adjacent to the levee at locations where the levee is not overbuilt, and at locations with relatively deep flow depths and higher velocities. Trees which stand alone or in very small groups can cause localized flow accelerations and turbulence around the tree trunk which can cause scour on the downstream side of the tree similar to a bridge pier. (See **Figure 1** for an example of tree scour from the 1986 flood on the American River and **Figure 2** to see an example of lone tree scour on a different river system).

Implementation Guidance for Section 3013 of Water Resources Reform and Development Act 2014 states that "In general, designs must be in accordance with minimum standards, and risk assessments can inform deviation from such standards. No deviations are allowed if there is an increase to incremental life safety risk. Districts must document the analysis and rationale for retaining existing vegetation, when vegetation needs to be removed, and/or design features that accommodate vegetation" (USACE 2017). Since a risk assessment determined lone trees on or near the levee embankment pose an unacceptable erosion risk to the levee, USACE cannot deviate from policy which requires removal of the trees in question unless the risk can adequately be mitigated with erosion protection measures and said measures are approved by USACE Headquarters. Because trees provide critical habitat within the Parkway and are important to recreation users of the Parkway, the purpose of Contract 4B is to perform the detailed analysis necessary to support deviation from USACE policy and preserve as many of the trees as possible. This analysis will be very time consuming and requires additional outreach and creative design consideration. Consequently, to avoid delaying Contract 3B USACE pulled the area out of the LAR Contract 3B footprint and formed LAR Contract 4B so that a new PDT, with additional resources, could thoroughly examine alternative methods to preserve the trees instead of removing them.

Additionally, since Contract 4B was initiated, additional erosion protection measures besides protection against lone tree scour are also in the Contract 4B footprint. Similar to the lone tree scour risk, Contract 3B tiebacks were terminated shorter than required to avoid encroaching into the vegetation free zone to avoid undue delay to Contract 3B. Constructing the tiebacks further landward into the vegetation free zone risked requiring a more time consuming approval process, so the tieback extents into the vegetation free zone was pulled out of Contract 3B and is now included in Contract 4B since Contract 4B will already be undergoing a time consuming approval process.

Figure 1. 1986 Flood Event Aftermath On The Lower American River and Localized Lone Tree Scour

Figure 2. Example of Localized Lone Tree Scour after the 2024 Big Sioux River Flood

2.2. **Location**

LAR Contract 4B is both on the north (right) bank of the LAR between downstream of Watt Avenue and on the south (left) bank of the LAR upstream of Watt Avenue in Sacramento County, California. Specifically, the locations being addressed with Contract 4B are classified as Segments 3-8, 3-11, and 4-1. The Figure 3 shows the location of Contract 4B.

2.2.1. Site Condition in 1981

LAR was listed as a Wild and Scenic River in 1981. Aerials of the project area taken on March 20, 1971, August 10, 1981, and January 23, 1987, collected from the University of California Santa Barbara's Library's Frame Finder Website (UCSB 2024) were used to determine the visible conditions when LAR was listed as a Wild and Scenic River. Refer to Attachment A to see a side-by-side comparison of the proposed erosion protection features with the aerials from these dates. Generally, it seems that vegetation has become denser since 1981 (Attachment A). The vegetation near the levee toe seemed to consist mostly of scattered trees in 1981 (Attachment A). Additionally, the vegetation on the riverbank existed but has taken over a larger area since 1981 (Attachment A). Maintenance roads and trails were present in the parkway in 1981; however, these trails seem to be far less shaded than they are today (Attachment A). It also seems that no visible revetment was present in 1981, though sediment seemed to be present at the river's edge that has sense been covered in vegetation (Attachment A).

There was some revetment already installed along LAR when LAR was established as a Wild and Scenic River in 1981 (**Figure 4**). At the LAR Contract 4B site, revetment was only present downstream of Watt Avenue on the North side of the river.

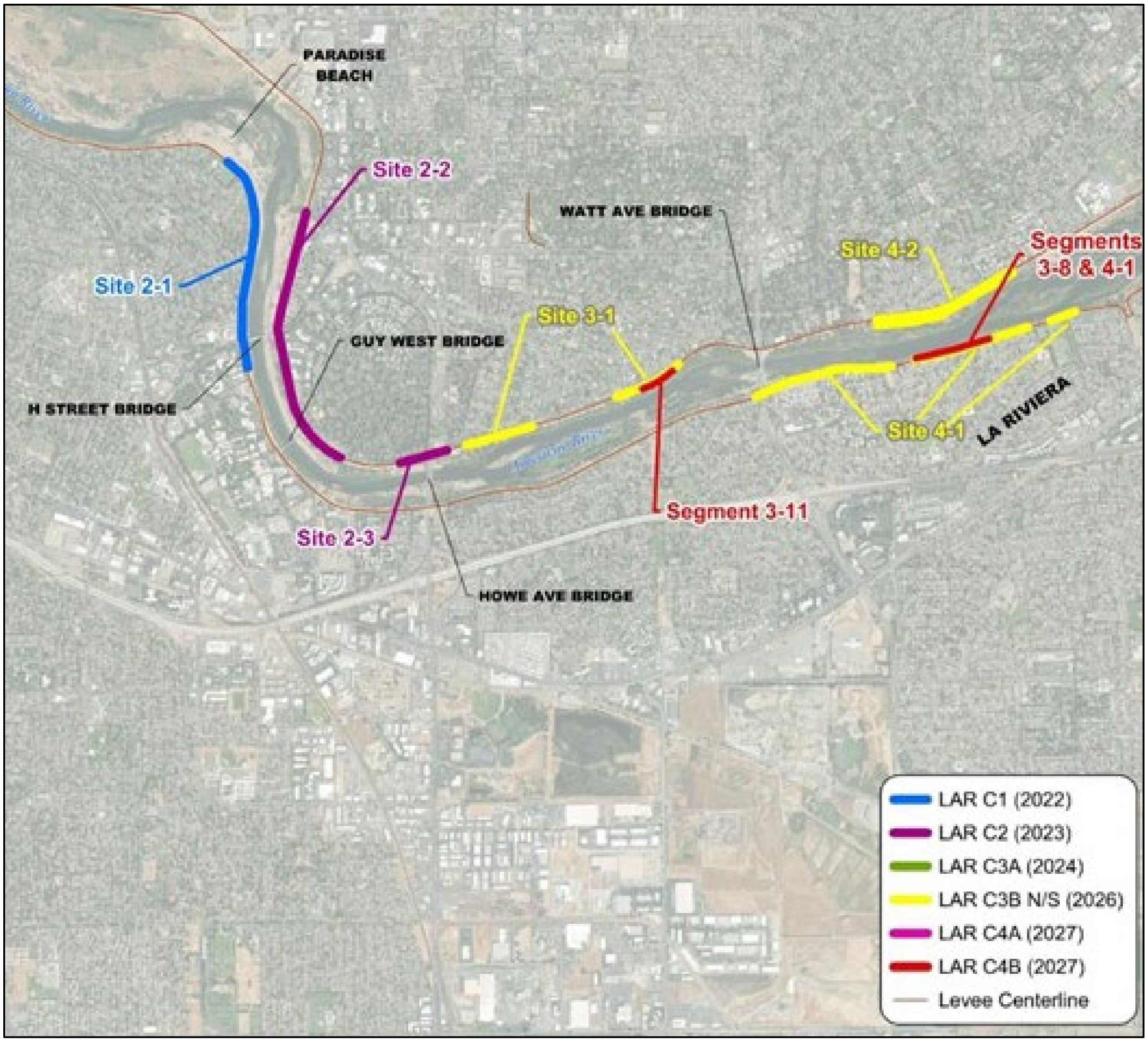

Figure 2. LAR Segments Which are the Focus Of LAR Contract 4B (Red Linework)

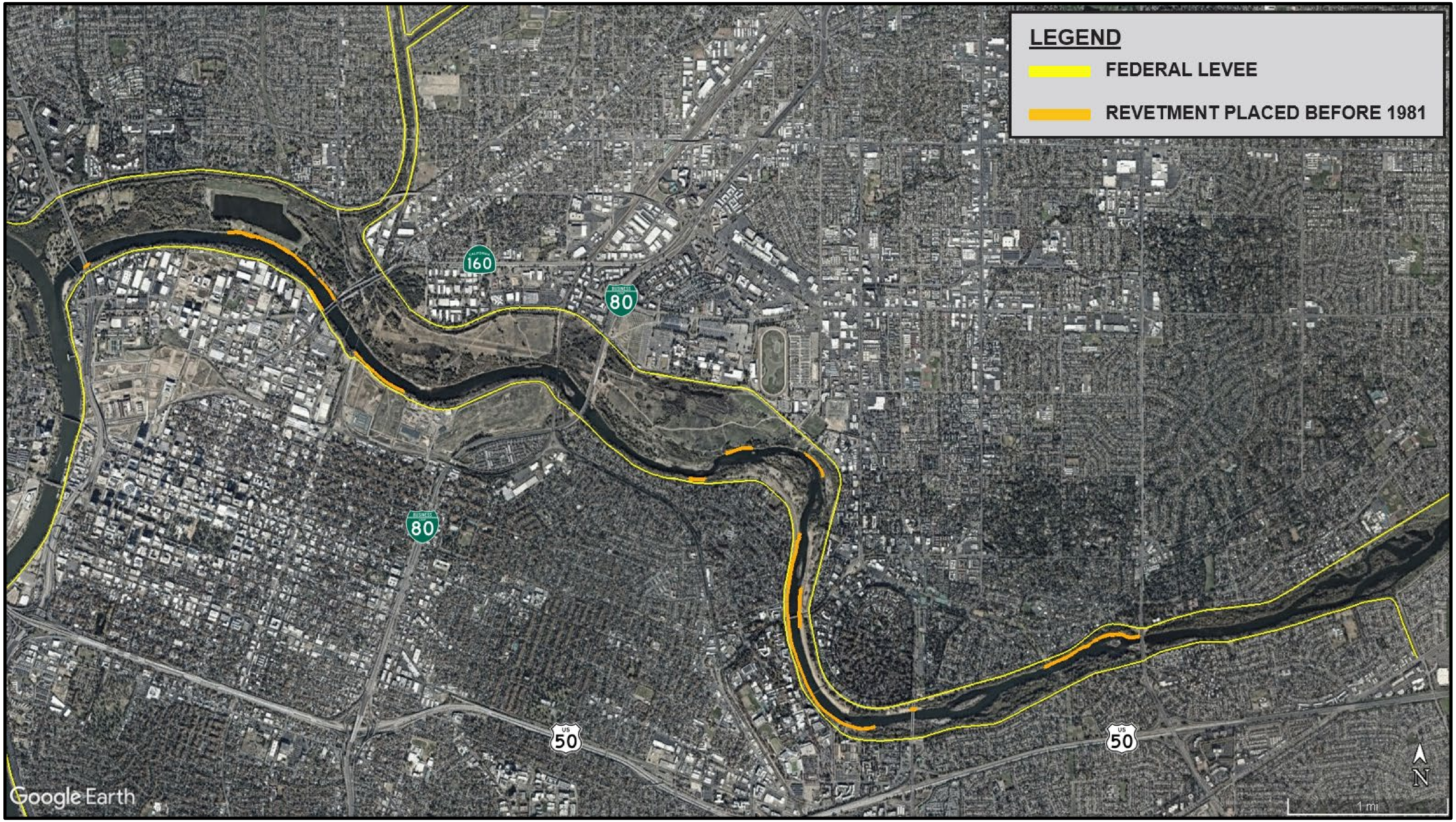

Figure 3. Location of Revetment That Was Present Along the LAR in 1981 When It Was Designated as a Wild And Scenic River

2.3. Schedule and Duration

LAR Contract 4B is currently in the early design phases. Once the scope of work is established, it is anticipated that it will take 2 years for USACE to receive a Vegetation Design Deviation for approval of the work. Currently, the Contract 4B PDT is projecting construction occurring from spring to fall in 2027.

2.4. General project features

The erosion protection areas included in LAR Contract 4B were analyzed in the ARCF GRR Final EIS/FEIR. However, erosion protection measure concerns were discussed and considered generally in the ARCF GRR Final EIS/FEIR, so erosion protection methods to specifically address tree scour were not detailed. Currently, the methods to protect the areas around lone tree from tree scour include: determining that the tree is not a risk to the levee and taking no action, determining that the tree is a risk to the levee and placing erosion resistant materials around the trees to prevent erosion from occurring or cutting down trees. Based on cursory analyses at this early stage of design, it is anticipated that only non-native trees or unhealthy trees would be removed (however with further examination, USACE may determine that healthy native trees cannot be saved without risking levee failure). Currently, the Contract 4B PDT is assessing 50 trees to determine if they pose a risk to the levee or if intervention may be necessary.

Additional erosion protection features separate from the lone tree scour risk would be installed at the Contract 4B location include extending the Contract 3B tiebacks into the vegetation free zone (which is within the Contract 4B footprint). Tiebacks are made up of revetment placed perpendicular to the river which impedes erosion from undermining the revetment from the landward side. Example tieback cross sections from LAR Contract 3B are available in **Figure 5** and **Figure 6**. Contract 4B would extend the top of the Contract 3B tiebacks into the Contract 4B footprint, further into the vegetation free zone (**Figure 8**).

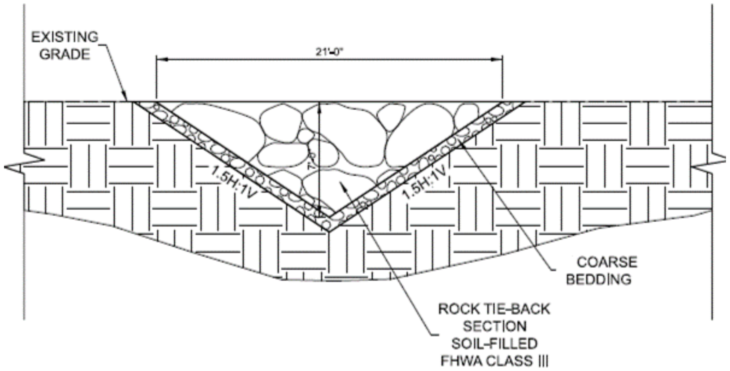

Figure 4. Example Cross Section (Cut Parallel to River) of Tie Backs Found At American River Erosion Contract 3B South

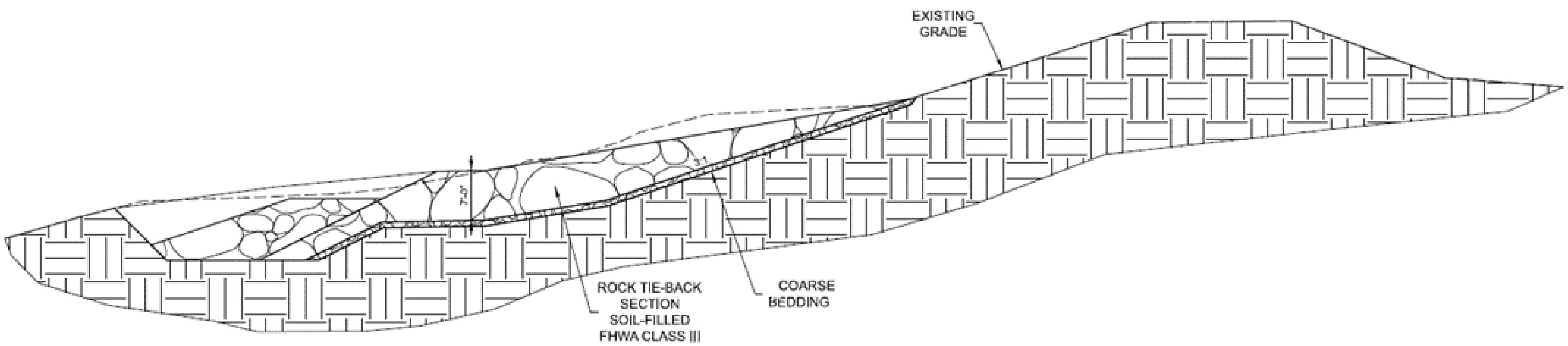

Figure 5. Example Cross Section (Cut Perpendicular to River) of Tie Backs Found at American River Erosion Contract 3B South

2.5. North Side of River

Trees on the north side of the river are currently being assessed for their lone tree scour risk t the levee. Once the assessment is complete, USACE will determine which trees can be treated with erosion resistant materials. Additionally, if USACE Landscape Architects determine that a tree is not healthy or would die from erosion protection features, the tree would need to be removed. Generally, trees are located within the footprint shown in **Figure 7**.

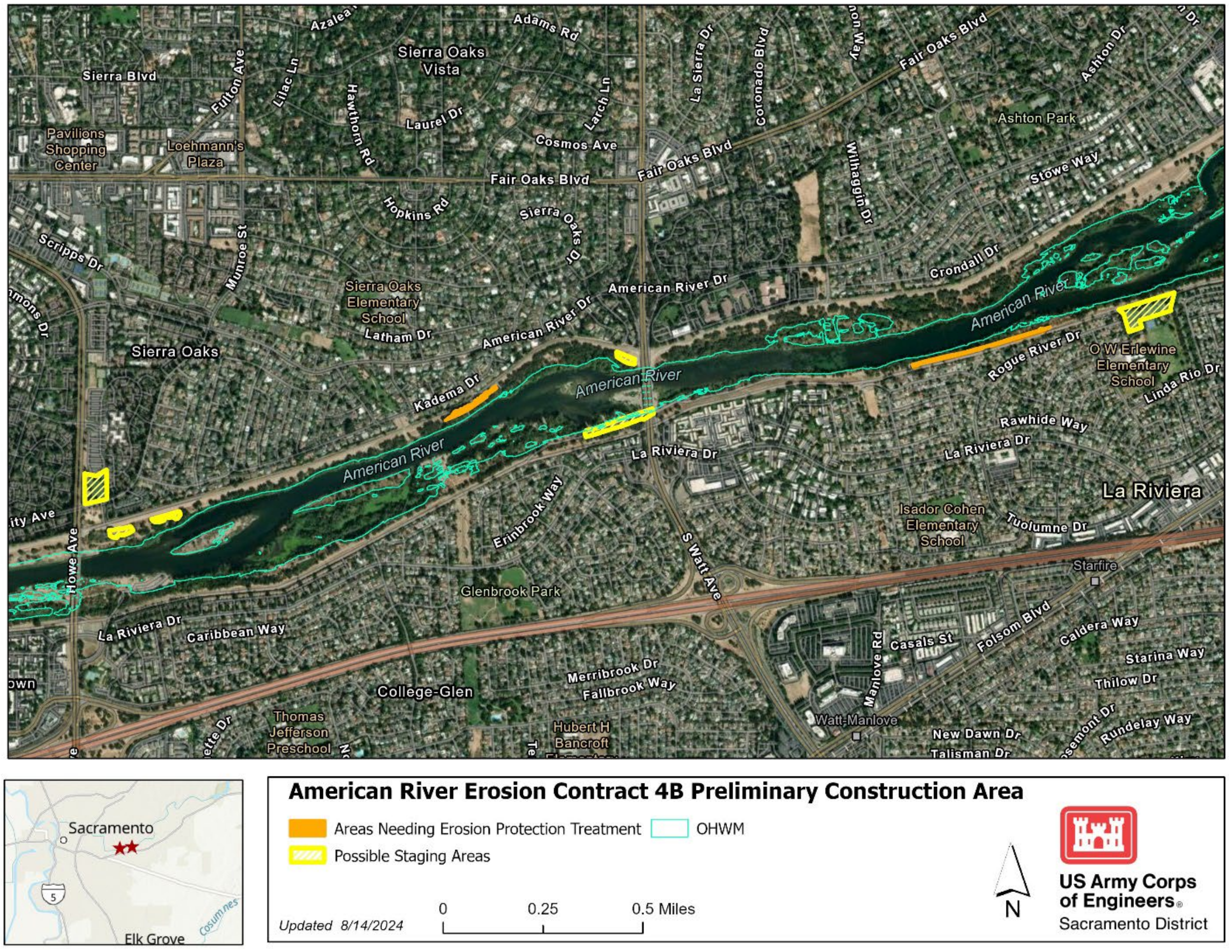

Figure 6. Preliminary Location of Erosion Protection needs at LAR Contract 4B

2.6. South Side of River

Similarly, trees on the south side of the river are currently being assessed for their risk to the levee. Once the assessment is complete, it is anticipated that erosion resistant material would be placed around any native tree that poses a potential risk to the levee. Any non-native tree, specifically black locust (*Robinia pseudoacacia*), posing a risk to the levee would be further considered if it has any value worth saving. In coordination with National Park Service, NMFS, USFWS, and Sacramento County Regional Parks Department (Regional Parks), if a non-native tree is determined to not have habitat or recreational value, it will be slated to be cut down. Additionally, if USACE Landscape Architects determine that a tree is not healthy or would die from erosion protection features, the tree would need to be removed. Generally, trees are located within the footprint in shown in **Figure 7**.

Additionally, tiebacks, which will be installed by Contract 3B up to the vegetation free zone, would be extended into the vegetation free zone under Contract 4B (**Figure 8**). This would involve installing revetment into the ground in strips perpendicular to the river (**Figure 5** and **Figure 6**).

Figure 7. Preliminary Location of Tieback extensions at LAR Contract 4B

2.7. On-site restoration features

The Contract 4B project area is within the vegetation free zone. Consequently, USACE does not anticipate providing any onsite mitigation. Where feasible areas would be topped with topsoil and reseeded with native grasses.

2.8. Offsite Mitigation

2.8.1. Future Mitigation Sites

If non-native trees removed are considered by USFWS as riparian habitat or if other native trees must be removed, offsite mitigation would be needed. Impacts to riparian habitat will be achieved via habitat restoration at the American River Mitigation Site (ARMS), sometimes referred to as the Urrutia mitigation site, and/or through purchase of credits from an approved mitigation/conservation bank. ARMS is within the Parkway and is anticipated to be constructed with four years; 2026, 2027, 2028, and 2029, with tree clearing beginning in 2026. Designs for this proposed mitigation area are currently at 30% and are scheduled to reach 95% designs in November/December 2024.

Offsite valley elderberry longhorn beetle (VELB) mitigation for Contracts 4B will be accomplished through additional offsite compensatory mitigation or purchase of credits from a USFWS approved conservation bank. No elderberry shrubs are anticipated to be within the Contract 4B project site, so there should not be a need to transplant elderberries. Some trees that are flagged to be removed may be within 25 meters of elderberry shrubs and could be VELB habitat. Compensatory mitigation for the loss of habitat for the VELB is required at a 3:1 ratio at ARMS and/or purpose of conservation bank credits.

2.9. Staging Areas and Haul Routes

Since LAR Contract 4B is adjacent to Contract 3B, it is assumed that staging areas used for LAR Contract 3B would be used for LAR Contract 4B as well. Possible LAR Contract 4B staging areas are shown in **Figure 7**. The following areas have been identified as possible staging locations:

North side of the American River

- University Park.
- Staging areas in the Parkway just upstream of Howe Avenue.
- Staging area just downstream of Watt Avenue Bridge and haul route.

South side of the American River

- Watt Avenue River Access parking areas (limited use as part of the parking lot is below the OHWM).
- Larchmont Community Park area adjacent to the levee embankment.

Staging areas would be used for material stockpiles, construction office and trailers, construction worker vehicle parking, and equipment staging. Haul traffic may also pass through staging areas.

Materials will be hauled on-site by truck. Access to the Contract 4B sites will be along existing public roadways and levee patrol roads (see **Figure 9**). Shallow depths in the American River prohibit use of barges.

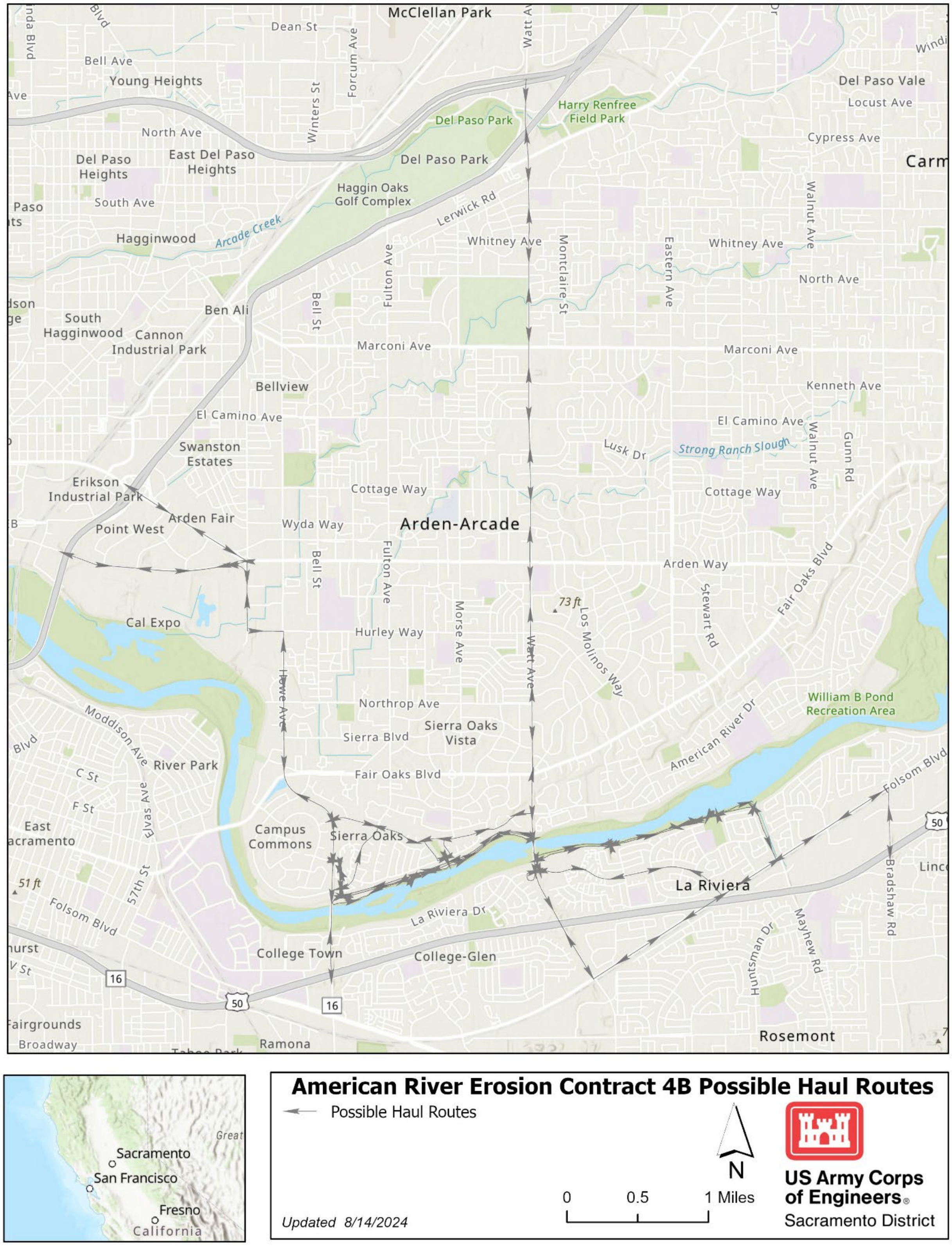

Figure 8. Possible Haul Routes for LAR Contract 4B

2.10. Access

Access to the LAR Contract 4B sites will be along existing public roadways and levee patrol roads. Construction at these sites will need to be coordinated with any other construction projects occurring in these areas at the same time period. Access to the LAR Contract 4B sites is anticipated to be from the landward side, as shallow depths in the American River generally prohibit use of barges. Load distribution platforms (LDPs) are required by the contract documents to protect the existing levee cutoff wall and utilities.

2.11. Construction Phasing

Designs are still in the early phase, but the current schedule projects work to begin with tree clearing in fall 2026 to early winter 2027. Construction of the erosion protection features is projected to begin spring 2027 and completing fall 2027.

3. Effects on Wild and Scenic Values

Table 2 provides a summary of LAR Contracts 4B temporal impacts.

3.1. Effects on Free-Flowing Nature of the River

Levees are present on both sides of the American River throughout the LAR Contract 4B reach. When the river was designated, only lands within the levees were included rather than the entire floodplain since development had already occurred immediately behind the levees.

The LAR Contract 4B north levees are on the right side of the American River as water flows downstream. Improvements are planned along linear strips within 15 feet of the waterside levee toe and on the waterside slope of the levee. Similarly, the LAR Contract 4B south levees are on the left side of the river as it flows downstream. Improvements are planned within 15 feet of the levee toe on the waterside of the levee.

The proposed erosion protection features are approximately 70 to 100 feet away from the ordinary high-water mark (OHWM). Under normal conditions the project site does not contain flows from the American River. Only under high flood conditions would the flow of the American River be obstructed by any erosion features constructed from the proposed project. Additionally, the erosion protection features are not anticipated to significantly change the current topography of the site as there would only be placement of erosion resistant materials at grade or underground to match the current grade. There would be no effect to the free-flowing nature of the American River due to proposed erosion protection features.

3.2. Effects on Water Quality

Water quality impacts for this project will be temporary and short-term. Construction site runoff could increase turbidity; however, increases would be limited by following the provisions of the Stormwater Pollution Prevention Plan for the project as required by the National Pollution Discharge Elimination System (NPDES). All work will be above the OHWM, so it is not anticipated that there will be any direct disturbance to the water that may impact water quality. There is one possible staging area (the Watt Avenue Boat Launch Parking lot) that is partially below the OHWM. If the Watt Avenue Boat Launch Parking lot is selected for staging, activities would be limited to parking vehicles and equipment. As a result, this project is anticipated to have a neutral effect on water quality in the long term.

3.3. Effects on the Anadromous Fishery

As mentioned in section 3.1, the project is above the OHWM and would only be inundated with water at high flood events. Some trees may need to be removed, but the trees would be so far away from the normal water level, they would not provide benefits to fish. Designs are very conceptual at this point in time, so it is unknown how much, if any, riparian habitat will be impacted. **Table 1** will be updated once specific details are known on any trees required to be removed and whether the non-native trees would be considered habitat.

Table 1. Summary of Habitat Types Impacted and Associated Habitat Mitigation (acres)

Habitat Types	Site 3-1	Site 4-1	Site 4-2	Totals
Riparian Habitat (Elderberry/VELB)				
Impact	unknown	unknown	unknown	unknown
Onsite Mitigation	0	0	0	0
Offsite Mitigation (3:1)	unknown	unknown	unknown	unknown
Riparian (YBCU* minus VELB)				
Impact	unknown	unknown	unknown	unknown
Onsite Mitigation	0	0	0	0
Offsite Mitigation (2:1)	unknown	unknown	unknown	unknown
Salmonid Habitat				
Impact	0	0	0	0
Onsite Mitigation	0	0	0	0
Offsite Mitigation (2:1 may change depending on construction timeline)	0	0	0	0

Note: Acres needed to compensate offsite for impacts are intended to be restored at the ARMS and Rossmoor West
* YBCU = Yellow-billed cuckoo

3.4. Effects on Recreation

Removal and replacement of trails follow Sacramento County standard construction specifications (Feb 1, 2017). Currently, USACE does not believe that there would be a need to detour the bike trail. However, if USACE determines later that a detour for the bike trail is needed, the detour path would be coordinated with Sacramento County. The priority of the bike trail detour route would be to stay within the original trail alignments where feasible. The trails will only be rerouted if it was determined to be unsafe for trail users and the requirement provided a suitable trail surface. Trail detours would remain in the Parkway if possible and must be approved by Sacramento County to detour on any city streets. Any long-term detour surface must be an approved, non-skid surface, hardened, and always free of debris. Any crossing of the trail by haul trucks will require construction flaggers and haul trucks will have priority to cross trails.

LAR Contract 4B is still in early design; however,43 access for construction should be similar to the detour plans of the LAR Contract 3B North 95% designs, so it is assumed similar haul traffic and trail closures would be utilized. The bike trail should be able to remain open during LAR Contract 4B construction. At the northern portion of LAR Contract 4B, the maintenance road along the top of levee and the maintenance road at the levee toe, both of which are used for recreation, are expected to be used for construction access and will require closure and detour of the recreational traffic.

Recreation traffic would be routed along the existing paved bike trail. Fencing will be provided to ensure separation of recreation traffic from construction traffic.

At the southern portion of LAR Contract 4B the maintenance road at the top of the levee would likely be used for construction access. Additionally, the trees flagged for lone tree scour are along the hiking/equestrian trail so the hiking/equestrian trail would be closed near the construction boundaries as well. It is anticipated that similar to LAR Contract 3B South, the area would be closed to recreational use and recreationalists would need to use neighborhood streets to detour around the construction.

The designs are still in the early phases, so it is unknown at this point in time what exactly the final designs will look like. It is not anticipated that woody vegetation or trees would be added to the Contract 4B project site as it is in the vegetation free zone. Additionally, where feasible, erosion protection features would be topped with soil and reseeded with native grasses. If it is determined that trees would be removed, removal of some of the trees could decrease the shade provided on the hiking/equestrian trail. Generally, in the parkway, the vegetation free zone is only planted with native grasses, so having the Contract 4B project site free of woody vegetation would match the general appearance of the levee in the parkway.

3.5. **Aesthetics**

As mentioned in section 3.4 the vegetation free zone of the levees, where LAR Contract 4B is located, is typically not planted with woody vegetation. Removing trees would be consistent with the levee along other parts of the American River. Otherwise, the designs are still in the early phases, so it is unknown at this point in time what exactly the final designs will look like. Where feasible, erosion protection features would be topped with soil and reseeded with native grasses.

3.6. **Avoidance and Minimization Measures**

Consistent with the guidelines set forth in the programmatic consistency analysis (USACE, 2021), **Table 3** summarizes how Contract 4B will adhere to the Best Practices for designated Wild and Scenic Rivers (NPS, 2020). During discussions held during the formulation of the programmatic consistency analysis, USACE and NPS jointly devised Universal Avoidance and Minimization measures which would be adopted in the remainder of projects on the LAR under the ARCF project. A summary of how the project adheres to the measures is given in **Table 4**.

Table 2. Summary of Temporal Impacts.

Contract/Site	Anticipated Dates as of July 2024	Actions	WSR Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
LAR Contract 4B – Phase 1 Vegetation Removal North Side of American River	Fall 2026 - Winter 2027	Vegetation Removal and elderberry transplant	**Aesthetics** impacts from tree removal and bare slopes. **Recreation** due to equestrian and walking trail closures/detours. **Recreation** due to loss of pedestrian use of the maintenance roads.	**Aesthetics:** Aesthetic riparian temporal mitigation is accounted for in an anticipated 2:1 habitat ratio.
LAR Contract 4B – Phase 1 Vegetation Removal South Side of American River	Fall 2026 - Winter 2027	Vegetation Removal and elderberry transplant	**Aesthetics** impacts from tree removal and bare slopes. **Recreation** due to equestrian and walking trail closures/detours. **Recreation** due to loss of pedestrian use of the maintenance roads.	**Recreation:** Detours will be developed with input from Regional Parks, and NPS, to ensure minimal disruption to recreational assets practicable.
LAR Contract 4B North – Phase 2 Site Construction North Side of American River	Spring – Fall 2027 (Erosion Protection) Spring 2028 (Revegetation)	Grading and placement of erosion resistant materials.	**Aesthetics** from tree removal and bare slopes.	**Aesthetics:** Aesthetic riparian temporal mitigation is accounted for in 2:1 habitat ratio.
LAR Contract 4B North – Phase 2 Site Construction South Side of American River	Spring – Fall 2027 (Erosion Protection) Spring 2028 (Revegetation)	Grading and placement of erosion resistant materials.	**Recreation** effects due to bike, equestrian, and walking trail closures/detour. **Recreation** due to loss pedestrian use of the maintenance road. **Recreation** due to closure of river access points.	**Recreation:** Detours will be coordinated with Regional Parks and NPS groups to ensure the least disruption to recreational assets practicable.
LAR Contract 4B – Phase 3 Maintenance (5-years) North Side of American River	Spring 2028 – Fall/Winter 2032	Maintaining grasses as needed	**Aesthetics** - people working on the slopes	None planned.

Contract/Site	Anticipated Dates as of July 2024	Actions	WSR Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
LAR Contract 4B – Phase 3 Maintenance (5-years) South Side of American River	Spring 2028 – Fall/Winter 2032	Maintaining grasses as needed	**Aesthetics** - people working on the slopes	None planned.
LAR Contract 4B – Phase 4 Long Term Operations & Maintenance LAR Contract 4B	For the life of the site	Mowing, weeding, and other activities as provided in the Parkway Plan	None	N/A

Table 3. Summary of Adherence to NPS Best Practices.

NPS Best Management Practice	Proposed Action
Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock.	The minimum amount of RCP required to meet risk management objectives is proposed. Design is in the early phases so it is unknown what the final erosion protection features will look like. Where feasible, erosion protection features would be topped with soil and reseeded with native grasses.
If necessary, stone fill (riprap) may only be used for abutment scour protection; the use of stone fill to stabilize the riverbanks is prohibited. To stabilize the riverbanks, use approved native boulders, cobble and gravel; loam; vegetation; and bio- engineering techniques such that the banks, when fully restored, have an appearance and function similar to the natural riverbank.	Erosion resistant materials would be placed on the levee slope and within 15 feet of the levee toe. Work would not occur on the riverbank near the water.
Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed.	Some trees may be permanently removed from the project site. The project is within the vegetation free zone, so no new woody vegetation can be replaced onsite.
Disturbed/exposed banks, staging and project access areas must be properly stabilized (seeded, mulched, or otherwise) with native vegetation to prevent erosion and establishment of invasive plant species. A non-persistent cover crop of annual rye or equivalent temporary seeding may be used to ensure a more rapid establishment of cover while native perennial plantings grow.	Immediately following construction, the site will be hydroseeded with an appropriate native seed mix.
Bio-engineering methods must be used or, where deemed necessary by the [insert river managing agency/ contact], clean broken rock riprap of an adequate size specific for bank stabilization.	The project is within the vegetation free zone, so no new woody vegetation can be replaced onsite.
The use of demolition debris for slope armoring is not allowed.	No demolition debris would be used for slope protection.
Avoid unnecessary tree removal within the project work area.	Tree removal will be minimized to the extent feasible.
A vegetation plan shall be in place to protect existing vegetation/trees from damage by construction equipment (*e.g.,* provide temporary barriers to protect existing trees, plants, root zone).	LAR Contract 4B is in early phases so specifications are not available at this time. LAR Contract 3B Specifications, which will likely be utilized to help make the LAR Contract 4B specifications, include measures such as: fencing off the project area, requiring an arborist present for tree trimming or grading near roots, financial penalties for tree damage, and root protection matting.
Disturbances of the riparian zone must be limited to the indicated access points; prior to the operation of heavy equipment (dozers, cranes, trucks), orange construction fencing must be erected to delineate the dripline of remaining trees to avoid compaction of tree roots.	Fences will be used to delineate the site boundaries. No work will occur outside the construction footprint or designated staging areas.

NPS Best Management Practice	Proposed Action
The fastening of ropes, cables, or fencing to trees is prohibited.	LAR Contract 4B is in early phases so specifications are not available at this time. LAR Contract 3B Specifications, which will likely be utilized to help make the LAR Contract 4B specifications, include measures preventing ropes, cables, or fencing from being fastened to trees marked for retention.
To ensure bank stability, trees removed within fifteen feet of the top of the riverbank shall be cut flush to the ground; stumps and roots shall be left in place; indiscriminate bulldozing of riparian trees is prohibited.	Design is in the early phases so it is unknown what the final erosion protection features will look like.
All trees removed from the riparian corridor shall be replaced with a native tree of like species. Replace each mature tree removed (12-inch or greater diameter at breast height [DBH]) with [insert specifications, e.g., replant 3:1 ratio depending on expected survival rate and with trees that are a minimum 3- inches DBH]. Plant only local, native trees/shrubs/grasses, naturally occurring within the [insert river name] riparian zone [insert plant species list and/or to be determined in coordination with appropriate staff].	Some trees may need to be removed from the site. If it is determined that these trees would be habitat, offsite mitigation for habitat would be done at a 2:1 or 3:1 ratio.
A qualified individual (arborists, foresters, or trained staff with similar experience) shall plant replacement trees at the appropriate time of year and in a random fashion to avoid a plantation effect. Cultivate and monitor planted tree seedlings/saplings for two years to ensure success; water plantings as necessary. Promptly replace planted stock showing signs of mortality.	Onsite mitigation plantings are not anticipated. Replacement trees for habitat impacts will be planted offsite at designated riparian habitat restoration areas according to designs prepared under the supervision of a California licensed USACE landscape architect with experience in developing habitat restoration. The mitigation sites will be managed and monitored according to the ARCF GRR Habitat Mitigation Monitoring and Adaptive Management Plan, which includes success criteria. Plants will be watered as needed for 3–5 years.
Stakes and guide wires shall be properly removed and disposed of once seedlings are established.	LAR Contract 4B is in early phases so specifications are not available at this time. However, it is a standard requirement of USACE construction contracts that sites be cleaned up and debris properly disposed of after construction is complete.

Table 4. Summary of Adherence to Universal Avoidance and Minimization Measures.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Levee Setbacks	Set back the levees wherever possible to allow the river to move.	Free-Flow	Levee setbacks are not feasible in this area due to the existence of homes and businesses, and major roadways immediately behind the levee.
Bioengineering and native plantings throughout the banks and levees	Avoid riprap to the extent possible. Use bioengineering techniques including use of wood (e.g., log crib walls, tree revetments, root revetments; engineered log jams) and deformable techniques (e.g., fabric-encapsulated soil lifts (i.e., geolifts), rock bags, coir rolls (i.e., bio logs), erosion control blankets/fabrics).	Free-Flow, Anadromous Fish	The project is within the vegetation free zone, so no new woody vegetation can be replaced onsite.
Riprap at the bank toe	Riprap would only be placed at the bank toe of segments where the levee prism and associated planting berms (if included) are at the extent of the Parkway limits.	Free flow	No work is being done at the riverbank toe.
Riprap at the bank toe	Ensure no hydraulic impacts from riprap.	Water quality	Hydraulic impacts would be considered during design of LAR Contract 4B.
Riprap at the bank toe	Ensure no direct and adverse impacts to anadromous fish.	Anadromous Fish	Work is being done above the OHWM, so there is no anticipated direct and adverse impacts to fish.
Riprap at the bank toe	Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. If rock is needed utilize cobble to the extent possible. Cover exposed riprap at the bank with soil and vegetation where cobble is not possible.	In-water recreation Aesthetics	Work is being done above the OHWM. No work would be done at the riverbank toe.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Avoid and Minimize use of riprap on the bank above the toe to the OHWM and near the water	Minimize the use and visibility of RCP. RCP should be avoided or minimized to the extent possible. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. Cover any necessary riprap on the bank above the OHWM with planting benches containing sufficient soil and capable of supporting riparian habitat.	Anadromous Fish Recreation Aesthetics	Work is being done above the OHWM. No work would be done between the OHWM and the riverbank toe.
Minimize use of Riprap on the levee slope	Cover revetment on the slope with sufficient soil and native grasses or forbs, as woody vegetation may not be possible due to USACE vegetation on levees policies.	Anadromous Fish Aesthetics	Design is in the early phases so it is unknown what the final erosion protection features will look like. Where feasible areas would be topped with top soil and reseeded with native grasses
Removal of vegetation	Minimize vegetation removal to the maximum extent practicable. Provide planting benches to reduce the affects for lost habitat on-site. Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed. Provide restoration in the parkway when revegetation cannot be completely restored in the project footprint. Re-vegetate all areas of the repair site above the waterline with native, ecotone appropriate, species. Design sites such that they are indistinguishable from the overall fabric of the Parkway.	Anadromous Fish Aesthetics Water quality	Trees would be removed from the site only at a last resort to ensure levee safety, or if trees are non-native or unhealthy. Work is above the OHWM so installation of planting benches is not feasible. The project is within the vegetation free zone, so no new woody vegetation can be replaced onsite. If habitat is removed, mitigation would occur at an offsite mitigation site within the American River Parkway. Where feasible erosion resistant materials would be topped with soil and reseeded with native grasses.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of bike trail	The first priority is to detour the bike trail on the nearest dedicated trail. That is, the trail should not be shared with automobiles. If the bike trail segment being detoured is paved, the detour route should also be completely paved to include all transitions from permanent to temporary trails/detours. In an event due to where the trail cannot be routed near construction boundaries for safety concerns it should be detoured to surface streets with bicycle safety measures for a minimal amount time. Detours to surface streets should be considered the last option and review by all stakeholders. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Minimize the extent of the closure. When feasible use flaggers instead of detours. Minimize the length of time the detours are needed. Detours will carry the same safety standards as a permanent trail and if detours go down to one bicycle lane, caution should be considered and the included use of flaggers with dismount zones in single lane areas. Any permanent re-routing of the bike trail should also include rerouting the equestrian trail. Re-routed trails should provide the same experience as the existing trail including the aesthetics. The new trail should be shaded with riparian vegetation.	Recreation	Bike trail detours will be provided around the work on the north side of the river if needed, however it is anticipated that the maintenance road and top of levee can be used for construction and not require the bike trail to be closed. All bike trail detours will be coordinated with County Parks and will minimize detours to streets. LAR Contract 4B is in early phases so specifications are not available at this time. LAR Contract 3B Specifications, which will likely be utilized to help make the LAR Contract 4B specifications, include measures requiring signs at trail closures and flaggers. There will be no permanent re-routing of the bike trail with LAR Contract 4B.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of levee maintenance road	Detour the route, if normally used as a hiking, horse, or mountain bike trail. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Plant vegetation to provide shading along this road once users return to the extent possible.	Recreation	It is anticipated that where work would be on the South side of the river, the hiking/equestrian trail would need to be closed. As with Contract 3B, recreationalists would be required to use neighborhood streets since there is not a safe way to detour recreationalists within the parkway. The project is within the vegetation free zone, so no new woody vegetation can be replaced onsite.
General Impacts of Work in the Parkway	Reduce work limits to the maximum extent practicable. Close trails and other recreational features only when necessary for safety of the public. Advance notice of work shall be provided at the site of the closures and on the web.	Recreation	Every effort will be made to reduce the work area to the extent practicable. Advance notice of the work would be provided on sacleveeupgrades.com.
General Impacts of Work in the Parkway	Phase work appropriately such that sites do not remain incomplete for excessive periods of time (e.g., bank work completed but planting delayed for years, or tree clearance years ahead of the construction etc.)	Aesthetics	Work is scheduled to be conducted sequentially. Gaps in the construction sequence would be limited to necessary safety stand downs during the flood season when no work may be conducted in the floodway.
Closure of boat ramp	Avoid closure of boat ramps to the maximum extent practicable. Phase work such that not more than one boat ramp is closed. Provide information at the closure and on the web about the location and duration of the closure and the nearest open boat ramp. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	Designs are in the early phases so it is unknown if the Watt Avenue Boat ramps will be closed.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of river access points	Avoid closure of river access points to the maximum extent practicable. Phase work such that consecutive river access points are not closed for more than one consecutive mile on account of this project. Provide information at the closure(s) and on the web about the location and duration of the closure and the nearest open river access points. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	If the same closures for LAR Contract 3B are used, University Park River Access, Kadema Drive River Access, the Watt Avenue Boat Launch, river access from the apartments upstream of Watt Avenue, Waterton Way River Access, river access through SARA park, river access through Larchmont Park and Rio Bravo Circle River Access will be affected by this work. Advance notice of the work would be provided on sacleveeupgrades.com. LAR Contract 4B is in early phases so specifications are not available at this time. However, it is a standard practice to require USACE construction contractors to post signs at trail closure locations.
In water work	Abide by NPDES requirements to ensure there is no adverse effect to water quality.	Water Quality	Site designs are consistent with this measure.
In water work	Abide by NMFS Biological Opinion to ensure there is no adverse effect to anadromous fish from water quality.	Anadromous Fish	Site designs are consistent with this measure.
In water work	Provide buoys or other demarcation for closed sections of the channel. The channel shall not be closed such that upstream or downstream navigation is precluded.	In-water recreation	There will be no in-water work.

4. Conclusion

USACE has determined that the LAR Contract 4B should be considered consistent with the mandates of the WSRA because:

a. The project is a part of the authorized ARCF project and fits within the scope of the overall project.

b. The minimization measures proposed for each design specific feature, as outlined in the Universal Minimization Measures, will be used.

c. This project will be conducted under the standing biological opinions for the ARCF project and will be subject to the terms and conditions therein.

d. This project will be conducted above the OHWM and will not require Clean Water Act 401 permitting.

USACE requests concurrence from NPS within 60 days of the date of this document.

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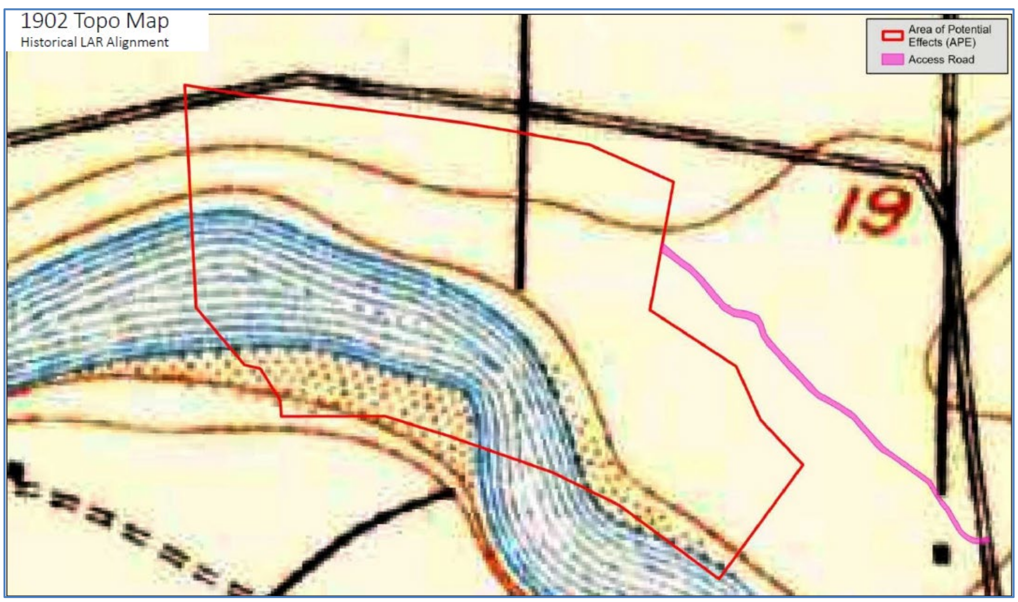
American River Common Features 2016 Project Section 7 Wild and Scenic Rivers Act DRAFT Consistency Analysis American River Mitigation Site

Compensatory Mitigation Sites on the Lower American River
Sacramento County, California



December 2024

US Army Corps of Engineers®
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Preface

*As discussed in the main body of Appendix H, consistency with the Federal Wild and Scenic Rivers Act is considered throughout design development for the LAR elements of the American River Common Features (2016) Project. The purpose of this attachment (**Attachment 4**) is to share with the public and decision makers the current Draft USACE Consistency Analysis for the American River Mitigation Site (ARMS). This draft is based upon the information currently available and will be updated as designs progress. ARMS has reached 35% level of design. Therefore, this Draft Consistency Analysis reflects that early design stage. Once designs have reached 95%, USACE will update this draft Consistency Analysis to provide more project specific details and will transmit it to the National Park Service together with a request that they conduct their consistency review.*

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Acronyms

Acronym	Term
ARCF	American River Common Features 2016
ARMS	American River Mitigation Site (Proposed Action)
CEQA	California Environmental Quality Act
cfs	Cubic feet per second
CVFPB	Central Valley Flood Protection Board
DWR	California Department of Water Resources
ESA	Endangered Species Act
FEIR	Final Environmental Impact Report (CEQA)
FEIS	Final Environmental Impact Statement (NEPA)
FWCA	Fish and Wildlife Coordination Act
GRR	General Reevaluation Report
IWM	Instream Woody Material
LAR	Lower American River
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
No.	Number
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
Parkway	American River Parkway
Proposed Action	American River Mitigation Site (ARMS)
RCP	Rock Channel Protection
SAFCA	Sacramento Area Flood Control Agency
Stat.	Statute
SWPPP	Storm Water Pollution Prevention Plan
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VELB	Valley elderberry longhorn beetle
WRDA	Water Resources Development Act
WSR	Wild and Scenic River
WSRA	Wild and Scenic River Act
XS	Cross section
YBCU	Yellow-billed cuckoo

1 Introduction

The American River Common Features 2016 Project (ARCF Project) is a congressionally authorized flood risk management project that is being implemented by the project cost-sharing partners the U.S. Army Corps of Engineers (USACE), the Central Valley Flood Protection Board (CVFPB), and the Sacramento Area Flood Control Agency (SAFCA). The California Department of Water Resources also participates and provides technical staff to support the CVFPB. The full scope of the ARCF Project is described in the 2016 American River Watershed Common Features General Reevaluation Report (GRR) and joint Final Environmental Impact Statement and Environmental Impact Report (FEIS/FEIR), and as revised and supplemented. This consistency analysis addresses the American River Mitigation Site (ARMS) also known as Urrutia, which is the Proposed Action. For consistency with other project documents, American River Erosion projects will be referred to as Lower American River (LAR) projects in this document.

2 Authority

As part of the larger ARCF Project, ARMS (Proposed Action) are authorized by Section 101(a)(1)(A) of the Water Resources Development Act (WRDA) of 1996, Public Law Number (No.) 104303 Section 101(a)(1), 110 Statute (Stat.) 3658, 3662–3663 (1996), as amended by Section 366 of the WRDA of 1999, Public Law No. 106-53, Section 366, 113 Stat. 269, 319-320 (1999). Following the interim general reevaluation study, additional authority was provided in Section 1322(b) of the WRDA of 2016, Public Law No. 114-322, Section 1322, 130 Stat. 1707, also known as the Water Resources Infrastructure Improvements for the Nation Act, and Public Law 115-123 (Bipartisan Budget Act of 2018).

2.1 Need for Consistency Determination

The Lower American River (LAR) has been designated by the Secretary of the Interior as a Wild and Scenic River (WSR) under the Wild and Scenic Rivers Act (WSRA) Section 2(a)(ii). The ARCF Project constitutes an “Other Proposed Federally Assisted Water Resources Project (Agency Other than the Federal Energy Regulatory Commission)” within the WSR-designated portion of the LAR (Interagency Wild and Scenic Rivers Council 2004). Section 7(a) of the WSRA requires Federal agencies to determine whether water resources projects planned in rivers under the jurisdiction of the act are consistent with WSRA requirements to protect river resources. The responsibility for the Section 7 determination is a federal responsibility not delegated to the state. Therefore Section 7 determinations are the responsibility of one of the four river administering agencies, Bureau of Land Management, U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service, or the National Park Service (NPS). The LAR does not run through federal lands under the jurisdiction of another federal river-administering agency, therefore the responsibility for the Section 7 determination rests with NPS. Accordingly, the Sacramento District, USACE prepared this analysis for the NPS as agency submitted documentation to support a consistency determination.

2.2 Purpose of this Report

The ARCF project was described in the American River Common Features (ARCF) Project 2016 Wild and Scenic Rivers Programmatic Consistency Analysis, dated June 22, 2021, and updated July 19, 2021 (NPS identifier 1.A.2 (PW-NR)). This project-specific consistency analysis focuses on the potential effects and benefits of ARMS, which is intended to provide compensatory mitigation for the Lower American River Erosion Contracts. This report considers whether the Proposed Action would directly and adversely affect the river values that were present in the LAR in 1981 when the LAR was designated as a component of the National Wild and Scenic Rivers System. The actions under ARMS are consistent with the purpose and need of the overall ARCF project. They are conducted within the overall location of the ARCF project as described in the programmatic consistency analysis. This report was prepared using the format provided in Appendix A of the programmatic consistency analysis (USACE, 2021).

3 Project Description

3.1 Location

ARMS is on the north (right) bank of the LAR between Discovery Park and Camp Pollock Sacramento, California. **Figure 1** shows the location of ARMS.

Figure 1. ARMS location on the LAR

3.1.1 Site Conditions in 1981

ARMS, also known as Urrutia, was previously privately held and operated as the Gardenland Sand and Gravel Mine. The area is zoned as American River Parkway Flood-Zone. Section 3.2, Existing Conditions describes conditions reflective of previous uses of this property.

3.2 Existing Conditions

In May of 2023 the project partners purchased all three parcels of the Urrutia property. Phase one surveys found no hazardous materials, but there are some contaminates and discarded construction materials such as concrete and asphalt. In summer 2024, SAFCA completed site cleanup to make the land usable as a mitigation project. This included removing the existing house and all outbuildings. The dilapidated bridge that crossed over Bannon Slough was removed by the previous owner, so the only access is now through Discovery Park or through Camp Pollock. Much of the vegetation onsite is nonnative, and the open grassy area around the pond is regularly mowed. The site is home to a nesting pair of bald eagles. They have had a successful nest the last two years with two chicks each year. Riparian habitat is restricted to the outer boundaries of the property resulting in migrating wildlife moving onto the bike trail and out into the open. The pond is only connected to the River and Bannon Slough during high flow events and currently functions as a fish trap as waters recede.

3.3 General project features

ARMS is part of the ARCF16 Project but is not part a levee improvement. Instead, ARMS is being designed and constructed to fulfill the Endangered Species Act (ESA), Fish and Wildlife Coordination Act (FWCA) and the WSRA compensatory mitigation requirements of the Project. This ARCF16 project component was not included in previous national environmental policy act (NEPA) documents but is analyzed the 2025 Supplemental Environmental Impact Statement and Supplemental Environment Impact Report.

The site is designed to function as a backwater channel that is connected to the LAR through a single inlet and outlet, shown on **Figure 2**. Habitat benches will be constructed at various water surface elevations to provide year-round shallow water habitat for salmonids and waterfowl. During the wet season the area will also provide deep water habitat. Riparian vegetation will be used to provide habitat for western yellow billed cuckoo, and higher elevations will support oak and elderberry habitat. Site grading and placement of fill material would occur to ensure proper water flows (drainage), create low-flow channels, remove non-native vegetation, and connect to the main stem of the river.

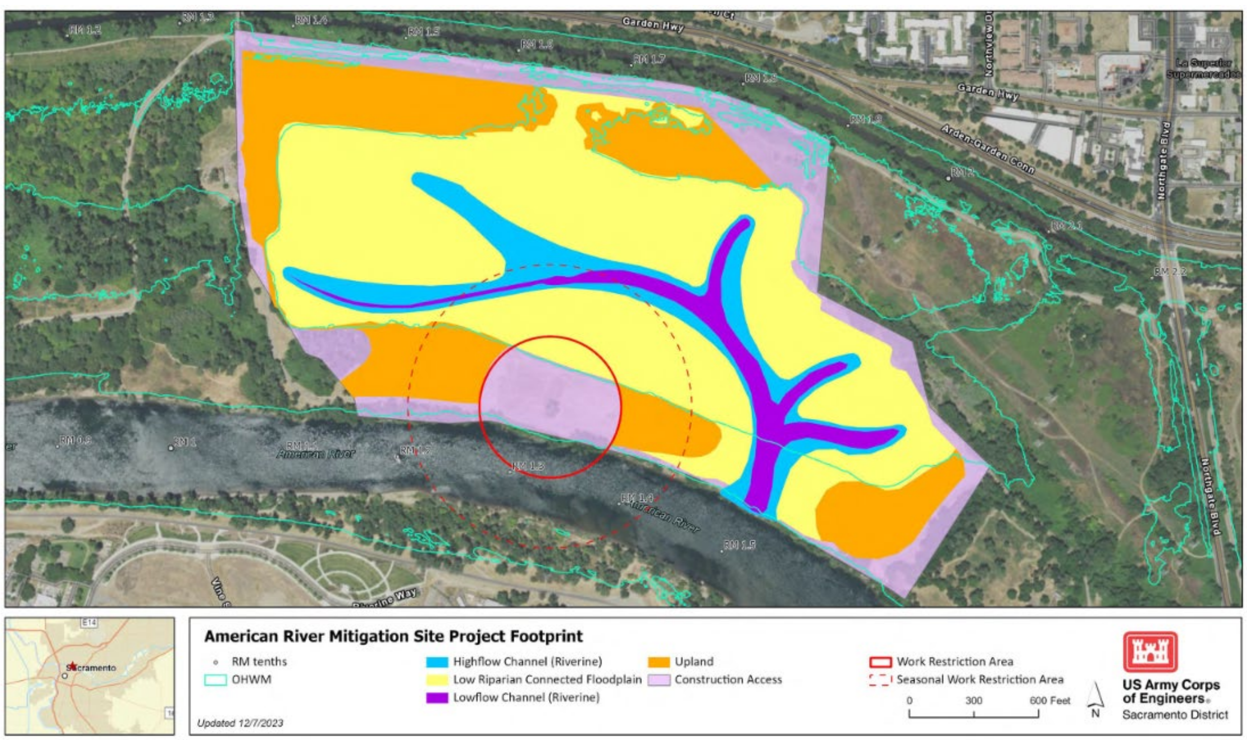


Figure 2. ARMS 35% Project Design with Bald Eagle Buffer.

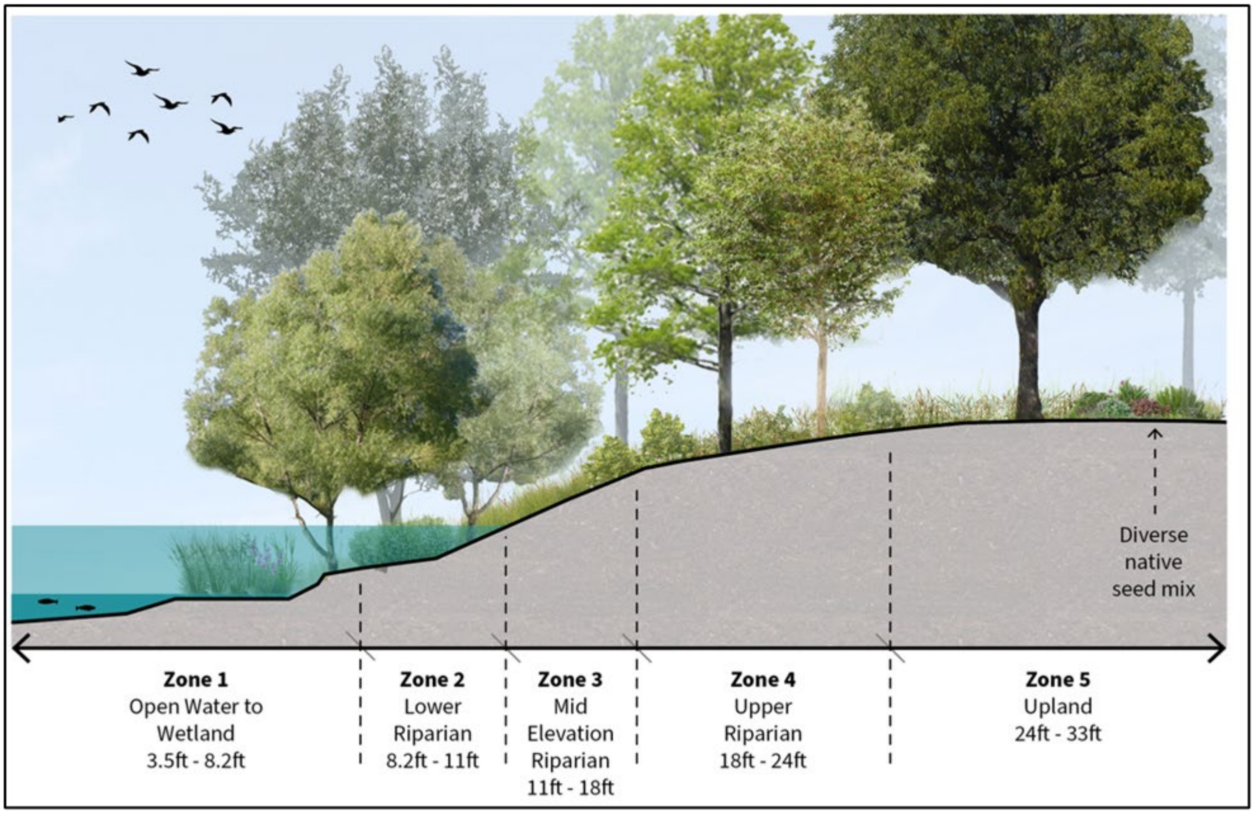
The project is primarily a process-based restoration project that will restore dynamic natural hydrology to the site to promote natural recruitment of native wetland and riparian vegetation and is not proposed to rely on intensive site planting and irrigation for most vegetation establishment. Assisted natural recruitment supplemented with focal plantings and seeding is expected to achieve habitat restoration performance standards within 10 years of site breaching. The focus in design is to provide erosion control and site conditions that produce robust vegetation, larger trees with maturing understory, and natural succession that will provide habitat for State and Federally listed species as well as local wildlife. This will require integration of civil design and landscape architecture and thorough and clearly articulated maintenance requirements that provide room for adaptive management during the establishment period.

Although not a primary goal of the ARMS design, passive recreational opportunities compatible with fish and wildlife and their habitat would be available. The property is no longer in a private holding, off-limits to the public. Once the habitat goals have been reached, the ARMS could be connected to the American River Parkway through formal or informal trail systems. The open water and young riparian habitats would allow for expanded wildlife viewing and bird watching opportunities. Additionally, the site would be protected and preserved as natural habitat, creating a natural buffer around the nesting eagle pair.

3.4 On-site habitat features

3.4.1 Habitat Zones

The ARMS site design includes five discrete habitat zones, shown in **Figure 3**. The lowest elevations (up to 8.2 ft) will be inundated year-round and will consist of open water and transitional wetland vegetation. Zone 1 is open water to wetland. Zone 2 is lower riparian, elevations 8.2 to 11ft. It will be inundated frequently and consist of willow scrub vegetation. Zone 3 is middle elevation riparian and extends from elevations 11 to 18 feet. Zone 3 will include willow, alder, birch, and other water tolerant native species. Zone 4 is upper riparian habitat and extends from elevations 18 to 24 feet. This zone will transition from riparian to woodland species, including black walnut, redbud, and milkweed. Zone 5, at elevations above 24 feet, will rarely be inundated. Zone 5 will consist of upland native vegetation such as oaks, mug wart, wild grape, and elderberry shrubs.



(Image produced by GEI)

Figure 3. Draft Habitat Zones at ARMS.

3.4.2 LAR Main Channel

The main channel of the LAR largely will not be disturbed. The bank at the breach will be removed using an excavator. An excavator and a bulldozer will be used to smooth out the grade into a gentle slope that does not pose a safety risk. The breach itself will not be stabilized with rock revetment; it will be hydroseeded with a native herbaceous seed mixture. Some old debris is present along the bank of the river. Where feasible and appropriate, the debris will be removed during project construction. Soil disturbed during the debris removal will be hydroseeded with a native herbaceous seed mixture.

3.4.3 Backwater Channels and Benches

The design includes dendritic back water channels to expand habitat for salmonids and other aquatic species. The backwater channels will gradually slope and drain towards the main river channel to prevent fish stranding and to provide water circulation. Benches constructed at different elevations will provide diverse habitat seasonal flows and water years fluctuate.

3.4.4 Salmon Designs Criteria

In general, all aquatic and riparian restoration and enhancements below the ordinary high water mark (24 feet NAVD 88) are suitable compensatory mitigation for salmonids. The design takes into consideration the flow and stage frequencies on the LAR, targeting depths and velocities to accommodate rearing fall-run Chinook salmon and Central Valley steelhead.

3.4.5 Yellow-billed Cuckoo and Riparian Design Criteria

Zones 1, 2 and 3 are designed with a variety of native riparian plant species to provide elevational transitions, creating a diverse riparian corridor. This will provide habitat for yellow billed cuckoo (YBCU) along their migratory route through California and restores a migratory corridor for other wildlife in the LAR.

3.4.6 Valley Elderberry Longhorn Beetle Design Criteria

Elderberry shrubs will only be located in Zone 5 as they prefer to be above the ordinary high water mark (24 feet NAV 88), either in understory of cottonwood or an open savannah with associated native vegetation. All areas planned as Valley Elderberry Longhorn Beetle (VELB) mitigation will be managed in accordance with the 2017 Framework.

3.4.7 Native Plant List

The plants selected for ARMS will bel those native to the LAR and which are consistent with the LAR Natural Resource Management Plan and the LAR Parkway Plan. **Table 1** shows the plant species in relation to habitat zones.

Table 1. Potential Native Plant List

Common Name	**Scientific Name**	**Size/type**
Trees		
Box elder	*Acer negundo*	Treepot 4*
White alder	*Alnus rhombifolia*	Treepot 4*
Oregon ash	*Fraxinus latifolia*	Treepot 4*
Sycamore	*Platanus racemosa*	Treepot 4*
Cottonwood	*Populus fremontii*	Treepot 4*
Valley oak	*Quercus lobata*	Treepot 4*
Interior live oak	*Quercus wislizenii*	Treepot 4*
Goodding's willow	*Salix gooddingii*	Treepot 4*
Goodding's willow	*Salix gooddingii*	Cuttings
Red willow	*Salix laevigata*	Treepot 4*
Red willow	*Salix laevigata*	Cuttings
Understory (Shrubs/Vines)		
Mugwort	*Artemesia douglassiana*	Treeband*
Coyote brush	*Baccharis pilularis*	Deepot 40*
Mule fat	*Baccharis salicifolia*	Treepot 4*
Buttonbush	*Cephalanthus occidentalis*	Treepot 4*
Western Redbud	*Cercis occidentalis*	Deepot 40*
Western Goldenrod	*Euthamia occidentalis*	Treeband*
Coffeeberry	*Frangula calilfornica*	Deepot 40*
Toyon	*Heteromeles arbutifolia*	Deepot 40*
Wild cucumber	*Mara macrocarpa*	Deepot 40*
Rose	*Rosa californica*	Deepot 40*
Blackberry	*Rubus ursinus*	Deepot 40*
Sandbar willow	*Salix exigua*	Treepot 4*
Sandbar willow	*Salix exigua*	Cuttings
Pacific willow	*Salix lasiandra*	Treepot 4*
Pacific willow	*Salix lasiandra*	Cuttings
Arroyo willow	*Salix lasiolepis*	Treepot 4*
Arroyo willow	*Salix lasiolepis*	Cuttings
Elderberry	*Sambucus mexicana*	Deepot 40*
Snowberry	*Symphoricarpus albus* var. *Laevigatus*	Deepot 40*
Pipevine	*Aristilochia californica*	Deepot 40*
Clematis	*Clematis lingustifolia*	Deepot 408
Grape	*Vitis californica*	Deepot 408
Herbaceous		
Santa Barbara sedge	*Carex barbarae*	Treeband*
Santa Barbara sedge	*Carex barbarae*	Plug*
Western Goldenrod	*Euthamia occidentalis*	Treeband*
Baltic rush	*Juncus balticus*	Treeband*
Common bog rush	*Juncus effusus*	Treeband*
Creeping wildrye	*Leymus triticoides*	Treeband*
Creeping wildrye	*Leymus triticoides*	Plug*

Common Name	Scientific Name	Size/type
Scouringrush Horsetail	*Equisetum hyemale* ssp. *Affine*	Plug*
Evening primrose	*Oenothera hookerii*	Treeband*
California bulrush	*Schoinoplectus californicus*	Treeband*
Tule	*Schoenoplectus acutus* var. *occidentalis*	Treeband*

**Type of potted plant*

3.4.8 Instream woody material

IWM is proposed with the goal of creating better habitat conditions for salmonids post-restoration. The primary purpose of IWM is to enhance the quality of fish habitat by providing refugia and increasing instream cover at low to moderate flows for the benefit of fish species. IWM also promotes bank stability and protection against wave or wake energy during the plant establishment period and encourages sediment deposition. IWM will be locally sourced hardwood, free of disease and rot. It will be placed in various locations and elevations for maximum benefits and will be anchored using natural or biodegradable materials.

3.5 Staging Areas and Haul Routes

The project construction limits define the temporary construction easement and limits of disturbance. This includes the site access, staging areas and grading limits. Material stockpiling, especially IWM, will require a large area. The stockpile location has not yet been identified. The primary proposed haul route (**Figure 4**) will be used by large dump trucks to transport soil fill, rock, and IWM. The trucks will travel in one direction in a circuit to and from the borrow and ARMS.

- The route from the borrow site will extend from the work area entrance via Northgate Blvd. following the powerline easement.
- The Riverdale Mobile Home Park/Camp Pollock dirt road is connected to the ARMS through (southeast corner of the site). The gate will remain closed during construction.
- The primary proposed access routes within the project area will follow existing paths.

No road closures are proposed, but the main construction access point will be reviewed by the County and the City of Sacramento Public Works Department. Before the start of construction activities, the contractor is required to prepare a Traffic Control and Road Maintenance Plan.

Figure 4. Access and Haul Routes

3.6 Schedule and Duration

Project construction is expected to begin in winter 2025 or spring 2026 with tree trimming along the haul route. Work behind the natural levee bank will occur over about a three year period beginning in 2026 and extending through 2028. Planting will occur sequentially over the construction period as portions of the site become ready for plant installation. In 2027 the levee bank height will be reduced to connect the river to the floodplain. This work will occur during the in-water work window of 2027. An adaptive management and monitoring phase will follow completion of construction. During this time some minor adjustments may be made to ensure the site performs as intended. This could include some minor grade adjustments and/or replanting, if needed. **Table 2** details the construction timing and sequence for ARMS.

Table 2. Approved Biological Work Windows within which Construction will Occur

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bald Eagle[1]												
Fisheries												
Flood Season Avoidance												
Tree Clearing												
VELB Avoidance			*	*	*	*						
VELB Transplant Window												

** Do Not Impact Elderberry Shrub*
[1] USACE intends to seek a disturbance permit from USFWS that will allow work to occur in all seasons.

Table 3. ARMS Construction Phasing and Sequencing

Activity	Tree Trimming	Earthwork	Greening/Mitigation Plantings
Timeline	Fall 2025-Winter 2026	2027	Winter-Spring 2028

3.7 Construction Phasing

Construction is expected to occur over approximately 3 years, beginning with tree trimming in late 2025 or early 2026 and ending when all planting is completed in early 2028. All construction activities are anticipated to take place from land. Material will be imported by truck and relocated with either a bulldozer, excavator, or other heavy equipment. The first action will be to construct a haul route from Northgate Blvd. The second action will be to remove trees and other vegetation from the construction footprint. Where feasible, some native trees within the footprint will be preserved. The third action will be to move soil material into the current pond, which is planned for restoration to slough and emergent wetland habitat. This would take place after all appropriate environmental surveys and fish relocations have occurred. Once the pond has been filled with soil, the construction team will begin grading the material to create the channels. The last step of construction is to breach the riverbank and connect the site with the American River."

3.8 Mitigation Realized

The ARMS Site is intended to provide offsite compensatory mitigation to offset t impacts to species and their habitat from bank protection LAR Contracts 1 through 4. **Table 4** and **Table 5** show the amount of impact and the onsite mitigation generated from each erosion protection site, and the amount of offsite mitigation provided by ARMS.

Table 4. LAR Bank Protection Site Impact Summary

Contract	Wetland Impacts	Riparian / Cuckoo Impacts	Fisheries Impacts	Wetland Onsite Mitigation	Riparian/ Cuckoo Onsite Mitigation	Fisheries Onsite Mitigation
1	0.00	10.43	8.50	0	12.86	7.59
2	0.00	12.21	5.44	0	15.75	8.65
3a	0.00	2.62	7.04	0	3.06	2.45
3b	0.00	7.50	20.13	0	15.59	13.74
4A	0.90	1.78	0.00	0	0	0
4B						
Totals	**0.90**	**34.54**	**41.11**	**0.00**	**47.26**	**32.43**

Table 5. LAR Mitigation Acreage Summary

Item	Wetland	Riparian/Cuckoo	Fisheries
Total Impact	1	35	41
Total Mitigation Required	2	69	82
Total Onsite Mitigation	0	47	32
Total ARMS Creation	7	72	66 to 76
Unmitigated	2	22	50

4 Effects on Wild and Scenic Values

4.1 Effects on Free-Flowing Nature of the River

When the LAR was designated as Wild and Scenic in 1981, it generally only included the lands within the federal levees rather than the whole floodplain because development had already occurred immediately behind the levees. The flows on the LAR are managed by operations at Folsom Dam and Nimbus Dam, which are located a few miles upstream of the project. The portion of the LAR that contains the ARMS site is bound by a federal levee on both the north and south sides. The Garden Highway runs along the top of the levee to the north. The southern levee is the bank of the river itself. No ARCF16 erosion protection contracts occur in this reach of the LAR.

The proposed work will reconnect floodplain that has been separated from the river for many years. It will breach the existing riverbank and allow water to flow freely into and out of a backwater channel that currently does not exist but will be created as part of ARMS. By contouring the pond and existing upland areas, the land inundated year-round by the river will be expanded. Therefore, this project will benefit and expand the free-flowing nature of the river.

4.2 Effects on Water Quality

Water quality impacts for this project will be temporary and short-term. In-water work and/or construction site runoff could increase turbidity; however, increases would be limited by following the provisions of the Stormwater Pollution Prevention Plan (SWPPP) for the project which is required by the National Pollution Discharge Elimination System (NPDES). Consistent with the Clean Water Act 401 water quality certification for the project, a turbidity curtain, or other similar measure, will be used where required. The work site will be monitored to ensure that turbidity increases are limited to the work area. Upstream sampling will be conducted to determine ambient conditions on site. To ensure standards are met, these results will be compared to downstream turbidity results from sampling conducted during the work.

The majority of the site grading would occur while the uplands remain disconnected from the LAR and from Bannon Slough. The rubble along the bank of the LAR will be removed and the bank will be hydroseeded and/or planted with native vegetation to prevent additional erosion and soil run off. Vegetation within the mitigation site will act as a filter for any materials entering the backwater channel through surface runoff. The water temperatures in the backwater will vary throughout the day as a result of the tidal influence, current weather patterns and downstream flows. Once vegetation has matured, the site could increase water oxygen levels and release beneficial nutrients into the downstream food web. Breaching the existing riverbank would temporarily increase noise and vibrations in the surrounding areas and would temporarily increase turbidity in the work area. However, this is expected to only last for a few days during the approved in-water biological work window. Negative impacts lasting more than a single construction season are not anticipated as a result of the mitigation site construction. Therefore, ARMS is anticipated to have a beneficial effect on water quality.

4.3 Effects on the Anadromous Fishery

The property in its current state is not habitat for salmonids on the LAR. As water overtops from either Bannon Slough or the American River fish may be introduced to the old gravel pit, now referred to as a pond. Then when water retreats, fish trapped within the pond are unable to migrate downstream and completed their lifecycle.

The ARMS design involves reconnecting the pond to the American River. The elevations and slopes will be graded to facilitate water draining from the backwater into the river as water recedes, eliminating the risk of fish entrapment. Emergent wetlands plants and riparian vegetation will be planted to create cover for juvenile fish enabling them to hide from predators in the slower moving, shaded water, with plentiful food sources. In addition to replacing the shaded riverine aquatic habitat impacted by the erosion protection projects, this site will also complement the placement of spawning gravel being completed upstream by Bureau of Reclamation by enhancing rearing habitat for the juvenile fish heading down stream.

4.4 Effects on Recreation

Before May 2023, this property was held in private ownership and was not open to the general public for use. However, this did not prevent the occasional hiker, bird water or fisherman from wandering onto the private property. The river on the south and the Jedidiah Smith Memorial Bike Trail to the north of the property have always been open to the public for recreational use.

Access and haul routes will through public space such as Discovery Park and Camp Pollock. There will also be a haul route directly off Northgate Boulevard. The timing and requirements of this use are being coordinated with Sacramento Count Regional Parks Department (Regional Parks) and the Sacramento Valley Conservancy. Signs warning of the construction activities will be posted roads and bike trails. A flagger and/ or detours will be used to ensure the safety of the public and contractors. Construction-related disruptions will not occur year-round because work within a federal floodway is restricted from November 1st to April 30th. Work will not be completed by boat or barge, so at no time would navigation of the river from upstream to downstream be restricted.

Once construction is complete and vegetation is established, the created backwater could be accessed by kayakers, as a new off channel area to explore. Once the vegetation has reached the required habitat functional levels, the maintenance routes could be adopted by the Regional Parks as official trails. This would increase public access to the site and provide new recreational opportunities for hiking, wildlife viewing and fishing opportunities. Based on all these factors, the Proposed Action will benefit recreation in this reach of the parkway.

4.5 Aesthetics

Currently the site looks like a large pond surrounded by a mowed field with riparian woody vegetation lining the outer boundaries. Due to the site's location, construction will be highly visible to the public from all sides.

The view from the river will be improved by the removal of old concrete blocks, where possible, the banks will be cut to a gentler, more natural, slope. In other locations, areas may be leveled off to created vegetated planting benches or mudflats. At the breach site, rather than seeing steep eroded riverbanks, the boaters or kayakers will see a channel with IWM and native vegetation leading into a backwater area.

The view from the bike trail and Camp Pollock will be similar to each other. Edge planting will be done in asymmetrical pods of riparian vegetation which will be planted to enhance the upland riparian corridor; example is shown in **Figure 5**. This area will also provide a sense of separation from the high traffic human use areas to the more isolated, natural feeling areas for both the wildlife and the hiker.

(Note: This image is a placeholder. The edge planting graphic in development)

Figure 5. Example of Edge Planting

Towards the middle of the site, in the lower elevations, the vegetation will change, the ground will slowly slope down. The grades slopes are being designed for both the safety of human use and of wildlife. Low flow channels that are inundated year-round will be sloped towards the breach point, preventing the stranding of any fish as water levels rise and fall.

The upper riparian areas will have mature oak and elderberry (**Figure 6** and **Figure 7**), the middle riparian areas will have cottonwood and willows transitioning into emergent plant species and open channels. The goal of the project is to mimic natural habitats along the American river, and will not have long-term, permanent, adverse impacts on the aesthetics in the parkway. Overtime, the future condition of the site will be indistinguishable from the fabric of the parkway.

(Image Provided by GEI)

Figure 6. Example Upper Riparian

(Image Provided by GEI)

Figure 7. Example Elderberry Savannah

4.6 Avoidance and Minimization Measures

Consistent with the guidelines set forth in the programmatic consistency analysis (USACE, 2021), **Table 9** summarizes how ARMS will adhere to the Best Practices for designated Wild and Scenic Rivers (NPS, 2020). During discussions held during the formulation of the programmatic consistency analysis, USACE and NPS jointly devised Universal Avoidance and Minimization measures which would be adopted in the remainder of projects on the LAR under the ARCF project. A summary of how the project adheres to the reduction of temporal impacts, the NPS Best Practices and the standard minimization measures is given in **Table 6** through **Table 12**.

Table 6. Summary of Temporal Impacts – ARMS - Phase 1 - Vegetation Removal

(will be updated for the 95% Designs)

Dates	Actions	WRS Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
Fall 2025 - Spring 2026	Vegetation Removal and Elderberry Transplant	**Aesthetics** - visual impacts from the bike trail, and Garden Highway from tree removal. **Water Quality** - turbidity and temperature increase from bank disturbance and removal of shade along the riverbank. **Anadromous Fish** - loss of near shore vegetative cover. **Recreation** - Potential for detour or traffic flaggers along the bike trail. Increased traffic through Camp Pollock, Discovery Park.	**Aesthetics** - Vegetation removal will be limited to the smallest extent possible to complete the elevation contouring and access roads. Non-native, invasive species may also be removed. **Water Quality** - Use of Best Management Practices (BMP's) to reduce runoff in compliance with NPDES permit. Ground disturbance will not occur until the NMFS in water work window. **Anadromous Fish** - Temporary impacts are unavoidable, however compensatory mitigation requires a 2:1 replacement of habitat that will be fulfilled onsite once construction is completed. **Recreation** - Detours and/or flaggers will be developed with input from Regional Parks, and NPS, to ensure the least disruption to recreational assets practicable

Table 7. Summary of Temporal Impacts – ARMS - Phase 2 - Site Construction

(will be updated for the 95% Designs)

Dates	Actions	WRS Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
Summer 2026 - Fall 2027	Site Grading and inland elevation modification	**Aesthetics** - visual impacts from the bike trail, and Garden Highway of active construction and ground disturbance. **Water Quality** - no effect **Anadromous Fish** - no effect **Recreation** - Potential for detour or traffic flaggers along the bike trail. Increased traffic through Camp Pollock, Discovery Park.	**Aesthetics** - Onsite habitat that is removed will be replaced at a 1:1 ratio. Also, additional vegetation will be planted to meet the 2:1 compensatory mitigation requirement applied to the ARCF construction contracts. **Water Quality** - The majority of this work will not be occurring on the American River, there should not be impacts to water quality. **Anadromous Fish** - The majority of this work will not be occurring on the American River, there should not be impacts to anadromous fish. **Recreation** - Detours and/or flaggers will be developed with input from Regional Parks, and NPS, to ensure the least disruption to recreational assets practicable

Dates	Actions	WRS Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
Summer 2027 - Fall 2028	Breach the Riverbank - complete the site grading	Aesthetics- visual impacts from the bike trail, and Garden Highway of active construction and ground disturbance. Also, visual impacts of active construction from the Sacramento and American River of the berm being breached and debris being removed. **Water Quality** – turbidity **Anadromous Fish** - turbidity, noise, vibrations **Recreation** - Potential for detour or traffic flaggers along the bike trail. Increased traffic through Camp Pollock, Discovery Park.	**Aesthetics** - Onsite habitat that is removed will be replaced at a 1:1 ratio. Also, additional vegetation will be planted to meet the 2:1 compensatory mitigation requirement applied to the ARCF construction contracts. **Water Quality** - Water quality testing during work in the American River. Contractor must adhere to the SWPPP. **Anadromous Fish** - work within NMFS approved window to affect the least amount of individual fish as possible. **Recreation** - Detours and/or flaggers will be developed with input from Regional Parks, and NPS, to ensure the least disruption to recreational assets practicable

Table 8. Summary of Temporal Impacts – ARMS - Phase 3 – Regreening

(will be updated for the 95% Designs)

Dates	Actions	WRS Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
Fall 2028 - Fall 2029	Instillation of container plants and will stakes as well as hydroseeding and allowing natural recruitment to occur.	**Aesthetics** - Landscapers onsite **Water Quality** - potential for turbidity increase when plants are installed. **Anadromous Fish** - potential for turbidity increase when plants are installed. **Recreation** - Potential for detour or traffic flaggers along the bike trail.	**Aesthetics** - Landscapers will be onsite during the county allowed work times. **Water Quality** - Use of Best Management Practices (BMP's) to reduce runoff in compliance with NPDES permit. Ground disturbance will not occur until the NMFS in water work window. **Anadromous Fish** - In water work will only occur during the NMFS approved work window. **Recreation** - Detours and/or flaggers will be developed with input from Regional Parks, and NPS, to ensure the least disruption to recreational assets practicable

Table 9. Summary of Temporal Impacts – Phase 4 - Site Establishment & Maintenance

(will be updated for the 95% Designs)

Dates	Actions	WRS Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
2029 +10	none	**Aesthetics** - No Temporary Impacts **Water Quality** - No Temporary Impacts **Anadromous Fish** - No Temporary Impacts **Recreation** - No Temporary Impacts	**Aesthetics** **Water Quality** **Anadromous Fish** **Recreation**

Table 10. Summary of Temporal Impacts – ARMS - Phase 5 -Long-term Operations and Maintenance

(will be updated for the 95% Designs)

Dates	Actions	WRS Resources Temporarily Affected	Planned Minimization Measures for Temporary Impacts
Life of the Project	none	**Aesthetics** - No Temporary Impacts **Water Quality** - No Temporary Impacts **Anadromous Fish** - No Temporary Impacts **Recreation** - No Temporary Impacts	**Aesthetics** **Water Quality** **Anadromous Fish** **Recreation**

Table 11. Summary of Adherence to NPS Best Practices

NPS Best Management Practice	Proposed Action
Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock.	Rock is only being considered at the breach point to prevent scour and bank collapse of the new backwater channel, otherwise the entirety of the site will be vegetated.
If necessary, stone fill (riprap) may only be used for abutment scour protection; the use of stone fill to stabilize the riverbanks is prohibited. To stabilize the riverbanks, use approved native boulders, cobble, and gravel; loam; vegetation; and bio- engineering techniques such that the banks, when fully restored, have an appearance and function similar to the natural riverbank.	Stone riprap may be placed at the breach point to prevent scour and erosion. The remainder of the site will be vegetated. Once the vegetation is established, the site should seamlessly blend into the rest of the parkway appearance.
Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed.	Riparian areas will be expanded as part of the project design.
Disturbed/exposed banks, staging and project access areas must be properly stabilized (seeded, mulched, or otherwise) with native vegetation to prevent erosion and establishment of invasive plant species. A non-persistent cover crop of annual rye or equivalent temporary seeding may be used to ensure a more rapid establishment of cover while native perennial plantings grow.	Immediately following construction, the site will be hydroseeded with an appropriate native seed mix.
Bio-engineering methods must be used or, where deemed necessary by the [National Parks Service], clean broken rock riprap of an adequate size specific for bank stabilization.	Site preparation cannot be accomplished through bioengineering methods; however, the overall purpose of the project is to provide natural, riparian habitat. Clean, broken riprap from an approved quarry would be used if necessary.
The use of demolition debris for slope armoring is not allowed.	No demolition debris would be used for slope protection.
Avoid unnecessary tree removal within the project work area.	Tree removal has been minimized to the extent feasible. The tree removal will only occur where necessary to change the grade elevation or breach the riverbank. Native trees will be planted onsite.
A vegetation plan shall be in place to protect existing vegetation/trees from damage by construction equipment (e.g., provide temporary barriers to protect existing trees, plants, root zone).	Trees that will be protected in place will be marked using orange construction fencing or chain-link fences.
Disturbances of the riparian zone must be limited to the indicated access points; prior to the operation of heavy equipment (dozers, cranes, trucks), orange construction fencing must be erected to delineate the dripline of remaining trees to avoid compaction of tree roots.	Orange construction fencing or chain link fences will be used to delineate the site boundaries. No work will occur outside the construction footprint or designated staging areas.
The fastening of ropes, cables, or fencing to trees is prohibited.	No ropes, cables, or fencing will be fastened to trees marked for retention.

NPS Best Management Practice	Proposed Action
To ensure bank stability, trees removed within fifteen feet of the top of the riverbank shall be cut flush to the ground; stumps and roots shall be left in place; indiscriminate bulldozing of riparian trees is prohibited.	Tree removal to adjust the ground elevations may require the removal of the root ball, invasive trees such as locust trees will need to have the stumps and roots removed to prevent resprouting., At no point would indiscriminate bulldozing occur.
All trees removed from the riparian corridor shall be replaced with a native tree of like species. Replace each mature tree removed (12-inch or greater diameter at breast height [DBH])]. Plant only local, native trees/shrubs/grasses, naturally occurring within the [insert river name] riparian zone [insert plant species list and/or to be determined in coordination with appropriate staff].	Limited tree and herbaceous vegetation will be removed from within the project footprint. Trees and vegetation not within grading areas will be protected from construction activities, unless they are invasive, non-native species. Riparian habitat acreage will be replaced by planting riparian trees and shrubs at a ratio of 1:1 (replacement habitat: affected habitat), The ARMS design is to accommodate the mitigation that could not fit onsite resulting from bank protection impacts. Only native plant species appropriate for the sites and approved by the County of Sacramento for planting in the Parkway, will be used.
A qualified individual (arborists, foresters, or trained staff with similar experience) shall plant replacement trees at the appropriate time of year and in a random fashion to avoid a plantation effect. Cultivate and monitor planted tree seedlings/saplings for two years to ensure success; water plantings as necessary. Promptly replace planted stock showing signs of mortality.	Replacement trees will be planted at designated riparian habitat restoration areas according to designs prepared under the supervision of a California licensed USACE landscape architect with experience in developing habitat restoration. The mitigation sites will be managed and monitored according to the ARCF GRR Habitat Mitigation Monitoring and Adaptive Management Plan, and a site-specific management plan which includes short term, long term, and adaptive management actions.
Stakes and guide wires shall be properly removed and disposed of once seedlings are established.	All stakes, fencing, and any other construction or mitigation related materials will be removed once construction is completed and once mitigation plants have become established and mature.

Table 12. Summary of Adherence to Universal Avoidance and Minimization Measures

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Levee Setbacks	Set back the levees wherever possible to allow the river to move.	Free-Flow	Levee setbacks are not feasible in this area due to the existence of homes and businesses, and major roadways immediately behind the levee. The breach at ARMS will reconnect disconnected floodplain.
Bioengineering and native plantings throughout the banks and levees	Avoid riprap to the extent possible. Use bioengineering techniques including use of wood (e.g., log crib walls, tree revetments, root revetments; engineered log jams) and deformable techniques (e.g., fabric-encapsulated soil lifts (i.e., geolifts), rock bags, coir rolls (i.e., bio logs), erosion control blankets/fabrics).	Free-Flow, Anadromous Fish	Riprap is being avoided int eh ARMS design to the maximum extent possible. On the riverbanks, old debris is being removed to naturalize the bank line an improve aesthetics and habitat value. IWM will be placed at appropriate water surface elevations to create a naturalistic appearance and restore function.
Riprap at the bank toe	Riprap would only be placed at the bank toe of segments where the levee prism and associated planting berms (if included) are at the extent of the Parkway limits.	Free flow	The ARMS site design does not include riprap at the bank toe.
Riprap at the bank toe	Ensure no hydraulic impacts from riprap.	Water quality	It is anticipated that the completion of the ARMS project will reduce hydraulic pressures in this portion of the river by opening up disconnected floodplain.
Riprap at the bank toe	Ensure no direct and adverse impacts to anadromous fish.	Anadromous Fish	The direct and indirect impacts to anadromous fish will only occur at the breach site. Construction will be completed during daylight hours, within the appropriate work window All direct and adverse effects to anadromous fish have been considered in the programmatic biological opinion for the project. Jointly with the National Marine Fisheries Service (NMFS). Upon completion of the project, the site will be a benefit to anadromous fish that out migrate on the LAR.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Riprap at the bank toe	Minimize the use and visibility of rock channel protection (RCP) and use only the minimum amount necessary to protect structures. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. If rock is needed utilize cobble to the extent possible. Cover exposed riprap at the bank with soil and vegetation where cobble is not possible.	In-water recreation Aesthetics	Riprap at the bank toe is not part of the ARMS design.
Avoid and Minimize use of riprap on the bank above the toe to the OHWM and near the water	Minimize the use and visibility of RCP. RCP should be avoided or minimized to the extent possible. Integrated plantings, soil, and native seed may be used to further reduce the profile of visible rock. Cover any necessary riprap on the bank above the OHWM with planting benches containing sufficient soil and capable of supporting riparian habitat.	Anadromous Fish Recreation Aesthetics	Rip rap is not a primary element of the AMRS design. If necessary, it will only be used at the breach point to avoid scour and bank collapse. The entirety of the site will be planted, hydroseeded or naturally vegetated.
Minimize use of Riprap on the levee slope	Cover revetment on the slope with sufficient soil and native grasses or forbs, as woody vegetation may not be possible due to USACE vegetation on levees policies.	Anadromous Fish Aesthetics	After site preparation the site will be hydroseeded with appropriate native grasses and forbs. Site designs are consistent with this measure.
Removal of vegetation	Minimize vegetation removal to the maximum extent practicable. Provide planting benches to reduce the affects for lost habitat on-site. Riparian areas must be restored to pre-disturbance conditions immediately after construction activities are completed. Provide restoration in the parkway when revegetation cannot be completely restored in the project footprint. Re-vegetate all areas of the repair site above the waterline with native, ecotone appropriate, species. Design sites such that they are indistinguishable from the overall fabric of the Parkway.	Anadromous Fish Aesthetics Water quality	Tree removal has been minimized to the maximum extent possible. Only trees within the construction footprint, or designated haul routes will be removed. Haul routes have been placed to avoid trees and elderberry shrubs to the extent feasible. Access ramps have been oriented to minimize the impacted area to the extent practicable. Established roads will be used as haul routes wherever possible. This site is intended to provide the compensatory mitigation that could not be accomplished at the ARCF bank protection sites. Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
Closure of bike trail	The first priority is to detour the bike trail on the nearest dedicated trail. That is, the trail should not be shared with automobiles. If the bike trail segment being detoured is paved, the detour route should also be completely paved to include all transitions from permanent to temporary trails/detours. In an event due to where the trail cannot be routed near construction boundaries for safety concerns it should be detoured to surface streets with bicycle safety measures for a minimal amount time. Detours to surface streets should be considered the last option and review by all stakeholders. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Minimize the extent of the closure. When feasible use flaggers instead of detours. Minimize the length of time the detours are needed. Detours will carry the same safety standards as a permanent trail and if detours go down to one bicycle lane, caution should be considered and the included use of flaggers with dismount zones in single lane areas. Any permanent re-routing of the bike trail should also include rerouting the equestrian trail. Re-routed trails should provide the same experience as the existing trail including the aesthetics. The new trail should be shaded with riparian vegetation.	Recreation	Bike trail detours will be provided around the work on 3B North and 3B South. Section 3.4 and Figures 36-40 of this report provides additional details. Existing trail system within the Parkway will be used for detours where feasible. Detours top of levee and to public surface street will also be used in certain locations. In the vicinity of Watt Bridge, two detour options will be available to bikes: both within Parkway trail options. In all cases, rider safety is of paramount importance. Signage, physical barriers separating riders from other motorized vehicles, and/or in-person flaggers will be present to avoid safety risks to bike riders. Informational signage will be posted at the upstream and downstream ends of the detour as well as at the closure points. Information will also be provided on-line.
Closure of levee maintenance road	Detour the route, if normally used as a hiking, horse, or mountain bike trail. Provide information at both ends of the closure and on the web about the location and duration of the closure and provide a map of the detour. Plant vegetation to provide shading along this road once users return to the extent possible.	Recreation	Where an affected levee maintenance road is used by hikers, bicycle riders and/or horseback riders, detours will be provided. Information will be provided at the closure points and online. Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
General Impacts of Work in the Parkway	Reduce work limits to the maximum extent practicable. Close trails and other recreational features only when necessary for safety of the public. Advance notice of work shall be provided at the site of the closures and on the web.	Recreation	Every effort has been made to reduce the work area to the extent practicable. Advance notice of the work would be provided on sacleveeupgrades.com. and coordinated with Regional Parks.
General Impacts of Work in the Parkway	Phase work appropriately such that sites do not remain incomplete for excessive periods of time (e.g., bank work completed but planting delayed for years, or tree clearance years ahead of the construction etc.)	Aesthetics	Work is scheduled to be conducted sequentially. Gaps in the construction sequence would be limited to necessary safety stand downs during the flood season when no work may be conducted in the floodway. Work in the dry will be completed before the breach is constructed to limit impacts to fisheries.
Closure of boat ramp	Avoid closure of boat ramps to the maximum extent practicable. Phase work such that not more than one boat ramp is closed. Provide information at the closure and on the web about the location and duration of the closure and the nearest open boat ramp. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	The ARMS design will not require the closure of any public boat ramps.
Closure of river access points	Avoid closure of river access points to the maximum extent practicable. Phase work such that consecutive river access points are not closed for more than one consecutive mile on account of this project. Provide information at the closure(s) and on the web about the location and duration of the closure and the nearest open river access points. Minimize closure time and keep it open when work is not being done on the weekends and in the evenings. Provide improvements to the boat launch once users can return to the site.	Recreation	The ARMS design will not require the closure of any public river access points. Once establishment has been met, the site may create additional river access.
In water work	Abide by NPDES requirements to ensure there is no adverse effect to water quality.	Water Quality	Site designs are consistent with this measure.

Proposed Design Feature:	Proposed Avoidance or Reduction of Impact Measure:	WSR Aspect(s):	Adherence to the Measure:
In water work	Abide by NMFS Biological Opinion to ensure there is no adverse effect to anadromous fish from water quality.	Anadromous Fish	Site designs are consistent with this measure.
In water work	Provide buoys or other demarcation for closed sections of the channel. The channel shall not be closed such that upstream or downstream navigation is precluded.	In-water recreation	Buoys or other demarcation would be provided at the turbidity curtain boundary. At no time would navigation be completely precluded.

5 Conclusion

USACE has determined that the ARMS should be considered consistent with the mandates of the WSRA because:

a) The project is a part of the authorized ARCF project and fits within the scope of the overall project.

b) The minimization measures proposed for each design specific feature, as outlined in the Universal Minimization Measures, will be used.

c) This project will be conducted under the standing biological opinions for the ARCF project and will be subject to the terms and conditions therein.

d) This project will be conducted under the programmatic 401 certification for the ARCF project and will be bound to the terms therein.

e) This project will improve habitats and ecological functions to the designated river that have been impacted by historic use onsite and by authorized improvements within ARCF.

f) This project will provide the compensatory mitigation required in previous WSRA Consistency Determinations.

USACE requests concurrence from NPS within 60 days of the date of this document.

6 References

Central Valley Regional Water Quality Control Board (CVRWQCB). 2021. Clean Water Act Section 401 Water Quality Certification and Order for the American River Common Features Project, Sacramento County (WDID#5A34CR00819). July 2021.

County of Sacramento. 2008. Sacramento County, American River Parkway Plan 2008. Municipal Services Agency, Planning and Community Development Department. Available: https://regionalparks.saccounty.net/Parks/Documents/Parks/ARPP06-092617_sm.pdf.

National Marine Fisheries Service (NMFS). 2021. *Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the American River Watershed Common Features General Reevaluation Report Reinitiation 2020.* File No. WCRO-2020-03082.

National Park Service (NPS). 2021. *American River Common Features Project, Consistency Determination under Section 7, National Wild and Scenic Rivers Act.* July 2021.

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U.S. Fish and Wildlife Service. 2021. *Biological Opinion, Reinitiation of Formal Consultation on the American River Common Features (ARCF) 2016 Project, Sacramento and Yolo Counties, California.* File No. 08ESMF00-2014-F-0518-R003.

1. APPENDIX K
CLEAN WATER ACT SECTION 404(b)(1) WATER QUALITY EVALUATION
AMERICAN RIVER COMMON FEATURES
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/ SUBSEQUENT ENVIRONMENTAL IMPACT REPORT XIV
SACRAMENTO, CALIFORNIA

This document constitutes the Statement of Findings, and review and compliance determination according to the Section 404(b)(1) Guidelines for the proposed project described in the American River Common Features Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR) issued by the U.S. Army Corps of Engineers (USACE), Sacramento District. This analysis has been prepared in accordance with the Section 404(b)(1) Guidelines, 40 CFR Part 230 and the USACE Planning Guidance Notebook, Engineer Regulation (ER) 1105-2-100.

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List of Acronyms

Acronym	Description
ARCF	American River Common Features
ARMS	American River Mitigation Site
BMPs	Best Management Practices
BO	Biological Opinion
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CFS	cubic feet per second
CVFPB	Central Valley Flood Protection Board
CVRWQCB	Central Valley Regional Water Control Board
CWA	Clean Water Act of 1972
DWR	State of California Department of Water Resources
ER	Engineering Regulation
ESA	Endangered Species Act
ETL	Engineering Technical Letter
FEIS	Final Environmental Impact Statement
FEIR	Final Environmental Impact Report
GRR	General Reevaluation Report
HTRW	Hazardous, Toxic and Radioactive Waste
IWM	Instream Woody Material
LAR	Lower American River
LEDPA	Least Environmentally Damaging Proposed Alternative
MCDC	Magpie Creek Diversion Canal
MCP	Magpie Creek Project
NEPA	National Environmental Policy Act
NEMDC	Natomas East Main Drainage Canal
NM FS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units
OHWM	Ordinary High Water Mark
O&M	Operations and Maintenance
pH	potential Hydrogen
SAFCA	Sacramento Area Flood Control Agency
SEIR	Subsequent Environmental Impact Report
SEIS	Supplemental Environmental Impact Statement

Acronym	Description
SREC3	Sacramento River Erosion Contract 3
SREL	Sacramento River East Levee
SRMS	Sacramento River Mitigation Site
SWPPP	Stormwater pollution Prevention Plan
UPRR	Union Pacific Railroad
U.S.	United States
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WOTUS	Waters of the U.S.

I. Introduction

a. Background

The Sacramento Metropolitan area is one of the most at risk areas for flooding in the United States (U.S.). The American River Common Features (ARCF) 2016 Program is a cooperative effort by U.S. Army Corps of Engineers (USACE); the Central Valley Flood Protection Board (CVFPB), the non-Federal sponsor, represented by the State of California Department of Water Resources (DWR); and the Sacramento Area Flood Control Agency (SAFCA), the local sponsor. The purpose of ARCF 2016 Program is to improve the existing infrastructure to reduce flood risk along the American and Sacramento Rivers. USACE completed the ARCF General Reevaluation Report (GRR) Final Environmental Impact Assessment/Environmental Impact Report (EIS/EIR) in 2016. USACE completed the Draft Supplemental EIS/Subsequent EIR (SEIS/SEIR) in 2023 to evaluate design refinements since the 2016 GRR FEIS/EIR including: American River Erosion Contract 3B, 4A, and 4B, Sacramento River Erosion Contract 3 (SREC3), Magpie Creek Project (MCP), American River Mitigation Site (ARMS), Sacramento River Mitigation Site (SRMS), and the Piezometer Network.

The ARCF SEIS/SEIR identifies seepage, stability and erosion concerns associated with the existing flood risk management system protecting the city of Sacramento and surrounding areas. There have been authorized improvements to Folsom Dam that allow higher emergency releases, up to 160,000 cubic feet per second (cfs). There is a high probability that increased flows from a 160,000 cfs emergency release from Folsom Dam would stress the network of levees protecting the City of Sacramento along the American River and Sacramento River to the point that levees could fail. The consequences of such a levee failure would be catastrophic, since the area inundated by flood waters is highly urbanized and the flooding could be up to 20 feet deep, in some areas.

The ARCF GRR Final EIS/EIR and its Clean Water Act (CWA Section) 404(b)(1) alternatives analysis previously analyzed several alternatives, including a No Action/No Project Alternative and two action alternatives. Alternative 1 includes levee improvements only and Alternative 2, the recommended plan, includes levee improvements and widening the Sacramento Weir and Bypass.

b. Amendment to the 2015 ARCF CWA 404(b)(1) Alternatives Analysis

This amended analysis evaluates the consistencies and differences of the Final EIS/EIR Proposed Action with the 2015 ARCF GRR's 404(b)(1). The source materials are:

- USACE (2015) *Draft Section 404(b)(1) Water Quality Evaluation American River Common Features General Reevaluation Report*. Appendix E in USACE (2016). This Clean Water Act Section 404(b)(1) evaluation first describes the alternatives considered, including the No Action and the Proposed Action. The differences between the alternatives are associated with the type of erosion protection, whether it be through construction of a launchable rock filled trench, bank protection, or a combination of the two. The alternatives description section also provides information on why certain alternatives were not selected, based on impacts to Waters of the U.S. and practicability factors. Lastly, the Proposed Action is compared to the determinations and findings of the 2015 404(b)(1) to demonstrate how the Proposed Action is consistent with those findings and is the Least Environmentally Damaging Practicable Alternative (LEDPA).

- USACE. 2016. *American River Watershed General Reevaluation Report, Final Environmental Impact Statement / Environmental Impact Report.* May. Sacramento, California. State Clearing House Number 2005072046.

    - USACE. 2023. American River Common Features, 2016 Flood Risk Management Project, Sacramento, California. Draft Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report XIV. State Clearing House Number 2005072046.

c. Summary

The ARCF GRR Final EIS/FEIR, and the associated CWA Section 404(b)(1) consistency determination, previously analyzed several alternatives, including a No Action/No Project Alternative and two action alternatives. Some of the actions described in the ARCF GRR Final EIS/EIR have been accomplished. This consistency determination analyzes design refinements still to be constructed as a part of the authorized 2016 ARCF Proposed Action, including engineering design modifications, footprint expansions, and compensatory habitat mitigation approaches. The design refinements include actions within eight project components: American River Erosion Contracts 3B, 4A, and 4B; (ARMS) at the Urrutia Property; SREC3; MCP; SRMS at Grand Island; and a piezometer network. American River Erosion Contract C4B and the piezometer network would not have impacts on waters of the U.S. (WOTUS); therefore, they will not be evaluated herein.

The differences between the 2015 ARCF GRR's 404(b)(1) evaluation and the 2024 SEIS Proposed Action impacts to WOTUS primarily consists of an increase in the acreage of fill, a new method of erosion protection – launchable rock toe, filling of a newly designated wetland, and the addition of two compensatory habitat mitigation sites.

d. Conclusion

The impacts resulting from the design refinements to the authorized 2016 ARCF Proposed Action increase the discharge of fill material into WOTUS and discharge into previously unspecified wetlands; therefore, these actions are not consistent with the previous consistency determination and additional evaluation is provided herein.

The LEDPA was determined according to the following findings:

A. The discharge represents the least environmentally damaging, practicable alternative.

B. The discharge does not cause or contribute to violation of any applicable state water quality standard, does not violate any applicable toxic effluent standard.

C. The discharge does not cause or contribute to significant degradation of the waters of the US (WOTUS).

D. All appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.

II. Proposed Action and Alternatives

a. Location

The Project includes several distinct locations where its components would be constructed: American River Erosion Contract 3B North and South, American River Erosion Contract 4A, ARMS, SREC3, SRMS, and the MCP. These locations shown in Figure 1 and described in more detail in Section f.(3) ‘Description of the Proposed Discharge Site.’

American River Erosion Contract 3B North and South are between river miles 7.8 and 10.3 on the lower American River. American River Erosion Contract 4A is on the right bank downstream from these locations near RM 2.0 under the State Route 160 Bridge and the Union Pacific Railroad (UPRR) Bridge. The ARMS is located on the American River at RM 1.3 between Discovery Park and Camp Pollock. The SRMS is an approximately 200-acre site located at the confluence of the Sacramento River, Steamboat Slough, and Cache Slough, near Sacramento RM 15. Sacramento River Erosion Contract 3 begins approximately 7 miles downstream from the confluence of the American and Sacramento Rivers adjacent to the Pocket-Greenhaven neighborhood. The MCP is located within Sacramento County between the North Highlands and Rio Linda communities, north of Interstate 80 (I-80), and is bisected by Raley Boulevard.

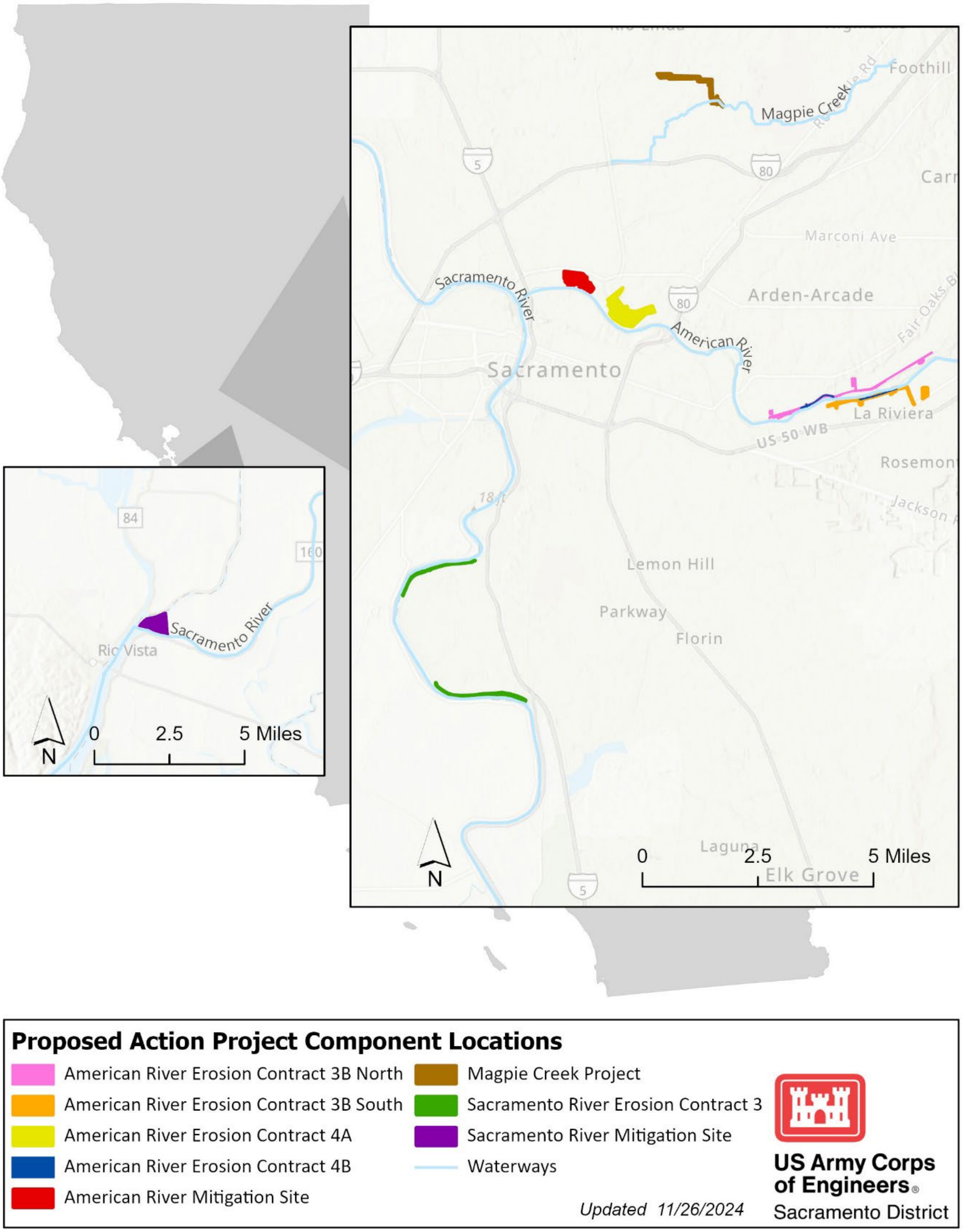

Figure 1. Location Map.

b. Proposed Project

The Proposed Action only includes the components that are modifications or design refinements of the ARCF GRR Final EIS/EIR Proposed Action: American River Erosion Contract 3B North and South, American River Erosion Contract 4A, ARMS, SRMS, SREC3, and MCP. This section describes each component in more detail. This action is considered a practicable alternative and will be retained and evaluated in determining the LEDPA.

(1) American River Erosion Contract 3B South

Site 4-1 levee improvement work would be conducted on the left bank of the Lower American River between RM 9.1 to RM 10.5. As with Sites 3-1 and 4-2, bank protection would be constructed on the levee and riverbank and consist of soil-filled revetment. Launchable trenches would be buried to allow site revegetation. The description of launchable rock toe under Site 3-1 generally applies to Site 4-1 as well. The two sites were designed slightly differently to minimize impacts to the Fair Oaks geologic formation. There would also be tie backs higher up on the bench, outside the launchable trench, as a form of erosion protection. These tie backs are built up of revetment placed in a triangular shape, to address flanking concerns. The top of the tiebacks are approximately 21 feet across, and the tip of the triangular shape is 7 feet below existing grade of the levee overbank. They are built so that during high flows, erosion would be minimized in between different types of erosion protection treatment. In addition, there are locations at Site 4-1 where there is a launchable toe at the riverbank toe (referred to as bank toe in SEIS/SEIR Figure 3.5.2-9), unlike the typical launchable toe at American River Erosion Contract 3B where the launchable toe is at the edge of the planting bench (as shown on SEIS/SEIR Figure 3.5.2-13). This erosion protection feature is covered in soil to allow vegetation to grow on top of it. Additionally, at Site 4-1 there is a location where the toe is there to stabilize the planting bench.

The design of the erosion protection features, specifically the planting benches, soil-filled revetment, and buried launchable trench allows for the site to be revegetated and used for onsite mitigation for riparian habitat and salmonid habitat. The description of onsite mitigation, excavation, ramps, tree removal, and use of excavated materials described under Site 3-1 apply to Site 4-1 as well.

(2) American River Erosion Contract 3B North

This section describes the flood risk reduction improvements proposed for American River Erosion Contract 3B North, which has been divided into two sites: 3-1 and 4-2. Construction at these sites would include approximately 1.8 miles of launchable rock toe, launchable trench, and bank protection.

Site 3-1

Site 3-1 flood risk reduction improvements would be conducted on the right bank of the Lower American River between RM 7.8 and RM 8.8. The erosion protection method proposed at Site

3-1 is a combination of bank protection (both on the levee and riverbank) and launchable rock toe protection with planting benches. Bank protection consists of a layer of soil-filled revetment. For Site 3-1, bank protection includes both soil-filled levee embankment and riverbank revetment. The revetment with either be buried or soil filled, a soil lift placed above the soil filled revetment, coir surface fabric and then replanted. Bank protection would be located both on the levee slope in some areas within the project site and just upslope of the launchable toe and planting bench. Some excavation may be required for the bank protection and launchable rock toe with planting bench to get to design grade. Additional excavation would be needed to construct temporary ramps to access the site.

The layout of launchable rock toe at Site 3-1 generally includes a peaked stone pile within the river that is supporting a planting bench between the stone pile and the existing bank. The launchable rock would be covered with a layer of choke stone fill (smaller rock that would fill in the gaps between the larger pieces of revetment) to both minimize potential for predatory fish to hide in rock voids, and to reduce the artificial appearance of the launchable rock. The launchable rock toe is designed to “launch” into areas where erosion of the channel bottom occurs and progresses during a flood event below the toe of the rock. This launched layer of riprap is designed so that it would cover the eroded surface of the new channel bottom and inhibit further progression of the eroded slope. Once fully launched, a layer of riprap (with a minimum thickness between 18 and 49 inches) would extend from the channel toe to the maximum depth of scour predicted in the river channel. Planting bench tiebacks would be placed periodically throughout the planting benches to limit the extent of erosion and subsequent damage to a planting bench during a flood event. Along the lower bench, instream woody material (IWM) structures consisting of whole trees with intact root wads would be installed to increase the roughness of the bench and to provide fine-textured woody material along the river margin for juvenile salmonid rearing habitat.

Additionally permanent operation and maintenance ramps will be installed to ensure that the erosion protection features can be monitored in the future.

Site 4-2

Located above the OHWM, Site 4-2 is not within or near a WOTUS. Site 4-2 consists of levee improvements on the right bank of the Lower American River between RM 9.7 and RM 10.3. Approximately 2,900 linear feet of bank protection and launchable trench would be used as the erosion protection method at Site 4-2. Bank protection would be located on the levee slope. The launchable trench would be buried to provide soil above the revetment to allow grasses to reestablish. The revetment with either be buried or soil filled, a soil lift placed above the soil filled revetment, coir surface fabric and then replanted with grasses.

The Site 4-2 work location is under existing infrastructure (a dirt maintenance levee toe road and the Jedediah Smith Memorial Recreational Trail) and areas within the vegetation-free zone with only grassy vegetation. The description of onsite mitigation, excavation, ramps, tree removal, and use of excavated materials described under Site 3-1 apply to Site 4-2 as well.

(3) American River Erosion Contract 4A

American River Erosion Contract 4A includes construction of an armored berm approximately 100 feet wide on the water side of the levee near RM 2.0. This feature would be constructed on the right bank of the American River immediately upstream of Jedediah Smith Memorial Trail's undercrossing of the California SR-160 bridge. This berm would disrupt the bike trail. Additionally, this alternative requires relocation of a 12” water line. If work is conducted while there is still water within the wetland, additional temporary impact to the wetland would occur as dewatering would be needed. A water bladder dam or sandbag dam would be used to dewater the wetland within the project area.

Erosion Protection

American River Contract 4A levee work would be conducted on the right bank of the Lower American River near RM 2.0 and upstream of the SR-160 bridges (SEIS/SEIR Figure 3.5.3-1). To reduce the risk that high-velocity flood waters could scour the levee around the SR160 bridge piers and destabilize the levee, a berm is proposed upstream of the bridge to deflect high-velocity flood waters away from the levee slope. Due to the physical constraints at this location, the berm footprint would impact a portion of an existing wetland and would extend up the levee. The berm would also block the current alignment of the Jedediah Smith Memorial Trail. The berm would be armored to prevent erosion (SEIS/SEIR Figure 3.5.3-5).

Bike Trail Reroute

The proposed berm would block the current path of the Jedediah Smith Memorial Trail. To allow continued used of the Jedediah Smith Memorial Trail in this area, a bike trail reroute will need to be constructed (SEIS/SEIR Figure 3.5.3-1 and SEIS/SEIR Figure 3.5.3-4 in the map listed as Alternative 3c). Constructing this route would require tree and vegetation clearing, regrading, paving, and adding fill into a WOTUS.

(4) American River Mitigation Site

The current preferred location for the ARMS is at the approximately 120-acre site purchased for mitigation between RM 1.0 and RM 1.6 in the American River Parkway, previously known as the Urrutia Property. AMRS is being designed to consider historical site conditions and adapt existing conditions to restore, enhance, and maximize habitat for salmonids. The design will restore up to 66 acres of salmonid habitat and will function as a backwater channel that fills through a single inlet from the main river channel located at the southeast limits of the site (SEIS/SEIR Figure 3.5.5-1). Habitat benches will be incorporated into the backwater channels to provide shallow water salmonid habitat at various water surface elevations. The lowest flow channels are being designed to be inundated year-round, and the entire basin would hold water during high water events. The benches will be continuous with gradual slopes and a positive gradient toward the main river channel to reduce stranding risks as water recedes.

Site grading design will be based on creation of backwater floodplain habitats, removal of non-native vegetation and seed bank, incorporation of IWM, and improved connectivity to the main river channel. Excavation would be required to provide connection to the main river channel.

The import of material and grading to fill the man-made pond in the floodplain is necessary to cover existing debris and improve rearing habitat for salmonids by reducing inundation depths and establishing elevations that provide an opportunity for wetland and riparian vegetation to establish and naturally recruit. The visual goal is for the habitat mitigation to blend in seamlessly with the surrounding riparian forest. Breaching of the existing bank line would result in removal of existing materials to create a connection to the inland of the project site. Once the site is connected to the river, the site would convert the existing pond to emergent wetlands and create additional acres of WOTUS.

(5) Sacramento River Mitigation Site

Analysis of the SRMS is presented at a program level because only conceptual designs are available for environmental analyses. Habitat mitigation improvements at SRMS would include breaching the existing perimeter berms, grading to create channels, stabilizing bank protection, and vegetation planting. Breaching the berms would allow surface water to flow through constructed channels for tidal wetland habitat. Channels would be designed for tidal circulation to improve food production in the wetland. This would convert the freshwater seasonal wetlands of the site's interior into tidally influenced shallow riverine habitat and emergent wetlands. The design would incorporate IWM where appropriate. Revegetation would include a palette of native trees, shrubs, grasses, and aquatic vegetation. Aquatic vegetation should include native submerged and emergent wetland plants. The shallow water and aquatic spawning habitat would provide sheltered slow-moving water, food and cover for Delta Smelt, juvenile Salmon and Steelhead. Appropriate aquatic habitat conditions could encourage invertebrate plankton populations to flourish within the constructed wetland to support the food web for Delta Smelt. The wetland design will incorporate habitat features that reduce the presence of predators and do not create fish traps during low water circumstances. The riparian vegetation would provide resting, foraging, roosting, and nesting habitat for numerous avian species, as well as the local terrestrial fauna. The visual goal for the habitat mitigation is for the site to blend in seamlessly with the surrounding riparian forest, although many years would be required for the vegetation to fully mature. The only fill material anticipated at SRMS is expected to occur within seasonal wetlands located on the land side of the levees, this fill is necessary to prevent creating fish traps and to provide appropriate tidal wetland elevations. Breaching of the levee would result in removal of existing materials to create a connection to the inland of the project site. Once the site is connected to the river, the site would create additional acres of WOTUS.

(6) Sacramento River Erosion Contract 3

Sacramento River Erosion Contract 3 includes three sites (7, 8 and 9) totaling 2.8 miles between river miles 47.3 and 53.1 in Sacramento's Pocket neighborhood. Sump 70, which is owned by the City of Sacramento, would be protected in place. The planned erosion protection method for all sites includes placement of rock revetment on the left (east) riverbank to prevent erosion and possible failure of the levee that protects the adjacent Pocket neighborhood. Quarry stone revetment would be placed on-grade along the riverbank between the riverbed and the summer water surface elevation to protect against scour and erosion during high river flows. The design would incorporate a launchable rock toe, consisting of a thicker layer of quarry stone along the riverbed. The launchable rock toe is designed to deploy and fill any eroded areas during high flows, protecting further erosion from occurring. To protect against boat wake erosion during the peak recreation season, quarry stone would be placed on the shoreline above the summer water surface elevation to slightly above the boat wake zone. This stone would feature soil fill to cover the voids in the rock and would be hydroseeded with native grasses and forbs. IWM would be placed along the shore to provide shaded riverine aquatic (SRA) habitat. The IWM will be placed at least 50-feet from the private boat docks. Rock tiebacks would be installed perpendicular to the river's flow to provide additional erosion protection for the upper banks. Tiebacks would be spaced intermittently, as needed, and eliminate the need for continuous rock protection up to the top of the levee. SEIS/SEIR Figure 3.5.4-1 and SEIS/SEIR Figure 3.5.4-2 show the approximate number and location of tiebacks. The launchable rock toe and tiebacks are design refinements that were not previously analyzed in the ARCF GRR Final EIS/EIR.

The design includes features to replace aquatic habitat impacted by the project. For the reestablishment of riparian vegetation, soil-filled planting benches would be incorporated into the rock revetment in areas where the slope allows. IWM consisting of whole trees would be anchored into the bank revetment at the summer water surface elevation to provide shelter and shading for fish. The IWM would be placed at least 50 feet from the private boat docks.

The anticipated method of construction has changed from what was described in the ARCF GRR Final EIS/EIR, which previously stated that all construction work would occur from equipment stationed on barges. The anticipated method of construction for the Proposed Action would still include equipment stationed on barges, but equipment would also leave the barges to place rock along the shoreline.

In this document the American and Sacramento River erosion protection measures are cumulatively referred to by the shorthand "erosion protection."

(7) Magpie Creek Project

Magpie Creek improvements include a levee extension, widening and realignment of a portion of the MCDC, culverts beneath the Sacramento Northern Bike Trail, and flowage easements to allow water retention on an approximately 80-acre area upstream of Raley Boulevard. A levee extension would be constructed crossing Raley Boulevard and extend approximately 1,000 feet to the east along the top bank of the MCDC to tie into existing high ground. Raley Boulevard would be realigned eastward and cross up and over the extended levee. The roadway grading would remain elevated as it crosses the MCDC to accommodate installation of three up to 7-foot- high by 10-foot-wide culverts (SEIS/SEIR Figure 3.5.1-2). The roadway alignment change would avoid permanently blocking the entrances of businesses during construction of the levee and culvert and would help maintain the mandatory safe stopping distance for vehicles traveling at the posted speed limit. There is a 2.4-acre wetland east of Raley Boulevard that would be affected by the construction of the MCP. The realignment of Magpie Creek and maintenance road construction on the right bank would permanently impact approximately 0.30 acre of this wetland.

The MCDC would be widened and realigned up to maximum 25-foot bottom width with an exception at Raley Boulevard to meet the width of the culverts, with 2:1 ratio slope between Raley Boulevard to Vinci Avenue (approximately 2,100 feet). The levee on the west bank of the channel would be raised to a uniform top elevation of 50.2 ft along the Raley Boulevard to Vinci Avenue segment. This segment would include a landside gravel maintenance road to the west of the levee.

Vegetation, including mature trees and shrubs, would be cleared from the bed and banks of the MCDC from Vinci Avenue to Dry Creek Road (approximately 2,700 feet). Channel slopes would also be modified in this reach to meet a 2:1 slope. Maintenance roads (12-foot wide with 2-foot shoulders) with gravel surfaces would be constructed on both sides of the top of the MCDCin this segment.

Three 5-foot-high by 5-foot-wide culverts would be constructed where Robla Creek passes under the Sacramento Northern Bike Trial. These culverts would relieve pressure on the bike trail bridge during high flow events and were initially evaluated in the ARCF GRR Final EIS/EIR in Section 2.3.3. The impact of increased water surface elevation between Dry Creek Road and the North Sacramento Bike Trail Bridge were considered in the ARCF GRR Final EIS/EIR.

Flowage easements would be purchased and applied to approximately 80 acres of floodplain to accommodate the difference between the design flow of 3,169 cfs and the 2,000 cfs capacity of the downstream diversion channel.

Changes to the Operations and Maintenance (O&M) manual would be required to address the changes in the facility, as the current condition of the MCDC is under-performing the necessary waterflow for a 1 in 200 annual exceedance probability (AEP) highwater event. The current maintenance agreement does not require the removal of woody vegetation; a new O&M manual would include routine vegetation removal to maintain the required channel capacity. In addition to maintenance roads along both top banks of MCDC from Vinci Avenue to Dry Creek Road (2,700 feet), the project includes the construction of a maintenance road along the landside toe of the levee from Raley Boulevard to Vinci Avenue (2,100 feet), see SEIS/SEIR Figure 3.5.1-1.

Several public utilities would be temporarily or permanently realigned. A sewer line made of vitrified clay pipe that runs near the east edge of Raley Boulevard and goes under the current MCDC would need to be temporarily rerouted and then permanently realigned to prevent damage due to its proximity to the new culvert construction. A water main located in the same area as the sewer pipe would also be relocated. High voltage power lines that run parallel to the Raley Boulevard roadway crossing would be relocated to enable earthwork to be completed. A 48-inch storm sewer that terminates into MCDC on the east side of Raley Boulevard would be temporarily relocated during construction and replaced in its current alignment after construction of the culvert and levee extension. Other utilities and encroachments would be protected in place.

c. Purpose and Need

The Sacramento Metropolitan area is one of the most at risk areas for flooding in the U.S. The ARCF GRR is a cooperative effort by USACE, CVFPB – the non-Federal sponsor, and the SAFCA – the local sponsor. Improvements have increased the capability to release emergencies flows from Folsom Dam up to 160,000 cfs. There is a need to reduce the overall flood risk associated with the 160,000 cfs releases along the American and Sacramento Rivers by addressing the failure risks due to seepage and erosion. Further study by USACE and its Project Partners, since the initial 2016 GRR FEIS/EIR, resulted in refinements to the initial flood risk reduction designs in the ARCF 2016 Project. The consequences of a levee failure would be catastrophic to life safety, since the area inundated by flood waters is highly urbanized and the flooding could be up to 20 feet deep in some areas.

(1) Authority

Authority for the American River Common Features, 2016 Flood Risk Management Project, Sacramento, California, is provided by Section 1401(2)(7) of the Water Resources Development Act of 2016, Public Law 114-322. Appropriations were provided under the Construction heading, Title N, Division B of the Bipartisan Budget Act of 2018, Public Law 115-123 enacted February 9, 2018.

d. Alternatives [40 CFR 230.10]

(1) No Action

The No-Action Alternative is the buildout of the authorized project as it was described in the ARCF GRR Final EIS/EIR (USACE and CVFPB, 2016). Since 2016, substantial portions of the authorized project have been constructed, as described in supplemental documents including the same documents listed in section 2.1.1 of the 2025 SEIS/SEIR.

The No Action Alternative for this water quality evaluation therefore includes all the components of the authorized ARCF GRR Final EIS/EIR Proposed Action (Alternative 2) that have been constructed as well as the remaining authorized components of the Proposed Action in the ARCF GRR Final EIS/EIR that have not yet been constructed. Table 3.4-1 of the 2024 SEIS/SEIR presents the remaining components of the authorized ARCF 2016 Project that will be constructed as part of the No Action Alternative.

The No Action Alternative would have no impacts on WOTUS beyond those described in the 2015 Section 404(b)(1) Water Quality Evaluation. Additional research and design have shown that the alternative does not meet the originally authorized project purpose because it does not adequately address the flood risk in the study area, and is, therefore, not considered to be the LEDPA.

(2) Other Project Alternatives

There were six alternatives considered and rejected from detailed analysis under the National Environmental Policy Act (NEPA) in the development and screening process (see Chapter 3. Description of Project Alternatives in the Final SEIS/SEIR). These were rejected due to not meeting environmental or flood risk reduction needs. The erosion vulnerabilities on the American and Sacramento Rivers are site specific and confined by adjacent urban development, thus there is little flexibility in the location for erosion improvements. The project alternatives considered for NEPA are summarized below.

a. Alternatives for American River Erosion Contract 3B North and South

There are no other alternatives analyzed in detail for American River Erosion Contract 3B North and South that would meet project environmental and flood risk needs. This includes consideration of erosion protection options without revetment such as levee setbacks and bioengineering. Refer to section 1.7.4 “Erosion Protection Design Alternatives” in Appendix G of the 2025 SEIS/SEIR for more details on alternatives considered in design but determined to be infeasible.

b. Alternatives for American River Erosion Contract 4A

Alternative 3. Alternatives include a landside berm to avoid bike trail reroute, a permanent bike trail reroute closer to the river, a permanent bike reroute that goes under the railroad, and a bike trail reroute around the railroad.

c. Alternatives for ARMS

d. Alternative 4a and 4b. There are two California Environmental Quality Act (CEQA) - only alternatives that would retain a portion of the existing man-made pond, reducing the need for fill material to create riparian topography and reducing the transportation, air quality, and greenhouse gas (GHG) emissions impacts. These were not selected because it would not fully restore the site to floodplain habitat and would not meet ARCF habitat mitigation acreage requirements.Alternatives for SRMS

Alternative 5a, 5b, and 5c. Alternatives to not construct SRMS include purchasing mitigation bank credits and funding a project called Sunset Pumps, which includes the removal of a rock weir that is blocking a migratory corridor for green sturgeon, chinook salmon, and steelhead; and pursuing an alternative mitigation site located at Watermark Farms on the Sacramento River in Yolo County, from approximately River Mile 50.5 to River Mile 51.25. These were not selected because constructing a large-scale tidal marsh or shallow water aquatic habitat mitigation site is preferred over purchasing mitigation bank credits in the current NMFS BO (WCRO-2020-03082, dated May 12, 2021) and the Watermark Farms site would need to be purchased from a private owner while SRMS is already owned by USACE.

e. General Description of Dredged or Fill Material

(1) General Characteristics of Material

Erosion protection measures on the American and Sacramento Rivers would involve the discharge of fill material into WOTUS. Fill materials for erosion protection would consist of large stone riprap, ranging from 3 to 36 inches (average 6 to 20 inches), to armor the waterside slope, or to construct a launchable rock toe, planting bench, and tiebacks. Choke stone will be used on top of the larger stone riprap at the launchable toe and on slopes below the summer water level to fill voids between the rock and reduce loss of planting soil. On the upper slope revetment will be soil-filled and planting bench soil fill material will be comprised of a range of silts, sands, and gravels to support plant growth. Soil filled revetment will be topped with topsoil to encourage higher success rates for plant survival. Native fill, topsoil, gravel, and geotextile would also be needed for the armored berm. The proposed soil, sand or silt for the erosion protection measures would come from clean, imported fill material. Native fill, topsoil, gravel, and geotextile would also be needed.

The MCP would involve the discharge of fill material into WOTUS to extend, widen, and realign the levee. Fill materials for levee raises would be silty and clayey soils with a minimum content of 20% fine particles, a Liquid Limit less than 45, and a plasticity index between 7 and 15. No organic material or debris may be present in the soil. The proposed soil would be clean and would be imported from either a tested and approved borrow site, or from a commercial source.

At ARMS, the majority of soil encountered during site investigations was generally sand or silty sands. Results from one potential borrow site option for ARMS showed clay materials.

At SRMS, we are not anticipating any import of fill material. The conversion of seasonal wetlands in the site's interior into tidally influenced shallow riverine habitat and emergent wetlands would be accomplished primarily through the regrading of existing on-site material and beneficial reuse within the design footprint. The project site consists mostly of sandy silt deposits underlain by medium plastic clays (CL) and silt (ML) with less than 10 percent organic content. The surficial material consists of sandy deposits. This initial layer of sandy material extends to an approximate depth of 5 feet below ground surface. Below the initial sandy layer lies an approximately 10-foot thick, soft clay loam layer. Underlaying the clay layer is silt that extends for another 10 feet deep and gets progressively sandier with depth. Boring logs indicate groundwater around 15 to 25 feet below ground surface.

(2) Quantity of Material

The quantity of material placed in WOTUS for each contract is listed in Table 1.

Table 1. Quantity of Material Placed in WOTUS

Contract	Quantity (cy)	Water Type
American River Erosion Contract 3B	55,000	American River
American River Erosion Contract 4A	1,801	American River
American River Mitigation Site	950,000	Man-made Pond
Sacramento River Mitigation Site	0	Seasonal Wetlands
Sacramento River Erosion Contract 3	280,200	Sacramento River
Magpie Creek Project	15,000	Forested Wetland

(3) Source of Material

Riprap and soil for bank protection would be imported from a licensed, permitted facility that meets all Federal and State standards and requirements. The material would be transported to the site via barge on the Sacramento River and via land side access for all other contracts.

f. Description of the Proposed Discharge Site

(4) Location

The Proposed Action includes the American River Erosion Contract 3B North and South, American River Erosion Contract 4A, ARMS, SRMS, and MCP. The locations of each component of the Proposed action are described in more detail below.

American River Erosion Contract 3B North and South are made up of three different sites.

- Site 3-1 includes 1.1 miles of erosion protection, is located on the right (north) bank of the Lower American River between Howe Avenue and Watt Avenue, and from river mile (RM) 7.8 to RM 8.8. The launchable toes and riverbank protection is for the most part located below the OHWM (see figure 3.5.2-4 in the 2025 SEIS/SEIR) and consequently would be the locations of permanent discharge for Site 3-1. This makes up about 6.3 acres of permanent impact within the WOTUS.

- Site 4-1 includes 1.5 miles of erosion protection, is located on the left bank of the Lower American River upstream of Watt Avenue and extends from RM 9.1 to RM 10.5. Site 4-1 has a mixture of features above and below the OHWM (Figure 3.5.2-9 in the in the 2025 SEIS/SEIR), only the features below the OHWM would be considered discharge to a WOTUS. Generally, majority of the launchable trench, riverbank bank protection and levee bank protection are above the OHWM. There are some locations where the launchable trench and riverbank protection is below the OHWM. Launchable toe and planting bench features are below the OHWM.

- Site 4-2 is completely above the OHWM (Figure 3.5.2-6 in the in the 2025 SEIS/SEIR) and outside of any WOTUS so there will be no discharge associated with Site 4-2.

American River Erosion Contract 4A includes a 100-foot berm, is on the right bank of the Lower American River, downstream from the American River Erosion Contract 3B sites, near RM 2.0, under the State Route (SR) 160 Bridge and the Union Pacific Railroad (UPRR) Bridge. The edge of a forested wetland considered a WOTUS needs to be filled in in order to construct the berm and part of the bike trail reroute. An estimated 1.02 acres of forested wetland would be filled with the berm and part of the bike trail reroute.

The American River Mitigation Site is located at RM 1.3 on the Lower American River. The 120-acre site is on the water side of the Federal levee and is subject to tidal influence. It was historically owned and operated as a sand and gravel mine and the discharge would primarily take place in the approximately 50-acre pond left over from the mining operation. The pond would not be converted to uplands, it would be partially filled and regraded to provide a backwater channel to the American River.

The SRMS is located at the confluence of the Sacramento River, Steamboat Slough and Cache Slough, near Sacramento RM 15, and is approximately 200 acres. It is currently open space habitat that is occasionally used as a dredge material disposal site. The site contains a decommissioned landfill and is bisected North to South by the Federal Levee.

Sacramento River Erosion Contract 3 begins approximately 7 miles downstream from the confluence of the American and Sacramento Rivers along the east levee, in a part of the Sacramento River that receives tidal influence. Contract 3 totals 2.8 miles of erosion protection work below the OHWM between RM 47.3 and 53.1

MCP improvements include a levee extension, widening and realignment of a portion of the MCDC, culverts beneath the Sacramento Northern Bike Trail, and flowage easements to allow water retention on an approximately 80-acre area upstream of Raley Boulevard. A levee extension would be constructed crossing Raley Boulevard and extend approximately 1,000 feet to the east along the top bank of the MCDC to tie into existing high ground. Raley Boulevard would be realigned eastward and cross up and over the extended levee. The roadway grading would remain elevated as it crossed the MCDC to accommodate installation of three up to 7-foot- high by 10-foot-wide culverts. There is a 2.4-acre wetland east of Raley Boulevard that would be affected by the construction of the MCP. The realignment of Magpie Creek and maintenance road construction on the right bank would permanently impact approximately 0.30 acres of this wetland.

(5) Size

Approximately 12 acres of fill would be placed at American River Contract 3B and 1 acre at American River Contract 4A, 27 acres at SREC3, 54 acres in the man-made pond at ARMS, 21 acres in the seasonal wetland at SRMS, and 4 in the MCDC at MCP. At American River Contract 4A the berm and bike path would fill 1.02 acres of a 11.5-acre wetland.

(6) Type of Site

To construct the erosion protection measures, riprap and soil fill would be placed along four miles of the American and three miles of the Sacramento River along the waterside slope of the levee, below the OHWM. American River Erosion Contract 4A would place fill in a forested wetland. To construct ARMS, a man-made pond would be filled and converted to shallow water habitat. The existing river bank line would be breached to reconnect ARMS to the American River. To construct SRMS, fill would be removed from the Sacramento River and Steamboat Slough, below the OHWM to create the connections. Fill would be placed and the ground elevation altered due to elevation work within a seasonal wetland to facilitate the tidally influenced flow channels. To construct the levee realignment and MCDC widening, soil will be placed along two miles of the MCDC.

(7) *Type of Habitat*

The Sacramento River is a highly manipulated waterway that is constrained by man-made levees on both sides. The river provides habitat for many species; however, it is not a pristine, unaltered environment. The habitat types along the footprint of the bank protection measures include valley foothill riparian habitat and open water habitat. The lower American River is also highly altered, though remnant floodplains do exist that provide habitat. These habitat types are described below.

<u>Valley Foothill Riparian Habitat</u>. The overstory of the riparian habitat consists of mature, well-established trees: Fremont cottonwood, valley oak, Goodding’s willow, and box elder. Though less common in this area, Oregon ash (*Fraxinus latifolia*), western sycamore, and white alder (*Alnus rhombifolia*) are also observed. The shrub layer consists of smaller trees and shrubs; representative species observed were poison oak (*Toxicodendron diversilobum*), sandbar willow, and Himalayan blackberry. Elderberry shrubs, the host plant of the valley elderberry longhorn beetle (VELB; *Desmocerus californicus dimorphus*), which is Federally listed as threatened, were observed in the riparian habitat along the American and Sacramento Rivers. Riparian habitat is classified as a sensitive habitat by California Department of Fish and Wildlife (CDFW).

Due to the urban development adjacent to the levees in the project area, wildlife is limited primarily to small mammals and various avian species, especially those species that are adapted to human disturbance. Additionally, several Federally listed species are reliant on riparian corridors, including VELB and the western yellow-billed cuckoo (*Coccyzus americanus occidentalis*).

Open Water. The American River and Sacramento River are located within the study area and would both be impacted by placement of fill into WOTUS Both of these rivers are navigable waterways that are jurisdictional under CWA Section 404..

Wetland: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin et al. 1979). There is a forested wetland located at American River Erosion Contract 4A, and seasonal wetlands and vernal pools located at MCP. Forested wetlands are seasonally wet areas with primary vegetation of woody trees. Vernal pools are a special status habitat that is a type of seasonal wetland. Within the study area, wetlands also include features such as drainage ditches and farm canals, and open water habitat such as rivers and creeks. Wetlands and vernal pools are considered sensitive habitats under CEQA.

Representative species observed in seasonal wetlands include Mediterranean barley (*Hordeum marinum ssp. gussoneanum*), Italian ryegrass, water pepper (*Persicaria hydropiperpoides*), and alkali mallow (*Malvella leprosa*). Wetlands provide habitat for crustaceans such as fairy shrimp (*Anostraca*) and seasonal water sources for ducks, and geese. Unlike the ducks, the fairy shrimp spend their entire life cycle relying on the seasonal waters, unable to relocate if the local environment becomes disturbed or eliminated. Many migratory waterfowl use seasonal wetlands as a place to find food and rest before continuing their migrations.

Wetlands in the study area are jurisdictional WOTUS that are subject to regulation. Prior to construction, wetland delineations would be conducted at locations of potentially jurisdictional wetlands within the project sites to confirm the presence of these sensitive habitats.

a. Timing and Duration of Discharge

The construction schedule for the ARCF project (Table 2) was estimated based on a 4-month construction window, per year, due to seasonal and environmental constraints. Construction would occur during the summer months, between July 1 and October 31 due to special status species work windows and the flood season.

Table 2. Project Schedule

Contract	Construction Start	Total Construction Duration	In-Water Work Duration
Sacramento River Erosion Contract 3	June 2026	2 seasons	2 Seasons June-Oct 2026 June-Oct 2027
American River Mitigation Site	April 2026	4 seasons	4 seasons July 1 – Oct 31 2026 July 1 – Oct 31 2027 July 1 – Oct 31 2028 July 1 – Oct 31 2029
Sacramento River Mitigation Site	April 2026	2 seasons	2 seasons July 1 – Oct 31 2026 July 1 – Oct 31 2027
American River Erosion Contract 3B	April 2026	2 Season	2 Seasons June-Oct 2026 June-Oct 2027
American River Erosion Contract 4A	May 2027	1 Season	1 Season May-Dec 2027 for wetland work
Magpie Creek Project	May 2028	2 seasons	1 season

g. Description of Disposal Method

Bank Protection (Soil-filled Revetment)

The site will be prepared by removal of select trees, small vegetation, and, on the Sacramento River, any old bank protection materials. Rock above the wetted channel will be moved from the barge to the bank with an excavator on the Sacramento River and dumped by truck on the American River, once on land it will be placed by a bulldozer or an excavator. Rock below the wetted channel will be placed by an excavator that is parked either on the barge or on the riverbank. This stone would feature soil fill to cover the voids in the rock and would be hydroseeded with grasses and forbs or the soil-filled revetment would also be covered with six-12- inches of topsoil to encourage establishment of vegetation. IWM would be placed along the shore to provide shaded riverine aquatic habitat.

Launchable Rock Trench

This measure includes construction of a launchable rock filled trench, designed to deploy once erosion has removed the bank material beneath it. All launchable rock trenches would be constructed outside of the natural river channel. As a result, launchable rock trenches are generally above the OHWM and fill materials would not be placed into waters of the U.S. At Site 4-1 for American River Erosion Contract 3B there is a launchable trench just on the edge of the OHWM that has locations where launchable Rock Trench goes below the OHWM.

The vegetation would be removed from the footprint of the trench and the levee slope prior to excavation of the trench. The trench configuration varies to meet local site needs, see figures 3.5.2-22, 3.5.2-23, 3.5.2-24, and 3.5.2-27 in the 2024 SEIS/SEIR for examples of the configurations. All soil removed during trench excavation would be stockpiled for reuse or disposal.

After excavation, the trench would be filled with riprap that would be imported from an offsite location. Generally, for American River Erosion Contract 3B, launchable trench is being placed under roads and bike trails. The roads and bike trails will be replaced once work is completed. After rock placement, in situations where the area will be replanted for onsite mitigation, the trench would be covered with a minimum of 1 foot of the stockpiled soil to increase success of plantings over the trench. Rock placed on the slope would be covered with the stockpiled soil. All disturbed areas would be reseeded with native grasses and woody vegetation where appropriate. Some vegetation could be permitted over the trench if planted outside the specified vegetation free zone required by Engineering Technical Letter (ET)L 1110-2-583. This vegetation would likely be limited to native grasses, shrubs, and trees with shallow root systems to ensure that they do not limit the functionality of the trench during a flood event.

Launchable Rock Toe

Launchable rock toe generally includes a peaked stone pile within the river that would support a planting bench between the stone pile and the existing bank (SEIS Figure 3.5.2-15). The launchable rock would be covered with a layer of choke stone fill (smaller rock that would fill in the gaps between the larger pieces of revetment) to both minimize potential for predatory fish to hide in rock voids, and to reduce the artificial appearance of the launchable rock. On the American River where feasible, a planting bench will be added between the stone pile and the existing bank. The launchable rock toe is designed to “launch” into areas where erosion of the channel bottom occurs and progresses during a flood event below the toe of the rock, covering the eroded surface of the new channel bottom and inhibiting further progression of the eroded slope. Once fully launched, a layer of riprap (with a minimum thickness between 25 and 32 inches) would extend from the channel toe to the maximum depth of scour predicted in the river channel.

Tie backs

There are two types of tie backs associated with designs: those higher up on the riverbank bench and those within planting benches. Tie backs installed higher up on the bench outside the launchable trench as a form of erosion protection. These tie backs are built up of revetment placed in a triangular shape. The top of the tiebacks are approximately 21-feet across, and the tip of the triangular shape is 7-feet below existing grade of the levee overbank. The tie backs are built so that during high flows, erosion would be minimized in between different types of erosion protection treatment.

Planting bench tiebacks would be placed periodically throughout the planting benches to limit the extent of erosion and subsequent damage to a planting bench during a flood event. Along the lower bench, IWM structures consisting of whole trees with intact root wads would be installed to increase the roughness of the bench and to provide fine-textured woody material along the river margin for juvenile salmonid rearing habitat.

American River Erosion Contract 4A Berm

American River Erosion Contract 4A would include construction of an armored berm approximately 100 feet wide on the water side of the levee near RM 2.0. Due to the physical constraints at this location, the berm footprint would impact a portion of an existing wetland and would extend up the levee. Additionally, filling the wetland will help support the bike trail reroute.

American River Mitigation Site

The existing man-made pond would be drained and graded, and pond bottom sediments would be capped. The site would be connected to the river by removing the existing bank, creating multi-elevational flow channels, and smoothing out elevations in between. Additional grading would be necessary to modify elevations across the site elsewhere, stabilize banks, and create access pathways. Bank protection measures may be required to protect the channels from eroding and being damaged during high-flow events. The design would incorporate IWM. Equipment could include bulldozers, skid loaders, backhoes, and other similar earth work equipment.

Sacramento River Mitigation Site

Channels would be constructed within the existing open space and dredge placement site prior to breaching the berms in one or more locations to allow surface water to flow through constructed channels for tidal wetland habitat. Additional grading would be necessary to modify elevations across the site elsewhere, stabilize banks, and create access pathways. Bank protection measures may be required to protect the channels from eroding and being damaged during high-flow events. The design would incorporate IWM. Equipment could include bulldozers, skid loaders, backhoes, and other similar earth work equipment.

Magpie Creek Project

A levee extension would be constructed crossing Raley Boulevard and extend approximately 1,000 feet to the east along the top bank of the MCDC to tie into existing high ground. Raley

Boulevard would be realigned eastward and cross up and over the extended levee. There is a 2.4-acre wetland east of Raley Boulevard that would be affected by the construction of the MCP. The realignment of Magpie Creek and maintenance road construction on the right bank would permanently impact approximately 0.30 acres of this wetland.

MCDC would be widened and realigned up to maximum 25-foot bottom width with an exception at Raley Boulevard to meet the width of the culverts, with 2:1 ratio slope between Raley Boulevard to Vinci Avenue (a distance of approximately 2,100 feet). The levee on the west bank of the channel would be raised to a uniform top elevation of 50.2 ft along the Raley Boulevard to Vinci Avenue segment.

Three 5-foot-high by 5-foot-wide culverts would be constructed where Robla Creek passes under the Sacramento Northern Bike Trial. These culverts would relieve pressure on the bike trail bridge during high flow events.

III. Factual Determinations

a. Physical Substrate Determinations (Sections 230.11 (a) and 230.20)

(1) Comparison of Existing Substrate and Fill

The project area generally consists of deep soils derived from alluvial sources, which range from low to high permeability rates and low to high shrink-swell potential. Soils immediately adjacent to the Sacramento River are dominated by deep, nearly level, well-drained loamy and sandy soils. The natural drainage is good, and the soils have low to moderate subsoil permeability. The river terraces consist of very deep, well drained alluvial soils. The porous nature of the soils underneath the existing levee system is an important consideration for the design of levee improvements within the ARCF 2016 Project study area. The major source of sediments deposited in the study area is from the erosion of the Sierra Nevada Mountain range and foothills to the east of the Sacramento Valley. Naturally occurring asbestos (NOA) is known to occur in the foothill metamorphic belt. Therefore, NOA may be present; however, the likelihood of project area soils containing significant concentrations of NOA is low due to the long distance from the source rock.

American and Sacramento River Erosion Protection
Erosion protection on the American and Sacramento Rivers would create permanent changes of substrate. As discussed in Section II(b) above, fill material for bank protection construction would consist of large stone riprap ranging from 3 to 36 inches (average 6 to 20 inches), to armor the waterside slope. For SREC3 the maximum stone diameter would be about 21 inches with the average being 11 inches in diameter. For American River Erosion Contract 3B the average stone size will be between 6 to 20 inches. The riprap would be soil filled when above the summer water level and would be topped with a fine soil, sand or silt fill over the top to allow for planting on the berms.

American River Erosion Contract 4A Berm
The revetment, soil, and topsoil for the armored berm would create permanent changes of substrate. The material would be clean, imported fill material or reused from material onsite. The berm will be made up of soil filled quarry stone and the size range of stone within the berm at American River Erosion Contract 4A is approximately 3 inches to20 inches.

ARMS
The mitigation project would result in significant permanent changes to the substrate through grading and fill of the man-made pond and reconnection to the American River.

SRMS
Exploratory drilling was performed in March 2024 by Geo-Ex Subsurface under the supervision of USACE Sacramento District personnel. A total of 4 borings were drilled to a maximum depth of 25 feet below ground surface. Based on the field findings and laboratory test results, the

project site consists mostly of sandy silt deposits underlain by medium plastic clays (CL) and silt (ML) with less than 10 percent organic content. The surficial material consists of sandy deposits. This initial layer of sandy material extends to an approximate depth of 5-feet below ground surface. Below the initial sandy layer lies an approximately 10-foot thick, soft clay loam layer. Underlaying the clay layer is silt that extends for another 10 feet deep and gets progressively sandier with depth. Boring logs indicate groundwater around 15 to 25 feet below ground surface.
It is expected that there is no import of soil material. Engineering design works with the existing topography to minimize cut and fill in the creation of fishery and riparian mitigation features.

MCP
The widening of MCDC and realignment of the levee would not result in permanent changes to the substrate of the canal. However, 0.30 acres of adjacent seasonal wetland would be permanently filled to widen the levee.

(2) Changes to Disposal Area Elevation

American and Sacramento River Erosion Protection

Due to the placement of rock bank protection along the riverbanks, there would be an increase in elevation of approximately 3-4 feet in the locations where fill is placed in the WOTUS. Some areas would require regrading or extra revetment to meet correct slopes and in those areas elevations with rock bank protection could see up to 17 feet elevation gain. Because some areas will need more site preparation than others, this elevation change will vary by site. The launchable rock toe, rock tie backs, and planting benches would typically increase elevations in the channel. The elevation increase varies by location, some locations would only increase 3-4 feet but many locations would increase by up to 10-17 feet. The project is required and designed to not impact the flow, circulation and capacity of the flood system.

American River Erosion Contract 4A Berm

The construction of American River Erosion Contract 4A will fill 1.02 acres of a 11.5-acre wetland. The berm would increase elevation from a maximum of 25 feet at its intersection with the levee and then tapering down. The remaining fill would raise elevation approximately 10-feet to support the levee, patrol road, bike trail reroutes and water line relocation.

ARMS

The existing man-made pond would be drained, filled with clean fill materials, and re-connected to the American River by removing the existing bank, creating multi-elevational flow channels, and smoothing out elevations in between. The existing elevations in the bottom of the pit range between minus 10 to 0, and we are proposing to grade the mitigation channels with bottom ranging between 3 to 4.5 or so, the top of bank of the mitigation channels are around elevation

8.2, and the area above that is graded pretty flag and ranging up to around elevation 10 or 12 generally. The existing slopes of the mining pit vary between 5:1 to 2:1, and the proposed grading at the slope tie in locations will be primarily 5:1 or flatter with a few locations at 3:1 max where the grading is tight.

SRMS

The regrading of the site would convert the seasonal wetlands of the site's interior into tidally influenced shallow riverine habitat and emergent wetlands. This will create a varied topography. The current site elevations range from 4 feet at the lowest to 30 feet at the top of the berms. Once construction is complete, the site elevations will range from –2 feet, to 14 feet within the northern cell and the majority of the berms will retain their existing height, maxing out at 30 feet.

MCP

The MCDC would be widened and realigned up to maximum 25-foot bottom width. The realignment of Magpie Creek and maintenance road construction on the right bank would permanently fill approximately 0.30 acres of a wetland.

(3) Migration of Fill

The erosion protection is designed to avoid significant migration of newly placed fill using geotextiles and the establishment of on-site vegetation. However, during the life span of the bank protection, there would be natural erosion and migration of fill, but at a slower rate than without bank protection. The erosion repairs within the project area are likely to somewhat reduce the sediment supply for riverine reaches directly downstream because the riprap would hold the bank or levee in place. However, from a system sediment perspective, the bank material that would be protected in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and, especially, the Yuba River systems.

Migration of fill is not expected at MCP beyond the natural erosion and migration of fill occurring at the site across the 50-year lifespan of the project.

At ARMS and SRMS, limited migration of fill is expected from natural erosion and sedimentation processes following the reconnection to the river and establishment of freshwater emergent/seasonal wetland habitat, riparian woodland, and riverine habitats. The low flow channels at SRMS may shift around or meander through natural processes. This type of fluctuation is consistent with natural, tidally influenced, low flow channels.

(4) Duration and Extent of Substrate Change

There would be a permanent change of substrate on the riverbanks from alluvial soils to stone riprap and riparian planting benches, in most locations. However, the rock berms would be covered with a silty or sandy layer of soil to allow for the planting of vegetation along the riverbanks and to reduce the visual impacts of having a rock slope. This silty or sandy layer of soil would be of a similar substrate type to the existing condition, at SREC3 this would be an improvement over the existing concrete and older hard bank protection. For launchable trench features and tiebacks, substrate would change from soil to soil filled revetment. The launchable rock toe measure would result in a change in substrate from undrained hydric soils to buried stone riprap with a silty or sandy layer of soil on the surface to allow for revegetation of the site. The launchable toe themselves would result in a change of substrate from undrained soils and cobbles on the river bottom to choke stone filled revetment at the launchable toes themselves. When planting benches are installed with the launchable toes on the American River, the planting benches would typically be at a higher level and change the substrate from undrained soils and cobbles on the river bottom to hydric soils. A typical bank protection site has an approximate life span of 50-years.

The substrate of the fill for the berm at American River Erosion Contract 4A would change from hydric undrained soils to soil filled revetment topped with upland soils and in some cases topped with a gravel road and paved bike trail.

The majority of the soil encountered during investigations at ARMS was sand and siltand results from one potential borrow site option for ARMS are available and shown to be clay materials. The majority of the surface substrate withing the project area will be modified due to the grading and import of fill materials. The SRMS project is not anticipating any import of fill, so there would be no change of materials.

MCDC would be widened, shaped, and compacted, but the substrate would remain unchanged.

(5) Changes to Environmental Quality and Value

The Proposed Action would result in potential impacts to water quality, including increased turbidity during bank protection construction, runoff of exposed soils, and cement, or fuel spills during construction. Emissions from construction equipment, haul trucks, and barges also pose a potential impact to environmental quality and value during the duration of construction activities. BMPs would be implemented during construction to reduce these impacts to less than significant. There would be a permanent change in substrate in the footprint of the erosion protection areas; however, these sites would be designed to be as consistent as feasible with natural riverbanks through the placement of silt over the rock layer and the planting of on-site shrubby vegetation and native grasses. To the extent feasible, large trees on the lower waterside slope would be left in place to maintain SRA habitat for special-status fish species and planting benches installed to allow new vegetation to establish. Generally, trees have to be removed when launchable toe, tie backs, launchable trench and bank protection must be installed, however.

After construction of the flood risk management features is completed, the direct effects to habitat for special status species would be compensated in accordance with the Biological Opinions. Mitigation plantings would be monitored during the plant establishment period for success. Successful habitat mitigation would compensate for significant effects to vegetation, wildlife, special status species, and aesthetic resources.

(6) Actions to Minimize Impacts

The following mitigation measures would be used during construction of the Proposed Action to reduce impacts to environmental quality:

- The whole project area was originally evaluated for its erosion risk, then it was divided into areas that did not need remediation, areas that needed a minimal repairs and areas required more significant repairs. The sites that did not need work are not being impacted. The sites with minimal repairs have been designed with less impacts and smaller footprints. The sites that need more intense repairs have gone through intense design evaluations to allow for the smallest, most efficient footprint but continue to provide maximum flood risk reduction.
- Prior to construction, USACE or its contractor would be required to acquire all applicable permits for construction.
- Prior to construction, a Stormwater Pollution Protection Plan (SWPPP), Spill Prevention Control and Countermeasures Plan, and a bentonite slurry spill contingency plan would be prepared, and best management practices (BMPs) would be proposed to reduce potential erosion and runoff during rain events.
- Minimize ground and vegetation disturbance during project construction by establishing designated equipment staging areas, ingress and egress corridors, spoils disposal and soil stockpile areas, and equipment exclusion zones prior to the commencement of any grading operations.
- After construction of the flood risk management features is completed, the direct effects to habitat for special status species would be compensated in accordance with the Endangered Species Act Biological Opinions. Mitigation plantings would be monitored during the plant establishment period for success. Successful habitat mitigation would compensate for significant effects to vegetation, wildlife, special status species, and aesthetic resources.
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b. Water Circulation, Fluctuation, and Salinity Determinations

The levee improvements from the Proposed Action to water circulation, fluctuation, and salinity would be mostly similar as what was described in the GRR 404(b)(1) and are summarized below. The ARMS and SRMS will result in minor, permanent alterations to water circulation. The Project Area is in the Sacramento Hydrologic Basin Planning Area and Lower American Hydrologic Subarea, as designated by the Central Valley Regional Water Quality Control Board (RWQCB). Water quality standards for this basin are contained in the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin (Basin Plan) per Section 303 of the Clean Water Act.

(1) Alternation of Current Patterns and Water Circulation

The Proposed Action's erosion protection measures are fix-in-place levee improvements that would have no effect on current patterns of water circulation.

The construction of SRMS will breach the existing levees, ARMS will breach the existing bank line, and both will install freshwater emergent/seasonal wetland habitat, riparian woodland, and riverine habitats, which will result in local, minor, permanent alterations to water circulation. Both sites will be reconnecting floodplain to the American and Sacramento Rivers, extending the flow area and circulation of WOTUS into areas that are currently unreachable under normal flows.

The widening of the MCDC, at MCP, will increase flow, but not alter current patterns and water circulation.

(2) Interference with Water Level Fluctuation

Because the Sacramento River and American River systems are regulated by upstream dams which allow a specific amount of water to be released into systems, the Proposed Action and the No Action, and No Project alternative would not change water level fluctuation patterns.

Potential implications of the simulated long-term changes in bed profiles can be increased stress along the toe of the project levees or overbank berms in the degradational reaches, which may result in increased scour along unrevetted channel sections. In the aggradational reaches, an increase in bed elevations may result in higher flood stages and reduced flood conveyance.

(3) Salinity Gradients Alteration

Salinity gradients would not be affected, as salinity normally only increases in the river system during low flow events when there is a higher-than-average tidal influx from the Delta. With-project conditions in the system would remain consistent with existing conditions during normal and low flow periods. Flows would be increased during high water events, however the flood flows during these events would be pushing any salinity intrusion back down into the Bay-Delta system and would not result in any salinity increases in the riverine system. A projected benefit of SRMS includes the reconnection of historically tidally influenced land to brackish, open water habitat.

(4) Effects on Water Quality

The Basin Plan states that where ambient turbidity is between 5 and 50 nephelometric turbidity units (NTUs), projects would not increase turbidity on the Sacramento River by more than 20 percent above the ambient conditions. Furthermore, if the ambient diurnal variation in turbidity fluctuates in and out of the 5 and 50 NTUs threshold, the Basin Plan states that averaging periods can be applied to data to determine compliance. For example, during the summer months, the Sacramento River turbidity could be less than 50 NTUs, and during the winter months, the turbidity could be more than 50 NTUs because of the higher flow rate causing more river scouring. Thus, the monthly average was calculated using hourly California Data Exchange Center (CDEC) data and is presented in Table 3 below. Specific construction activities that are part of the potential alternatives would need to comply with the above-stated thresholds for turbidity.

Water quality impacts that could result from project construction activities and project operations were evaluated based on the construction practices and materials that would be used, the location and duration of the activities, and the potential for degradation of water quality or beneficial uses of project area waterways.

The placement of riprap along the riverbanks would temporarily generate increased turbidity in the immediate vicinity of the construction area. Additionally, placement of riprap in the water could result in a sediment plume, generated from the channel bottom and levee side, becoming suspended in the water and could generate turbidity levels above those identified as acceptable by the Basin Plan. Turbidity effects from landside construction (e.g., vehicle, staging, placement of construction equipment) would be limited to stormwater runoff carrying loose soil from staging areas and construction vehicle access areas. Best management practices would be implemented to reduce the effect of runoff into the stormwater system to less than significant. BMPs include such things as coir mats or hay bales to prevent runoff, rock groins to retain sediment, sandbags to prevent erosion, and drain screens to prevent sediment from traveling outside the construction area footprint and into the storm drains system.

As rock riprap is placed in the open water, significant indirect effects would result as the sediment and turbidity plume would drift further downstream and later affect the water quality in those areas further downstream of the project area. By implementing the BMPs contained within the SWPPP, impacts would be reduced to less than significant.

(a) Water Chemistry

The potential of hydrogen (pH) is a unit for measuring the concentration of hydrogen ion activity in water and is reported on a scale from 0 to 14. If a solution measures less than 7, it is considered acidic. If a solution measures more than 7, it is considered basic, or alkaline. If a solution measures 7, it is considered neutral. Many biological functions occur only within a narrow range of pH values. The Basin Plan objective for pH is between 6.5 and 8.5. Furthermore, discharges cannot result in changes of pH that exceed 0.5. The monthly average pH of the Sacramento River from 2003 to 2009 remained stable throughout the year (Table 3-4). Construction materials such as concrete or other chemicals could affect the pH of the Sacramento River if a discharge were to occur. The proposed materials and construction activities have the potential to affect water chemistry during the duration of construction. Construction contractors would be required to prepare and implement a SWPPP and comply with the conditions of the NPDES general stormwater permit for construction activity. The contractor would be required to obtain a permit from the Central Valley RWQCB detailing a plan to control any spills that could occur during construction. The plan would describe the construction activities to be conducted, BMPs that would be implemented to prevent discharges of contaminated stormwater into waterways, and inspection and monitoring activities that would be conducted.

(b) Salinity

The proposed materials and construction activities are not expected to affect salinity.

(c) Clarity

Placement of fill materials would temporarily reduce clarity due to an increase in total suspended solids within the project area. Clarity is not expected to be substantially affected outside the immediate project area. The reduction of clarity caused by construction activities would be short in duration and would return to pre-construction levels upon project completion.

(d) Color

The proposed project is expected to affect color only during fill activities. Placement of fill materials would temporarily induce a color change due to an increase in turbidity. These effects would be consistent with those discussed above for clarity. The change in color caused by construction activities would be short in duration and would return to pre-construction levels upon project completion.

(e) Odor

The proposed project would not result in any major sources of odor, and the project would not involve operation of any of the common types of facilities that are known to produce odors (e.g., landfill, wastewater treatment facility). Odors associated with diesel exhaust emissions from the use of onsite construction equipment may be noticeable from time to time by adjacent receptors. However, the odors would be intermittent and temporary and would dissipate rapidly from the source with an increase in distance. Furthermore, as required by California Air Resources Board (CARB) regulation 13 California Code of Regulations (CCR) 2449(d)(3), no in-use off-road diesel vehicles may idle for more than 5 consecutive minutes. Therefore, this direct effect would be less than significant. In addition, implementation of mitigation measures, which are required under other air quality effects, would further reduce exhaust emissions, and provide advanced notification of construction activity.

(f) Taste

The proposed materials and construction activities are not expected to affect taste.

(g) Dissolved Gas Levels

The reduction in SRA habitat will allow more sunlight to warm the water and result in a temporary increase in water temperature at the project sites, which could reduce the concentration of dissolved gases. This impact would likely not be measurable due to the small reduction of shade across the larger river system that is also being affected by moving and mixing water.

(h) Temperature

Water temperatures can be affected by a number of factors, including air temperatures, elevation, flow and velocity, and presence of riparian vegetation. For the American River, the major factor that impacts water temperature are the operations of Folsom Dam. The releases from Folsom are heavily studied and modeled in several recent Central Valley Project/State Water Project Biological Assessments from the Bureau of Reclamation, as well as the respective Biological Opinions from NMFS (2009, 2019, pending 2024/2025). While the removal of bank vegetation in several areas may seem extensive, the removal is a temporary occurrence that will be vegetated upon completion. Adjacent habitat upstream and downstream will provide interim cover for fish during the construction timeframe. Temporary removal of the amount of vegetation on the proposed sections of the Lower American River and Sacramento River are not expected to cause a measurable increase to water temperatures due to the small shaded area relative to the surface area of the river and the fact that the volume and temperature of water drive the temperature of the water, overwhelming other influences.

At ARMS, there will be long term benefits to water temperature. The man-made pond, which currently is not shaded by trees, will be replaced with a functional freshwater emergent/seasonal wetland habitat, riparian woodland, and riverine habitats that are connected to the American River. At SRMS, there will be no change to water temperatures, the newly connected floodplain will be planted with emergent and riparian vegetation to shade the water channels.

There will be minimal affect to temperature at MCP. MCP is primarily fed by wastewater and surface runoff that will not be impacted by the Proposed Action. In addition, tree removal is limited and is unlikely to affect temperature as they shade a negligible amount of the MCDC.

(i) Nutrients

The proposed project's construction activities have the potential to affect nutrient levels during construction and in the long term. Release of suspended sediments during construction could potentially cause thresholds for nutrients to be exceeded. However, the construction contractor would implement a SWPPP including BMPs that would prevent release of excess nutrients during construction. Long-term nutrient levels would not be substantially altered by the proposed mitigation project. Its design includes planting benches and restored riparian areas along a created shallow water channel in which trees and shrubs would be planted, and at maturity would provide nutrient inputs comparable to the existing SRA corridor. In addition, nutrients from the upstream watershed would remain in the system.

Post construction, once the two mitigation sites have had a chance to establish, they would provide beneficial nutrients to and remove pollutants from the river systems by filtering water through the emergent wetland plants and increasing the functions and services available in the localized area.

(j) Eutrophication

The project is not expected to contribute excess nutrients into the stream or promote excessive plant growth due to BMPs and the high content of rock in disposal material.

c. Suspended Particulate/Turbidity Determinations

(1) Alteration of Suspended Particulate Type and Concentration

The placement of riprap along the riverbank, dewatering at American River Erosion Contract 4A, breaching the levee for SRMS and bank line for ARMS, and realigning MCDC would temporarily generate increased turbidity in the immediate vicinity of the construction area. This could result in a sediment plume, generated from the channel bottom and levee side, becoming suspended in the water and could generate turbidity levels above those identified as acceptable by the Basin Plan. Turbidity effects from construction (e.g., vehicle, staging, placement of construction equipment) would be limited to stormwater runoff carrying loose soil from staging areas and construction vehicle access areas. BMPs would be implemented to reduce the effect of runoff into the stormwater system to less than significant. BMPs include such things as coir mats or hay bales to prevent runoff, rock groins to retain sediment, sandbags to prevent erosion, and drain screens to prevent sediment from traveling outside the construction area footprint and into the storm drain system.

Coordination with Central Valley (CV) RWQCB through the Clean Water Act Section 401 water quality certification process would also ensure that appropriate measures would be implemented to minimize the effects of stormwater runoff on turbidity. The SWPPP would describe the BMPs that would be implemented to contain spills and prevent discharges of stormwater into waterways. BMPs could include but are not limited to straw waddles, geotextile and coir mats, tire wash stations at ingress/egress points to prevent tracking soil offsite onto roadways and entering the municipal stormwater collection system, and sand filter bags at stormwater collection inverts. Potential turbidity effects from landside construction (e.g., vehicle, staging, placement of construction equipment) would be limited to stormwater runoff carrying loose soil from staging areas and construction vehicle access areas. Following construction, BMPs would continue to be monitored and implemented while vegetation matures enough to stabilize surface soil at all of the Proposed Action’s construction sites. Further, the installed bank protection would include plantings of native riparian vegetation that could slow flows down and reduce turbidity during flood flows.

(2) Particulate Plumes Associated with Discharge

Placement of riprap, breaching the levee for SRMS and bank line for ARMS, and realigning MCDC could result in a sediment plume, generated from the channel bottom and levee side, becoming suspended in the water and could generate turbidity levels above those identified as acceptable by the Basin Plan. Significant indirect effects would result as the sediment and turbidity plume would drift further downstream and later affect the water quality in those areas found further downstream of the project area. By implementing avoidance and minimization measures, discussed in Section 3.5.6 of the ARCF GRR Final EIS/EIR and Section 4.4.4 of the 2025 SEIS/SEIR, impacts could be reduced to less than significant.

(3) Changes to Environmental Quality and Value

There could be significant affects to water quality due to increased turbidity during construction, as discussed above. On the Sacramento River, the use of barges to install the riprap could cause additional turbidity as the barge moves into the site and anchors. On the American River, placement of material directly into the water by equipment could cause additional turbidity as vehicles drive and place material into the water. With the implementation of the BMPs that will be established in the SWPPP, these effects would be temporary and reduced to less than significant during construction. Once construction is complete there could be reduced turbidity in the direct vicinity of the site because there would be no exposed soil to erode and deposit into the river. Further, the bank protection sites would include the installation of riparian vegetation which could slow the flows down and reduce turbidity during high flows.

Construction contractors would be required to prepare and implement a SWPPP and comply with the conditions of the NPDES general stormwater permit for construction activity. The contractor would be required to obtain a permit from the CVRWQCB detailing a plan to control any spills that could occur during construction. The plan would describe the construction activities to be conducted, BMPs that would be implemented to prevent discharges of contaminated stormwater into waterways, and inspection and monitoring activities that would be conducted.

(4) Actions to Minimize Impacts

Since 2015 the project team has further evaluated the construction sites to reduce the project footprints where possible. Vegetation is being replanted where possible to provide natural bank protection. Trees will be hand selected for removal, rather than clear cutting the levee. Construction contractors would be required to prepare and implement a SWPPP and comply with the conditions of the NPDES general stormwater permit for construction activity. The contractor would be required to obtain a permit from the CVRWQCB detailing a plan to control any spills that would occur during construction. The plan would describe the construction activities to be conducted, BMPs that would be implemented to prevent discharges of contaminated stormwater into waterways, and inspection and monitoring activities that would be conducted. Work below the OHWM would only be permitted during low periods, July 1 to November 30th.

d. Contaminant Determinations

Construction activities would involve the use of potentially hazardous material, such as fuels, oils and lubricants, and cleaners, which are commonly used in construction projects. Construction contractors would be required to use, store, and transport hazardous materials in compliance with Federal, State, and local regulations during project construction and operation. Testing of borrow sites would occur prior to the use of material and sites which have contaminated soils would not be used for this project. Any hazardous substance encountered during construction would be removed and properly disposed of by a licensed contractor in accordance with Federal, State, and local regulations. Compliance with applicable regulations would reduce the potential for accidental release of hazardous materials during transport and construction activities. The risk of significant hazards associated with the transport, use, and disposal of these materials is low.

A Phase I ESA (Environmental Site Assessment) was conducted in 2012 for the project locations considered in the ARCF GRR Final EIS/EIR and included areas within a 1-mile buffer of these locations. Within this buffer a search of Federal, state, and local environmental databases and historic aerial, topographic, and fire maps were reviewed. A site visit of the study area was also conducted to identify recognizable environmental conditions (RECs). The 2012 Phase I ESA identified seven sites with the potential to affect the ARCF footprint in the GRR Final EIS/EIR; however, none of those sites impact the areas considered under the Proposed Action in this SEIS/SEIR. Due to the addition of new areas considered under the Proposed Action, updated Phase I ESAs were conducted at the American River sites and Magpie Creek. Several Phase II investigations, which include laboratory analyses of soil and water samples, were conducted at Magpie Creek (see Appendix B 3.8 Hazards and Hazardous Materials for more details). Below is a list of sites, dates, and findings of the new ESAs:

- American River 3B: A Phase I ESA was conducted in 2020 and did not find any new hazardous materials sites. Contaminated groundwater is unlikely due to overall groundwater gradients and presence of a levee cutoff wall.

- American River 4A: A Phase I ESA was conducted in 2023 and found a record of a drinking water well within ¼ mile of the site with PFAS (per- and polyfuoroalkyl substances) contamination.

- Magpie Creek: A Phase I ESA was conducted in 2015 on the undeveloped parcels to the east and west of Raley Blvd to be acquired by SAFCA for floodplain conservation. Due to the former agricultural use and the proximity of McClellan Airforce Base, the report recognized the potential for soil and groundwater contamination. A limited Phase II investigation followed in 2017. A Phase I ESA was conducted at Magpie Creek between Raley Blvd and Vinci Avenue in 2020. A Phase II investigation was conducted in this same area in 2021. The results are discussed in greater detail in the following section.

To minimize the impacts associated with contaminants, the Proposed Action would incorporate the following measures described in the GRR EIS/EIR:

- Construction contractors would be required to use, store, and transport hazardous materials in compliance with Federal, State, and local regulations during project construction and operation.

- Testing of borrow sites would occur prior to the use of material and sites which have contaminated soils would not be used for this project.

- Any hazardous substance encountered during construction would be removed and properly disposed of by a licensed contractor in accordance with Federal, State, and local regulations.

- The risk of significant hazards associated with the transport, use, and disposal of these materials is low, and compliance with applicable regulations would reduce the potential for accidental release of hazardous materials during transport and construction activities.

- Project areas would be tested contaminants prior to construction, and any materials found would be disposed of in accordance with all Federal, State, and local regulations at an approved disposal site.

- The contractor would be required to prepare a SWPPP and a Spill Prevention Control and Countermeasures Plan (SPCCP), which detail the contractor's plans, including BMPs, to prevent discharges from the construction site into drainage systems, lakes, or rivers.

e. Aquatic Ecosystem and Organism Determinations

(5) Effects on Plankton

Plankton are drifting organisms that inhabit the pelagic zone of oceans, seas, or bodies of fresh water. Project construction activities would be temporary and short-term. The only short-term effect would be a less abundant supply of plankton for the Delta smelt, and other fish and aquatic organisms. With implementation of mitigation measures and BMPs, this project would not introduce materials that would disrupt the nutrient supply for plankton, and as a result effects to plankton would be temporary and less than significant. A projected benefit of ARMS and SRMS include the reconnection of historically tidally influenced land to open water habitats. Connectivity will provide hydrodynamic and ecological processes necessary for the establishment of marsh habitats and riparian interactions. An expected outcome from restoration would include the establishment of ecosystem processes which benefit zooplankton growth and abundance. Most native, and in some cases non-native zooplankton, are important prey for pelagic and anadromous native fish species across a range of life histories.

(6) Effects on Benthos

Benthic organisms would be permanently disturbed as a result of constructing erosion protection and realigning the MCDC. However, the rock placed below the water surface will naturally accumulate soil material and plant species. The bank above the low water elevation will be covered in soil to start the redisposition process. The vegetation planted above will provide organic material and food sources for fisheries. The native benthic organisms are expected to recolonize the area in time. In addition, vernal pool species such as the vernal pool fairy shrimp and the vernal pool tadpole shrimp are known to occur in wetlands near the MCP and are assumed to occur in seasonal wetlands within the project area. Impacts to vernal pool shrimp will be mitigated per the USFWS Biological Opinion.

A projected benefit of the ARMS and SRMS includes the reconnection of historically tidally influenced land to open water habitats, thus restoring the historic benthic environment to these sites.

(7) Effects on Fish

Multiple fish species actively inhabit the project area. Threatened and endangered species include four runs of Chinook salmon, steelhead trout, delta smelt, longfin smelt, and green sturgeon. These species are expected to use habitat in parts of the study area. Most of these species are listed as Threatened or Endangered (T&E).

Within the Sacramento River is designated critical habitat for winter-run Chinook salmon from Keswick Dam in Shasta County to River Mile 0 at Chipps Island in the Sacramento-San Joaquin Delta. Critical habitat for spring-run Chinook salmon includes all river channels and sloughs within the ARCF study area on the Sacramento River, and on the American River from the confluence to the Watt Avenue bridge (NMFS 2006b). Critical habitat for Central Valley steelhead includes the stream channels and the lateral extent as defined by the ordinary high water mark or bank-full elevation in the designated stream reaches of the Sacramento and American River, NEMDC and Dry/Robla Creek portions (MCP) of the ARCF project area. Critical habitat for delta smelt consists of all water and all submerged lands below ordinary high water, and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the contiguous waters in the Delta (USFWS 1994). Critical habitat for delta smelt is designated in the following California counties: Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo (USFWS 2003). Designated critical habitat for the southern distinct population segment (DPS) of green sturgeon includes the Sacramento River downstream of Keswick Dam, the lower portion of the LAR from the confluence to Highway 160, the Feather River downstream of Oroville Dam, and the Yuba River downstream of Daguerre Dam; portions of Sutter and Yolo Bypasses; the legal Delta, excluding Five Mile Slough, Seven Mile Slough, Snodgrass Slough, Tom Paine Slough, and Trapper Slough; and San Francisco, San Pablo, and Suisun bays. Mitigation measures for green sturgeon are currently being fulfilled per agreements with the regulatory resource agencies.

Rock placement on the Sacramento and American Rivers would most likely temporarily disturb the native resident fish by increasing vibration, water turbulence, and turbidity, causing them to move away from the area of placement. In some pelagic native juvenile species utilizing the near shore habitat for cover, moving away from that cover could put them at a risk of predation. However, direct effects to T&E fish species are less than significant in the long-term, with the implementation of mitigation. Proposed mitigation for salmonid species includes the creation of planting berms to provide shade and IWM elements of SRA habitat. The natural bank element of SRA would be lost with the placement of rock along the levee slope. Over time sediment would settle into the rock voids and provide similar substrate characteristics as a natural bank. The direct effects would also not result in a substantial reduction in population abundance, movement, and distribution for salmonid species.

SREC3 would result in permanent impacts to 27 acres of Delta smelt shallow water habitat, and spawning habitat. Construction-related effects include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae, and alteration of spawning and incubation habitat. With the implementation of compensation for the impacts to Delta smelt shallow water habitat and spawning habitat, these effects would be reduced to less than significant.

SREC3 would result in permanent impacts to 27 acres of salmonid habitat through the loss of existing shallow water vegetation along the riverbanks. Lower American River Erosion Contract 3B would result in permanent impact to 24 acres of salmonid habitat due to loss of existing shallow water vegetation along the riverbanks. These areas provide food and shelter for both adults and juvenile salmon as they migrate seasonally up and down the river. At SREC3, salmon and green sturgeon use the same habitat in the project area. Construction would result in direct effects to green sturgeon through the loss of benthic feeding habitat due to the change in substrate at the bank protection sites. If larvae or juveniles are present during construction, in-water activities could result in localized displacement and possible injury or mortality to individuals that do not readily move away from the channel or nearshore areas. Project actions associated with bank protection measures may increase sediment, silt, and pollutants, which could adversely affect rearing habitat or reduce food production, such as aquatic invertebrates, for larval and juvenile green sturgeon. Compensation would be implemented in the form of on and off-site mitigation, as well as the purchase of mitigation bank credits.
Compensation for these impacts consists of newly constructed habitat at ARMS and SRMS. The construction of ARMS will create approximately 55 acres of new freshwater emergent/seasonal wetland habitat, riparian woodland, and riverine habitats that will benefit all aquatic organisms. The construction of ARMS will benefit Chinook salmon and steelhead by breaching the existing riverbank and allowing surface water to flow through constructed channels. Channels would be designed to remain inundated year-round with the riparian habitat inundated during higher flow to create salmon habitat. Construction of SRMS will create approximately 19 acres of tidally influenced emergent wetland with riparian vegetation to benefit Chinook salmon, steelhead, and delta smelt.

(8) Effects on Aquatic Food Web

Effects on the aquatic food web, or the plankton, benthic, and fish communities, would be temporary and less than significant. Indirect effects were not considered significant to resident native fish species because it was determined that existing conditions would not be worsened by project construction and would not result in a substantial reduction in population abundance, movement, and distribution. The aquatic food web will be enhanced at ARMS and SRMS through the construction of new freshwater emergent/seasonal wetland habitat, riparian woodland, riverine habitats, and connectivity to tidally influenced open water.

(9) Effects on Special Aquatic Sites

(a) Sanctuaries and Refuges

No sanctuaries and refuges are within the project area.

(10) Wetlands

Due to the physical constraints at American River Contract 4a, the berm footprint would impact 1.02 acres of an existing 11.5 acre wetland and would extend up the levee. A bladder dam or a sandbag dam may be used if the wetland has water in it at the time of construction.

There is a 2.4-acre seasonal wetland east of Raley Boulevard that would be affected by the construction of the MCP. The realignment of Magpie Creek and maintenance road construction on the right bank would permanently impact approximately 0.30 acres of this wetland. Reasonable effort would be taken in the detailed design of the project to avoid disturbance to existing wetlands and implementation of environmentally sustainable designs. Any destruction, loss, or degradation of wetlands would be compensated through creation of new wetland habitat.

(c) Mud Flats

No mud flats are within the project area.

(d) Vegetated Shallows

No vegetated shallows are within the project area.

(e) Coral Reefs

No coral reefs are within the project area.

(f) Riffle and Pool Complexes

No riffle pool and complexes are within the project area.

(11) Threatened and Endangered Species

Implementation of the Proposed Action would result in direct effects to salmonids, green sturgeon, Delta smelt, longfin smelt, and valley elderberry longhorn beetle. Impacts to special status fish species were addressed above in Section e(3) Fish.

Adverse effects could occur to Western yellow-billed cuckoo due to the removal of riparian vegetation during construction. Western yellow-billed cuckoo is not currently known to nest in the project area, but the area is considered stopover habitat and they could be present during their migration period. As a result, USACE proposes to compensate for the removal of riparian vegetation onsite to the maximum extent possible. If onsite mitigation is not possible, offsite mitigation would occur along the main stem of the American and Sacramento Rivers, or credits would be purchased at a mitigation bank.

Because avoidance, minimization, and compensation measures would be implemented in accordance with the requirements of the Endangered Species Act (ESA) and other relevant regulatory requirements, and the project would protect habitat in place and create habitat, potential adverse effects on special-status species and on sensitive habitats would be reduced to a less than significant level.

(12) Other Wildlife

The project site is used by a variety of species associated with annual grassland, mixed oak woodland, upland and riparian scrubs, riparian woodland, non-native woodland, and riverine habitats. Effects on fish species using riverine habitat at the project site are discussed in the preceding section regarding effects on the fish. Grading and other ground-disturbing activities, noise from construction activities, and removal of vegetation could disrupt movement and foraging, or displace, injure, or kill wildlife. These effects would be temporary and many affected species would be expected to return to areas affected by construction after on-site plantings mature and natural recruitment occurs, estimated at within 8 to 10 years. In fact, the planting benches on the American River will double riparian habitat when compared to pre-project conditions.

Additionally, there would be extensive similar, unaffected, areas of riparian, oak woodland, and grassland habitat in the vicinity of the project site and along the Lower American River that could be used by these species. Therefore, for most species of terrestrial wildlife, the Proposed Action would not result in a permanent reduction in population abundance, movement, and distribution. However, in addition to the species Federally listed as T&E that were discussed previously, a number of special-status species occur in the project site. These species are less abundant, have more limited distributions, and are more vulnerable to population-level effects than common wildlife species. These special-status species include western pond turtle, American badger, pallid bat and western red bat, and several raptors and other birds that may nest at or in the vicinity of the project site (Swainson’s hawk, Cooper’s hawk, white-tailed kite, burrowing owl, great egret, great blue heron, and purple martin).

To minimize potential effects on these special-status species, the applicable avoidance and minimization measures from the ARCF GRR Final EIS/EIR and 2025 SEIS/SEIR have been incorporated into the Proposed Action, with revisions to reflect the revised Project Area and current mitigation requirements. These measures include worker environmental awareness training; pre-construction surveys for western pond turtles, bat maternity roosts, American badger dens, and nesting birds; and establishment of avoidance buffers as necessary. Implementing these measures would protect maternity roosts of special-status bats, and avoid or minimize effects on western pond turtle, American badger, and nesting birds.

Furthermore, on-site replacement of riparian habitat and restoration of riparian habitat off site as compensatory mitigation would provide replacement habitat at a 2:1 ratio, which in the long-term would improve habitat conditions for riparian-associated species.

(13) Actions to Minimize Impacts

The proposed project is not likely to result in take of these species for either Alternative as long as the applicable conservation and mitigation measures, as detailed in Section 3.8.6 of the ARCF GRR Final EIS/EIR and Section 4.5.3 of the 2025 SEIS/SEIR are adhered to. Among other measures listed in the SEIS/SEIR, the conclusion of non-jeopardy is based on USACE' commitments to: (1) avoid direct impacts by maintaining buffers around sensitive habitat and/or conducting construction activities outside of sensitive timeframes (e.g. during the salmonid work window or outside of the fledging period of special-status birds); (2) implement a SWPPP and associated BMPs; including the designation of staging areas for stockpiling of construction materials, portable equipment, vehicles, and supplies and (3) appoint on-site biologists to provide worker environmental awareness training to contractors and to monitor, report, and remove and transport special-status species if necessary or suspend construction activities until special-status species leave the project on their own. Concurrent implementation of these conservation measures would adequately avoid, minimize, and mitigate adverse effects on the special-status fish, wildlife and plant species discussed in this document.

f. Proposed Disposal Site Determinations

(14) Mixing Zone Size Determination

Not applicable.

(15) Determination of Compliance with Applicable Water Quality Standards

Water quality could be affected within the actual construction area and upstream and downstream of the work area. Construction activities such as rock placement, clearing and grubbing, and slope flattening, have the potential to temporarily degrade water quality through the direct release of soil and construction materials into water bodies or the indirect release of contaminants into water bodies through runoff.

The ARCF study is located within the jurisdiction of the CVRWQCB, within the greater Sacramento Valley watershed. The preparation and adoption of water quality control plans, or Basin Plans, and statewide plans, is the responsibility of the SWRCB. State law requires that Basin Plans conform to the policies set forth in the California Water Code beginning with Section 13000 and any State policy for water quality control. These plans are required by the California Water Code (Section 13240) and supported by the Federal CWA. Section 303 of the CWA requires states to adopt water quality standards which "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses." According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected and water quality objectives to protect those uses. Adherence to Basin Plan water quality objectives protects continued beneficial uses of water bodies. Because beneficial uses, together with their corresponding water quality objectives, can be defined per Federal regulations as water quality standards, the Basin Plans are regulatory references for meeting the State and Federal requirements for water quality control (40 CFR 131.20). The potential effects of the proposed project on water quality have been evaluated and are discussed in Section 4.4.4 “Water Quality” and Appendix B Section 3.4 “Water Quality” of the 2025 SEIS/SEIR. Compliance with the California Water Code will be accomplished by obtaining certifications from the CVRWQCB prior to construction.

(16) Potential Effects on Human Use Characteristics

a) Municipal and Private Water Supplies

The Sacramento River waterways historically were used as places to dispose of contaminants. In recent decades, treatment for municipal wastewater, industrial wastewater, and management of urban stormwater runoff have increased and improved greatly. Industries and municipalities now provide at least secondary treatment of wastewater. The American River originates in the high Sierra Nevada just west of Lake Tahoe, in the Tahoe and El Dorado National Forests. Its three main forks – the South, Middle, and North – flow through the Sierra foothills and converge east of Sacramento. The waters of the American River provide recreation, municipal power, and irrigation for the northern California area. The fill material would not violate Environmental Protection Agency or State water quality standards or violate the primary drinking water standards of the Safe Drinking Water Act (42 USC 300f-300j). Project design, compliance with State water quality thresholds and standard construction and erosion practices would preclude the introduction of substances into surrounding waters. The groundwater table is separated from the slurry wall by a non-permeable layer of soil, therefore there would be minimal risk to groundwater supply. Materials removed for disposal off-site would be disposed of in an appropriate landfill or other upland area.

b) Recreation and Commercial Fisheries

Under the Proposed Action, there would not be long term/long distance closure of recreation facilities including the bike trails, walking trails, parks, and boat launches. There will be short-term closures of parks, trails, and boat launches. Notification and coordination with agencies managing the recreational areas would be arranged. Flaggers, signage, detours, and fencing would be present to notify and control recreation access and traffic around construction sites.

The Proposed Action would cause direct effects to fish habitat from the removal of vegetation from the levee slopes. Direct effects from the placement of rock at a bank protection site would cause an increase in turbidity. A Vegetation Design Deviation would allow waterside vegetation, which would include native grasses, shrubs, and trees, to remain on the lower one-third of the waterside slope along the Sacramento River. The American River's riverbank is wide enough below the OHWM that the vegetation can be retained when feasible or planted along the river's edge without needing a Vegetation Design Deviation. Bank protection sites, planting benches, and launchable rock toes would be revegetated with native grasses, shrubs and trees following construction. ARMS and SRMS would provide compensatory mitigation for permanent fish habitat impacts. Once establishment is reached, the ARMS site could be accessed and used for recreational purposes as part of the American River Parkway. SRMS will not be advertised for public recreational use, but there will not be fencing or security to prevent access. BMPs would be implemented to address turbidity.

c) Water-related recreation

Recreational boating is one of the primary uses of the American River. Boat access is located at Discovery Park on both the Sacramento and American River side of the park. Formal boat launches within the Parkway are located at Howe Avenue, Watt Avenue, and Gristmill Park. The river can become very shallow between Sunrise and Howe Avenue when releases from Folsom Dam are reduced, making motorized boating impracticable. Rafting on this stretch of the river is very common during summer months with the highest use on the weekends and holidays. Watt Avenue's Boat Launch will be closed during construction, causing a short-term significant impact on the American River. The Watt Avenue Boat Launch will be returned to its existing condition once work is complete, so there would be no long-term effects.

Construction will occur during the summer months when the river recreation activities are at the peak. There would be short-term term significant effects along the Sacramento River reach of the project, however, there would be no long-term effects because the area would be returned to the pre-construction conditions once completed. The timing of construction cannot be mitigated as it is unsafe to perform construction activities in the floodway during the flood season.

d) Aesthetics

The Proposed Action would result in vegetation loss and construction activities would disrupt the existing visual conditions in the American River Parkway and along the Sacramento River. Native trees would be planted after construction is completed on planting berms and on top of launchable rock trenches. For the American River Erosion Contract 3B, vegetation would also be planted along bank protection. Even with replanting there would still be a temporal loss of vegetation as it will take 8-10 years for vegetation to mature. Disturbed areas would be reseeded with native grasses.

e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

Following is a description of the parks and their activities (see Figures 2.2-1 through 2.2-5 of Appendix B of the 2025 SEIS/SEIR):

American River Parkway. American River Erosion Contract 3B, American River Erosion Contract 4A, American River Erosion Contract 4B, and the ARMS are all within the American River Parkway. The Lower American River is designated as a recreational river both under the Federal Wild and Scenic Rivers Act (Heritage Conservation & Recreation Service 1980) and the State Wild and Scenic Rivers Act (Public Resources Code Section 5093.545h) for its outstandingly remarkable (Federal) and extraordinary (State) anadromous fishery resource and recreational values. The American River Parkway Plan supplies guidance on how to manage land use in the American River Parkway. Other recreational activities within the American River Parkway include walking, cycling, running, hiking, bird watching, wildlife viewing, and horse riding. Recreational events, such as Ride the Parkway, Run the Parkway, Great American Triathlon, and the American River Half Marathon, occur within the American River Parkway.

Camp Pollock. The Sacramento Valley Conservancy manages Camp Pollock, which is approximately 11 acres. Camp Pollock is located on the right bank of the American River within the American River Parkway just downstream of the State Route 160 Bridges. The Sacramento Valley Conservancy allows kayaking, canoeing, paddle boarding, fishing, weddings, youth educational camping, and events with over 200 people at Camp Pollock. In addition, there is a native plant nursery at Camp Pollock.

Discovery Park. Located just north of downtown Sacramento at the confluence of the American River and the Sacramento River, this 302-acre park is a popular site for rafters and waders. Discovery Park is the trailhead for the 32-mile long Jedediah Smith Memorial Trail. The park also features a boat launch. Discovery Park was designed to flood and take pressure off American River levees during high water events. For safety reasons, the park closes when water flows into the public areas and remains closed until the water subsides.

Dry Creek Parkway. Sacramento County manages the Dry Creek Parkway, and the recreational facility is 1,300 acres. The Dry Creek Parkway is a 6-mile corridor that contains recreational resources such as a golf course, horse trails, picnic facilities, soccer fields, and hiking trails. Only the most southern section between Rio Linda Boulevard and Rose Street is within the Project Site.

Garcia Bend Park. Located between Pocket Road and the Sacramento River, this 19-acre community park is a popular place for recreation providing soccer fields, lighted tennis courts, play areas, picnic areas, restrooms, and a public boat ramp providing access to the Sacramento River.

Gristmill Park. Located off Mira Del Rio Drive and Folsom Boulevard in Rancho Cordova, Gristmill Park is a popular place for fishing, bird watching, and nature watching/photography. The area also has some nice walking paths popular with the locals that wind through oak woodlands along the southern bank of the river in either direction from the parking area. In addition to the usual assortment of birds in these woodlands such as woodpeckers, Northern flickers, and red-shouldered hawks, it is not unusual to spot deer and coyote here as well. Due to the calmness of the river at this location, it is a popular launch spot for kayaking and canoeing.

Guy West Bridge. The Guy West Bridge is a pedestrian-only suspension bridge crossing the historic Lower American River. It is modeled after the famed Golden Gate Bridge in San Francisco, but spans only 600 feet compared to the Golden Gate's 6,450 feet. The bridge was constructed to tie the California State University campus to a business and residential community on the north side of the American River.

Larchmont Community Park. Larchmont Community Park is approximately 12 acres and is managed by the Cordova Recreation and Park District. This park is adjacent to the American River levee near the College Green East neighborhood and has large soccer fields, multi-use fields, tennis courts, a playground, and picnicking areas.

Miller Park. Adjacent to the Sacramento Marina, off Harborview Drive from Front Street, this 57-acre city park is right on the Sacramento River. The park includes picnic areas, boat trailer parking, and a boat ramp and dock. There is also a store called Rat's Snack Shop.

The Riverfront Promenade. A new addition to Sacramento's riverfront, a couple blocks were opened in 2001. It is located just downstream of Old Sacramento and is still in the early stages of development. When complete, the promenade will be a mile long walking and cycling path that connects Old Sacramento to Miller Park.

University Park. University Park is approximately 3.4 acres and is managed by the City of Sacramento. This park is just east of Howe Avenue. University Park is under powerlines, but has open grassy fields, benches, and a small playground. In addition, there is a dog park in the southern portion of University Park.

Walter S. Ueda Parkway. The City of Sacramento manages the Walter S. Ueda Parkway, and the recreational area is 491.84 acres. The area contains a 12.5-mile walking path. Only the most northeastern section between Rio Linda Boulevard and Rose Street is within the Project Site.

Waterton and Save the American River Association. Just off of U.S. 50 at Watt Avenue, Waterton Access is a small site providing access along the river. The area is inhabited by deer and jackrabbits, so it is ideal for nature watching. The nearby Save the American River Association Access offers similar opportunity.

Watt Avenue. Just off Watt Avenue is an American River access point popular as a take-out spot for rafters, canoeists, and kayakers. Fishing is also popular here because of the range of shallow and deep water.

Zacharias Park. Located in the Pocket neighborhood, off Clipper Way. This 6-acre park is right on the Sacramento River. The park amenities include river access, soccer fields and a picnic area.

Construction of the Proposed Project will have short-term significant impacts to recreation. Portions of the road on top of the levee would be closed to pedestrian access during the construction period. Additionally, construction of erosion protection on the American River would temporarily disturb several miles of bike trails as well as access to public parks and boat launches within or adjacent to the Parkway. Once construction is complete the recreation facilities would be returned to the pre-construction conditions and long-term effects would be less than significant. These closures and disturbances would also result in direct and adverse effects to recreation, an outstandingly remarkable value under the Wild and Scenic Rivers Act.

To ensure public safety, flaggers, warning signs, and signs restricting access would be posted before and during construction, as necessary. In the event that bike trails would be disrupted; detours would be provided. Detour routes would be clearly marked, and fences would be erected to prevent access to the project area. In areas where recreational traffic intersects with construction vehicles, traffic control will be utilized to maintain public safety. Detours would be short duration, only while work is being completed in the immediate vicinity.

These mitigation measures will reduce the effects on recreation; however, impacts would still be significant because of the duration of construction and the inability to provide similar quality recreation during construction. Any recreation facilities affected by the project would be replaced in-kind within the existing area and no long-term impacts are anticipated.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

Effects of the proposed action include reductions in nearshore aquatic and riparian habitats that are used by aquatic and terrestrial species. USACE actions which could create a cumulative effect on WOTUS in the Sacramento area include the other features of ARCF 2016 Program such as Seepage, Stability and Overtopping work on the Sacramento River East Levee (SREL), and construction of the new Sacramento Weir and Bypass. Other projects occurring in the same area include: Dredging at Miller Park, Sacramento Riverbank Protection Project (SRBPP), North

Sacramento Streams Project, West Sacramento Project, and the Sacramento River Parkway. The I Street Bridge replacement is anticipated to begin construction in the next 5 years and the Broadway Bridge is expected to begin construction in the next 15 years.

Ongoing non-Federal activities that affect listed salmonids and VELB, and their habitat, will likely continue in the short-term, at intensities similar to those of recent years. However, some activities associated with the State's proposed Central Valley Flood Protection Plan or State or local efforts to implement the Engineering Pamphlet (EP) 1110-2-18 could result in increased effects on listed species. Potential cumulative effects on fish also may include any continuing or future non-Federal diversions of water that may entrain adult or larval fish or that may incrementally decrease outflows or water quality, thus changing habitat for these species.

Water quality could be affected at the project footprint as well as upstream and downstream of the work area. Construction activities associated with the Proposed Action, West Sacramento Projects and Dredging have the potential to temporarily degrade water quality. All projects occurring simultaneously would be required to coordinate with the RWQCB and comply with their 401 permits.

h. Determination of Secondary Effects on the Aquatic Ecosystem

The placement of rock would not only reduce the risk of erosion but would also anchor remaining trees in place and reduce the potential for trees falling over during a high flow event. The understory, which provides habitat for small rodents, ground nesting birds and waterfowl, and various reptiles, would be temporarily removed in order to provide a clean surface to place the rock. In areas with a planting bench or soil placed over revetment would allow for vegetation to establish on the Lower American River. Because the riparian corridor will be replanted when feasible, the sites would still provide value to fish and wildlife species, and compensatory mitigation would be implemented for trees that were removed, impacts are consider less than significant over the long term.

Risk exists for the unintentional placement of dredge and/or fill material to be placed outside of the proposed project area. Unintentional placement could result in additional adverse impacts to water quality, erosion and accretion patterns, aquatic and other wildlife habitat, recreation, aesthetics, and air quality. In order to reduce the risk of such impacts, contract specifications would require the contractor to mark the project boundaries, and that the contractor install erosion control (i.e., silt fencing, silt curtains) where possible within any standing waters.

IV. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation

No significant adaptations of the guidelines were made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site

There is no other location that this work can be done to provide the same level of protection. The adjacent community backs up to the levee, therefore no space is available to construct a setback levee in Sacramento metropolitan area. On the Sacramento River, onsite alternative methods such as rock trenches are not feasible because there is no remaining floodplain between the riverbank and the levee itself. They would also result in the removal of additional vegetation. There are no other practicable alternatives that provide the same level of life and safety protection and sufficiently reduce the risk of levee failure. Sections 1.7.4 “Erosion Protection Alternatives” and 2.5.2 “Contract 3B” of Appendix G of the 2025 SEIS/SEIR provide details on alternative selection for American River Contract 3B design and why the alternatives were considered not feasible. Alternative 3c has been selected for American River Erosion Contract 4A, as alternatives 3a, 3b, 3d and the Proposed Action have been determined to not be feasible due to design constraints.

The proposed ARMS at the Urrutia property is the LEDPA because it would restore and enhance onsite habitat functions and values to as close to pre-mining habitat conditions as possible. The goal is to improve conditions for 35 special-status species that may rely upon these habitats for all or part of their life cycle, while still achieving the compensatory mitigation needs for salmonids, yellow-billed cuckoo (YBCU), and VELB on the LAR. The proposed design surface elevations are set to achieve winter and spring water surface elevations (WSEs) that would mimic pond-like conditions, while still providing shallow water habitat for salmonids and other species that rely upon diverse riparian and floodplain habitats, thus supporting the greatest cross-section of species. Additionally, movement of wildlife should be enhanced post-construction by the increased structural complexity and vegetative cover over existing conditions. Lastly, the proposed project was developed in consideration of the Parkway Plan policies, along with the terms and conditions of other relevant governing permits and authorizations and the project expands upon the 2008 City of Sacramento project conceptualized for the site.

The proposed SRMS would reconnect the historic tidal island to the river and it would restore and enhance onsite habitat functions and values. This was the only available real estate large enough to provide sufficient mitigation acreage on the main stem of the Sacramento River, which was the preference from USFWS and NMFS in the Endangered Species Act consultation.

c. Compliance with Applicable State Water Quality Standards

The proposed project would implement BMPs to ensure that it does not violate State water quality standards identified in the Central Valley Basin Plan (CVRWQCB 2019). USACE received a 401 Programmatic Order in 2020 for ARCF, effective date is 13 July 2021 and expiration date is 12 July 2026, WDID 5A34CR00819. Each individual contract is submitting a

Notice of Intent under the programmatic and is obligated to follow all BMP's, avoidance, and minimization measures within the order.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act

The discharges of fill materials will not cause or contribute to, after consideration of disposal site dilution and dispersion, violation of any applicable State water quality standards for waters. The discharge operations will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. Compliance with Endangered Species Act of 1973

The placement of fill materials in the project area(s) will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973. Formal consultation was completed with the regulatory agencies:

- U.S. Fish & Wildlife Service (USFWS; 08ESMF00-2014-F-0518-R003) Dated March 2021
- National Marine Fisheries Service (NMFS; WCRO-2020-03082) Dated May 2021
- Reinitiation of-consultation is currently ongoing with NMFS and USFWS with new BOs scheduled to be received in spring 2025.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

Not applicable.

g. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

Appropriate and practicable steps to minimize potential adverse effects of discharge and fill on the aquatic ecosystem include:

- Placing fill material only where it is needed for the proposed project and confining it to the smallest practicable area.
- Conducting work in the dry to the maximum extent possible, during the low flow season.
- Complying with in-water work BMPs. Requiring the project to have no hydraulic impact to eliminate impacts to flow and circulation.

On the basis of the guidelines, the proposed project is specified as complying with the inclusion of appropriate and practical conditions to minimize pollution or adverse effect on the aquatic ecosystem.

V. Summary and Conclusion

A. The discharge represents the least environmentally damaging, practicable alternative (LEDPA).

B. The discharge does not cause or contribute to violation of any applicable state water quality standard and does not violate any applicable toxic effluent standard.

C. The discharge does not cause or contribute to significant degradation of the waters of the US (WOTUS).

D. All appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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In Reply Refer to:
2022-0003130-R004

March 21, 2025
Sent Electronically

Kevin Harper
Chief, Environmental Resources Branch
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1325 J Street
Sacramento, California 95814
Marshall.k.harper@usace.army.mil

Subject: Reinitiation of Formal Consultation on the American River Common Features 2016 Project, Sacramento and Yolo Counties, California

Dear Kevin Harper:

This letter is in response to the U.S. Army Corps of Engineers' (Corps) request for reinitiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed American River Common Features (ARCF) 2016 Project (proposed project) in Sacramento and Yolo Counties, California. Your request was received by the Service on October 28, 2024. The Corps has refined some of the project designs and is updating the project description and effects to listed species as well as adding the newly federally endangered longfin smelt (*Spirinchus thaleichthys*). At issue are the proposed project's effects on the federally threatened vernal pool fairy shrimp (*Branchinecta lynchi*), valley elderberry longhorn beetle (*Democerus californicus dimorphus*), (giant garter snake (*Thamnophis gigas*), and western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) delta smelt (*Hypomesus transpacificus*), and delta smelt designated critical habitat and the federally endangered vernal pool tadpole shrimp (*Lepidurus packardi*), and longfin smelt (*Spirinchus thaleichthys*). This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (Act), and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The federal action on which we are consulting is the Corps' ARCF 2016 Project, which includes levee improvements and bank protection along the Sacramento River, levee improvements along Arcade and Magpie Creeks, widening the Sacramento Weir, and bank protection along the lower American River. Pursuant to 50 CFR 402.12(j), you submitted a biological assessment for our review and requested concurrence with the findings presented therein. These findings conclude that the proposed project may affect, and is likely to adversely affect the valley elderberry longhorn beetle, the delta smelt and its critical habitat, the giant garter snake, and the yellow-billed cuckoo. The project is outside of critical habitat designated for the valley elderberry longhorn beetle and the yellow-billed cuckoo. The findings also conclude that the proposed project may affect but is not likely to adversely affect the longfin smelt.

In considering your request, we based our evaluation on the following:

1) May 2024 Biological Assessment American River Watershed Common Features;

2) October 28, 2024 additional information letter; and

3) Various e-mails with project modifications provided between November 2024 and December 2024.

The Service concurs that the proposed project is not likely to adversely affect the longfin smelt. Potential habitat for longfin smelt will be affected with the placement of riprap along the left bank of the Sacramento River around river mile 47 to 53. Longfin smelt adults have been infrequently captured at the confluence of Cache Slough and the Sacramento River (river mile 15). The erosion protection work will occur 30 miles upstream of this location and at the edges of the range of the longfin smelt where take is unlikely to occur. Work will occur between July 1 and October 31 which is during the time that longfin smelt are downstream in the Suisun Bay. Construction of the Sacramento River Mitigation Site could affect longfin smelt when the proposed project breaches the berm to allow water to enter the newly created floodplain and channels. This work will also be done in the work window to avoid longfin smelt. Finally, the mitigation site for this project will also benefit longfin smelt by providing additional aquatic habitat. Based on these reasons the Service believe the proposed action may affect but is not likely to adversely affect the longfin smelt.

The remainder of this document provides our biological opinion on the effects of the proposed project on the valley elderberry longhorn beetle, vernal pool fairy shrimp, vernal pool tadpole shrimp, delta smelt and its critical habitat, giant garter snake, and yellow-billed cuckoo.

Consultation History

September 4, 2013:	The Service commented on the April 2013 draft biological assessment.
April 8, 2014:	The Service commented on the October 2013 draft biological assessment.
June 30, 2014:	The Corps initiated section 7 consultation with the Service.
July 23, 2014:	The Service sent a letter in response to the Corps initiation requesting additional information.
April 3, 2015:	The Corps provided an updated biological assessment with responses to the Service's July 23, 2014, request for additional information.
August 31, 2015:	The Corps provided a revised biological assessment that addressed questions the Service had regarding the project description.

September 11, 2015:	The Service provided the Corps with a biological opinion on the proposed project.
January 25, 2017:	The Corps reinitiated consultation with the Service.
June 8, 2017:	The Service provided an amended biological opinion to the Corps.
April 15, 2019:	The Corps reinitiated consultation with the Service to add geotechnical explorations.
June 17, 2020:	The Corps reinitiated consultation with the Service due to changes in project description and effects to listed species.
June 2020 – March 2021:	The Corps provided numerous e-mails and held numerous meetings to discuss changes to the project description and effects to listed species.
March 2021:	The Service provided an amended biological opinion to the Corps.
May 13, 2024:	The Service received a reinitiation request from the Corps on the Common Features project.
June 12, 2024:	The Service sent an letter to the Corps requesting additional information.
October 28, 2024:	The Corps provided the information requested in the June 2024 Service letter.
October 2024 – March 2025:	The Corps continued to provide information to the Service regarding effects to listed species to include in the biological assessment.

BIOLOGICAL OPINION

The purpose of this section 7 consultation is to evaluate the effects of the proposed action on listed species and designated critical habitat. After reviewing the proposed action with programmatic actions as proposed by the Corps, the Service has determined that the proposed action presents a programmatic action, as defined in 50 CFR § 402.2.

Description of the Proposed Action

Congress directed the Corps to investigate the feasibility of reducing flood risk to the city of Sacramento and surrounding areas. The Corps completed feasibility studies in 1991 and 1996, recommending a concrete gravity flood detention dam on the north fork of the American River at the Auburn site along with levee improvements downstream of Folsom Dam. Other plans evaluated in the report were Folsom Dam improvements and a stepped release plan for Folsom Dam releases. These additional plans also included levee improvements downstream of Folsom Dam. Congress recognized that levee improvements were “common” to all candidate plans in the report and that there was a Federal interest in participating in these “common features.” Thus, the ARCF Project was authorized in the Water Resources Development Act (WRDA) of 1996 and a decision on Auburn Dam was deferred to a later date. Major construction components of ARCF in the WRDA 1996 authorization included construction of seepage remediation along about 22 miles of American River levees and construction of levee strengthening and raising of 12 miles of Sacramento River levee in Natomas.

The following problems were identified within the Sacramento levee system:

- Seepage and underseepage;
- Levee erosion;
- Levee stability;
- Levee overtopping;
- Access for maintenance and flood fighting;
- Vegetation and encroachments;
- Releases from Folsom Dam;
- Floodplain management; and
- Additional upstream storage from existing reservoirs.

The project is designed to allow for the release of 160,000 cubic feet per second (cfs) from Folsom Dam. The levees along the American River are unable to withstand these maximum flows for extended periods of time without increased risk of erosion and potential failure.

The Corps' project involves the construction of fix-in-place levee remediation measures to address seepage, stability, erosion, and height concerns identified for the Sacramento River and American River levees, Natomas East Main Drainage Canal (NEMDC), Arcade, and Magpie Creeks. Most height concerns along the Sacramento River will be addressed by a widening of the Sacramento Weir and Bypass to divert more flood flows into the Yolo Bypass, thereby lowering water surface elevations downstream. Due to the urban nature and proximity of existing development within the American River North and South basins the Corps is planning fix in place remediation. This will improve the flood damage reduction system to safely convey flows to a level that maximizes net benefits. Table 1 summarizes the levee problems discussed above and the proposed measure for each waterway.

Table 1. Remediation by Waterway.

Waterway	Seepage Measures	Stability Measures	Erosion Protection Measures	Overtopping Measures
American River[1]	---	---	Bank Protection (31,000 linear feet), Launchable Rock Trench (45,000 linear feet)	---
Sacramento River	Cutoff Wall (50,300 linear feet)	Cutoff Wall (50,300 linear feet)	Bank Protection (43,000 linear feet)	Sacramento Bypass and Weir Widening, Levee Raise (1,500 feet)
NEMDC	Cutoff Wall (6,000 linear feet)	Cutoff Wall	---	Floodwall (15,600 linear feet)
Arcade Creek	Cutoff Wall (22,000 linear feet)	Cutoff Wall	---	Floodwall (22,000 linear feet)

Dry/Robla Creeks	---	---	---	Floodwall (2,500 linear feet)
Magpie Creek	---	---	---	Levee Raise (2,100 linear feet) and Training Levee (1,000 linear feet)

[1]American River seepage, stability, and overtopping measures were addressed in a previous construction project.

Sacramento Area Flood Control Agency (SAFCA), the project's local sponsor, will complete some portions of the Federal project. SAFCA is seeking permission from the Corps pursuant to 33 USC §408 (Section 408) for alteration of the Federal levees along the NEMDC and Arcade Creek.

In addition to the proposed levee improvements measures shown in Table 1, the following measures and policies will be addressed during construction:

- The Corps will apply a semi-quantitative risk assessment methodology to evaluate the placement of on-site mitigation vegetation.
- The non-Federal sponsor, Central Valley Flood Protection Board (CVFPB), will bring the levees into compliance with the Corps' standard levee footprint using a System Wide Implementation Framework (SWIF) process. A SWIF is a plan developed by the levee sponsor(s) and accepted by the Corps to implement system-wide improvements to a levee system (or multiple levee systems within a watershed) to address system-wide issues, including correction of unacceptable inspection items, in a prioritized way to optimize flood risk reduction. The standard levee footprint consists of a 20-foot crown width, 3 to 1 (height to vertical) (3H:1V) waterside slope and 2H:1V landside slope. There may be locations where a 3H:1V waterside slope design is not possible and, when possible. If the 3H:1V waterside slope is not possible, then a minimum 2H:1V waterside slope will be established with revetment.

American River

Levees along the American River require improvements to address erosion. For design and construction purposes, the lower American River is divided into 4 subreaches. The proposed measures for these areas consist of bank protection or launchable rock trenches with a maximum of 31,000 linear feet (LF) of bank protection, and a maximum of 65 acres/45,000 LF of launchable rock trench. These measures are being implemented to prevent undermining of the levee foundation. Typical designs are described below.

<u>Bank Protection</u>
This measure consists of placing rock revetment on the river's bank to prevent erosion and will consist of the following types of repairs.

Bank protection entails installing revetment along the stream bank based on site-specific analysis. When necessary, the eroded portion of the bank will be filled and compacted prior to the rock placement. The sites will be prepared by clearing and stripping of loose material and understory growth prior to construction. Where possible large woody vegetation will be left on-site. Temporary access ramps will be constructed, if needed, using imported borrow material that will be trucked on site.

The placement of rock onto the bank will occur from a land-based staging area using long reach excavators and loader. The loader brings rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the waterside of the levee. A soil filled planting bench could be established on these rock surfaces for revegetation purposes.

The revetment will be placed on the existing bank at a slope varying from 2H:1V to 3H:1V depending on site specific conditions. Rock will be placed at the toe of the repair which is designed to launch at certain high flows to protect against toe erosion.

After revetment placement has been completed, where hydraulic stage impacts have been deemed acceptable and space allows, a soil-filled planting berm will be constructed on the repair site to allow for vegetation to be planted, outside of the vegetation free zone as required by the Corps. This vegetation will be designed on a site-specific basis in coordination with the Service and in such a way as to not impact the hydraulic conveyance of the channel.

Planting benches will provide on-site mitigation for juvenile salmonids contributing to their foraging and refuge habitat. The planting benches will provide adequate soil volume to establish native tree species. Design of the planting benches should include providing a variety of slopes both parallel and perpendicular to the river and a diverse planting pallet including trees, shrubs, and understory plants. Instream woody material in the form of small dead trees with intact roots will be placed at the lower elevations that are frequently inundated. The planting bench will terminate at the launchable toe where rows of willow stakes will be planted to stabilize the planting bench soil. During the initial plant establishment, planting benches will be protected with biodegradable erosion control fabric on the surface. The planting bench will be placed over a minimum two-foot thick layer of clean riprap. The launchable toe will be of sufficient volume to launch the riprap into scours that could develop along the natural river bottom during high flows.

Launchable Rock Trench

This measure includes construction of a launchable rock filled trench, designed to deploy once erosion has removed the bank material beneath it. All launchable rock trenches will be constructed outside of the natural river channel. The vegetation will be removed from the footprint of the trench and the levee slope prior to excavation of the trench. The trench configuration will include a 2H:1V landside slope and 1H:1V waterside slope and will be excavated at the toe of the existing levee. All soil removed during trench excavation will be stockpiled for potential reuse. The bottom of the trench will be constructed close to the summer mean water surface elevation in order to reduce the rock launching distance and amount of rock required.

After excavation, the trench will be filled with revetment that will be imported from an offsite commercial location. After rock placement the trench will be covered with a minimum of 3 feet of the stockpiled soil. Vegetation may be planted over the trench if it is planted outside of the vegetation-free zone. This vegetation will be limited to native grasses and woody vegetation with shallow root systems to ensure they do not limit the functionality of the trench during a flood event.

<u>Cut Bank</u>
This measure consists of excavating the channel banks to create stable slopes that could be planted with riparian vegetation to provide erosion protection along the channel margins and include the following potential activities.

The design is intended to be deformable vegetated bankline, which will allow small amounts of river processes such as erosion and accretion. The design will reduce the likelihood of erosion by reducing bank slope, creating planting areas on the lower slope at elevations observed to recruit and sustain natural riparian vegetation to increase slope stability and erosion resistance. Inclusion of launchable buried rock tiebacks will both protect the levee and the bank.

<u>Velocity and Tree Scour Work</u>

<u>These two activities will protect against fluvial erosion and scour around trees and will include removing trees when necessary.</u> The location of each native tree will be assessed to see if the alternative methods listed below could be used as erosion protection in place of tree removal. It is anticipated that only non-native trees or trees that cannot be saved using the methods below will be removed.

- About 2 feet of soil-filled revetment will be installed. This also may require about 5 feet of excavation below the surface of the ground for scour protection at the levee toe embankment. Some trees may not survive the excavation and may need to be removed. All this work is proposed to prevent erosion from velocities at 160,000 cfs.
- Smaller rocks will be placed above the ground around the trees to armor the trees from scour.

Sacramento River

Levees along the Sacramento River require improvements to address seepage, stability, and erosion. About 43,000 LF of bank protection and 50,300 LF of cutoff wall or slope stability work is proposed for the Sacramento River. In addition, these levees require a total of one mile of intermittent height improvements in order to convey additional flows that exceed current design levels.

Levee Raising

Where the existing levee does not meet the levee design requirements, as discussed above, slope flattening, crown widening, and/or a minimal amount of levee raise is required. This improvement measure addresses problems with slope stability, geometry, height and levee crest access and maintenance. To begin levee embankment grading, loose material and vegetation understory will be cleared, grubbed, stripped, and where necessary, portions of the existing embankment will be excavated to allow for bench cuts and keyways to tie in additional embankment fill. Excavated and borrow material (from nearby borrow sites) will be stockpiled at staging areas. Haul trucks and front-end loaders will bring borrow materials to the site, which will then be spread evenly and compacted according to levee design plans.

The levee will be raised about 1 to 2 feet resulting in the levee footprint extending out a maximum of 5 feet on the landside from the existing levee. The levee crown patrol road will be re-established at the completion of construction.

Cutoff Walls
To address seepage concerns, a cutoff wall will be constructed through the levee crown. The cutoff wall will be installed by one of three methods: (1) conventional open trench cutoff walls, (2) deep soil mixing (DSM) cutoff walls, and (3) jet grout cutoff walls. The method of cutoff wall selected for each reach will depend on the depth of the cutoff wall needed to address the seepage. The open trench method can be used to install a cutoff wall to a depth of about 85 feet. For cutoff walls of greater depths, the DSM method will be utilized.

Prior to any cutoff wall construction method, the construction site and any staging areas will be cleared, grubbed, and stripped. The levee crown will be degraded up to half the levee height to create a large enough working platform (about 30 feet) and to reduce the risk of hydraulically fracturing the levee embankment from the insertion of slurry fluids. This method of slurry wall installation will also reduce the risk of slurry mixture following seepage paths and leaking into the river or into landside properties.

Open Trench Cutoff Wall
Under the open trench method, a trench about 3 feet wide will be excavated at the top of levee centerline and into the subsurface materials up to 85 feet deep with a long boom excavator. As the trench is excavated, it is filled with low density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench is mixed nearby with hydrated bentonite, and in some applications cement. The soil bentonite mixture is backfilled into the trench, displacing the temporary slurry. Once the slurry was hardened, it will be capped, and the levee embankment will be reconstructed with impervious or semi-impervious soil.

DSM Cutoff Wall
The DSM method involves a crane supported set of two to four mixing augers used to drill through the levee crown and subsurface to a maximum depth of about 130 feet. As the augers are inserted and withdrawn, a cement bentonite grout will be injected through the augers and mixed with the native soils. An overlapping series of mixed columns will be drilled to create a continuous seepage cutoff barrier. A degrade of up to one half the levee height will be required for construction of the DSM wall. For both methods, once the slurry has hardened it will be capped and the levee embankment will be reconstructed with impervious or semi-impervious soil.

Jet Grout Construction
Jet grout construction involves injecting grout into the soil at very high pressures and will be used in areas where there are utilities that cannot be removed such as the regional sewer line and Pacific Gas and Electric (PG&E) natural gas line near the Pioneer Bridge. The grout is a mixture of cement and water that will be mixed in a batch plant located in the staging area and transported through high- pressure hoses to the location of construction. The jet grout process involves drilling straight down into the levee to a depth of up to approximately 130 feet, then injecting grout into the hole through a high-pressure nozzle. As the grout is injected from the bottom to the top of the hole, the high pressure excavates the soil around the nozzle to a radius of 3 to 4 feet, mixing the soil within the levee with grout. The grout injection may be accompanied with air and water to assist the excavation of soil. The nozzle is rotated and lifted at a slow, smooth, constant speed to achieve thorough mixing and consistent quality. The grout then solidifies to create a column of low permeability. Multiple columns constructed together create a wall through the levee that prevents seepage. Soil that is displaced from the injection site will be piped into drying beds or containment cells located in the staging area for later disposal.

Jet grouting activities near Pioneer Bridge may occur 24 hours a day to expedite work which will generate noise and require night lighting.

Municipal Drainage Systems

Several municipal drainage systems, both legacy and operational, have pipes that run through the levee. These facilities require removal and replacement to install the cutoff walls. Temporary waterside access below the ordinary high-water mark of the river is required to remove or replace these structures. A small portion of the concrete apron will be placed as part of the Sump 70 replacement and will likely extend below the OHWM. Temporary access will consist of dewatering the area with the use of a sandbag cofferdam approximately five feet high (1.75 feet above the typical water level) and approximately 120 feet in length. The sandbag cofferdams will be installed, and work completed between July 1 and October 31, which is outside of sensitive fish species migration windows. A portion of the existing revetment will be sawcut and removed. Work to replace individual drainage facilities is estimated to take up to 15 days. There may be up to five areas where in-water work may be needed to remove or replace these pump systems throughout all Sacramento River east levee contracts.

Stability Berms and Blankets

Stability berms and blankets address shallow foundation and/or levee embankment through-seepage. A stability berm or blanket is a prism of compacted soil that acts as a buttress to increase stability factors of safety and, in some cases, includes an inclined filter/drain zone placed on the landside slope of a levee to capture seepage that will otherwise exist on and potentially erode the unprotected levee slope. Typical stability berms are 10-15 feet high (depending on the height of the levee) and 10-25 feet wide and are considered in limited areas that do not have substantial right of way issues. Alternatively, the stability berm can be constructed within the existing levee in areas with constrained access along the landside levee toe. The inset stability berm will be constructed by excavating the landside levee slope, constructing the filter/drain zone, and then rebuilding the levee slope to about the original grade with compact fill.

Relief Wells

Relief wells provide protection against levee underseepage by providing a path for underseepage to exist the ground surface at the landside toe of the levee without creating sand boils or piping levee foundation materials. Relief wells will be constructed near the levee landside toe to provide pressure relief beneath surficial fine-grained soils (clay or silt "blanket"). The wells will be constructed using soil-boring equipment to bore a hold vertically though the fine-grained layer. Pipe casings and filters will be installed to allow the pressurized water to flow to the ground surface in the well casing, thereby relieving the pressures beneath the clay blanket layers.

Toe Drains

The primary purpose of a toe drain is to divert through-levee seepage before it reaches the levee slope, where it could cause erosion and instability, and to filter the discharge in such a way as to reduce velocity and fine soil carrying capacity. A toe drain will typically be used when through-seepage or through-seepage driven landslide slope stability is problematic. Toe drains can be used in several limited reaches where the levee does not have an existing shallow cutoff wall and there is a concern regarding potential seepage breakout on the levee slope or the levee toe. Toe drains will be constructed by excavating into the levee prism and constructing a filtered drain within the waterside toe of the levee embankment.

<u>Bank Protection</u>

Proposed bank protection along the Sacramento River will address erosion concerns. Studies have shown that the Sacramento River levees have a medium to high risk of breach due to erosion. Bank protection will be addressed by standard bank protection with planting berm. The standard bank protection measure for the Sacramento River consists of placing rock protection on the bank to prevent erosion. This measure entails filling the eroded portion of the bank, where necessary, and installing revetment along the waterside levee slope and streambank from streambed to a height determined by site-specific analysis. Large trees on the lower half of the waterside slope will be protected in place to retain shaded riverine aquatic (SRA) habitat. The sites will be prepared by removing vegetation along the levee slopes at either end of the site for construction of a temporary access ramp, if needed. The ramp will then be constructed using imported commercial borrow material that will be trucked on site.

The placement of rock onto the levee slope will occur from atop the levee and/or from the waterside by means of barges. Rock required within the channel, both below and slightly above the water line at the time of placement, will be placed by a crane and/or excavator located on a barge. Construction will require two barges: one barge will carry the crane and/or excavator, while the other barge will hold the stockpile of rock to be placed on the channel slopes. Rock required on the upper portions of the slopes will be placed by an excavator located on top of the levee. Rock placement from atop the levee will require one excavator and one loader for each potential placement site. The loader brings the rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the waterside of the levee.

The revetment will be placed via the methods discussed above on existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After revetment placement has been completed, a small planting berm will be constructed in the rock to allow for some revegetation of the site.

<u>Additional Measures</u>

Additional bank protection measures may be considered and found to be appropriate during the implementation of site-specific designs. Design and analysis of any additional measures will be carried out during the site-specific planning and design phase. Examples of additional measures include, but are not limited to, toe protection, flow modification, cut bank, and alternative design and materials for reduction of riprap. These and other measures, which may be developed in the future, will be designed in coordination with the Service and National Marine Fisheries Service (NMFS) to minimize effects to listed species and their habitat from the proposed action and to ensure that the effects from these actions are covered in the effects of this biological opinion.

Natomas East Main Drain Canal

The east levee of the NEMDC requires 6,000 LF of improvements to address seepage and stability at locations where historic creeks had intersected the current levee alignment. A cutoff wall will be constructed at this location to address the seepage and stability problems. The cutoff wall will be constructed by one of the methods described in the Sacramento River section above. SAFCA is proposing to construct 2,500 LF of cutoff wall beginning just south of the confluence of Arcade Creek and extending south along the NEMDC. The Corps will construct the remaining 3,500 LF of cutoff wall.

Arcade Creek

The Arcade Creek levees require improvements to address seepage, slope stability, and overtopping when the event exceeds the current design. A centerline cutoff wall will be constructed to address seepage along 22,000 LF of the Arcade Creek levees. Levees from Rio Linda Boulevard to Marysville Boulevard will have a cutoff wall constructed at the waterside toe of the levee. Construction of the waterside toe cutoff wall will require constructing a work bench along the toe of the levee. Excavation for the bench will extend deep enough below existing grade to remove organic material and soft, unsuitable foundation soils. Bench excavation will also extend into the existing waterside slope of the levee as needed. Riprap will be placed on the waterside benches after construction of the waterside toe cutoff wall. Some portions of the Arcade Creek north levee will require more substantial excavation and reconstruction of the waterside slope to provide a low permeable seepage levee slope barrier. Bench fill material will be integrated with the slope reconstruction fill to provide an integral seepage barrier with the cutoff wall over the full height of the levee slope. A small section of levee will have a sheet pile cutoff wall at the centerline of the levee, rather than the waterside toe cutoff wall.

There is a ditch adjacent to the north levee at the landside toe which provides a shortened seepage path and could affect the stability of the levee. The ditch will be replaced with a conduit or box culvert and then backfilled. This will lengthen the seepage path and improve the stability of the levee. Additionally, pressure relief wells will be installed along the landside toe of the levee along the north levee west of Norwood Avenue.

Most of the Arcade Creek levees have existing floodwalls, however, there remains a height issue in this reach. A 1 to 4-foot floodwall will allow the levees to pass flood events greater than the current design level. The floodwall will be placed on the waterside hinge point of the levee and will be designed to disturb a minimal amount of waterside slope and levee crown for construction. The waterside slope will be re-established to its existing slope and the levee crown will grade away from the wall and be surfaced with aggregate base.

Magpie Creek Diversion Canal

The Magpie Creek Diversion Channel (MCDC) is located north of Interstate 80 and is bisected by Raley Boulevard. The project area is about 8,600 feet long. The MCDC moves water from the McClellan Business Park area to Robla Creek, then west into the Natomas East Main Drainage Canal (NEMDC). The NEMDC terminates in the American River, making it a part of the American River North Basin, one of the subbasins for the American River Watershed.

About 2,100 linear feet of levee will be raised from Raley Boulevard to 100 feet south of Vinci Avenue Bridge. The levee will be extended east of Raley Boulevard for 1,000 linear feet on the south side/left bank of the MCDC. A traffic crossing feature consisting of concrete culverts will be installed on Raley Boulevard. New maintenance roads will be constructed on top of the levee extension and on the north side/right bank of the MCDC east of Raley Boulevard.

From Vinci Avenue to Dry Creek Road, vegetation will be cleared from the canal and a new canal profile will be created. To maintain this new profile a maintenance road will be constructed on either side of the canal. Vegetation will be cleared in stages from the channel to allow for better water flow during high water events. Riparian vegetation will not be allowed to grow back within the canal. The canal is currently filled with mature riparian vegetation and aquatic plants.

The vegetation clearing from Dry Creek Road to the end of the levee extension, will remove a total of 2.75 acres of riparian habitat.

To reduce impacts the proposed project will create a buffer to protect the seasonal wetlands using temporary construction fencing, wire backed silt fence, multiple layers of an absorbent material such as straw waddles, and a final silt fence. A coffer dam will be installed and the water pumped out of the work site when work within the canal itself is necessary. This will be either a steel sheet pile or stone/soil coffer dam. There is a possibility for nightwork to be performed to reduce impacts for traffic from closing Raley Boulevard and shorten the construction schedule..

Staging is proposed at two sites. Site One (about 1.9 acres) is located in upland area but the parcel it is located within does have seasonal wetlands features such as swales that may need to be protected if the entire parcel is used. Site Two (about 1.25 acres) is a high ground location that is heavily disturbed and covered with invasive grass species.

Construction is anticipated to occur in 2026 - 2027 and will be completed in one construction season. Work is expected to start at the Northern Sacramento Bike Trail Bridge to construct the concrete culverts to improve downstream water flow. Maintenance roads will be constructed to allow access to the canal between Dry Creek Road and Vinci Avenue, followed by the excavation of the canal to widen and flatten the slopes to meet the new water conveyance requirements. A different set of concrete culverts that are a part of the traffic crossing feature may be constructed at this time. Canal realignment and widening between Raley Boulevard and Vinci Avenue and the levee construction east of Raley Boulevard will be the final portions of the project to be constructed.

Piezometer Installation

Piezometers will be installed permanently along the existing levees within the authorized footprint of the proposed project. The purpose of installing a piezometer network is to provide an empirical data collection system to provide real time data for water level within the levee to water resource managers, levee maintenance agencies, and project engineers. These installations could occur along the Sacramento River left bank, Lower American River left and right banks, Magpie Creek left bank, and Sacramento Bypass right bank that are all action areas of the proposed project. The distribution of piezometers will be based on the size of each construction zone and local hydrologic conditions. All piezometer installation locations will require pre-construction surveys for biological and cultural resources. About 100 piezometers will be installed along the levee segments listed above with piezometers on the levee crown and/or near the landside levee toe. Some areas may have higher concentrations of piezometers than other areas. On average, between 3 to 15 piezometers will be installed at each construction reach. There is an existing network of previously installed piezometers within the authorized footprint. Some of these existing piezometers may need to be replaced and/or require new sensors.

Sacramento Weir and Fish Passage Facility

The Sacramento Weir was completed in 1916. It is the only weir in the Sacramento River Flood Control Project that is manually operated; all others overflow by gravity on their own. It is located along the right bank of the Sacramento River about 4 miles upstream of the Tower Bridge, and about 2 miles upstream from the confluence with the American River. Its primary purpose is to protect the city of Sacramento from excessive flood stages in the Sacramento River channel downstream of the American River. The weir limits flood stages (water surface elevations) in the Sacramento River to project design levels through the Sacramento/West Sacramento area. Downstream of the Sacramento Weir, the design flood capacity of the American River is 5,000 cfs higher than that of the Sacramento River. Flows from the American River channel during a major flood event often exceed the capacity of the Sacramento River downstream of the confluence. When this occurs, floodwaters flow upstream from the mouth of the American River to the Sacramento Weir.

A new 1520-foot fixed-crest passive weir structure will be constructed north of the existing Sacramento Weir. Additionally, a new bridge over the new weir will be constructed along Old River Road, a fish passage structure will be constructed in the new weir structure, a levee embankment will be constructed between the existing weir and the new weir, County Road 12 will be realigned, and the railroad embankment will be removed.

The California Department of Water Resources is implementing the Lower Elkhorn Basin Levee Setback project, which will widen the Sacramento Bypass by degrading the existing north levee of the Sacramento Bypass and constructing a new levee 1,500 feet to the north. This project was analyzed in a separate consultation (Service file # 2018-F-0479) and is not part of this project description.

The widening of the Sacramento Weir will result in stage increases of about 0.1 to 0.15 foot in the Yolo Bypass during the 1/100 and 1/200 annual exceedance probability (AEP) events and up to 0.3 feet during the 1/325 AEP event. These increases will not substantially change the area of the Yolo Bypass that will be inundated or substantially increase inundation depths in the bypass.

Due to operational criteria and system hydrology, the Sacramento Weir has historically not spilled on occasions when the Fremont weir was not already overtopping (i.e., the Fremont Weir always spills before the Sacramento Weir). Thus, under current conditions, the Sacramento Bypass has never been inundated by Sacramento Weir flood flows unless the Yolo Bypass was already inundated by flows over Fremont Weir Due to the volume of water that passed over the Fremont Weir, when the Fremont Weir spills and inundates the Yolo Bypass, some of the flow backs up and inundates the Sacramento Bypass. Additionally, because it takes an extended period of time for Yolo Bypass flows to drain back into the Sacramento River near Rio Vista, inundation in the Sacramento and Yolo Bypasses may persist for weeks or months after the weirs have stopped overtopping.

A change in operations will occur because the widened weir crest will be constructed at a lower elevation than the current weir. The lowered weir crest will result in the widened Sacramento Weir spilling more often, than current conditions. However, when the operation is modeled with the last 50 years of historical data, the proposed project will not substantially increase the frequency or duration of inundation in the Yolo Bypass.

<u>New Weir and Bridge</u>

A new 1,496-foot-long passive weir will be constructed along the right bank (looking downstream) of the Sacramento River, north of the existing weir. The new weir and existing weir will be separated by a levee embankment. The proposed weir will be composed of 60-foot-wide weir bays, separated by 3- to 5-foot-wide piers. A concrete approach slab and weir crest will form the floor between the piers. The weir crest elevation will be at 26 feet.

The new primary weir structure will be constructed behind the existing levee and Old River Road; therefore, only 1 year of in-water work is anticipated for the levee degrade, rock slope placement, and fish exit pool construction.

The existing levee, which will be in front of the new weir, once constructed, will be degraded in the final year of construction to create a graded approach to the new weir. The bank will be sloped back impacting 5.56 acres of riverine habitat and 2 acres of upland habitat which will result in 7.5 acres of riverine habitat once completed. The elevation of the graded approach to the new weir will be excavated down to an elevation of 22 feet. Once grading of the approach is completed, part of the area will be seeded with native perennial herbaceous species to stabilize the approach and protect it from erosion. Based on the proposed elevation of the approach, it is anticipated that this area will likely be inundated on an annual to biennial basis, given the OHWM is 2 feet higher than the proposed approach.

Once the graded approach is completed, areas that cannot be seeded due to erosion risk will have rock slope protection placed. Rock placed above the 10-foot contour will be 20 inches thick, while rock placed below this elevation will be 30 inches thick. A total of 18,358 cubic yards of rock are anticipated to be necessary. Placement of the rock will be achieved using an excavator staged from a barge or on land, and/or by bottom dumping rock from a barge. It may also be necessary to install a vibratory driven sheet-pile cofferdam to dewater the work area for installation of the rock slope protection. Turbidity will be controlled via a cofferdam, installation of a turbidity curtain, or other means and methods approved by the Regional Water Quality Control Board and NMFS.

<u>Fish Passage Structure and Channel</u>
The proposed action's fish passage design includes the following design elements:

- Hydraulic Control Structure and Fishway Exit Pool
- Fish Ladder
- Fish Passage Channel
- Stilling Basin Drain
- Transition of open channel fish way into Tule Canal.

Like the new weir, most of the fish passage facility will be constructed behind the existing Sacramento River and Tule Canal levees.

A fish passage channel begins at the downstream end of the flow control structure and runs parallel to the north wall of the fish ladder. Downstream, the channel turns to connect to the fish ladder entrance pool, then continues west, aligned with the fish ladder centerline. It may be necessary to install a vibratory driven sheet-pile cofferdam to dewater work area where relatively high groundwater levels may otherwise limit dry conditions for channel grading and shaping. The Bypass Transport Channel will extend to the Tule Canal. As the Bypass Transport Channel approaches the Tule Canal a segment of existing canal will be modified resulting in a change in the depth, shape, and alignment of the existing canal. A small amount of riprap will be placed where the Bypass Transport Channel discharges into the Tule Canal.

Fish monitoring will occur in both the Sacramento River and Tule Canal. Active construction monitoring will consist of deploying a hydro acoustic receiver array and acoustic positioning systems. This technology is currently being utilized throughout the west coast and compliments other ongoing acoustic studies in the area. The array and positioning system will determine the fish's site fidelity and behavioral characteristics within the project area as construction activities are occurring. Pre-construction monitoring is anticipated to occur in the spring of 2020, using the acoustic array. Pre-construction monitoring is occurring to establish baseline conditions within the project/action area.

Fish monitoring will include the placement of up to 25 individual 14" diameter steel poles or pilings to be placed in the Sacramento River from RM throughout the ARCF action area in the Sacramento River. Minor pile driving activities are anticipated to occur. The purpose of the poles is for the placement/tethering of multi-functioning fish acoustic monitoring equipment, water quality monitoring equipment and an acoustic doppler current profiler. There will be navigation warning signs placed on top of each station. Monitoring will provide data for majority of the fish studies occurring within the Sacramento River.

Interior Drainage

A drainage ditch will be constructed north of the levee parallel to the proposed County Road 124. The new drainage ditch will include a culvert through the railroad embankment and will discharge to a drainage ditch being constructed through the Department of Water Resources' setback levee project.

Utility Relocation

Many utilities will be avoided; however, some utilities may need to be temporarily removed or relocated prior to construction. Temporary bypass pumping may be required for sanitary sewers. SAFCA and the construction contractors will coordinate with utility owners to manage the utilities in advance of construction. Disturbed utilities will be restored after construction consistent with CVFPB requirements.

Stormwater Pollution Prevention

Temporary erosion/runoff best management control measures will be implemented during construction to minimize stormwater pollution resulting from erosion and sediment migration from the construction, borrow, and staging areas. These temporary control measures may include implementing construction staging in a manner that minimizes the amount of area disturbed at any one time; secondary containment for storage of fuel and oil; and the management of stockpiles and disturbed areas by means of earth berms, diversion ditches, straw wattles, straw bales, silt fences, gravel filters, mulching, revegetation, and temporary covers as appropriate. Erosion and stormwater pollution control measures will be consistent with National Pollutant Discharge Elimination System (NPDES) permit requirements and included in a Stormwater Pollution Prevention Plan (SWPPP).

After completion of construction activities, the temporary facilities (construction trailers and batch plants) will be removed and the site will be restored to pre-project conditions. Site restoration activities for areas disturbed by construction activities, including borrow areas and staging areas, will include a combination of regrading, reseeding, constructing permanent diversion ditches, using straw wattles and bales, and applying straw mulch and other measures deemed appropriate.

Geotechnical Explorations

Geotechnical explorations include activities such as: geotechnical borings, erosion jet tests, geotechnical trenching, and geotechnical potholing. A brief description of each follows below.

<u>Geotechnical Borings</u>
Borings are done to determine the geologic composition of the foundation of various flood features (erosion protection, slurry walls, and Sacramento Weir). Each borehole will be about 4 to 6 inches in diameter and will be drilled to a depth of 50 to 100 feet. Equipment will include a tire-mounted drill rig, a support truck, and three crew trucks. Prior to initiating drilling, the workers will clear surface vegetation within the immediate borehole location (about 12 inches in diameter at each borehole). Woody vegetation will be avoided. Upon completion of each boring, the borehole will be backfilled with cement-bentonite grout. Drilling fluid and cuttings will be disposed of at an offsite location.

Erosion Jet Tests – Soil jet tests are used to classify erosion conditions along the waterside banks of the rivers. Tests will be conducted as close to the bank toe as feasibly possible. All jet tests will occur in the dry but may occur below the ordinary high-water mark. Two to six jet tests will be conducted at each site.

<u>Geotechnical Trenching</u>
This action involves digging trenches about 10 feet deep. The purpose of geotechnical trenching is to validate the composition of the levee embankment or other surface soil conditions. Additionally, trenching is often conducted in a similar manner as part of preconstruction geoarchaeological studies to determine the potential for presence of buried archaeological resources in the project area. Following site characterization, the trenches will be backfilled with soil.

<u>Geotechnical Potholing</u>
Geotechnical potholing is used when the purpose of the study is to determine the locations of pipes or other underground features that have the potential to be damaged by other techniques. The potholing is carried out using a vacuum truck to minimize potential damage to the utilities, and to biological resources. Any excess excavated material will be hauled offsite. All disturbed areas will be returned to their original state upon completion of each pothole.

Borrow Sites, Haul Routes, Mobilization, and Staging Areas

<u>Borrow Sites</u>
It is estimated that a maximum amount of borrow material is shown in Table 2 and will be needed to construct the ARCF Project. Detailed studies of the borrow material needs have not been completed. Actual volumes exported from any single borrow site will be adjusted to match demands for fill. Clean rock will be commercially acquired in order to construct the American and Sacramento River bank protection sites.

Borrow material will be obtained from locations on the project site that will undergo grade changes a part of project implementation, or from permitted offsite locations within 30 miles of the project site. Site selection will include the following criteria: avoidance of threatened and endangered species and their habitat, compatible with current land use patterns, and appropriate soil types. Fill may be borrowed from bank protection sites, when available, for the use of project-related mitigation.

Haul Routes

For construction of the enlarged Sacramento Weir, necessary aggregate base rock material will be obtained from a commercial sand and gravel operation, most likely in the Sacramento area, with majority of the riprap material to be transported by barge from quarries located within about 100 miles of the Sacramento Weir. The primary access to the Sacramento Weir project area will be from Interstate (I) 80 and Highway (Hwy) 50 via Harbor Boulevard and/or Reed Avenue, and then along Old River Road. The primary corridor for construction traffic will include temporary construction access roads, and local county roads.

For sites on the American River, haul routes will travel to the sites from either I-80 to the north or from Hwy 50 to the south and then through the residential neighborhoods utilizing various parkway access sites. Internal transfer dump trucks will utilize the top of the levee, the levee toe road, and bike paths to move material from the staging area where needed.

For the Sacramento River, rock will be acquired from a commercial source in the Bay Area and barged up the Sacramento River to the construction sites (see Table 2 for total barge trips estimated). Rock for the American River sites will be acquired from a commercial source within a 50-mile radius and will be hauled in trucks to the construction sites from either I-80 or Hwy 50 and through residential neighborhoods utilizing various Parkway access sites. Internal transfer dump trucks will utilize the top of the levee, the levee toe road, and bike paths to move material from the staging area to erosion repair sites.

Table 2. Barge Traffic Associated with Erosion Activities.

Activity	Total Number of Trips Modeled	Total Volume of Material Transported
Sacramento Weir and Bypass 2021	28 barge trips	25,000 cubic yards (cy)
Sacramento Weir and Bypass 2023	83 barge trips	75,000 cy
Sacramento River Erosion Contract 1	26 barge trips	23,000 cy
Sacramento River Erosion Contracts 2, 3* and 4	1,101 barge trips	1,000,000 cy

*Volume and trips are per year, there are likely to be 2 years of construction.

Mobilization

Mobilization will take place at each project site. Mobilization may include creation of temporary access roads, if needed; securing the site; and transporting equipment and materials to the site (e.g., clearing and grubbing, and construction of the repair). Access routes to construction sites will be primarily along existing roads, levee crown roads, or unpaved private farm roads. Barges will be used to transport rock to the sites on the Sacramento River. At several sites, a barge crane may be used to transport and stockpile rock and soil to the site.

Staging Areas

Staging areas will be selected so removal of trees and shrubs are minimized. Previously disturbed areas will be preferred. Landside staging areas may frequently be required for stockpiling materials and equipment. Activities that will occur within staging areas will include storing necessary imported materials (e.g., rock, soil); parking, refueling, and servicing of construction equipment; establishing a temporary restroom; and parking construction staff transportation vehicles.

Construction Process, Sequencing, and Equipment

Site Preparation

Vegetation clearing may need to occur for site access and construction purposes. Site preparation may also include the removal of submerged wood and fallen trees within the construction footprint. A turbidity curtain or other Service and NMFS approved minimization measure will be installed prior to any in-water work conducted on the waterside of the levee where there is potential for listed fish. The work limits and staging areas will be fenced (orange construction fencing) to prevent vehicles and equipment from approaching the waterside edge of the existing bank (where applicable), to protect sensitive habitat, and to identify disturbance area limits.

Where necessary, existing vegetation within the work area will be removed during project construction except for trees or shrubs identified and marked for protection prior to construction. Trees within the repair area identified for protection and outside the work limit may require trimming or removal for equipment clearance, excavation, or due to severely undermined tree health. All tree and sensitive plant removal will be documented. The construction site may be cleared of grasses, ground cover, or any other undesirable materials, using mechanized equipment.

Construction Process

Rock or other fill material (eg., sand, soil, cobble) will be placed using a long-arm bucket excavator, barge crane, or other heavy equipment. IWM may be installed, if feasible, near the water surface during time of construction to replace or enhance riverine aquatic habitat to the repair area.

Demobilization, Rehabilitation, and Clean-up

Following construction, all equipment and materials will be removed from the work area and excess materials will be disposed of at appropriate facilities. All areas will be cleaned and cleared of rubbish and left in a safe and suitable condition.

Compensatory Mitigation

Elderberry Shrub Transplanting

Sites currently being pursued by the Corps, non-Federal sponsor, and local maintaining agency in coordination with the Sacramento County Parks, include, but are not limited to Rio Americano West and East, Glenn Hall, and Rossmoor. Additional sites are being investigated in anticipation of the full implementation of the proposed project. These sites will be used to transplant elderberry shrubs from erosion protection measures along the lower American River. Table 3 shows the size of the current known elderberry and riparian mitigation sites in the lower American River.

Site Elements

Each site will require temporary access for initial construction and mitigation site establishment activities and permanent access for long-term maintenance. Temporary activities include access to the river or a well for irrigation pump facilities, and a staging area. Site fencing will be determined on a site-by-site basis. Irrigation will be available for at least the first three years. The elderberry shrubs will be removed using an excavator and transplanted in cluster groups of 3 to 12 shrubs. Maintenance of the sites during the establishment period will include irrigation, removal of non-native vegetation, and mowing.

Erosion Protection On-Site Mitigation

The incorporation of IWM, willow fascines, and plantings is being implemented to replace lost habitat. Entire almond or walnut trees with root balls and canopies may be used as IWM. The IWM will be placed at the waterside edge of the riparian bench and anchored into the quarry stone by the root ball. The fascines are anchored near the winter mean water surface elevation. Plantings will include an appropriate mix of local native riparian trees and shrubs and will occur at appropriate elevations.

Vegetation installation within the sites will be developed in coordination with the Service and NMFS during the design phase. A variety of materials for revegetation and site-enhancement may be used depending on the site-specific conditions. Below is a description of commonly used materials and methods used for revegetation purposes.

The incorporation of IWM functions to replace lost in-stream cover and habitat form construction impacts. Entire trees with root balls and canopies are used as the IWM. The trees shall be anchored into the quarry stone to one half of the tree length. They are placed to be submerged when fish are generally present in the area.

Willow fascines and pole cuttings are also incorporated into the site designs in order to replace lost in-stream cover and habitat due to construction. The fascines are anchored just below the winter mean water surface elevation at 15-foot triangular spacing. Pole cuttings will be planted in rows where the planting bench will terminate at the launchable toe to help stabilize the planting bench soil.

Table 3. Valley Elderberry Longhorn Beetle and Riparian Habitats

Site	Total Site Acreage	Mitigation Acreage	Temporary Work Acreages	Permanent Access Route Acreages	Plantable Acreage
Glenn Hall (RM 4.9 L)	17.28	8.71	1.33	0.83	5.72
Rio American West (RM 10.4 R)	12.88	5.32	1.84	2.24	3.33
Rio American East (RM 11.1 R)	5.67	2.44	0.43	0.52	2.13

Rossmoor West (RM 15.5 L)	43.70	21.61	3.60	0.94	15.88
Rossmoor East (RM 16.4 L)	12.77	6.07	0.86	1.04	4.68

Plant material installation is designed to mitigate for lost riparian habitat post construction. The proposed planting design includes an appropriate mix of local system native riparian trees and shrubs. Plantings will be incorporated into the sites at appropriate elevations to provide successful on-site mitigation.

American River Mitigation Site

The American River Mitigation Site (ARMS) Project is being designed to consider historical site conditions based on historic aerial images and adapt existing conditions to restore, enhance, and maximize habitat for the following species: salmonids, riparian birds, and the valley elderberry longhorn elderberry beetle. The acres restored are targeted at 79 acres for juvenile salmonid rearing habitat, 56 acres of riparian habitat, and up to 15 acres of elderberry shrub habitat for the valley elderberry longhorn beetle. The reconfigured site will continue to receive water from the American River via seepage as well as a new surface connection through a notch in the river embankment to allow entry/exit for salmonids into the created sinuous side channel. There is a possibility for nightwork to be performed to reduce impacts to traffic. This work will be a continuation of what happens during normal work hours and will not expand the footprint of the project. Due to the preexisting noise disturbance along Garden Highway at this location, this project work will not add a new impact via noise or physical disturbance.

The design will fill an existing off channel pond from past mining activities on the site and create a network of backwater channels that fills through a single inlet from the main river channel located at the southeast limit of the site. Habitat benches will be incorporated into the backwater channels to provide shallow water habitat at various water surface elevations. The benches will have gradual slopes and a positive gradient toward the main river channel to reduce stranding risks as water recedes.

Site design will include the creation of backwater floodplain habitats, removal of non-native vegetation and seed bank, incorporation of instream woody material (IWM), and improved connectivity to the main river channel. The site will be connected to the lower American River through a notch graded in the embankment of the main river channel. The import of material and grading to fill the mining pit in the floodplain is necessary create rearing habitat for salmonids by altering inundation depths and establishing elevations that provide an opportunity for wetland and riparian vegetation to establish and naturally recruit. The goal is for the habitat mitigation to blend in seamlessly with the surrounding riparian forest.

Site design refinements will continue to be coordinated with the Service to provide the best possible outcome for state and federally protected species as well as local residential wildlife.

Construction is currently anticipated to begin in 2025 and continue through 2027. Work will typically occur between 7 am and 6 pm Monday through Saturday. If necessary, night work will occur. In-water work in the American River main channel, not including areas of the man-made pond behind the river embankment, will be permitted within the annual NMFS-approved in-water work window for the proposed action. Most channel and riparian features will be completed before the right bank is breached to minimize any turbidity impacts on the river. Filling and grading within the existing man-made pond will include partial or complete dewatering to control water during fill operations and may require use of temporary cofferdams or inflatable bladders. A turbidity curtain and/or temporary sheet piles will be installed prior to making the hydrologic connection with the river. Revegetation will occur in the spring, after construction is complete, as early as 2026. Demobilization and cleanup will occur after construction. Trash, excess construction materials, and construction equipment will be removed.

The site will be accessed either from Garden Highway by Natomas Park Drive going through Discovery Park, or from Northgate Boulevard via the Riverdale Mobile Home Park access and existing operations and maintenance roads for overhead power lines within the site. Trucks will access the regional road network via Northgate Boulevard and/or Garden Highway, State Route-160, Interstate-5, or Interstate-80. Access to the site is controlled by a locking gate on Natomas Park Drive, but there are no existing access controls from Northgate Boulevard or Camp Pollock. Some road work such as tree trimming, or minor road repairs may be needed for access. Staging for site construction will occur within the site boundary or local vicinity. Staging areas will be fenced and will have security lighting. Staging areas will be used for material stockpiles, construction office and trailers, construction worker vehicle parking, and equipment staging. Haul traffic may also pass through staging areas. Staging areas will be subject to strict containment and spill prevention best management practices (BMPs) to help avoid Stormwater Pollution Prevention Plan (SWPPP) violations. Once work is complete, staging areas will be returned to their initial conditions or planted with native vegetation to provide additional habitat. Staging areas will avoid effects to listed species.

Sacramento River Mitigation Site (SRMS)

The Sacramento River Mitigation Site (SRMS) is intended to create 30 acres of salmonid/steelhead/green sturgeon, 30 acres of delta smelt habitat, and 17 acres of riparian habitat. Habitat creation will require breaching the existing perimeter berm, grading to create channels, stabilizing bank protection, and vegetation planting.

Revegetation will include a palette of native trees, shrubs, grasses, and aquatic vegetation. Aquatic vegetation should include native submerged and emergent wetland plants. The riparian vegetation will provide resting, foraging, roosting, and nesting habitat for numerous avian species, as well as the local terrestrial fauna. Riparian habitat will include willows, alders and cottonwoods when possible. Elderberry will be transplanted outside the construction footprint only when needed or protected in place.

The wetland habitat will provide sheltered slow-moving water, connectivity between open water and tidal marsh, food, and cover for native species. The wetland design will incorporate tidal marsh wetland with dendritic channels allowing for the daily exchange of the tidal prism within the site. Elevations and grading of tidal marsh features will slope so water recedes to not create fish stranding. Designs are currently between 35 and 65 percent complete. The project team has shifted toward locating the dredge material disposal site at the point of the island and having a single habitat area north of the access road. There will be around five habitat zones. Zone one is open water this includes marsh transition with mudflat and emergent vegetation in elevations from less than 2 feet up to 7 feet. Zone 2 is low riparian with willow, button bush white alder in elevations from 7 to 9 feet. Zone 3 is middle riparian with willow cottonwood and maybe elderberry, elevations from 9 to 10 feet. Zone 4 is upper riparian includes alder, sycamore, and elderberry from 10 to 13 feet. Zone 5 is in elevation 13 feet and above and is upland comprised of oaks, sycamore, cottonwood, and elderberry. It is anticipated there will be one breach on Steamboat Slough to provide hydrologic connection onto the site.

The SRMS will be constructed over three construction seasons from 2025 through 2027, with revegetation to occur after site contouring is complete. Wetland vegetation will be planted and established for several months prior to breaching the berms to the adjacent water bodies. Work will typically be conducted between 7am and 6pm Monday through Saturday; however, work times may be extended, including potential night work, due to the site's remote location. A balanced cut-fill design for the wetland (excavation) and riparian habitat (fill for terracing) is an objective to minimize transport of fill and cost. The construction area is enclosed by a high berm, separating it from water in the adjacent sloughs and river. During the final phase of construction the coffer dams will be removed, connecting the new wetland, waterway, and riparian habitat to the river.

Vegetation grubbing, controlled burns for invasive species control, and tree removal will occur first. In-water work for aquatic beneficial use features along the outside perimeter of the sites and opening the berms to connect the wetland habitat to the adjacent waterbodies will occur within the annual NMFS-approved in-water work window for the proposed action. Demobilization and cleanup will occur in October and November of each year after construction is complete. The staging areas, landside berm slope, and any other bare earth areas will be reseeded with native grasses and forbs to promote revegetation and minimize soil erosion. Any roads or other access areas damaged by construction activities will be fully repaired and restored to preconstruction condition. Trash, excess construction materials, and construction equipment will be removed, and the site will be left in a safe and clean condition.

Site access and haul routes will be via Grand Island Road and maintenance roads within the site. From Grand Island Road, trucks and workers will access the regional road network via SR-160, SR-4, I-5, I-80, I-580, and I-680. Access to the site is controlled by locked gates at the turn off from Grand Island Road. Some work such as tree trimming, minor grading, paving, and adding aggregate may need to be done along the haul routes to allow access to the site. The staging areas will be located within the site boundary. Staging areas will be fenced and will have security lighting. Staging areas will be used for material stockpiles, construction office and trailers, construction worker vehicle parking, and equipment staging. Haul traffic may also pass through staging areas. Waterside staging areas will be subject to strict containment and spill prevention BMPs to help avoid SWPPP violations. Once work is complete, staging areas will be returned to their initial conditions or planted with native vegetation to provide additional habitat.

Operation and Maintenance

Operation and maintenance (O&M) of the levees in the Sacramento area are the responsibility of the local maintaining agencies, including the American River Flood Control District, DWR, and the City of Sacramento. The applicable O&M Manual for the Sacramento area levees is the Standard Operation and Maintenance Manual for the Sacramento Flood Control Project. Typical levee O&M in the Sacramento in the Sacramento area currently includes the following actions:

- Vegetation maintenance up to four times a year by mowing or applying herbicide.
- Control of burrowing rodent activity monthly by baiting with pesticide.
- Slope repair, site-specific and as needed, by re-sloping and compacting.
- Patrol road reconditioning up to once a year by placing, spreading, grading, and compacting aggregate base or substrate.
- Visual inspection at least monthly, by driving on the patrol road on the crown and maintenance roads at the base of the levee.
- Post-construction, groundwater levels will be monitored using the piezometers.

The Corps will work with local maintaining agencies to develop additional maintenance activities necessary for long-term operations and maintenance. This will occur during the preconstruction engineering and design phase of the project. The Corps will evaluate if these maintenance activities affects any Federally listed species and reinitiate section 7 consultation if there will be adverse effects to listed species.

Conservation Measures

<u>Valley Elderberry Longhorn Beetle</u>

- The Corps assumes complete avoidance of the valley elderberry longhorn beetle when a 100-foot (or wider) buffer is established and maintained around elderberry shrubs.
- When work will occur within the 100-foot buffer, a setback of 20 feet from the dripline of each elderberry shrub will be maintained whenever possible.
- During construction activities, all areas to be avoided will be fenced and flagged with as large as a buffer as possible.
- Signs will be erected every 50 feet along the edge of the avoidance area, identifying the area as an environmentally sensitive area.
- A qualified biologist will monitor the work area at appropriate intervals to ensure that all avoidance and minimization measures are implemented. The amount and duration of monitoring will depend on the project and will be coordinated with the Service.
- As feasible, all activities that will occur within 50 meters of an elderberry shrub, will be conducted outside of the flight season of the valley elderberry longhorn beetle (March through July).
- Any damage done to the buffer area will be restored.
- Buffer areas will continue to be protected after construction.
- Erosion control will be implemented, and the affected area will be re-vegetated with appropriate native plants.

- Herbicides will not be used within the dripline of the shrub. Insecticides will not be used within 30 meters (98 feet) of an elderberry shrub. All chemicals will be applied using a backpack sprayer or similar direct application method. Mechanical week removal within the dripline of the shrub will be limited to the season within adults are not active (August through February) and will avoid damaging the elderberry shrubs.

- Dust will be controlled by reducing speed limits to 10 miles per hour on unpaved roads, regularly watering roads, and wetting down soil and rock during grading operations and placement.

- Elderberry shrubs that cannot be avoided and that can be feasibly transplanted without safety concerns or detriment to the surrounding environment will be transplanted to an appropriate riparian area at least 100 feet from construction activities; see the 2017 Framework for further information.

- It is estimated that no more than 10 percent of the shrubs will not be transplanted due to water quality or safety of personnel. For shrubs that cannot be transplanted, all stems will be cut at ground level, collected, and distributed among the transplanted shrubs within the valley elderberry longhorn beetle conservation areas.

- Elderberry shrubs will be surveyed prior to construction to ensure that the actual effects match the estimated effects of this biological opinion. If the Corps will affect more valley elderberry longhorn beetle habitat than estimated than they will reinitiate consultation with the Service.

- Elderberry shrubs will be transplanted between November 1 and February 15, when shrubs are dormant.
- The Corps is proposing to compensate for effects to valley elderberry longhorn beetle through creation of compensation sites as described in the Service's 2017 Valley Elderberry Longhorn Beetle Framework and as below. The Corps will compensate at a 3:1 ratio for effects to valley elderberry longhorn beetle habitat. Tables 5 through 8 describe the calculated acreages and compensation. At the ARMS there are four elderberry shrubs that will be transplanted onsite to facilitate the restoration of the site. At the SRMS 1.0 acre of valley elderberry longhorn beetle habitat will be transplanted on site to allow for the restoration of the site. The transplanted elderberries will be maintained and monitored with the mitigation plantings.

Table 5. American River Elderberry Shrub Habitat and Compensation

Reach	Acreage/Amount	Compensation Ratio	Compensation Acreage
Subreach 2	2.84 acres elderberry shrubs[1] 8.07 acres associated riparian[2]	3:1	32.73
Subreaches 1, 3, and 4	4.27 acres elderberry shrubs[1] 13.71 acres associated riparian[2]	3:1	53.94

1 – There are about 300 to 400 individual elderberry shrubs
2 – This encompasses the riparian habitat within 25 meters of the elderberry shrubs

Table 6. Sacramento River Bank Stabilization Elderberry Shrub Habitat and Compensation

Acreage	Compensation Ratio	Compensation Acreage
0.12 acre elderberry shrubs[1] 2.69 acres associated riparian[2]	3:1	8.43

1 – There are about 300 to 400 individual elderberry shrubs
2 – This encompasses the riparian habitat within 25 meters of the elderberry shrubs

Table 7. Sacramento River Seepage and Stability Elderberry Shrub Habitat and Compensation

Number of Isolated[1] Elderberry Shrubs	Compensation Ratio	Compensation Credits/Acreage
40	2:1	80/3.31

1 – Given the linear nature of the work and the narrow width of the riparian habitat elderberry shrubs in this portion of the project will be compensated by a 2:1 ratio based on the number of shrubs that will be transplanted.

Table 8. Sacramento Weir Elderberry Shrub Habitat and Compensation

Acreage	Compensation Ratio	Compensation Acreage
0.69 acre elderberry shrubs[1] 2.05 acres associated riparian[2]	3:1	8.22

1 – There are about 300 to 400 individual elderberry shrubs
2 – This encompasses the riparian habitat within 25 meters of the elderberry shrubs

- If possible, elderberry shrubs will be transplanted during their dormant season (November through the first two weeks in February). If transplantation occurs during the growing season, increased mitigation will apply.

- The Corps is developing conservation areas to offset the transplantation, and loss of valley elderberry longhorn beetle habitat. Sites are being developed in the Lower American River and at the Beach Lakes Conservation Area along Morrison Creek. The Corps will find areas within the lower American River parkway which will either expand existing compensation areas or provide for connectivity between conserved valley elderberry longhorn beetle habitat areas. Sites within the lower American River parkway will be coordinated with Sacramento County Parks and the Service during the design phase of the project. Sites will be designed and developed prior to any effects to valley elderberry longhorn beetle habitat. The Corps will create 19.96 acres of riparian habitat which supports valley elderberry longhorn beetle within the lower American River parkway for the transplantation of elderberry shrubs. In addition, the local sponsors will create an additional 40 acres of land to benefit the valley elderberry longhorn beetle or purchase 40 acres of credits at a Service approved conservation bank to offset the loss of habitat due to trimming of elderberry shrubs along the lower American River, Sacramento River, Dry/ Robla Creeks, Arcade Creek, Magpie Creek, and NEMDC. If offsite compensation cannot be identified a portion of the compensation can purchase credits at a valley elderberry longhorn beetle conservation bank.

- Management of these lands will include all measures specified in the Service's Framework (2017) related to weed and litter control, fencing, and the placement of signs.

Giant Garter Snake

- Unless approved otherwise by the Service, construction will be initiated only during the giant garter snakes' active period (May 1–October 1, when they are able to move away from disturbance).

- Construction personnel will be given a Service-approved worker environmental awareness program.

- A survey for giant garter snakes will be conducted within 24 hours prior to construction beginning in potential giant garter snake habitat. Should there be any interruption in work for greater than 2 weeks, a biologist will resurvey the area within 24 hours prior to the restart of construction.

- Giant garter snakes encountered during construction will be allowed to move away from construction activities on their own.

- Movement of heavy equipment to and from the construction site will be restricted to established roadways. Stockpiling of construction materials will be restricted to designated staging areas, which will be located more than 200 feet away from giant garter snake aquatic habitat.

- Giant garter snake habitat within 200 feet of construction activities will be designated as an environmentally sensitive area and delineated with signs or fencing. This area will be avoided by all construction personnel.

- Habitat temporarily affected for one season (the 5.5 acre borrow site along the NEMDC and the 3.1 acres of aquatic and 32.7 acres of upland habitat associated with the fish passage channel located between the south Cross Canal and Tule Canal along the landside of the existing Sacramento Bypass North Levee) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants and one year of monitoring. If for any reason the construction season in giant garter snake habitat extends into an additional active season, the Corps will replace the habitat on-site and purchase credits at a ratio of 1:1 at a Service-approved conservation bank in advance of the second construction season in suitable habitat.

- Habitat temporarily affected for more than three or more seasons will be restored and twice as much habitat will be created.

- Habitat permanently affected in the Sacramento Bypass in the form of 0.3 acre of drainage ditches and irrigation canals and 2.3 acres of surrounding upland habitat will be offset through the creation of the Bypass Transport Channel, which will create 6.7 acres of aquatic habitat.

- A biological monitor will be on-site during all ground disturbing activities at borrow site 2.

- Exclusionary fencing will be placed at least 10 days prior to the beginning of ground disturbing activities after May 1, to exclude giant garter snakes from entering areas where upland disturbance (borrow site 2) will occur during the active season (May 1 to October 1). Prior to fencing installation, the fence line will be mowed (with a minimum height of 6 inches) in order to conduct a surface survey of potential burrows. Fencing will be installed with a minimum of 6 inches buried in the ground and a minimum of 24 inches above ground. Fence staking will be installed on the inside of the exclusion area. One-way escape funnels will be installed every 50 to 100 feet and sealed along the fence line to provide an escape for any giant garter snake that may be within the exclusion area. The fencing will enclose the entirety of the site, or additional exclusionary fencing can be extended 200 to 400 feet beyond the proposed entrance area. The fencing will be inspected before the start of each workday and maintained by the contractor until completion of the project. The fencing will be removed only when project activities are completed.

<u>Yellow-Billed Cuckoo</u>

- Prior to construction, a Service-approved biologist shall conduct nesting bird surveys to determine the presence of nesting birds, including the yellow-billed cuckoo. If cuckoos are located the Service will be contacted to establish appropriate buffers. Surveys will be repeated if construction stops for a period of two weeks or longer.

- All vegetation removal shall occur between October 1 and March 1 outside of the cuckoo nesting season.

- Loss of riparian habitat that can serve as migratory stopover habitat for the yellow-billed cuckoo will be offset at a 2:1 ratio.

- Riparian habitat that is removed due to project construction will be mitigated within the American River parkway and at the Beach Stone Lakes compensation site. The Corps intends to expand existing conserved riparian lands within the parkway that could support the yellow-billed cuckoo. The design of replacement riparian areas will be coordinated with the Service to ensure that the habitat benefits both the valley elderberry longhorn beetles and yellow-billed cuckoo.

<u>Delta Smelt</u>

- The Corps is proposing to work outside of the delta smelt work window. In-water construction activities (e.g., placement of rock revetment) will be limited to the work window of July 1 through November 30.

- The Corps will purchase 90 acres of delta smelt credits from a Service-approved conservation bank or through the creation of a mitigation site to compensate for the loss of up to 30 acres of shallow water habitat due to the placement of riprap along the river bed and bank. If the Corps creates a compensation site instead of purchasing credits at a conservation bank, the site will be constructed and planted prior to the end of the construction of the Sacramento River sites.

- The Corps will create on-site mitigation in the form of riparian or wetland benches in the shallow water habitat zone. These sites will be developed in coordination with the Service and NMFS.

- The Corps will develop and implement a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with the implementation of the proposed project.

- Erosion control measures (BMPs), including Storm Water Pollution Prevention Program and Water Pollution Control Program, that minimize soil or sediment from entering the river shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects to federally listed fish and their designated critical habitat.

- Screen any water pump intakes, as specified by NMFS and the Service screening specifications. Water pumps will maintain an approach velocity of 0.2 feet per second or less when working in areas that may support delta smelt.

- Minimize the removal of existing vegetation during project-related activities.
- The Corps shall include as part of the project, a Riparian Corridor Improvement Plan with the overall goal of maximizing the ecological function and value of the existing levee system within the Sacramento Metropolitan area.

Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

- Erosion control measures will be placed to avoid sediment going into adjacent wetlands. Additionally, construction fencing will be placed on the outside of wetlands so construction equipment avoids the wetlands.

- For every acre of habitat directly, at least three acres of vernal pool tadpole shrimp and fairy shrimp credits will be purchased at a Service-approved conservation bank prior to groundbreaking.

- If habitat is avoided (preserved) on site, then a Service-approved biologist (monitor) will inspect any construction related activities at the proposed project site to ensure that no unnecessary take of listed species or destruction of their habitat occurs. The biologist will have the authority to stop all activities that may result in such take or destruction until appropriate corrective measures have been completed. The biologist also will be required to immediately report any unauthorized impacts to the Service.

Fencing will be placed and maintained around any avoided (preserved) vernal pool habitat to prevent impacts from vehicles. Additional Conservation Measures:

- A qualified biologist will provide training for all contractors, work crews, and any onsite personnel on the status of the valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo, their habitats, the need to follow conservation measures, and the possible penalties for not complying with these requirements.

- The Corps will go through the design deviation process to limit vegetation removal prior to final design and construction phase for any contract.

- The Corps will include as part of the project, a Riparian Corridor Improvement Plan with the overall goal of maximizing the ecological function and value of riparian habitat within the existing levee system in the Sacramento Metropolitan area.

- Engineering designs will be modified to avoid potential direct and indirect effects.

- The Corps will include the Service and NMFS during the design of project components, including mitigation sites. This will include soliciting input and comments on designs and plans.

- The Corps will develop and implement a compensatory mitigation accounting plan to ensure the tracking of compensatory measures. The Corps will continue to coordinate with the Service during all phases of construction, implementation, and monitoring by hosting meetings. Additionally, prior to beginning construction, the Corps will provide a brief project description and describe the acres of listed species habitat effected and the amount of compensation for that contract that is being proposed.

- The Corps will develop, in conjunction with the Service and NMFS, interim management plans for mitigation sites. These will include performance standards that will be met. The Corps, in conjunction with the Service, NMFS, and the future maintainer, will develop long-term management plans for any mitigation that is developed as part of the project. Monitoring will occur for 8 consecutive years or as determined through the long-term management plan planning process. Annual monitoring reports will be submitted to the Service.

- Compensation areas will be protected in perpetuity and have a funding source for maintenance (endowment).
- Site access will be limited to the smallest area possible in order to minimize disturbance. Litter, debris, unused materials, equipment, and supplies will be removed from the project area daily. Such materials or waste will be deposited at an appropriate disposal or storage site.

- Designating a qualified biologist as a point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped threatened or endangered species. This representative shall be identified to the employees and contractors during an all employee education program conducted by the Corps. They shall have knowledge of the listed species that are discussed in this biological opinion.

- The Corps will provide an analysis of the launchable toe and buried rock trench, which shall evaluate the likelihood of the toe and trench launching. This analysis will also include the long-term durability of habitat which is established on the planting bench and the rock footprint of the launched buried rock trench. This analysis will be done by December 31, 2021. If long-term durability of the planting benches is diminished and the habitat will not be viable in perpetuity, then the Corps will work with the Service to offset effects to listed species due to this design feature.

- Stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 100% containment system.

- Stockpile construction materials such as portable equipment, vehicles, and supplies, at designated construction staging areas and barges, exclusive of any riparian and wetland areas.

- Implement BMPs to prevent slurry from seeping out to the river and require piping systems on the landside of the levee.

- Immediately (within 24 hours) cleanup and report any spills of hazardous materials to the resource agencies. Any such spills, and the success of the efforts to clean them up, shall also be reported in post-construction compliance reports.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." For the proposed project, the action area encompasses the Sacramento River from the Sacramento Bypass downstream to River Mile 45, the lower American River from Arden Way to the confluence of the Sacramento River, Arcade Creek from Marysville Boulevard to the confluence of the NEMDC, the NEMDC from the south Dry Creek levee to just south of the NEMDC Arcade Creek confluence, the southern Dry Creek levee between Dry Creek Road and Rose Street, the borrow site along the NEMDC, and any borrow sites. Additionally, we are including a buffer of 300 feet from construction to account for effects to listed species due to dust and noise.

Analytical Framework for the Jeopardy Determination

Section 7(a)(2) of the Act requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this biological opinion considers the effects of the proposed federal action, and any cumulative effects, on the rangewide survival and recovery of the listed species. It relies on four components: (1) the *Status of the Species*, which describes the rangewide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which analyzes the condition of the species in the action area without the consequences to the listed species caused by the proposed action, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines all consequences to listed species that are caused by the proposed federal action; and (4) the *Cumulative Effects*, which evaluates the effects of future non-federal activities in the action area on the species. The *Effects of the Action* and *Cumulative Effects* are added to the *Environmental Baseline* and considering the status of the species, the Service formulates its opinion as to whether the proposed action is likely to jeopardize the continued existence of the listed species.

Analytical Framework for the Adverse Modification Determination

Section 7(a)(2) of the Act requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification" was published on August 27, 2019 (84 FR 44976). The final rule became effective on October 28, 2019. The revised definition states:

> "*Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

The destruction or adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which describes the current rangewide condition of the critical habitat in terms of the key components (i.e., essential habitat features, primary constituent elements, or physical and biological features) that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the critical habitat overall for the conservation/recovery of the listed species; (2) the *Environmental Baseline*, which analyzes the condition of the critical habitat in the action area without the consequences to designated critical habitat caused by the proposed action, the factors responsible for that condition, and the value of the critical habitat in the action area for the conservation/recovery of the listed species; (3) the *Effects of the Action*, which determines all consequences to designated critical habitat that are caused by the proposed federal action on the key components of critical habitat that provide for the conservation of the listed species, and how those impacts are likely to influence the conservation value of the affected critical habitat; and (4) *Cumulative Effects*, which evaluate the effects of future non-federal activities that are reasonably certain to occur in the action area on the key components of critical habitat that provide for the conservation of the listed species and how those impacts are likely to influence the conservation value of the affected critical habitat. The *Effects of the Action* and *Cumulative Effects* are added to the *Environmental Baseline* and considering the status of critical habitat, the Service formulates its opinion as to whether the action is likely to destroy or adversely modify designated critical habitat. The Service's opinion evaluates whether the action is likely to impair or preclude the capacity of critical habitat in the action area to serve its intended conservation function to an extent that appreciably diminishes the rangewide value of critical habitat for the conservation of the listed species. The key to making that finding is understanding the value (i.e., the role) of the critical habitat in the action area for the conservation/recovery of the listed species based on the *Environmental Baseline* analysis.

Status of the Species

Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

For the most recent comprehensive assessment of the rangewide status of the fairy shrimp and tadpole shrimp, please refer to the *Vernal Pool Fairy Shrimp (*Branchinecta lynchi*), Vernal Pool Tadpole Shrimp (*Lepidurus packardi*), and Conservancy Fairy Shrimp (*Branchinecta conservatio*) 5-Year Review: Summary and Evaluation* (Service 2024). No change in either species' listing status was recommended in this 5-year review. Threats evaluated during that review and discussed in the final document have continued to act on the species since the review was finalized.

Valley Elderberry Longhorn Beetle

For the most recent comprehensive assessment of the species' range wide status please refer to the *Withdrawal of the Proposed Rule to Remove the Valley Elderberry Longhorn Beetle from the Federal List of Endangered and Threatened Wildlife* (Service 2014a). Threats discussed in the final document have continued to act on the species, with the loss of habitat being the most significant effect. The Service is currently working on a 5-year review for this species.

Delta Smelt

The Service listed the delta smelt as threatened on March 5, 1993 (Service 1993), and designated critical habitat for the species on December 19, 1994 (Service 1994). The delta smelt was one of eight fish species addressed in the Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes (Service 1996). A 5-year status review of the delta smelt was completed on March 31, 2004 (Service 2004). The review concluded that delta smelt remained a threatened species. A subsequent 5-year status review recommended uplisting delta smelt from threatened to endangered (Service 2010a). A 12-month finding on a petition to reclassify the delta smelt as an endangered species was completed on April 7, 2010 (Service 2010b). After reviewing all available scientific and commercial information, the Service determined that re-classifying the delta smelt from a threatened to an endangered species was warranted but precluded by other higher priority listing actions (Service 2010c). The Service reviews the status and uplisting recommendation for delta smelt during its Candidate Notice of Review (CNOR) process. Each year it has been published, the CNOR has recommended the uplisting from threatened to endangered. Electronic copies of these documents are available at https://ecos.fws.gov/ecp/species/321. Please refer to the 2022 delta smelt Species Assessment and Listing Priority Assignment Form of the CNOR for the status of the species. Electronic copies of this document are available at https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/publication/4119.pdf (Service 2023).

Delta smelt is now considered a conservation-reliant species with most individuals completing a large majority of their life cycle in captivity at UC Davis' Fish Conservation and Culture Laboratory (FCCL; Lindberg *et al.* 2013). In December 2021, the Service, along with the CDFW, California Department of Water Resources, and U.S. Bureau of Reclamation, began experimentally releasing captively produced delta smelt into the Sacramento-San Joaquin River Delta in an experiment intended to help inform future supplementation of the species in the wild. For the past several years, most of the spawning population was composed of fish raised at FCCL. The actual numbers of fish released in each of the past three winters was 55,733 in Water Year (WY) 2022, 43,940 in WY2023, 91,468 in WY2024, and 124,946 in WY2025 (Service unpublished). The actual number of spawning fish each year has likely been lower because some fish die before they finish maturing and start looking for opportunities to spawn. Because the delta smelt was nearly extirpated when experimental releases of captive-bred fish began in December 2021, it is unlikely that individuals without any FCCL ancestry still exist at this writing. This year's catch data do not indicate that the species' status has improved. Thus, the delta smelt now exists only as an integrated hatchery-wild population as envisioned in the Delta Smelt Supplementation Strategy (Service 2020).

Delta Smelt Critical Habitat

Legal Status

The Service designated critical habitat for the delta smelt on December 19, 1994 (Service 1994). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code) (Service 1994).

Conservation Role of Delta Smelt Critical Habitat

The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle, including spawning, larval and juvenile transport, rearing, and adult migration back to spawning sites. Delta smelt are endemic to the Bay-Delta and the vast majority only live one year. Thus, regardless of annual hydrology, the Bay-Delta estuary must provide suitable habitat all year, every year. The primary constituent elements considered essential to the conservation of the delta smelt as they were characterized in 1994 are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (Service 1994). The Service recommended in its designation of critical habitat for the delta smelt that salinity in Suisun Bay should vary according to water year type, which it does. For the months of February through June, this element was codified by the SWRCB "X2 standard" described in D-1641 and the SWRCB's current Water Quality Control Plan.

The Service designated critical habitat for the delta smelt on December 19, 1994 (Service 1994). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code) (Service 1994). The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle, including spawning, larval and juvenile transport, rearing, and adult migration back to spawning sites. Delta smelt are endemic to the Bay-Delta and the vast majority only live one year. Thus, regardless of annual hydrology, the Bay-Delta estuary must provide suitable habitat all year, every year. The primary constituent elements (PCEs) essential to the conservation of the delta smelt are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (Service 1994).

Summary of Status of Delta Smelt Critical Habitat

The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle.

The delta smelt's critical habitat is currently not adequately serving its intended conservation role and function because there are very few locations that consistently provide all the needed habitat attributes for larval and juvenile rearing at the same times and in the same places (Table 1). The Service's review indicates it is rearing habitat that remains most impacted by ecological changes in the estuary, both before and since the delta smelt's listing under the Act. Those changes have stemmed from chronic low outflow, changes in the seasonal timing of Delta inflow, and lower flow variability, species invasions and associated changes in how the upper estuary food web functions, declining prey availability, high water temperatures, declining water turbidity, and localized contaminant exposure and accumulation by delta smelt.

Table 1. Summary of habitat attribute conditions for delta smelt in six regions of the estuary that are

	Landscape	Turbidity	Salinity	Temperature	Food
Montezuma Slough	Appropriate	Appropriate	Appropriate *when outflow is sufficient, or when the Suisun Marsh Salinity Control Gates are operated to lower salinity*	Usually appropriate	Appropriate
Suisun Bay (including Honker and Grizzly bays)	Appropriate except in shipping channel	Usually appropriate	Appropriate *when outflow is sufficient*	Usually appropriate	Depleted
West Delta	Limited area 4 to 15 feet deep	Marginal, declining	Appropriate	Can be too high during summer	Depleted
North Delta (Cache Slough region)	Appropriate	Appropriate	Appropriate	Can be too high during summer	Appropriate, but associated with elevated contaminant impacts
Sacramento River above Cache Slough confluence	Limited area 4 to 15 feet deep; swift currents	Marginal except during high flows, declining	Appropriate, but possibly lower than optimal	Usually appropriate	Likely low due to swift currents and wastewater inputs

South Delta	Appropriate except too much coverage by submerged plants	Too low	Appropriate	Too high in the summer	Appropriate

Giant Garter Snake

For the most recent comprehensive assessment of the species' range-wide status, please refer to the *Giant Garter Snake (Thamnophis gigas) 5-year Review: Summary and Evaluation* (Service 2020). No change in the species listing status was recommended in this 5-year review.

Western Yellow-Billed Cuckoo

For the most recent assessment of the species range-wide status please refer to the October 3, 2014, *Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (Coccyzus americanus occidentalis)* (Service 2014b). Ongoing threats to the yellow-billed cuckoo include habitat loss from flood control projects and maintenance, alterations to hydrology, climate change, and invasive species.

Environmental Baseline

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from federal agency activities or existing federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

The proposed project occurs along the mainstem Sacramento River from river mile (RM) 46 upstream to the American River confluence (RM 60), along the Sacramento north of the existing Sacramento Weir (RM 63), the lower American River from RM 0 to RM 11, and portions of the NEMDC, Arcade Creek, and Magpie Creek.

The Sacramento River in this part of the Sacramento Valley is moderately sinuous with the channel confined on both sides by man-made levees. The channel is a fairly uniform width and is not able to migrate due to the levees. Portions of the bank along the Sacramento River have had rock revetment placed to halt erosion of the bank and levees. Narrow bands of riparian habitat occur along the Sacramento River and tends to be comprised of cottonwoods, willows, buttonbush and box elder. Activities in this area consist mostly of maintenance of the levees and recreation consisting of walking, biking, and fishing. Wave wash erosion occurs from boaters in the Sacramento River.

The lower American River is not as constrained as the Sacramento River with portions of the levees set back from the river channel. This results in wider bands of riparian habitat, though there are sections where it is not continuous due to the levee being close to the river or to other land use such as golf courses which preclude native habitats. Non-native species such as black locust (*Robinia pseudoacacia*), tree of heaven (*Ailanthus altissima*), and red sesbania (*Sesbania punicea*) occur throughout the area. Recreation impacts the lower American River, particularly in the form of unauthorized camping which can result in the loss of vegetation and fires, which remove riparian vegetation.

The NEMDC, Arcade Creek, and Magpie Creek are all smaller waterways with levees adjacent to them. Riparian habitat is sporadic and, in some areas, completely missing. These creeks interface between urbanized areas and the open space of Sacramento County.

Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

Historical land use in the Magpie Creek Project was used for agriculture. In the early 1990s, the Corps investigated flood protection needs in the Magpie Creek area, compared detention basin and channel widening (channel plan) alternatives that included the former McClellan Air Force Base (AFB) (currently known as McClellan Business Park), and recommended the channel plan. Seasonal wetlands can be found along Magpie Creek. There are 20.84 acres of aquatic habitat suitable for the tadpole and fairy shrimps within 250 feet of the proposed projects footprint. Both vernal pool tadpole shrimp and vernal pool fairy shrimp have been observed within 0.5 mile of the action area (CNDDB 2025).

Valley Elderberry Longhorn Beetle

Habitat for the valley elderberry longhorn beetle occurs within riparian habitat along the Sacramento River, the American River, Arcade Creek and Sacramento Weir expansion footprint.

Sacramento River - Riparian habitat along the Sacramento River, south of the city of Sacramento, occurs in narrow bands along the riverbank and levee. Generally, an overstory layer is present, composed of cottonwood, sycamore, and oak trees. Shrubs occur as a mid-story layer including buttonbush, blue elderberry, white alder, and Oregon ash. Elderberry shrubs occur randomly along the reach of river proposed for improvements. The Corps has documented at 2.81 acres of valley elderberry longhorn beetle habitat and 40 individual shrubs that occur within the action area for erosion and seepage and stability work along the Sacramento River. Natural river processes of erosion and accretion effect elderberry shrubs which is the host plant of the valley elderberry longhorn beetle by eroding away bank and potentially elderberry shrubs. Levee maintenance can adversely affect elderberries within this stretch of the Sacramento River either by pruning or drift of herbicides used along the levee slope.

American River – Valley elderberry longhorn beetles have been identified along the lower American River Parkway in the CNDDB (2021). The Corps has designed and built six sites along the lower American River as habitat for the valley elderberry longhorn beetle. These sites extend from RM 0.9 up to RM 21. Bank protection along the lower American River will remove and transplant 28.89 acres of habitat for the valley elderberry longhorn beetle. Levee maintenance can adversely affect elderberry shrubs, though the largest threat to valley elderberry longhorn beetle is fires that have been started in the parkway and burned habitat that supports valley elderberry longhorn beetles.

Arcade Creek – Arcade Creek is dominated by grassland, with some areas of oak woodland and cottonwood forest. Two elderberry clusters of elderberry shrubs are located along Arcade Creek. Similar to elderberry shrubs along the Sacramento and American Rivers, these shrubs are subject to flood maintenance activities.

Sacramento Weir – At the Sacramento Weir expansion 2.82 acres of valley elderberry longhorn beetle habitat occurs within riparian habitat, along a railroad embankment. The Sacramento River is to the east of the embankment with a continuous canopy of trees extending to the river, but with very little understory and a walnut orchard to the west.

Delta Smelt

The portions of the Action Area that fall within the range of delta smelt include the Sacramento River east levee, south of Sacramento and the Sacramento Weir. Delta smelt typically migrate up into this area as early as December and move out in the spring and summer. The proposed project contains habitat components that can be used for feeding, spawning, rearing, and movement. According to a 2007 riprap database done for the Corps rock erosion protection currently exists between RMs 46 and 60 for a total of 19 miles, this includes both sides of the river. This section of the river is highly constrained with levees close to the river channel, which results in a good portion of the Sacramento River's bank is also in the levee template. The Corps' project will occur within 30 acres of delta smelt shallow water habitat.

Delta Smelt Critical Habitat

The erosion work along the Sacramento River will occur within critical habitat for delta smelt. These sites contain Primary Constituent Element #1, described above. The proposed project is occurring in the upper limits of the designated critical habitat, which includes potential spawning habitat. Sediment load in this portion of the Sacramento River is high and depending on the water year, sediment can drop out and cover areas with large amounts of cobble creating potential spawning habitat, or flush out accredited sediment and expose areas that are less suitable for spawning.

Giant Garter Snake

The proposed project is located within both the American Basin Recovery Unit (NEMDC borrow area) and the Yolo Basin Recovery Unit (ditch in the Sacramento Bypass) both are identified in the *Recovery Plan for the Giant Garter Snake* (Service 2017). Habitat within the proposed project occurs within the NEMDC and in the enlarged Sacramento Bypass. A borrow site located adjacent to the NEMDC in the southern part of the Natomas basin is upland giant garter snake habitat. The borrow site is on the southern edge of the agricultural lands and developed land interface. The NEMDC near this borrow site is an aquatic feature with large open areas of grassland that can serve as upland habitat for the giant garter snake. A snake observed 0.5 mile to the west of the NEMDC along Elkhorn Boulevard in 1996 (CNDDB 2021). Borrow site 2's northern boundary is Elkhorn Boulevard on the east side of the NEMDC. Giant garter snakes could be using the NEMDC for aquatic habitat and the surrounding grasslands for uplands.

Snakes have been located within the Yolo Bypass within 2 miles of the Sacramento Bypass. Numerous irrigation and drainage canals exist which provide connectivity from the Sacramento Bypass and areas that are known to support snakes in the Yolo Bypass. The canal segment between the southern cross canal and the Tule Canal that will be modified as a result of construction of the Bypass Transport Channel contains about 38.4 acres of giant garter snake habitat (3.4 acres of aquatic habitat and 35 acres of upland habitat).

Western Yellow-Billed Cuckoo

Riparian habitat along the Sacramento River is narrow and linear. This habitat is not wide enough to support a nesting pair of cuckoos. Yellow-billed cuckoos use riparian habitat for foraging and nesting. Larger habitat patches exist within the lower American River. There are 65 acres of riparian habitat along the Lower American River that yellow-billed cuckoos could be using in the project area. The Corps will remove 110 acres of riparian habitat along the Sacramento River and disturb an additional 50 acres of riparian habitat by removing the understory and placing rock around the large trees. Riparian habitat exists landside of the levee at the Sacramento Weir extension. There are 13.74 acres of riparian that the cuckoo could use during migration at the Sacramento Weir extension.

Effects of the Action

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

There are 20.84 acres of seasonal wetlands and vernal pools within 250 feet of the construction footprint along Magpie Creek, all of which is considered potential habitat for the two vernal pool crustaceans. Conservation measures such as the use of erosion control measures and fencing will avoid effects to 12.16 acres of vernal pools and swaless. Of the remaining 8.68 acres, 0.56 acre will be permanently lost with the placement of fill and grading for levee raises and maintenance road construction. The remaining 8.12 acres of vernal pool crustacean habitat will be subject to temporary effects due to their hydrological connection to the habitat being filled. It is expected that a small amount of sediment may migrate into these hydrologically connected habitats. This will be minimal given that the lowest points of these features are being filled and any sediment will not move upgradient.

As noted previously in the *Description of the Proposed Action* section, the Corps has proposed a set of conservation measures, including the commitment to purchase 1.68 acres of vernal pool species credits at a Service-approved conservation bank as part of the action. This compensatory habitat is intended to minimize the effect on the species of the proposed project's anticipated incidental take, resulting from the permanent loss of habitat described above.

This component of the action will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat as part of a relatively large, contiguous block of conserved land may contribute to other recovery efforts for the species.

Valley Elderberry Longhorn Beetle

Vegetation removal, including elderberry shrubs can cause mortality of any beetle larvae within the elderberry shrub. Transplanting the shrubs between November 1 and February 15, when the shrubs are dormant, will minimize the likelihood of killing larvae within the shrub. However, with transplantation there is no guarantee that the shrub will live which will result in both the death of any larvae in the shrub and the loss of habitat for the beetle. Proper care of the transplants through watering in the initial years can minimize this loss and increase the likelihood that the shrub will survive and provide habitat for the valley elderberry longhorn beetle.

The Corps is avoiding many elderberries along the lower American River and Sacramento River. Elderberry shrubs along the Sacramento River are being avoided with at least a 20-foot buffer from the dripline. On the lower American River 8.34 acres of valley elderberry longhorn beetle riparian habitat will have construction occurring within 20 feet of the dripline of elderberry shrubs, but the shrubs will be protected in place. Construction and geotechnical studies that occur near elderberry shrubs that will be protected in place can kill adult beetles if construction equipment is operating between the months of March and July when valley elderberry longhorn beetles have emerged from the elderberry shrubs, are locating mates for reproduction, and laying eggs on the elderberry shrubs. Fencing the area which contains riparian habitat, specifically elderberry shrubs, will minimize the likelihood of killing an adult beetle, but given the large amount of construction that will be occurring, the project will cause mortality to adult beetles.

The linear nature of this project could result in a loss of habitat connectivity for the valley elderberry longhorn beetle, which will affect the long-term viability of the beetle in the lower American River and along the Sacramento River because the beetle is a poor disperser. A large number of elderberry shrubs are being transplanted out of the construction footprint. Because final designs have not been completed for all of the bank protection work, the Corps is including the Service in the design process as well as in the selection and design of mitigation sites. Sites will be selected that increase both habitat connectivity as well as habitat patch size. Fulfilling recovery actions in the Valley Elderberry Longhorn Beetle Recovery Plan will be considered when selecting mitigation sites.

Overall, the Corps is impacting the following amount of elderberry shrub habitat : 28.89 acres along the lower American River; 2.81 acres along the Sacramento River for bank protection; 2.74 acres at Sacramento Weir; and 40 individual shrubs along the Sacramento River for seepage and stability. The 40 individual elderberry shrubs were not associated with riparian habitat and the Corps is proposing to offset adverse effects through the creation of 3.31 acres of valley elderberry longhorn beetle habitat. The Corps is proposing to offset the loss of 34.44 acres of beetle habitat through the creation of 84.94 acres of valley elderberry longhorn beetle habitat primarily along the lower American River, Sacramento River Mitigation Site, and at the Stone Lakes Conservation site, with up to 8.22 acres protected at a valley elderberry longhorn beetle conservation bank. Restoration of the American River Mitigation Site and Sacramento River Mitigation Sites will result in the removal of 1.0 acre of valley elderberry longhorn beetle habitat. The elderberry shrubs within this habitat will be transplanted to areas where riparian restoration will occur. Take of the beetle is likely due to transplantation, though the Corps will transplant shrubs during the dormant season and maintain and water them along with the remainder of the mitigation on the sites. These components of the action (the creation and protection of valley elderberry longhorn beetle habitat and the purchase of bank credits) will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat in a way that provides relatively large, contiguous blocks of conserved land may contribute to recovery efforts for the valley elderberry longhorn beetle.

Operations and Maintenance - The Corps has proposed to evaluate effects to listed species including valley elderberry longhorn beetle when long-term maintenance activities for the Lower American River and Sacramento River can be described. Therefore, this biological opinion does not address effects to the valley elderberry longhorn beetle from any long-term levee maintenance activities.

Delta Smelt

Construction along the Sacramento River will place bank protection along a total of 43,000 non-contiguous linear feet (total of 8.14 miles) sections of the left bank of the Sacramento River. This will result in the majority of this section of river having rock bank protection placed on it. Delta smelt are a pelagic species typically associated with open water. However, as described in the status of the species they do spawn on sandy beaches in shallow water habitat. Suitable spawning habitat in this portion of the Sacramento River is present along the riverine edge of the left bank where proposed activities will occur. The rock footprint and other construction related activities below the mean high-water mark will change the substrate up to 43,000 linear feet (30 acres of shallow water habitat).

In-water construction activities (July 1 through October 31) will avoid the adult migration season and exposure to the adult spawning, incubation *(i.e.*, eggs/embryos), and larval transport from heavy equipment such as barges and cranes. Infrequent detection of larger juveniles in beach surveys suggests that the Sacramento River serves as a spawning ground and not as a nursery ground (Service 2020). Therefore, the early start of construction of July 1 in this section of the Sacramento River, while has the potential to effect individuals, this will be a small number of individuals. The bulk of the work will be completed during the August 1 to November 30 work window that typically avoids effecting individual delta smelt.

Effects due to increasing sediment downstream of the work area will be minimized through the conservation measures involving monitoring water quality during construction to ensure that effects do not extend into the portion of the Delta that delta smelt occupies during the late summer/fall period.

Construction to widen the Sacramento Weir will involve excavation of 5.56 acres of riverine habitat and roughly 2 acres of excavation of the upper bank. Once completed there will be 7.5 of riverine habitat with natural substrate. Only 1 acre of riprap will be used in this area immediately around the fish passage channel to limit erosion. The 7.5 acres of riverine habitat will be available to delta smelt the following year, resulting in no loss of habitat available to the delta smelt.

The primary adverse effect of the project is on potential spawning habitat is the modification of substrate within the shallow water zone (*e.g.*, sand to riprap). Rock used for bank protection is large enough to retard erosional forces of the river and therefore has interstitial spaces. Should delta smelt spawn over this riprap substrate, it is very likely that any eggs will fall into these interstitial spaces resulting in the loss of eggs and potentially causing fertilization to not occur if the eggs fall into the interstitial spaces. Rock slope protection limits the lateral mobility of a river channel, increases flow velocities (Sedell et al. 1990), limit sediment transport, and eliminates bankside refugia areas (Gregory et al. 1991). Rock placement can also affect primary productivity through the loss of vegetation. The Corps will protect large trees in place and plant riparian benches at the conclusion of the rock placement to replace some of the loss of vegetation. Planting benches and vegetation planting will help to offset the increased velocities that the bank protection sites will experience due to the smoother rock surface. Current designs of the sites have a launchable toe, which is designed to provide protection against toe erosion. Because this is a feature that could move in the future, the Corps has committed to analyzing the likelihood and effects to the on-site planting bench if the toe rock launches. If it is found that the launch of the toe rock will affect the long-term viability of the on-site mitigation, the Corps will consult with the Service to determine how the launchable toe could affect the delta smelt and its critical habitat and reintitiate consultation if necessary.To offset the loss spawning potential and the loss of riverine edge habitat the Corps has proposed to purchase credits at a Service-approved delta smelt conservation bank, as well as completing on-site mitigation and off-site mitigation at the Sacramento River Mitigation Site. The total amount of mitigation will result in the creation and protection of up to 90 acres of delta smelt habitat for the effects to up to 30 acres of shallow water habitat..

From a temporal perspective it is assumed that mitigation will be in place and available to the species by the end of construction, assuming construction will be done by 2028. Construction of the mitigation site at Sacramento River Mitigation Site will have minimal effects to delta smelt since effects will be limited to the 1.21 acres where the breach in the berm will occur. Potential for construction-related turbidity will be minimized by creating the channels and marshes prior to breaching the berm and allowing water into the site. This will reduce impacts to protected fish species by allowing releases of turbid water to occur when the species are least likely to be present or adequate water flow is present to dilute dissolved materials being washed into the waterway. An inflatable bladder dam or a solid coffer dam may be needed during construction of the SRMS site to either prevent water intrusion from the Sacramento River or turbidity escaping the site. Long-term the site will provide up to 35 acres of new habitat for the delta smelt. The Corps is coordinating with the Service on the development of mitigation. If they find that mitigation will not be completed by 2028 they will work with the Service to determine what the effects to delta smelt will be and reinitiate consultation as appropriate.

The proposed conservation plan of the action will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat in a way that provides relatively large, contiguous blocks of conserved land may contribute to recovery efforts for the delta smelt.

Operations and Maintenance - The Corps has proposed to evaluate effects to listed species including delta smelt when long-term maintenance activities for the Sacramento River can be described. Therefore, this biological opinion does not address effects to the delta smelt from any long-term levee maintenance activities.

Delta Smelt Critical Habitat

Implementation of the proposed project will affect PCE #1 Physical Habitat as described under the environmental baseline section above. The placement of rock or other construction activities under the mean high-water mark will change the substrate of shallow water habitat for 30 acres. Any loss of shallow water habitat will be compensated through the purchase of credits at a delta smelt conservation bank, creation of on-site shallow water planting benches, or a Service-approved mitigation site. Creation of on-site benches can minimize and mitigate effects to delta smelt critical habitat if they are in the shallow water habitat zone and accessible to delta smelt during the spawning season. Previous erosion repair sites have accreted sandy soils on the benches which will be available to the delta smelt for spawning. This will not be available every year given it is dependent on the Sacramento River flows. A Conservation Measure which includes the Service in the development of the plans for the planting benches will ensure that the benches can provide habitat for the delta smelt. It is expected that planting portions of the sites post-construction will replace loss of primary productivity within the Sacramento River water column. On-site mitigation will be determined on a site-by-site case in consultation with the Service. The current discussion of off-site mitigation includes sites which are not currently connected to the river, through some sort of levee breach. This will open up new potential spawning habitat to the delta smelt within critical habitat.

Giant Garter Snake

Borrow Site 2 – Upland habitat for the giant garter snake will be disturbed at borrow site 2 (5.5 acres) when heavy equipment is brought in to remove soil for the Arcade Creek levee repair. Removal of soil from the site will result in the crushing of burrows that snakes use for aestivating and thermoregulation. Fencing the borrow site prior to borrow excavation will minimize the likelihood that snakes will be in the borrow site when construction equipment begins to mobilize. Fencing the site will temporarily (one active season) exclude the use of the area for giant garter snake. This could result in snakes having to move further distances to find upland refugia in the summer months and expose them to predation or other sources of mortality such as being run over by a vehicle on the levee road on the opposite side of the NEMDC. About 1.2 acres of aquatic habitat for the giant garter snake will be unavailable to the snake for up to 3 months during the snake's active season due to dewatering. Since snakes use aquatic habitat to forage for food, thermoregulate, and evade predators, the loss of this 1.2 acres will negatively affect the giant garter snake. Snakes will have to find alternative areas to forage in during these 3 months which could leave snakes more vulnerable to predation as they move to other areas for foraging.

Upon completion of the project, the site will restored and re-graded to create three habitat types. The 0.4 acre of freshwater marsh will provide a small increase in habitat along the bank during the summer months when the snake is active and will provide cover, an area for prey production, and refugia from predators. Additionally, the seasonal wetland bench will only provide aquatic habitat in the winter months when the snake is typically in burrows. The wetland bench will provide some upland habitat for the giant garter snake during the summer when the snake is active in the form of basking habitat and if dried wetland vegetation remains, some refugia from predators. However, because the site will be flooded in the winter it will not serve as overwintering habitat for the snake. The remaining 3.5 acres of the borrow site will be restored to native grassland and will function as summer upland refugia and basking habitat and in the winter serve as overwintering habitat for the snake.

Sacramento Bypass – Enlarging the Sacramento Bypass and Weir will result in temporary effects to giant garter snake habitat. Geotechnical borings will be conducted during the active season of the snake and will be done in a manner that tries to avoid areas where giant garter snakes may be underground in burrows. Creation of the Bypass Transport Channel will result in temporary effects to 2.3 acres of aquatic habitat and 32.7 acres of upland habitat. An additional 0.3 acre of aquatic and 3.1 acres of upland habitat will be permanently affected through the filling of a section of canal. Construction effects will result in the project area being unavailable to the giant garter snake for one year. Construction equipment and earthmoving activities will result in collapsing of burrows and crushing of snakes that are in the project area. Upon the one year completion of this portion of the project there will be an additional 6.7 acres of aquatic habitat available to the giant garter snake. Water availability should be similar to existing conditions with agricultural drainage providing a water source in the summer months when the snake is active. Conservation measures including working during the snake's active season will minimize the amount of individuals that could be killed or injured.

Operation of the expanded Sacramento Weir and Bypass will result in an increase of water surface elevation of approximately 0.5-foot on the levee slopes on either side of the Yolo Bypass. However, when this increase occurs, during a 200-year flood event, the Yolo Bypass levees already contain water up to 21 feet deep. As a result, giant garter snake burrows will likely already be saturated before the additional water associated with the widened Sacramento Bypass is a factor. The additional 0.5-foot resulting from this action will not significantly change the timing or duration of this flooding and will not result in further impacts to giant garter snake habitat.

The Corps has proposed to evaluate effects to listed species including giant garter snake when long-term maintenance activities for the Sacramento Bypass can be described. If maintenance activities will affect giant garter snakes the Corps will reinitiate consultation with the Service. Therefore, this biological opinion does not address effects to the giant garter snake from any long-term levee maintenance activities.

Yellow-Billed Cuckoo

Sacramento River – The Corps is planning on removing 70 acres of riparian habitat along the Sacramento River. The riparian corridor in this section of the Sacramento River is narrow (about 100 feet wide) because the levees were constructed so close to the edge of the channel bank. This bank of riparian habitat is too narrow for the yellow-billed cuckoo to nest; however it is possible for the yellow-billed cuckoo to use the habitat as a stopover when migrating to the Central Valley to breed. Vegetation removal under the proposed project will reduce the width of the riparian corridor from 100 feet to 40 feet on average. The Corps proposal to plant the bank protection sites will create at least a 25-foot-wide soil filled planting berm. Similar to the discussion above under delta smelt effects, these planting benches will have a launchable rock toe that could deploy over the life of the project. The study the Corps is currently undertaking will determine the likelihood and effect to the planting bench. If it is found that the launch of the toe rock will affect the long-term viability of the on-site mitigation, the Corps will consult with the Service to determine the effects to the yellow-billed cuckoo and its habitat. The Corps proposes to offset the loss of the 70 acres of riparian habitat through creation of habitat on-site and the creation of up to 140 acres of riparian habitat along the lower American River. The Corps is including the Service in the development of the mitigation sites such that they can be sited and designed to create riparian habitat that will benefit the yellow-billed cuckoo.

American River – The construction of launchable rock trench and bank protection will remove up to 65 acres of riparian habitat along the lower American River. While large patches of riparian habitat will not be removed (only a strip will be removed adjacent to the levee), the removal of this strip could reduce the size of some of the riparian areas in the lower American River that could serve as potential nesting areas for the cuckoo.

To compensate for this loss of riparian habitat, the Corps is proposing to plant up to 130 acres of riparian habitat along the lower American River. As described in the Conservation Measures, a variable sized soil filled planting bench will be constructed in the bank repair sites, where feasible. This will be used to offset some of the effects of loss of riparian vegetation. The launchable toe is also proposed for the bank protection and effects to on-site mitigation will occur as discussed in the Sacramento River effects section above. The remainder of the mitigation will occur along the lower American River. The American River Mitigation Site will have 8.63 acres removed as part of the restoration of the site. Overall, 11.29 acres of additional riparian habitat will be created on-site in a mosaic of riparian and scrub habitat that will provide greater diversity for the cuckoo.

Sacramento Weir – Due to the expansion of the weir and Sacramento Bypass, the Corps will remove 13.74 acres of valley oak riparian that is on the railroad alignment and to the east of the railroad alignment. This area will be converted to a concrete weir. While this patch, similar to riparian along the Sacramento River, does not serve as nesting habitat for the yellow-billed cuckoo because of its small size, it does provide migratory stopover habitat for the cuckoo. The Corps is proposing to compensate for the loss of this habitat either in the Lower American River, at the Beach Stone Lakes Conservation Area, or through the purchase of riparian floodplain credits at a mitigation bank.

In addition to the habitat loss for both the Sacramento and American Rivers, construction activities have the potential to adversely affect individual yellow-billed cuckoos. Construction that occurs when the cuckoo is in the Sacramento Valley has the potential to harass the bird due to noise. To minimize effects to the cuckoo due to construction noise, the Corps' conservation measure to do pre-construction bird surveys prior to beginning construction and to remove all vegetation outside of the migratory bird nesting season (March 1 to September 31), will enable the Corps to avoid nesting yellow-billed cuckoos. However, cuckoos that could be foraging in the area could be disturbed due to construction activities and noise and move to other locations in the lower American River parkway which could expose individual cuckoos to increased predation.

The conservation areas will provide both habitat for yellow-billed cuckoo and valley elderberry longhorn beetles. These areas will also ensure that there is a net increase of potential yellow-billed cuckoo nesting habitat along the lower American River Parkway. Recognizing that there is overlap in valley elderberry longhorn beetle habitat and yellow-billed cuckoo habitat and due to the different ratios proposed by the Corps, impacts due to the proposed project and mitigation sites will be developed and coordinated with the Service to ensure that habitat is created and balanced for both species. In total there will be up to 306 acres of habitat that will be heterogenous and provide habitat for the valley elderberry longhorn beetle, yellow-billed cuckoo, and salmonids. This acreage will be broken up in a combination of on-site, off-site, and conservation bank credits and will be coordinated with the Service.

The proposed conservation plan of the action will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat in a way that provides relatively large, contiguous blocks of conserved land may contribute to recovery efforts for the yellow-billed cuckoo.

Operation and Maintenance - The Corps has proposed to evaluate effects to listed species including yellow-billed cuckoo when long-term maintenance activities for the Sacramento River and American River can be described. If maintenance activities will affect yellow-billed cuckoos the Corps will reinitiate consultation with the Service. Therefore, this biological opinion does not address effects to the yellow-billed cuckoo from any long-term levee maintenance activities.

Cumulative Effects

Cumulative effects include the effects of future non-Federal actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. During this consultation, the Service did not identify any future non-federal actions that are reasonably certain to occur in the action area of the proposed project.]

Conclusion

After reviewing the current status of the valley elderberry longhorn beetle, delta smelt, longfin smelt, giant garter snake, and yellow-billed cuckoo, the environmental baseline for the action area, the effects of the proposed American River Common Features 2016 project, and the cumulative effects, it is the Service’s biological opinion that the American River Common Features 2016 project, as proposed, is not likely to jeopardize the continued existence of the valley elderberry longhorn beetle, vernal pool fairy shrimp, vernal pool tadpole shrimp, delta smelt, giant garter snake, and yellow-billed cuckoo. The Service reached this conclusion because the project-related effects to the species, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding recovery or reducing the likelihood of survival of the species based on the following:

1) Conservation measures will be implemented that limit when work will occur to avoid when listed species are in the action area, or when they are less likely to be affected by the project;

2) The project will affect a small number of acres of habitat for each species in comparison to the total habitat in the range of these species;

3) Habitat will be created and preserved to offset effects to the vernal pool fairy shrimp and tadpole shrimp, valley elderberry longhorn beetle, delta smelt, and yellow-billed cuckoo. For most of these species there will be a net increase in habitat over what was affected; and

4) On-site creation of riparian habitat will maintain connectivity for all for aquatic and riparian species.

After reviewing the current status of designated critical habitat for the delta smelt, the environmental baseline for the action area, the effects of the proposed American River Common Features 2016 project, and the cumulative effects, it is the Service’s biological opinion that the

American River Common Features 2016 project, as proposed, is not likely to destroy or adversely modify designated critical habitat. The Service reached this conclusion because the project-related effects to the designated critical habitat, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding the function of the delta smelt critical habitat to serve its intended conservation role for the species based on the following:

1) Habitat effected within critical habitat for delta smelt will be offset through the creation/preservation of 3 times that which is being affected within the critical habitat area and

2) Benches will be constructed on-site in the shallow water habitat zone will be created on-site and created in a way that allows for sediment to accrete and serve as potential delta smelt spawning habitat.

The effects to delta smelt critical habitat are small and discrete, relative to the entire area designated, and are not expected to appreciably diminish the value of the critical habitat or prevent it from sustaining its role in the conservation of the delta smelt.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by Service regulations at 50 CFR 17.3 as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the same regulations as an act which actually kills or injures wildlife. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act if such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of Take

Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

The Service anticipates that incidental take of tadpole shrimp and fairy shrimp will be difficult to detect due to their life histories and ecologies. It is not possible to know how many vernal pool shrimp eggs are in the soil of any wetland features, or how many individuals or eggs will occupy any wetland feature later in time. The anticipated loss of individuals of these shrimp species also cannot be quantified due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their vernal pool habitats, or additional environmental disturbances. In instances where the total number of individuals to be taken cannot be determined, the Service may use the acreage of habitat impacted as a surrogate for the take of eggs/individuals. Therefore, the Service anticipates take incidental to the construction of the proposed project as the harm and mortality of all tadpole shrimp and fairy shrimp and eggs within the 0.56 acre of habitat that will be permanently lost by the proposed project.

Valley Elderberry Longhorn Beetle

The Service anticipates that incidental take of valley elderberry longhorn beetle will be difficult to detect due to its life history and ecology. Specifically, valley elderberry longhorn beetles can be difficult to locate since most of their life cycle is spent in the elderberry shrub and finding a dead or injured individual is unlikely due to their relatively small size. There is a risk of harm, harassment, injury and mortality as a result of the proposed construction activities; therefore, the Service is authorizing take incidental to the proposed action as harm, harassment, injury, and mortality of all valley elderberry longhorn beetles within 35.44 acres of habitat and 44 isolated elderberry shrubs that will be transplanted as a result of construction.

Delta Smelt

The Service expects that incidental take of delta smelt will be difficult to detect or quantify for the following reasons: the small size of adults, their occurrence in turbid aquatic habitat makes them difficult to detect, and the low likelihood of finding dead or impaired specimens. The Service anticipates that the extent of incidental take will be minimized due to the proposed conservation measures and low relative abundance. Due to the difficulty in quantifying the number of delta smelt that will be taken as a result of the proposed action, the number of acres of affected habitat becomes a surrogate for the species that will be taken. The Service anticipates that all individual adult delta smelt in the 31.21acres of the action area may be subject to incidental take in the form of harm as described in this biological opinion. Incidental take of delta smelt for maintenance activities is not covered in this biological opinion.

Giant Garter Snake

The Service anticipates that incidental take of the snake will be difficult to detect or quantify for the following reasons: snakes are cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, and other cover. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that will be harassed during construction activities, including in staging areas and roads carrying vehicular traffic. In instances when take is difficult to detect, the Service may estimate take in numbers of species per acre of habitat lost or degraded as a result of the action as a surrogate measure for quantifying individuals. Therefore, the Service anticipates the number of giant garter snakes that may be found in 12.7 acres of aquatic and upland habitat will be harmed or killed as a result of habitat modification due to the proposed project. Incidental take of giant garter snake for maintenance activities is not covered in this biological opinion.

Yellow-Billed Cuckoo

The Service anticipates that incidental take of yellow-billed cuckoo will be difficult to detect due to its life history and ecology. Specifically, yellow-billed cuckoos can be difficult to locate due to their cryptic appearance and behavior and finding a dead or injured individual is unlikely. There is a risk of harm and harassment as a result of proposed construction activities and operations and maintenance of the restoration plantings; therefore, the Service is authorizing take incidental to the proposed action as harm and harassment of all yellow-billed cuckoos within 143.63 acres. Incidental take of yellow-billed cuckoo for maintenance activities is not covered in this biological opinion.

Upon implementation of the following reasonable and prudent measures, incidental take of vernal pool fairy shrimp and vernal pool tadpole shrimp, valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo associated with the American River Common Features 2016 will become exempt from the prohibitions described in section 9 of the Act. No other forms of take are exempted under this opinion.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

All necessary and appropriate measures to avoid or minimize effects on the valley elderberry longhorn beetle, vernal pool fairy shrimp, vernal pool tadpole shrimp, delta smelt, giant garter snake, and yellow-billed cuckoo resulting from implementation of this proposed project have been incorporated into the project's proposed conservation measures. Therefore, the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of the valley elderberry longhorn beetle, vernal pool fairy shrimp, vernal pool tadpole shrimp, delta smelt, giant garter snake, and yellow-billed cuckoo:

1) All conservation measures, as described in the biological assessment and restated here in the *Description of the Proposed Action* section of this biological opinion, shall be fully implemented and adhered to. Further, this reasonable and prudent measure shall be supplemented by the terms and conditions below.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The Corps shall include full implementation and adherence to the conservation measures as a condition of any permit or contract issued for the project.

2. To monitor whether the amount of incidental take anticipated from implementation of the proposed project is approached, the Corps will adhere to the following reporting requirement.

    a. For those components of the action that will result in habitat degradation or modification whereby incidental take in the form of harm is anticipated, the Corps shall provide a letter prior to construction of the actual impacts and mitigation as well as a precise accounting of the total acreage of habitat impacted per contract to the Service at the completion of the construction season.

    b. The Corps shall immediately contact the Service's Sacramento Fish and Wildlife Office (SFWO) at (916) 414-6541 to report direct encounters between listed species and project workers and their equipment whereby incidental take in the form of, harm, injury, or death occurs. If the encounter occurs after normal working hours, the Corps shall contact the SFWO at the earliest possible opportunity the next working day. When injured or killed individuals of the listed species are found, the Corps shall follow the steps outlined in the Salvage and Disposition of Individuals section below.

Salvage and Disposition of Individuals:

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, and the name of the person who found it, and the bag containing the specimen frozen in a freezer located in a secure site, until instructions are received from the Service regarding the disposition of the dead specimen. The Service contact person is the Military and Waterway Planning Division, Division Supervisor at the Sacramento Fish and Wildlife Office at (916) 414-6541.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following actions:

1) The Service recommends the Corps develop and implement restoration measures in areas designated in the Delta Fishes Recovery Plan (Service 1996) the Giant Garter Snake Recovery Plan (2017) and the Valley Elderberry Longhorn Beetle Recovery Plan (2019).

2) The Corps and SAFCA should develop and implement projects that support DWR's Central Valley Flood System Conservation Strategy. This document provides goals and measurable objectives and potential projects which could be implemented in a manner that while improving the riverine ecosystem also will improve the flood system.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION—CLOSING STATEMENT

This concludes formal consultation on the American River Common Features 2016 project. As provided in 50 CFR §402.16(a), reinitiation of consultation is required and shall be requested by the federal agency where discretionary federal involvement or control over the action has been retained or is authorized by law, and:

1) If the amount or extent of taking specified in the incidental take statement is exceeded;
2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or
4) If a new species is listed or critical habitat designated that may be affected by the identified action.

If you have any questions regarding this biological opinion, please contact Jennifer Hobbs (Jennifer_hobbs@fws.gov), at the letterhead address or at (916) 414-6541.

Sincerely,

MICHAEL FRIS

Digitally signed by MICHAEL FRIS
Date: 2025.03.21 11:52:56 -07'00'

Michael Fris
Field Supervisor

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region, California Central Valley Office
650 Capitol Mall, Suite 5-100
SACRAMENTO, CA 95814

Refer to NMFS ECO #: WCRO-2024-01347

March 13, 2025

Mr. Kevin Harper
Chief, Environmental Resources Branch
US Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the American River Common Features General Reevaluation Report reinitiation 2024

Dear Mr. Harper:

Thank you for your letter of May 14, 2024, requesting reinitiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for American River Common Features General Reevaluation Report reinitiation 2024.

Thank you also for your request for essential fish habitat (EFH) consultation. NMFS reviewed the proposed action for potential effects on EFH pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. We have concluded that the action would adversely affect EFH designated under the Pacific Coast Salmon Fishery Management Plan. The EFH consultation concludes with conservation recommendations.

The enclosed biological opinion (opinion) analyzes the effects of the American River Watershed Common Features General Reevaluation Report (ARCF). This opinion is based on the final ARCF biological assessment for the project (USACE 2020), supplemental ARCF reinitiation biological assessment (USACE 2024a) and appendixes, Sacramento Weir operations and maintenance biological assessment (USACE 2024b), and on the best available scientific and commercial information. The opinion concludes that the analyzed project is not likely to jeopardize the continued existence of the federally listed as endangered, Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU), the threatened Central Valley spring-run Chinook salmon ESU (*O. tshawytscha*), the threatened southern distinct population segment (sDPS) of the North American green sturgeon (*Acipenser medirostris*), and the threatened California Central Valley steelhead (O. mykiss) DPS, and is not likely to destroy or adversely modify their designated critical habitats. NMFS has included an incidental take statement with reasonable and prudent measures and terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the project.

Please contact Lyla Pirkola at the California Central Valley Office of NMFS at (916) 930-5615 or via email at Lyla.Pirkola@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for
California Central Valley Office

Enclosure

cc: ARN 151422-WCR2024-SA00023
Robert Chase, Robert.D.Chase@usace.army.mil
Susan Rosebrough, Susan_Rosebrough@nps.gov

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region, California Central Valley Office
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

American River Watershed Common Features General Reevaluation Report

NMFS Consultation ECO Number: WCRO-2024-0134

Action Agency: United States Army Corps of Engineers (USACE)

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	If likely to adversely affect, Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	If likely to adversely affect, is Action Likely to Destroy or Adversely Modify Critical Habitat?
Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley spring-run Chinook Salmon ESU (*Oncorhynchus tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead DPS (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern DPS of North American green sturgeon (Acipenser medirostris)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for California Central Valley Office

Date: March 13, 2025

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1. Introduction

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Sacramento NMFS Office.

1.2. Consultation History

Authorization for the overall American River Common Features (ARCF) Project is provided by Section 101 of the Water Resources Development Act (WRDA) of 1996 (PL 104-303), and modified by WRDA 1999, Section 366 (PL 106-53). The authorization was reassessed under a reevaluation study known as the ARCF General Reevaluation Report (GRR) (USACE 2015). On September 9th, 2015, the National Marine Fisheries Service (NMFS) issued an opinion (NMFS 2015) and on September 11, 2015, the U.S. Fish and Wildlife Service (USFWS) issued a biological opinion (File No. 08ESMF00-2014-F-0518; referred herein as 2015 USFWS opinion; USFWS 2015) on the ARCF GRR in accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 et seq.). In 2020, reinitiation of consultation with NMFS was requested due to project changes. On May 12, 2021, NMFS issued a reinitiated opinion (referred herein as 2021 NMFS opinion).

The history of the section 7 consultation on the ARCF Project started during the development of the ARCF GRR in 2015. The opinions were issued by NMFS and USFWS as described above. Full consultation history of all aspects prior to this reinitiation can be found in the consultation history of the September 9, 2015, NMFS opinion (referenced in this document as 2015 NMFS opinion) and the 2021 NMFS opinion.

Several aspects of the 2015 and 2021 NMFS opinions have already been implemented or are beginning to be constructed as follows:

- Sacramento River East Levee cutoff walls in several areas (2020-2024)
- Tree removal at several locations (2018-ongoing)
- Partial areas of seepage berm installed on the Sacramento River (2019)
- Beach Stone Lakes Mitigation Site south of Freeport, north of Morrison Creek on the east side of the Sacramento River (2020-2023)
- Arcade Creek (2017-2020)
- Purchase of 20 mitigation credits at Fremont Landing Conservation Bank (2019)
- Lower American River Erosion Contracts 1, 2, and 3A (2022-2024)
- Sacramento River Erosion Contracts 1 and 2 (2021-2024)
- Sacramento Weir (2023-ongoing)

NMFS has provided technical assistance during the development of site designs and the reinitiation Biological Assessment (BA). Project technical assistance and design team involvement have been occurring regularly since the beginning of the project.

- On October 4, 2022, USACE and NMFS discussed proposed project changes including a new construction schedule and infeasibility of the previously proposed mitigation strategy.
- On April 20, 2023, USACE sent NMFS BA-supporting materials including the current schedule and the impacts and mitigation tracking spreadsheet.
- During August 2023, NMFS provided USACE technical assistance in drafting the reinitiated BA.
- On May 13, 2024, NMFS received a letter from USACE describing the proposed project changes with a reinitiation analysis that concluded reinitiation was not triggered.
- On June 25, 2024, NMFS provided USACE with a letter requesting additional information and indicating that formal reinitiation of consultation is required due to changes in the proposed action which may result in effects to listed species and critical habitat in a manner or extent not previously considered.
- On July 16, 2024, USACE provided the additional information NMFS requested with the exception of the analysis related to the Sacramento Weir Operations and Maintenance.
- On August 14, 2024, USACE provided NMFS a BA for the Sacramento Weir operations and maintenance, and consultation was initiated.

1.2.1. Completed Actions

USACE has completed construction of flood risk features for the following contracts:
- Sacramento River East Levee (SREL) Seepage and Stability Contracts 1-4
- Sacramento River (SR) Erosion Contract 1-2
- Lower American River (LAR) Erosion Contracts 1-2

The completion of these contracts included site preparation (tree removal and bank grading) as well as cleanup, hydroseeding, and on-site revegetation. The timing and impact acreages for each completed contract are included in Table 1. Construction has also begun and is on-going at the Sacramento Weir (2021 NMFS opinion, Section 1.3.4).

USACE has also completed purchase of 20 acres of salmonid/green sturgeon credits from the Fremont Landing Conservation Bank and 12 acres of salmonid restoration credits from the North Delta Fish Conservation Bank. Both are NMFS-approved banks and credit purchases occurred consistent with the 2021 NMFS opinion.

Table 1 Timing and Impacts of Completed Contracts

Contract	Year(s) completed	Permanent Impacts (acre)	Temporary Impacts (acre)
LAR Contract 1	2022-2023	8.50	0.0
LAR Contract 2	2022-2024	5.44	0.0
SR Contract 1	2022	3.08	0.0
SR Contract 2	2023-2024	18.03	0.0
SREL Contract 1	2019-2023	0.0	0.0
SREL Contract 2	2019-2023	0.0	0.0
SREL Contract 3	2019-2023	0.0	0.003
SREL Contract 4	2019-2023	0.0	1.4
Total	-	35.05	1.403

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act. 89 Fed. Reg. at 24268; 84 Fed. Reg. at 45015. We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (see 50 CFR 402.02). We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not. Under the MSA, "federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a federal agency (see 50 CFR 600.910).

The proposed action was previously described in the 2021 NMFS opinion and includes actions to reduce flood risk in the City of Sacramento and surrounding areas by addressing levee seepage, under seepage, erosion, stability, and overtopping concerns along the Sacramento River and American River. Because the nature of the work proposed remains largely unchanged, we have adopted the information provided in the 2021 NMFS opinion by reference where relevant. References to the 2021 NMFS opinion will include the section where the relevant information can be found. A web link to the 2021 NMFS opinion can be found in the References section of this document.

For the purpose of defining the proposed federal action specific to this present request for reinitiating the biological opinion, the sections below describe the actions yet to occur and which are subject to the analysis of this opinion.

1.3.1. Updated Proposed Action

According to the 2024 USACE BA, the Updated Proposed Action will accomplish the same goal of reducing flood risk in the City of Sacramento and surrounding areas.

1.3.1.1 Work Windows and Project Schedule

USACE proposes a work window of May 1 - November 30, for work occurring below the Ordinary High Water Mark (OHWM), but outside of the wetted channel. In-water work in the wetted channel will be limited to July 1 – October 31. USACE will contact NMFS in writing via email at least one month prior to the start of construction for any work below the OHWM. NMFS will also be notified by September 30 of each year with a description of any work below the OHWM anticipated past October 31.

Previously, all work associated with the ARCF project was anticipated to be complete by 2024. The current schedule anticipates construction through 2028 as detailed below.

Lower American River (LAR) Erosion:

- LAR Contract 3A, 2025
- LAR Contract 3B, 2026-2027
- LAR Contract 4A, 2028
- LAR Contract 4B, 2028

Sacramento River (SR) Erosion:

- SR Contract 3, 2026-2027

1.3.1.2 American River

USACE has concluded that levees along the American River require improvements to address erosion. The proposed measures for these levees consist of waterside armoring to prevent erosion to the riverbank and levee, which could potentially undermine the levee foundation. Construction is proposed for contracts 3A, 3B, 4A, and 4B on the lower American River. Section 1.3.1 of the 2021 NMFS opinion described the designs for these locations, this includes bank protection, launchable rock trench, toe protection and/or cut banks. Sections 1.3.9 to 1.3.11 of the 2021 NMFS opinion described the construction process, staging, equipment, vegetation planting installations, demobilization, rehabilitation and cleanup.

The design for contract 4A has been updated to include a berm (described below). The remaining three contract designs remain unchanged. The two primary measurements that are used to describe the American River levees in the ARCF GRR: (1) a maximum of 31,000 linear feet (LF) of bank protection, and (2) a maximum of 65 acres/45,000 LF of launchable rock trench. Remaining contract work is currently estimated to result in 30 acres of permanent rock placement along the American River.

LAR Contract 4A

Lower American River Contract 4A levee work would be conducted on the “river-right” (facing downstream) bank of the Lower American River near RM 2.0 upstream of the State Route (SR) 160 bridge. To reduce the risk that high-velocity flood waters could scour the levee around the SR160 bridge piers and destabilize the levee, a berm is proposed upstream of the bridge to deflect high-velocity flood waters away from the levee slope. The berm would be armored with rock slope protection (RSP) to prevent erosion. The Jedediah Smith Memorial Trail near the State Highway 160 bridge would be rebuilt as a new permanent paved bike trail route along an existing dirt maintenance / access road. A section of the bike trail would be built along an elevated berm, with an elevation increase from 22 ft to 28 ft, North American Vertical Datum of 1988 (NAVD88) this increase in elevation would create a barrier to fish movement during periods of high water. The berm would enclose approximately five acres of floodplain to form a small basin that would not drain to either the river or wetland along the levee. Based on average flows, this area would be inundated once every nine years.

American River Mitigation Site (ARMS)

ARMS is the current proposed mitigation site to offset project impacts on the American River. ARMS is an approximately 120-acre site located between RM 1.0 and RM 1.6 in the American River Parkway, purchased by USACE for mitigation. ARMS is being designed to consider historical and existing conditions to restore, enhance, and maximize habitat for salmonids. The design will restore up to 66 acres of salmonid habitat and will function as a backwater channel that fills through a single inlet from the main river channel located at the southeast limits of the site (Figure 1). Habitat benches will be incorporated into the backwater channels to provide shallow water habitat for juvenile salmonids at various water surface elevations. The benches will be continuous with gradual slopes and a positive gradient toward the main river channel to reduce stranding risks as water recedes. Site design will create backwater floodplain habitats, remove existing non-native vegetation, incorporate instream woody material, and improve connectivity to the main river channel. Excavation would be required to provide connection to the main river channel. The import of material and grading to fill the mining pit in the floodplain is necessary to cover existing debris (e.g., concrete, rip rap) and improve rearing habitat for salmonids by reducing inundation depths and establishing elevations that provide an opportunity for wetland and riparian vegetation to establish and naturally recruit.

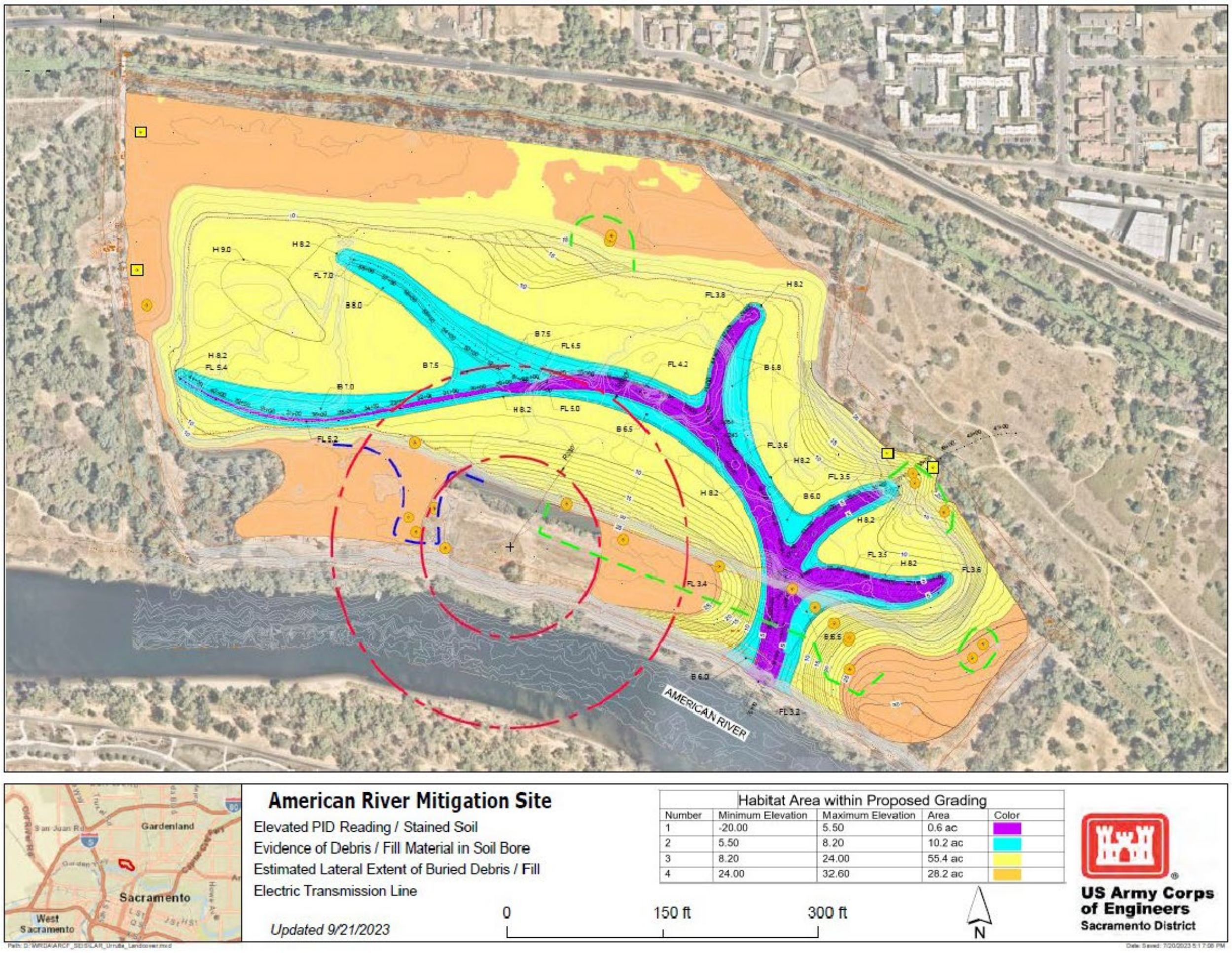


Figure 1. Proposed American River Mitigation Site Design

ARMS Construction Schedule and Sequencing

Construction is anticipated to begin in 2025 and continue through 2028. Work would typically occur between 7 am and 6 pm Monday through Saturday. Occasional night work may occur. In-water work in the American River main channel, not including areas of the man-made pond behind the river embankment, would occur within the proposed in-water work window for the proposed action. Most channel and riparian features would be completed before the river-right bank is breached to minimize any turbidity impacts on the river. Filling and grading within the existing man-made pond would include partial or complete dewatering to control water during fill operations and may require use of temporary cofferdams or inflatable bladders. A turbidity curtain and/or temporary sheet piles would be installed prior to making the hydrologic connection with the river. Revegetation would occur in the spring, after construction is complete as early as 2026. Demobilization and cleanup would complete the construction phase.

ARMS Access, Haul Routes and Staging Areas

Access and haul routes will be on the water side of the levee and below the OHWM. They will only be used while the site is in the dry. Staging areas onsite would be subject to strict containment and spill prevention best management practices (BMPs) to avoid Stormwater Pollution Prevention Plan (SWPPP) violations. Once work is complete, staging areas would be returned to their initial conditions or planted with native vegetation to provide additional habitat.

ARMS Operations and Maintenance

The short-term and long-term success criteria, performance criteria, management, operations, and maintenance are under development. A habitat management plan incorporating these standards will be prepared in coordination with project partners and Resource Agencies. Then that plan will be used to update the relevant operations and maintenance manuals. If there is an anticipated effect to listed species related to these activities, a new consultation will be initiated at that time.

1.3.1.3 Sacramento River

USACE reports that levees along the Sacramento River need improvements to address seepage, stability, and erosion to be addressed through cutoff walls, slope stability work, and intermittent height improvements. Construction is proposed for contracts 3 and 4 on the Sacramento River. Section 1.3.3 of the 2021 NMFS opinion describes the designs for these locations. Sections 1.3.9 to 1.3.11 of the 2021 NMFS opinion describe the construction process, staging, equipment, vegetation planting installations, demobilization, rehabilitation and cleanup. Erosion contract 3 is described below, contract 4 remains unchanged from the description in the above referenced sections of the 2021 NMFS opinion. Impacts related to contract 4 are estimated to be approximately 4 acres.

SR Erosion Contract 3

Sacramento River Erosion Contract 3 includes three sites totaling 2.8 miles between river miles (RMs) 47.3 and 53.1 in Sacramento's Pocket neighborhood. The planned erosion protection method for each site includes placement of rock revetment on the river-left (facing downstream or east) riverbank to prevent erosion and possible failure of the levee protecting the adjacent Pocket neighborhood. The construction method, materials, equipment, access, staging footprint, and effects to listed species have not changed since the 2021 NMFS opinion. However, the 2021 opinion assumed that Sacramento River Erosion Contract 3 construction would occur in 2023 and 2024, this is no longer the case. The two northern sites are anticipated to be constructed in 2025, and the southern site is anticipated to be constructed in 2026. Tree clearing (completed through a separate service contract) would occur during the fall or winter prior to the relevant site's construction season.

Sacramento River Mitigation Site (SRMS)

The Sacramento River Mitigation Site would be constructed on approximately 200-acres at Grand Island, located near Sacramento RM 15 and the confluence of Cache and Steamboat Sloughs. Habitat mitigation improvements would include breaching the existing perimeter berms, grading to create channels, stabilizing bank protection, and vegetation planting (Figure 2).

The site is currently anticipated to generate up to 20 acres of habitat for salmonids and sturgeon. Breaching the berms would allow surface water to flow through constructed channels for tidal wetland habitat. Channels would be designed for tidal circulation to improve food production in the wetland. Revegetation would include a palette of native trees, shrubs, grasses, and aquatic vegetation. Aquatic vegetation would include native submerged and emergent wetland plants. The wetland habitat would provide sheltered slow-moving water, shade, food, and cover for salmonids. The wetland design will incorporate habitat features with the intent to limit the possibility of fish stranding during low water circumstances.

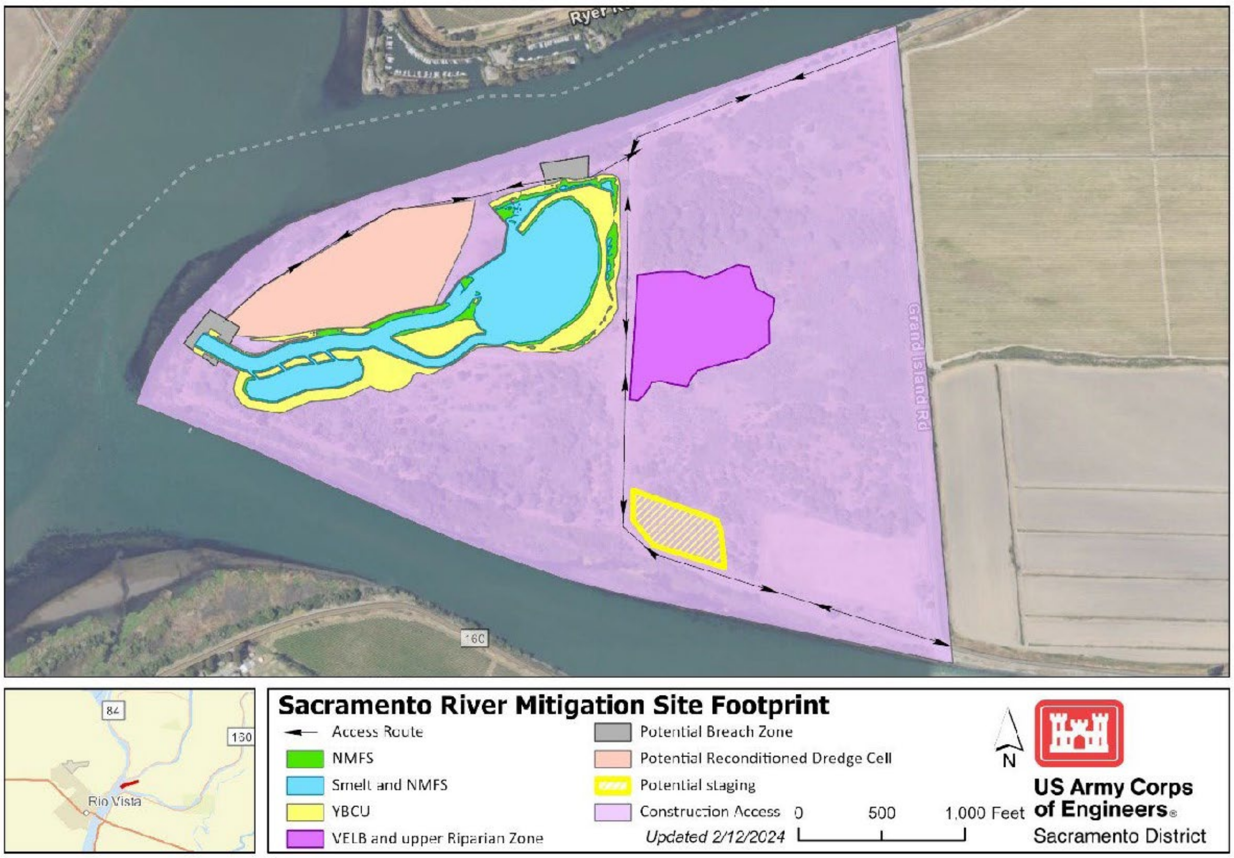


Figure 2. Sacramento River Mitigation Site Design

SRMS Construction Schedule and Sequencing

SRMS would be constructed over two construction seasons in 2025 and 2026, with revegetation to occur after site contouring is complete. Wetland vegetation would be planted and established for several months prior to breaching the berms to the adjacent water bodies. Work would typically occur between 7am and 6pm Monday through Saturday; however, work times may be extended, including potential occasional night work. A balanced cut-fill design for the wetland (excavation) and riparian habitat (fill for terracing) is an objective to minimize transport of fill, greenhouse gas production, and cost. The construction area is enclosed by a high berm, separating it from water in the adjacent sloughs. Vegetation grubbing and tree removal may occur prior to May. In-water work for aquatic beneficial use features along the outside perimeter of the sites and opening the berms to connect the wetland habitat to the adjacent waterbodies would be permitted within the proposed in-water work window for the proposed action. Demobilization and cleanup would occur in October and November of each year after construction is complete. The staging areas, landside berm slope, and any other bare earth areas would be reseeded with native grasses and forbs to promote revegetation and minimize soil erosion. Any roads or other access areas damaged by construction activities would be fully repaired and restored to preconstruction condition. Trash, excess construction materials, and construction equipment would be removed, and the site would be left in a safe and clean condition.

SRMS Access, Haul Routes, and Staging Areas

Site access and haul routes would be via Grand Island Road and maintenance roads within the site. Some work such as tree trimming, minor grading, paving, and adding aggregate may need to be done along the haul routes to allow access to the site. The staging areas would be located within the site boundary. Staging areas would be fenced and would have security lighting. Staging areas would be used for material stockpiles, construction office and trailers, construction worker vehicle parking, and equipment staging. Haul traffic may also pass through staging areas. Waterside staging areas would be subject to strict containment and spill prevention BMPs to help avoid SWPPP violations. Once work is complete, staging areas would be returned to their initial conditions or planted with native vegetation to provide additional habitat.

SRMS Operations and Maintenance

The short term and long-term success criteria, performance criteria, management, operations, and maintenance are under development. They will be determined in coordination with project partners and Resource Agencies to draft a habitat management plan that is site specific. Then that plan will be used to update the overarching O&M manuals. If there is an anticipated effect to listed species related to these activities, ESA section 7 consultation will be reinitiated at that time.

1.3.1.4 Additional Ongoing Activities

Additional actions which have been ongoing and anticipated to continue are listed below along with the relevant section in the 2021 NMFS opinion which describe these proposed actions:

- Utility relocation (1.3.5)
- Stormwater pollution prevention (1.3.6)
- Geotechnical explorations (1.3.7)
- Borrow sites and haul routes (1.3.8)
- Operations and Maintenance (1.3.12)

1.3.1.5 Mitigation and Compensation

Ongoing actions that will continue to occur related to mitigation and compensation to offset impacts of the project are listed below, along with the relevant section in the 2021 NMFS opinion which describe those actions:

- Green sturgeon habitat mitigation and monitoring plan (1.3.13)
- Green sturgeon study (1.3.14)
- Riparian Habitat Mitigation Site Maintenance (1.3.16)

Compensatory Mitigation

In addition to the above-mentioned on-going mitigation and compensation, USACE proposes to incorporate compensation for shaded riparian aquatic (SRA) habitat losses either by project constructed compensation sites (on-site and off-site) or in combination with purchase of credits at a NMFS-approved conservation bank, where appropriate. USACE will construct the ARMS and SRMS restoration locations. The 2021 NMFS opinion established ratios to determine appropriate offset for each acre of impact based on (1) temporal lag in mitigation functionality and (2) proximity of the mitigation site to impacts (2021 NMFS opinion, Section 1.3.17). To address temporal habitat loss, USACE and NMFS agreed upon a ratio factor of one to be added for all permanent impacts if mitigation is not functionally complete concurrent with construction. In considering compensation timing, USACE seeks to avoid exposure of more than one generation of a population with a multiple age class structure (the shortest of which is four years for steelhead). A ratio factor of one will be added for every four years such that functionally-complete mitigation in place prior to construction impacts is credited a 1:1 ratio, within 4 years of construction impacts is a 2:1 ratio, and beyond 4 years is a 3:1 ratio.

These ratios are based on the agreed upon ratios as described in the 2021 NMFS opinion, the locations of the proposed ARMS and SRMS sites, and the current project schedule. USACE will maintain an impact and mitigation ledger and coordinate with NMFS to ensure impacts are offset as proposed. If the timing of impacts and/or mitigation shifts such that a higher ratio would apply, USACE will notify NMFS and provide an updated ledger with ratios based on the most current schedule as well as the proposed form of mitigation to achieve offset (on-site mitigation, off-site mitigation, bank credit purchase, etc.). Impacts are considered to occur at the start of the first construction season. Mitigation is considered complete upon the end of the final construction season for on-site mitigation, or upon 50% complete for offsite mitigation.

Project impacts on the Lower American River will be offset at ARMS at a 2:1 ratio. That is to say, 1 acre of habitat impact on the Lower American River will be considered offset by every 2 acres of restored habitat at ARMS. Impacts on the Sacramento River will be offset at a 1.75:1 ratio with every 1 acre of Sacramento River habitat impact requiring 1.75 acres of restoration at SRMS to offset. Purchase of conservation bank credits may also be used to provide additional offset if needed. Temporal ratios will apply to credit purchases as described above.

1.3.1.6 Conservation Measures

USACE proposes the following sets of minimization measures, including mitigation, to minimize and offset effects of the Updated Proposed Action on federally listed fish species. A number of measures are similar to those included in the 2021 opinion and will be undertaken for the entire project, while other measures may be appropriate at specific locations within the project area. Bold text indicates the changes made from the 2021 NMFS opinion.

Construction Contractor Requirements

1) In-water construction activities will be conducted within NMFS-approved in-water work windows to avoid and minimize effects to critical salmonid life stages (juvenile rearing, and juvenile/adult migration) typically from July 1 through October 31. **In areas below the OHWM but outside of the wetted channel, work may be conducted with the implementation of additional conservation measures described herein.** USACE will request NMFS approval for any in-water work outside this window.
2) USACE's contractors will develop a SWPPP and Water Pollution Control Plan for each construction contract to prevent and minimize soil or sediment from entering the river, including daily inspections of all heavy equipment for leaks.
3) Contract specifications will minimize the removal of existing vegetation to the greatest practicable extent. When feasible, removed, or disturbed vegetation will be replaced with native riparian vegetation.
4) Contractors will stockpile construction materials and portable equipment, including vehicles and supplies, at designated construction staging areas and barges. **No staging will occur below the OHWM.**
5) Contractors will stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 100% containment system **in designated staging areas above the OHWM.**
6) The construction footprint will be limited to the smallest area possible in order to minimize disturbances.
7) To minimize ground and vegetation disturbance during project construction, project limits will be clearly marked, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; **the OHWM for work limits**, and equipment exclusion zones.
8) Contractors will immediately (within 24 hours) cleanup and report any spills of hazardous materials to the USACE, USFWS, NMFS, and California Department of Fish and Wildlife (CDFW). Any such spills, and the success of clean-up efforts, will also be reported in post- construction compliance reports.
9) USACE will designate a NMFS-approved biologist as the point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped fish of a threatened or endangered species. The USACE representative will be identified to Contractor employees during an all-employee education workshop. If lethal take of any ESA listed species occurs, USACE and NMFS will be advised immediately.

General Commitments

1) USACE will provide a copy of the issued opinion or similar documentation, to each prime contractor, making the prime contractors responsible for implementing all requirements and obligations included in these documents and for educating and informing all subcontractors about the requirements of the issued opinion and supplemental documentation related to the opinion such as revegetation plans. A notification that contractors have been informed of this information will be provided to the NMFS. A NMFS-approved Worker Environmental Awareness Training Program for construction personnel will be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program will inform workers of their responsibilities with regard to federally listed fish, their critical habitat, and will provide an overview of the life-history of relevant species, information on take prohibitions, protections afforded these animals under the ESA, and an explanation of the relevant terms and conditions of the operative opinion. Written documentation of the training shall be submitted to NMFS within 30 days of the completion of training.
2) USACE will coordinate construction activities with appropriate hatcheries to suspend in-water work for two (2) days following upstream Chinook releases.
3) Acoustic fish monitoring will be conducted at ARCF sites pre-construction, during and post- construction when feasible. For erosion prevention features along the Sacramento River, USACE plans to conduct telemetry monitoring of green sturgeon for 3 years post-construction. Acoustic telemetry will be conducted in the ARCF action area and will include staff monitoring of real-time telemetry data available online.

Additional Measures to Reduce Fisheries Impacts

1) A qualified biologist will be on-site during all construction activities that occur below the OHWM to monitor construction activities and listed fish.
2) Soil disturbance below the OHWM but outside of the wetted channel will be held to the minimum necessary to complete project construction and will be mitigated by application of BMPs, transplanting of elderberry shrubs, or revegetation efforts.
3) Vegetation clearing undertaken below the OHWM and outside of the in-water work window will not include removal of root wads, stumps, or other debris that may significantly disturb the soil to minimize the risk of turbidity and erosion related effects.
4) All trees and shrubs requiring removal will be felled away from the water and debris will be collected without soil disturbance and will be processed outside of the OHWM.
5) Heavy equipment will not be operated within 15 feet from the wetted channel. All vegetation clearing within 15 feet of the wetted channel will be conducted with hand tools.
6) Prior to processing (e.g., bucking, chipping), any cleared vegetation originating below the OHWM will be lifted, not dragged, to above the OHWM to designated staging areas a minimum of 25 feet away from the wetted channel to minimize the influx of vegetation debris into the wetted channel.
7) To avoid any injury or harm to fish caused by extreme sounds, noise or vibration which may be transmitted through water from construction related equipment, the following measures will be implemented when work is conducted below the OHWM and outside of the in-water work window:

a. The Sound Exposure Level (SEL) from the Project will not exceed 187 dB (re: 1 $\mu Pa^2 \bullet sec$) in any single event, measured at a distance of 32.8 ft from the source. Maintaining this SEL cap ensures that acceptable thresholds for avoidance and minimization of harm are not exceeded.
b. The peak sound pressure level, as a result of Project construction, will not exceed 203 dB (re: 1 μPa peak) in any single strike, measured at a distance of 32.8 ft from the source.
c. 200 feet or greater distance from the wetted channel shall be maintained during placement of riprap below the OHWM outside of the in-water work window.

1.3.1.7 Sacramento Weir and Fish Passage Facility

Construction at the Sacramento Weir began in 2023 and will be on-going through 2027. Section 1.3.4 of the 2021 NMFS opinion details the action which includes a new fixed-crest passive weir structure north of the existing Sacramento Weir, setting back the Sacramento Bypass north levee approximately 1,500 feet, a new bridge over the weir on Old River Road, a fish passage structure, a levee embankment between the existing weir and new passive weir, realignment of County Road 124, and removal of the railroad embankment.

Updates to the Sacramento Weir and Fish Passage Facility construction proposed action are limited to changes in the proposed work window. To accommodate completion of construction within three seasons, USACE proposes an April 1 to November 30 work window for work below the OHWM but outside of the wetted channel. This work would include pile driving of 20-inch diameter steel pipe piles, excavation, and heavy equipment usage up to the edge of the active channel (not in-water). In-water work, including the dewatering and cofferdam installation will occur June 1 to November 31. Construction near the wetted channel is expected to mainly occur in late 2025 through 2026.

1.3.1.8 Sacramento Weir Operations and Maintenance

The Proposed Action related to Sacramento Weir operations and maintenance (O&M) includes features to increase adult fish passage and reduce fish stranding. The intent of widening the Sacramento Weir is to limit flood stages to the Sacramento River's floodplain, allowing maximum use of the Sacramento River Channel flood capacity downstream of the weir. Adverse effects of the weir may result in fish becoming stranded in the Sacramento Bypass. Enhanced fish passage through the Bypass area will provide a hydraulic pathway to facilitate the safe navigation of adult fish from the Sacramento Bypass to the Sacramento River. Additionally, there is potential for juvenile fish to migrate from the river down through the bypass. This section describes the O&M procedures for the fish passage. Operations and maintenance will be the responsibility of the project's non-federal sponsor, the California Department of Water Resources (DWR).

The new fish passage has four major parts: 1) fish passage structure, 2) exit gate structure allowing fish to return to the Sacramento River, 3) fish passage channel, and 4) bypass transport channel (BTC), plus a drain channel from the existing stilling basin (Figure 3). The fish passage structure consists of a flow control structure and fish ladder. The flow control structure bifurcates incoming flow from the Sacramento River into two concrete channels – the fish ladder and the concrete fish passage channel – and provides a common exit for fish passing upstream out of the Sacramento Bypass en route to the Sacramento River. The flow control structure has two flow control gates: one for the fish ladder and one for the concrete fish passage channel. The fish ladder has 16 pools ranging from 18 to 30 feet in length, separated by single slot baffles with orifices. The fish passage channel portion of the flow control structure has seven single, center-slot baffles.

Downstream of the flow control structure, the concrete fish passage channel transitions into a trapezoidal channel lined with grouted rock slope protection. The stilling basin for the new widened weir drains into the concrete fish passage channel at the downstream end of the flow control structure. The fish passage channel runs parallel to the fish ladder on the north side. The fish ladder and stilling basin flow into the fish passage channel at the entrance pool downstream of the fish ladder. The fish passage channel connects to the bypass transport channel downstream of the combined fish ladder and fish channel. The BTC is a single, earthen, trapezoidal channel that consolidates flows from the fish passage channel and fish ladder to the Tule Canal and interior delta.

A new drain channel connects the stilling basin of the existing weir to the BTC, ultimately draining to Tule Canal. Modifications to the existing stilling basin allow the full length of the existing stilling basin to drain into that new drain channel. The new drain to the existing weir stilling basin is not intended as a fish passage function from bypass to Sacramento River, but only to mitigate stranding in the existing weir stilling basin by providing a reasonable path from the existing stilling basin to the BTC. Once fish enter the BTC, the purpose of the drain channel is complete.

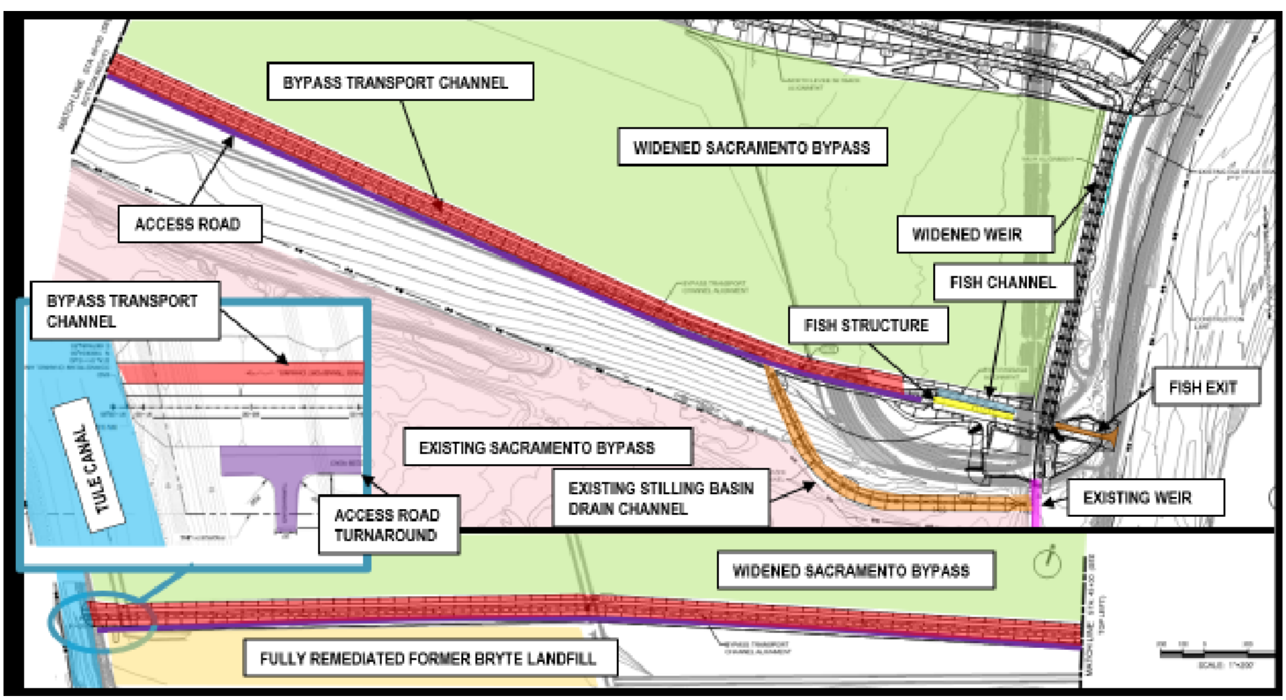


Figure 3. Sacramento Weir Fish Passage Overview

The debris management system upstream of the flow control structure where fish exit into the Sacramento River protects the fish passage structure from floating debris. The debris wall and floating debris barrier guide the flow of debris around the exit channel in two directions, either back to the Sacramento River or over the existing weir into the bypass. The retaining wall would primarily be used for access by DWR maintenance crews to reach the fish structure exit for cleaning and maintenance. The overall debris management system helps limit the volume of debris that can accumulate at the fish passage structure exit, helps guide hydraulics to limit fallback of fish when returning to the Sacramento River, and improves access to remove debris when accumulation occurs.

1.3.1.8.1 Normal Startup and Operating Procedure

This section describes the equipment operation for each functional system of this facility. It also provides initial system setpoints based on an operational strategy and summarizes an approach to adaptively manage and improve facility operations over time.

Facility Operational Strategy

In a flood event, the Sacramento River's water surface elevation (WSE) rises, and at 26 feet and higher water spills over the weir, in which flow attracts fish from the bypass, through the passage facility and back into the river. The fish passage structure begins to operate when the hydrograph is on the descending limb of the storm event, and the WSE returns to 27 feet. That elevation triggers the fish ladder gate to begin opening, to allow the gate more opportunity to reach full open by the time the river reaches WSE 26. Opening the fish ladder gate allows water to go down the fish ladder (i.e., fish passage begins to operate).

At WSE 17 feet, the fish passage channel gate opens and spills water into the fish passage channel. Both the fish ladder and fish passage channel operate between WSE 17 feet and 14 feet. At WSE 14 feet, the fish ladder gate closes and only the fish passage channel gate remains open until WSE 10 feet. When the WSE reaches 10 feet the fish passage channel gate closes, and operation of the fish facility is completely shut down until the next triggering storm event. There are other scenarios that trigger facility shutdown such as the end of known ESA listed fish migration, downstream impacts, and agriculture summer operations. Gates close on May 31 each year regardless of WSEs. Except for summer closure, other closure scenarios require communication between DWR flood maintenance and operation staff and Central Valley Flood Operations during every event to determine the right operational strategy to close the gates.

In the event the WSE in the Sacramento Bypass is greater than the WSE in the Sacramento River, both gates in the flow control structure would be closed to prevent water from flowing backward (from the Sacramento Bypass into the Sacramento River). Flow would be prevented from flowing backward when the WSE in the Sacramento Bypass is below the weir crest elevation (EL) 26.0. At WSEs in the Sacramento Bypass above EL 26, water would flow freely over the Sacramento Weir, from the Sacramento Bypass, into the Sacramento River.

The WSE downstream of the fish passage structure is controlled by the WSE in the Sacramento Bypass, in the Yolo Bypass, in Tule Canal, or the BTC, depending on the hydraulic conditions downstream of the fish passage structure. The facilities are designed to provide passage between WSEs 26 feet and 10 feet in the Sacramento River when the downstream WSE is controlled by the BTC. The downstream WSE will be higher when the elevation is controlled by the Sacramento Bypass, Yolo Bypass, or Tule Canal. In the event this occurs, fish would be able to volitionally pass between the Sacramento River and Tule Canal more easily because most of the passage structure would be submerged and the velocities relatively reduced. Given that the purpose of the structure is to provide passage and avoid stranding, the flow regime in this situation would not pose a specific issue.

The fish passage flow control gates either operate fully open or fully closed, they do not operate partially open. The gates are controlled by a stream gauge, a wall-mounted pressure transducer, which is at the upstream side of the fish passage structure gates, on the south retaining wall just outside (east of) the fish passage structure. The currently installed gauge north of the existing weir will be replaced with a new gauge (bubbler) to serve as a backup gauge for fish ladder operations in case the main gauge malfunctions. Both gauges are connected to the supervisory control and data acquisition (SCADA) system.

For safety reasons, the initial operation of the gates must be triggered by an operator. Once a WSE 27 feet has been reached on the descending hydrograph, the signal from the pressure transducer gauge triggers the SCADA system to send an alarm for the operators. The alarm is accompanied by a dialog box asking the operators if they wish to initiate fish passage operation. The operators would perform an in person, visual security check that no one is downstream of the fish ladder or fish passage channel, or within the BTC. When operators confirm the channels are free of any significant obstruction to operation or human presence, the operators must push the button on the human interface (HMI) screen to initiate the otherwise automatic operation of the fish passage gates. Once initiated, automated fish passage operation starts with the sounding of the alarm tower siren, followed by the opening of the fish ladder gate. The fish passage channel gate opens automatically when the desired WSE is reached. The security check takes place when the fish passage structure starts up for the first time during a storm event. Shutdown will take place automatically when the set WSEs are reached. For safety reasons, the gates will have full lockout-tagout capability to prevent inundation of workers or equipment downstream due to inadvertent gate operation.

Facility Seasonal Start-Up

Prior to annual readiness of the facility (October 1 of each year), all pre-season activities will be completed as follows:

- Adaptive management measures are implemented as determined through the cooperative decision-making process.
- The O&M Manual for this facility is updated and revised in accordance with staff changes, lessons learned, facility modifications, or recommendations arising from an adaptive management process, as deemed necessary by DWR.
- Any training necessary for new staff is accomplished.

- Verify all facility equipment is maintained per this manual and conforms to manufacturer's maintenance recommendations.
- All facility equipment has been inspected and functionality tests conducted to confirm that all are in good working order.
- Install Adaptive Resolution Imaging Sonar (ARIS) cameras and acoustic sensors.

Upon completion of the pre-season readiness activities, the facility and all such equipment should be ready to operate as intended during a normal operational mode. Facility start-up will commence on October 1 of each year or thereafter when winter seasonal floods are expected to occur. October 1 was chosen based on historical hydrographs starting in 1983 through 2019. This date may be adjusted if future rain event trends show an earlier or later start. Start-up procedures begin with verifying the gates are in their normal operation position (closed). Once it is verified the gates are closed, the control panel switch will be moved from the OFF position to the REMOTE position, allowing automatic operation to begin upon initiation by the operator at the HMI screen.

Normal Operations

When operating during the flood period (winter months), the facility operational strategy hierarchy on the SCADA is as follows:

1) When the river levels reach a WSE of 26 feet, an alarm will notify the operators that the gates need to be opened soon, which should prompt operators to conduct the security check.
2) Operators will visually verify (in person) that no safety concerns exist prior to opening the gates.
3) When flood waters begin to recede for a period of 30 minutes and WSEs remain below 27 feet, a second alarm will go off that the fish ladder gate needs to be opened. Operators will push a start button on the SCADA to begin automated actuation th ofe fish ladder and fish passage gates. The SCADA system will call the fish ladder gate to open. The receding period will be adjustable by the operator at the HMI screen, to allow for adaptive management of the system.
4) When flood waters recede to WSE 17 feet, a screen notification will appear to inform the operators that the fish passage channel gate is opening. The fish passage channel gate will open automatically.
5) When flood waters recede to WSE 14 feet, the fish ladder gate closes automatically. A notification will appear on the SCADA.
6) When flood waters recede to WSE 10 feet, the fish passage channel gate closes automatically, and the automated fish passage operation ends. A notification will appear on the SCADA, which also indicates the fish passage structure is shutting down.

This operational strategy assumes that Steps 1 through 6 listed above are carried out normally through an algorithm programmed into the local programmable logic controller (PLC) that is interconnected with the various power, communication, and monitoring systems at the facility.

In the case of an ongoing storm event with an oscillating hydrograph, the SCADA system will automatically adjust the fish ladder and fish passage channel gates per the WSE changes. If the WSE is between 27 feet and 17 feet, only the fish ladder gate is open. At WSEs between 17 feet and 14 feet, both gates are open. For WSEs between 14 feet and 10 feet, only the fish passage channel gate is open.

For example, if the WSE is at 13 feet, the fish ladder gate is closed and the fish passage gate is open. A storm event causes the WSE to rise again to 19 feet. The fish ladder gate will open when the WSE reaches 14 feet, and the fish passage gate will close when the WSE reaches 17 feet. If the WSE goes above 27 feet again, the fish ladder gate will close until the hydrograph is on the receding side and falls to WSE 27 feet again, triggering the fish ladder gate to open. In the event the WSE varies between 26 feet and 27 feet during an ongoing storm, the fish ladder gate would remain open. The gates would close if the Sacramento Bypass WSE exceeded the Sacramento River WSE.

1.3.1.8.2 System Equipment and Operating Procedures

This section describes the equipment used to operate the facility, operational modes, and operational procedures.

Flow Control Structure

The fish passage structure is comprised of the flow control structure and fish ladder. Flow through the flow control structure is controlled by two gates: the fish ladder and fish passage channel gates. The gates are the same type of lift gates with different sizes. They are equipped with an actuator for automatic operation. Upstream and downstream of each gate are guide slots for temporary bulkheads to allow the gate area to be dewatered for maintenance or emergency repair. Maintenance platforms, a catwalk, and stairway provide access to the gates.

Gates and Actuators

Both flow control gates are equipped with one actuator per gate for automated operation. The actuators for each gate are identical and independently operable. The gates are vertical lift gates with wheels for manual operation. The actuators are connected to the local PLC, which is connected to the pressure transducers that signal the PLC to trigger the actuators. The PLC is in the utility building south of the fish passage structure

The actuators feature LOCAL/OFF/REMOTE switches and a pendant with OPEN/STOP/CLOSE buttons. Actuator switches are to be locked away when not in use. The pendants plug in near the actuator and are removable. When not in use, store the pendants inside the locked utility building and lock the junction boxes where the pendants plug. The actuators display gate position as a percentage of open. Any gate put in either LOCAL or OFF position, while the system is operating in AUTO mode, causes the gate to be removed from the sequence of control, and the system continues to attempt automatic control with the remaining equipment. When the gate is in the OFF position, it is inhibited from movement both locally and remotely. Gate closing rates are estimated to be a maximum of 1.1 foot per second. The gates can be operated in the following ways, 1) automatic operation, 2) local operation, 3) manual operation. Each operation method is described below.

Automatic Operation
When a gate is in the REMOTE position, the PLC has control and can open and close the gate as required by the logic algorithm. When placed in SCADA AUTO mode, the gates are controlled by the pressure transducers that send the WSE to the PLC.

Local Operation
An electric pendant connection is installed at the gate to allow local gate operation. The pendant itself is stored in the utility building for security reasons. When a gate is in the LOCAL position, the pendant has control and can open and close the gate as required by the operator. The intended use for the pendant is for maintenance.

Manual Operation
Gates are also equipped with a handwheel to manually open and close the gate. To open or close a gate, press the push button (clutch) located in the middle of handwheel and rotate the handwheel until the gate moves to the desired position. Manual operation can also be achieved with a square nut operator and a portable, powered, mechanical valve operator.

Bulkheads

There are two sets of bulkheads: One set of 16-foot-wide bulkheads is provided for four identical bulkhead slots. These bulkheads are provided to isolate the gates and/or each channel (fish ladder and fish passage). There are approximately12 bulkhead panels for both gates (up to 5 panels per slot and 2 spare panels) that are stored adjacent to the utility building when not in use. A second set of 18-foot-wide bulkheads is provided at the fish exit with approximately 5 bulkhead panels (and one spare panel) to isolate the fish passage structure. These panels are stored at the fish exit retaining wall. The bulkheads isolate the channels and/or gates so repair and maintenance for the gates may be conducted in dry conditions. Isolation from the Sacramento Bypass and Sacramento River is provided up to WSE 30.6 feet (about 10-year Sacramento River flood). It is not anticipated that the bulkheads are used during the operational period of the fish structure, as they are designed for static water conditions. The bulkhead panels require manual installation to be lowered into the bulkhead slots. To set the bulkhead panels into the guide slots, a crane needs to be brought to the site. As part of the bulkhead panels, a spreader bar is stored on site. The spreader bar attaches to the crane and picks up the panels and puts them into the slots. Bulkhead panels can only be installed when water is not flowing in the channel. The bulkhead panels can be installed at any WSE in the channel where installation can be performed safely

Fish Passage Channel

The fish passage channel provides egress for adult fish migrating north from the Sacramento Bypass into the Sacramento River when the WSE ranges from 10 feet to 17 feet. The channel begins at the downstream end of the flow control structure. Flows from the flow control structure and fish ladder converge into the fish passage channel and head downstream into the BTC. This will also allow any juveniles migrating south to pass safely. The most upstream portion of the fish passage channel is hardened with grouted rock. At the fish ladder entrance pool, the channel lining is compactable soil, sands, and gravels. The fish passage channel requires maintenance, but no operations activities except for the safety checks.

Bypass Transport Channel (BTC)

The BTC is an open channel that receives and conveys water for about 8,500 feet (1.6 miles) from the confluence of the fish ladder and fish passage channel to the Tule Canal. Most of the BTC is native material with some sections of grouted riprap. The BTC requires maintenance, but no operations activities.

Existing Weir Drain Channel

The existing weir drain channel (EWDC) is an open channel that connects the stilling basin at the north end of the existing weir with the BTC. Gravity drains the stilling basin of the existing weir into the BTC to provide an escape for fish when waters recede. The first 30 feet of the EWDC, following the transition structure, is a grouted riprap reach with a bottom width of 10 feet. Protection of the EWDC side slopes is provided using appropriately sized riprap. The channel invert downstream of the grouted riprap reach consists of coarsened streambed material, including a designed gradation of material from boulders to fines, which is expected to remain stable during high flow events. The EWDC is approximately 1,375 feet long. The downstream end, prior to the confluence with the BTC, is crossed by the proposed access road via a low flow crossing (Arizona Crossing) that includes a downstream cutoff wall and rock apron to prevent degradation. The drain channel to the existing weir requires maintenance, but no operations activities.

Debris Management System

The debris management system prevents floating debris from entering the fish passage structure and is between the Sacramento River and fish passage exit. The debris management system includes several components intended to: 1) protect the flow control gates from incurring damage from impact of large floating debris; 2) help guide floating debris passing down the Sacramento River around the fish passage structure; and 3) reduce the amount of debris that enters the fish passage structure. Features in this system include the debris wall, debris fence, and floating debris barrier. The debris management system requires maintenance, but no operations.

The floating debris barrier operates automatically via buoyancy, moving as the Sacramento River WSE rises and falls. The floating debris barrier is between the east end of the debris wall and the northeast corner of the retaining wall, along the south side of the fish passage exit channel. Periodic visual inspection of the floating debris barrier is needed to confirm it remains in place; large debris may hit the floating barrier disabling its ability to float and providing opportunity for debris to enter the fish passage structure. Debris that accumulates at the floating debris barrier must be removed to protect the facility. The debris can only be removed when it is safe to do so, either during a non-operational period or when the WSE is low enough that equipment access is available.

Power Supply System

Power for the fish passage control structure is provided by grid power. A utility building that houses the electrical gear is located south of the fish passage structure. Power is provided to the gate actuators, via remote motor starters controlled by the local control panel in the electrical building and provides for local operations with a handheld pendant. Power and control wiring are distributed to the fish passage structure via underground conduits to the gate structures, then surface mounted conduit to the various electrical loads on site.

In case of a power outage, a portable generator would be brought to the site by DWR staff and connected to the utility building. Once the generator is connected, staff would need to manually adjust the transfer switch to the generator source, and manually switch back to the utility source once the utility power is available again. Because the site always requires power to properly operate in accordance with design, standby power needs to be provided to the site. In the event of an unplanned loss of grid power, the gates would remain in their positions at the time of power loss. If power is lost outside of the operational period, then operators may operate the gates manually using the handwheel or valve-boss until temporary or permanent power is restored. However, the gates will be closed outside the operational period unless their position is changed by the operators for maintenance purposes. If power is lost while the fish passage facility is operating each gate would stop in a full open, full closed, or partially open position. In such an event, operators would determine how the gate positions may impact the safety of people and infrastructure; and how the position of the gates may impact fish passage performance. If gate positions must be changed for safety, operators would do so manually via the handwheel or a valve-boss.

Instrumentation, Control, and Communication System

The “instrumentation and control system” provides remote observation and control capability. The local PLC acts as the data control platform and communicates via ethernet with all interconnected equipment. Data is transmitted via Ethernet/IP protocol over fiber optic connection and an internet service provider. Information is provided to the PLC via feedback from all integrated equipment and instruments. Instrumentation includes the pressure transducers to measure WSEs. The data monitored on the PLC is the WSE, gate positions, motor status, gate remote status, emergency stop, control power available, and system alarms. The local control in the utility building can override the remote control. In the event data communication via the internet is lost, automated operation of the fish passage facility via the on-site SCADA system will continue.

The WSE for the fish passage structure will be measured at three locations with level transducers. One is at the far end of the fish ladder (fish ladder entrance), the second is at the downstream end of the concrete fish passage channel, and the third is attached to the retaining wall upstream of the fish exit. The stream gauge serves as backup to the fish exit level transducer.

Alarm Systems and Security

Several alarms are provided to let the operators know that something needs attention. Audible and visual hardwired alarms will activate for public notification prior to operation. Headwater and tailwater alarms will indicate when the fish passage structure gates should open and close. Additional alarms will be in place to indicate infrastructure malfunction, loss of power, intrusion, and to indicate when the system is placed in MANUAL or OFF.

Site Access

An access road is necessary to provide ingress/egress for operation and maintenance vehicles and personnel. The access road connects an area for maintenance benches established adjacent to the southern wall of the fish passage structure (east access bench), and at the west end of the fish passage structure (west access bench). The access road is 20 feet wide with 12 inches of compacted gravel over 8 inches of lime modified subgrade. An 18-foot-wide access road over native soil also parallels the BTC from the Tule Canal to the access roads and maintenance benches located near the fish passage structure. The access road and maintenance benches need to be maintained, but do not require special operation activities.

1.3.1.8.3 Scheduled Maintenance Procedure

This section describes scheduled (i.e., preventive) maintenance procedures at the Sacramento Weir fish passage facility. Equipment provided by a manufacturer requires additional inspections per the manufacturer's recommendations. These inspections are not included in this manual and can be obtained from the specific manufacturer operation and maintenance manuals.

Inspection and Maintenance Schedule

The facility inspection and maintenance schedule are in progress documents. Details of required inspection and maintenance activities will continue to be developed as information is received from the construction contractor. DWR would be responsible for all O&M activities. Because of funding and resource limitations, DWR may not be able to complete all maintenance activities annually or on a set rotational basis. DWR's maintenance activities are limited by operational capacity; therefore, maintenance activities are conducted on an as-needed basis. In some cases, maintenance activities may be conducted at an interval of several years to decades, while in other areas maintenance activities are conducted annually or every-couple-of-years, when more frequent maintenance activity is required. Monthly timing described herein is when maintenance activities generally occur. However, these activities may occur outside of these timeframes if work is necessary for continued safe operations or conditions allow. Categories of O&M activities include sediment removal, debris/obstruction removal, upland vegetation management, channel vegetation management, pipe/culvert maintenance, and channel scour repair.

Sediment Removal

Sediment removal will occur at variable frequencies dependent on rate and magnitude of accumulation as well as effects on conveyance and function. Sediment removal at structures such as culverts is anticipated to occur between April-November, while removal from structures including the BTC channel, fish passage structure, and fish passage channel will occur May through October with the option to extend into January based on canal conditions.

Debris/Obstruction Removal

Removal of debris (including trash, flood-deposited woody and herbaceous vegetation, downed trees/branches, and any other human debris) from structures may occur year-round as needed based on inspection. It is anticipated that debris will be removed annually with approximately 10% of channels being cleared every five years.

Upland Vegetation Management

Physical/mechanical treatments for upland vegetation management include mowing, grazing, strip disking, and controlled burning. Mowing would occur annually within the expanded Sacramento Bypass. For the grassland habitat surrounding the wetted BTC, grazing and strip disking would be limited in use or applied in localized situations. These activities may occur from March to December. Herbicide and pesticide application may occur year-round and is expected to be conducted on approximately 20% (1.2 acres) of the grasslands adjacent to the wetted portion of the BTC annually. Woody vegetation removal will consist of trimming, limbing, cutting, and masticating which will occur between May to August with equipment and year-round with hand tools. Woody vegetation removal will typically occur every several years on an as-needed basis with approximately 1 acre of the expanded Sacramento Bypass area expected to be removed annually. Finally, any bulldozing associated with woody vegetation removal will occur as needed between May to November as conditions allow.

Channel Vegetation Management

Channel vegetation management includes the ~6-acre wetted BTC and ~12-acre dry BTC. Aquatic vegetation removal methods include mechanical removal with an excavator or dragline and herbicide/pesticide application. Aquatic vegetation removal will occur on an annual basis, as needed, between May and October. Up to 20% of the BTC area may be cleared annually. Woody vegetation removal will be achieved using trimming, limbing, cutting with hand tools, masticating, and bulldozing. This work will typically occur every several years on an as-needed basis, expected approximately once every 7-12 years. Woody vegetation removal will be limited to May to November with the potential to extend as conditions allow. Work with hand tools may occur year-round. Approximately 10% (0.18 acre) of woody vegetation in the BTC would be removed annually. Herbicide and pesticide application may also be used to remove woody vegetation. Application will be at an as-needed basis to target undesirable plants and will be conducted on approximately 10% of the BTC annually.

Pipe and Culvert Repair and Replacement

Pipe and culvert inspections will occur year-round annually. Repair, replacement, and abandonment would be limited to April to November. Minor repairs may occur year-round. The amount of annual disturbance will vary and would likely be limited in scope and to localized areas estimated at 0.5 acre once every 50 years, or 0.01 acre annually.

Channel Scour Repair

Channel scour repair would only occur near the Sacramento Weir in the Sacramento Bypass and at the BTC outlet at the Tule Canal, between the months of April and November. Repair of dry portions of the BTC and bypass will occur by scraping, disking, filling, leveling, and regrading the ground surface as needed. This work will be conducted approximately every ten years in approximately 10% of the extended bypass and 10% of the BTC (0.06 acres).

Inspection and Maintenance Procedures

Equipment-specific maintenance procedures are summarized below. Preventative maintenance is outlined for the following equipment:

- Fish passage structure, fish passage channel, BTC
- Slide gates
- Bulkheads
- Fish salvage (Section 1.2.3.7.4)

Fish Passage Structure, Fish Passage Channel, BTC, EWDC

Bypass Transport Channel (BTC)
Most of the BTC is native material. Vegetation growth is a primary concern in this area. Removal of vegetation and debris from the structure will be critical for unimpeded fish passage. Sedimentation, erosion, and scour can occur in the BTC. Occasional re-grading of the BTC may be required to address sedimentation, erosion, and scour. Refer to the maintenance outlined under the Access Road section below for proper re-grading techniques. Some parts of the BTC are grouted riprap. The BTC can be maintained and re-graded with native backfill material using equipment positioned on the access road.

Fish Passage Structure
The fish passage structure consists of reinforced concrete with a series of pools, weirs, slots, and ramps that allow fish to swim upstream to reach the Sacramento River. After each flood event, and when the channel is dry, the structures need to be cleaned and debris removed using appropriate equipment. It also may be necessary to remove debris by hand, especially right behind the weirs to prevent damage to the weir walls.

Fish Passage Channel
The fish passage channel is made with grouted riprap. Vegetation removal is the most important maintenance item for unimpeded fish passage. If enough sedimentation occurs that affects the volume or surface elevation of the channel and/or the BTC, it will have to be managed to ensure that the channel maintains appropriate gradient and stranding pools are not present.

Existing Weir Drain Channel (EWDC)

Along the EWDC, an 8-foot-wide by 7-foot-tall, finished opening is planned to facilitate a request by DWR to drive equipment the full length of the existing stilling basin. The skid steer would be able to remove debris and sedimentation from the EWDC.

Slide Gates
Other than periodic cleaning to maintain smooth operation or painting to maintain appearance, no maintenance is required on slide gates. Gates may require occasional cycling to alleviate sticking

Bulkheads
The bulkheads should be inspected annually; overgrown vegetation removed; and bulkheads cleaned of dirt or other obstructive materials. The guide slots for the bulkheads need to be inspected annually to make sure they are free of any obstructions. Slide slots will be cleaned to ensure proper fitting of the bulkheads.

Regular maintenance and cleaning of the fish passage structure is anticipated to primarily occur in the summer and early fall and may require use of the bulkheads. Cleaning of the concrete channels and maintenance of the gates requiring the use of the bulkheads would be focused on periods of low flow in the Sacramento River, when the water depth in the fish passage structure is low enough to allow personnel to work in the wet channel. This equates to about 3 feet of water depth, or Sacramento River WSE 11 feet or less. The flushing method for removing sediment from bulkhead slots would largely be used prior to May 31. In rare instances, flushing may be required after May 31, but would be considered either an emergency situation or uncommon cleaning event. Flushing would raise gates up to 2 feet and allow for flushing to occur for about 30 minutes, but not exceed two hours. The total volume of water expected to be passed during this time would generally be 745,000 gallons or 2.3 acre-feet but may range up to 8.4 million gallons or 26 acre-feet. The overall usage of water would be minimal and the potential for attractant flow for downstream fishes would be negligible. Any water diverted at the upstream end would be protected by a screen of appropriate size and mesh, as identified by NMFS screening guidelines.

The cleaning method is part of the adaptive management required for maintenance of the facility. This approach is expected to be reviewed and modified throughout the life of the facility based on the performance of this cleaning method.

1.3.1.8.4 Fish Salvage

In the event fish salvaging needs to occur after facility operation, it is anticipated that the California Department of Fish and Wildlife (CDFW) will conduct fish salvaging and rescue operations. The salvaging would be conducted through existing and future contracts established between CDFW and DWR, through the U.S. Bureau of Reclamation. CDFW currently and historically has conducted most fish salvaging operations within the Central Valley at weir facilities, including the existing Sacramento Weir.

It is anticipated CDFW will lead a qualified team to perform Fish Handling and Relocation (FH&R) field work. CDFW will safely remove and transport aquatic species from the

Sacramento Bypasses, stilling basins, fish passage structure, fish passage channel, and bypass transport channel to locations upstream or downstream in the Sacramento River or Tule Canal, outside of harm's way. The following are anticipated of CDFW's FH&R Team and DWR Operations and Maintenance:

1) All permitting will be addressed under CDFW's existing authority and within the standard operating procedures as established by CDFW for fish salvage that have been maintained and updated, as needed.
2) DWR will coordinate with CDFW prior to when FH&R is anticipated to be needed. FH&R dates will be established and agreed upon by both entities. This coordination must include lockout tagout to prevent gate operation when workers are downstream.
3) During FH&R efforts, personnel will provide fish transport, net installation, spotting, and other efforts as required to safely relocate aquatic species. CDFW will provide the following personnel dedicated to the FH&R effort:
    a. Able-bodied labor personnel, capable of traversing over varied terrain while carrying buckets or other vessels containing water and aquatic life and weighing up to 50 pounds.
    b. Equipment operators and equipment spotters.
    c. Personnel trained in fish collection, handling, transport, identification, and relocation. Personnel with training deemed inadequate shall not perform FH&R work.
4) CDFW will provide the necessary materials and equipment necessary to perform the FH&R effort. Materials and equipment may include:
    a. Weighted and floated seine nets.
    b. Equipment dedicated to the task of fish transport, 4-wheeled motorized cart with large bucket and aerators, or similar. The purpose of this equipment is to shuttle aquatic life to designated release locations in adjacent river areas.

Fish salvage will be an adaptive management activity. The approach identified herein is expected to be reviewed and modified throughout the life of the facility based on its performance and environmental, regulatory, and other requirements.

1.3.1.8.5 Implement Cooperative Decision-Making Process

This section describes the cooperative process that will be used to make joint decisions and/or recommendations on any modifications to operations and maintenance of the proposed action. Participants, committee structure, and a description of how the process will operate are outlined in the subsequent sections. Success is dependent upon each participants commitment to the implementation of the process outlined herein. All participants recognize that each agency has statutory responsibilities that cannot be delegated, and the cooperative decision-making process does not and is not intended to invalidate the statutory responsibility of any committee participant.

Cooperative Process Participants

The following agencies will participate in the Cooperative Decision-making Process: the USACE, DWR, and NMFS. The U.S. Fish and Wildlife Service (USFWS) and CDFW also have an interest in the proposed action and this cooperative process; therefore, their expertise will be sought where appropriate. These agencies will participate in one of two committees that will drive the cooperative decision-making process: the management committee and the biology committee.

Management Committee

The management committee governs the process. Oversight and administration of the cooperative decision-making process will be the primary responsibility of the management committee. This committee will also be responsible for guiding activities of technical-level staff participating in the biological committee. USACE will chair the management committee with cooperation from DWR. As chair, USACE will receive information and recommendations from the biological committee and make final decisions and/or recommendations regarding proposed annual operations and maintenance activities. The management committee will also lead discussions on inter-basin coordination with other managers of the Yolo Bypass facilities to address facility performance and any adjustments as needed to optimize conditions. Technical experts may be invited to such meetings, but the initiation and coordination of the meetings will be the responsibility of the management committee.

Biology Committee

The biology committee serves in an advisory role to the management committee, with a primary responsibility to provide technical recommendations to the management committee on all NMFS-regulated species issues. Members include USACE, DWR, and NMFS. SAFCA may participate as a non-federal sponsor as needed. Each member will have one voice in the cooperative decision-making process. Participation will not be restricted to one person from each member agency; rather, professional expertise from different backgrounds (e.g., hydrology, engineering, fish biology, and water quality) will be sought. Expertise from outside consultants, agencies, or entities such as USFWS and CDFW will be sought where appropriate. USACE will serve as Chair of the biology committees. This committee will meet annually, each summer, to review monitoring data from the preceding season if data were collected, and the weir operated. During non-operation years when monitoring didn’t occur in the prior season, discussion on anticipated operations, maintenance or other related activities will occur. Additional meetings will be scheduled as needed to evaluate new information required to provide recommendations to the management committee. Monitoring at the fish passage structure while it is in operation will occur up to, but not exceed, five years post-construction.

Annual Reporting

A single annual report will be generated to provide the foundations for the cooperative decision-making process that will include a summary of biological data (if collected), overall progress, and any activity outside of monitoring pertinent to maintaining the performance of the facility as related to fish passage. Annual reports and meetings will only occur when the weir and facility have operated that calendar year. This document will be developed by the management committee prior to implementation. Monitoring and evaluation activities, other necessary operations and maintenance activities (that may impact fish passage performance, positively or negatively) to be accomplished by the next flood season, along with the proposed schedule will be provided. The report is not a comprehensive report of maintenance and operations but focused on aspects related to fish passage. USACE will submit the draft annual monitoring report to the biology committee for review on or before October 1 of each year after the latest overtopping has occurred. The biology committee members will have one month to review the report and submit recommended comments.

1.3.1.8.6 Post Construction Evaluations

The post-construction evaluation period is intended to verify that the as-built fish passage structure reasonably conforms to the design specifications outlined in Section 1.3.4. of the 2021 NMFS opinion. These evaluations are not intended to result in retrofits to the proposed action unless the as-built installation does not conform to the design specifications within a reasonable margin of performance. Three post-construction evaluations will be performed to determine if the fish passage structure is performing as intended: (1) verification that the fish passage structure is installed in accordance with the approved design and that construction procedures are sound; (2) validate hydraulic conditions in the fish passage structure to confirm it is performing as expected; and (3) perform biological monitoring to confirm successful fish passage.

Fish Passage Structure As-Built Conformance

The contractor will be required to ensure incorporation of digital advanced models during construction activities and will perform all modeling in AutoDesk Civil 3D or other modeling software as approved by the Contracting Officer. The contractor will prepare the Working As-built, Final As-built and Shop drawing files for approval. Upon completion of work, the contractor will provide Final As-built Record Drawings, which are the final, complete, fully approved record of actual conditions and elements reflected in the as-built drawings. The Final As-built Record Drawings will be provided to NMFS when available.

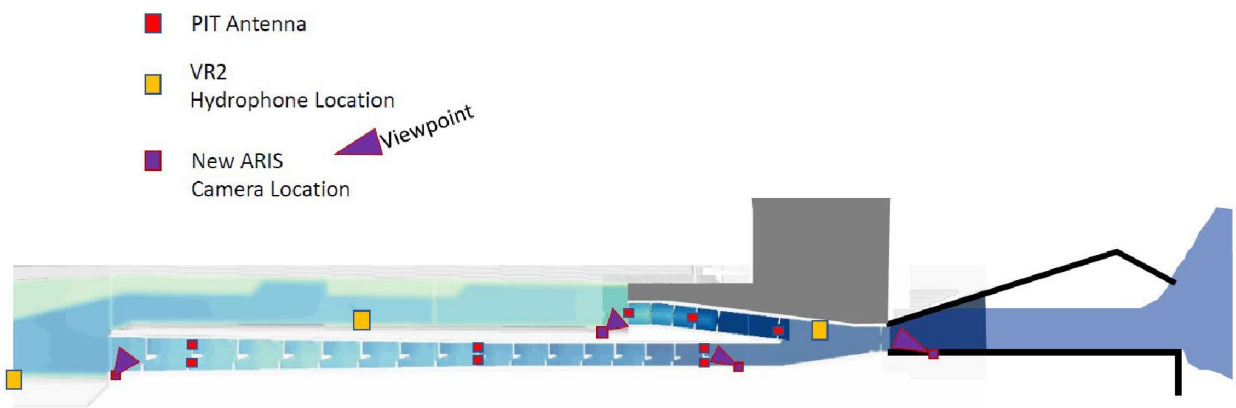
Water Velocity and Depth Validation

Water velocities and depths would be monitored inside the fish passage structure over the two full over-topping events (water stage exceeds 26') and not a 5-year period following post-construction monitoring period as required by the 2020 NMFS opinion (Fisheries Conservation Measure #20). This revision was developed in coordination and under the preference of the NMFS representative biologist and Sacramento weir PDT. The purpose post-construction evaluation is to determine if conditions throughout the fish passage structure are suitable for upstream migration of adult salmonids and sturgeon. It is anticipated that flow velocities and depths would be monitored throughout the structure at a variety of flow levels during operation. All collected data will be processed into a technical memo to characterize findings following the following season.

Fish Passage Monitoring

USACE will implement a fish passage monitoring program to understand the presence, movement, and behavior of fishes moving through and around the fish passage structure and project site. Monitoring will use three technologies, each with its own benefit: acoustic hydrophones, PIT antennas, and ARIS cameras. Data collected using these monitoring techniques will be used to determine if the fish passage structure is meeting the performance metrics defined below. Figure 4 depicts the approximately location of each monitoring component, these locations may be adjusted slightly as required during construction and installation.

Figure 4. Fish Passage Monitoring Components Approximate Locations



Fish Passage Structure Performance Metrics

Specific performance metrics for the fish passage structure may be updated or adaptively modified based on findings of the post-construction evaluations and cooperative decision-making process. The following performance metrics were collaboratively identified with NMFS to establish a baseline for discussion and to highlight the nature, detail, and scope of performance metrics anticipated.

1) Timely passage is important for all species using the facility and will be species specific. Salmonids are anticipated to move efficiently through the system within the course of a day, but sturgeon may take more time or even temporarily hold. Stacking is defined as fish collecting in a specific area and holding for long periods of time (days to weeks). Stacking is not desired and will be monitored for and addressed as needed if it is shown adverse harm was caused to the species.
2) Consistent operation of equipment during monitoring is also key. Semifrequent checks of the Passive Integrated Transponder (PIT) and acoustic telemetry system with dummy tags will be employed to test. Also, imagery checks of the ARIS cameras and adjustment to the image focus/location with motorized mounts will be conducted and documented.
3) Pooling or standing water that may result in stranding is not desired. Upon gates closing and water receding, checks for any pooled water or areas not allowing fish to exit will be

sought out visually. CDFW will report on any stranding issues during their salvage activities as well to the USACE.

4) Poaching is outside the control of the proposed action proponents, but any observed poaching activity will be reported on and addressed by CDFW. The proposed action is generally setup to avoid poaching (signage and limited access) and any unauthorized activity will be considered trespassing and against the law, but if poaching frequency is notable, discussion on actions that may be taken by CDFW or other responsible enforcement entities will occur.

The following post-construction evaluations will be performed to document that the as-built installation of the fish passage structure is meeting the anticipated performance metrics.

Hydrophones

Hydrophones will be deployed to detect acoustic transmitters previously surgically implanted within adult green sturgeon. Currently, Vemco/Innovasea brand transmitters and receivers are deployed in the Sacramento River. A pool of tagged adult green sturgeon currently exists, and further efforts are planned to increase the number of tagged adults associated with other proposed actions. The benefit of the hydroacoustic array is that adults can be detected for long distances (sometimes upwards of 500m or more), transmitters can last for up to 10 years, and detection stations are autonomous and relatively easy to deploy. Up to four locations consisting of approximately 10 receivers are planned to be deployed in the area of the Sacramento Weir fish passage facility, one near the intersection of the Tule Canal and the BTC, one near the Sacramento River entrance to the fish passage facility, and one near the entry of both the fish ladder and fish passage channel. Each location will have a VR2W and HR3 (or equivalent) frequency hydrophones to detect different tag frequency types. The hydrophones will be capable of detecting the presence of individually identified green sturgeon by logging a code ID and a timestamp. Data is downloaded from the hydrophones when accessible and saved to a hard drive for processing. Hydrophones can rapidly be deployed and removed, so it is expected that the units will be installed seasonally if it appears that the fish passage channel will operate.

PIT Antennas

The fish passage facility will be fitted with custom PIT antennas utilizing full duplex scanning technology. PIT transmitters or tags do not require a battery and are very small (9-12 millimeters in length). The tags are energized when they pass into a field created by the detection antennas where they can then transmit their unique identifier code that is associated with a time stamp. The lack of an onboard battery means that the transmitter can last for the life of the fish. Also, due to their small size and relatively inexpensive cost, tags were placed in green sturgeon when they were tagged with the larger (more costly) acoustic tags, mentioned above. In addition, it is common for salmonids to be tagged with PIT transmitters as well, providing benefit for other potential studies on fish movement. Detection antennas are planned to be installed in three locations of the fish passage channel and in three locations of the fish ladder. Since the fish ladder has both orifices and slots for fish passage (i.e., two routes), a total of two antennas for each of the three locations will be deployed (six total). By separating out the orifice and vertical slot pathway detection zones, the exact pathway the fish took can be identified.

All detections will be shared with NMFS and other stakeholders, so that other researchers can be provided with detection information if their tags are identified passing through the facility. Detection antennas will be permanently installed, and all receiver and logging hardware will be housed alongside other electrical equipment in a dedicated closed area. Units will be turned on and activated if the facility begins operation, which can be done from the electrical equipment room.

Acoustic Cameras

Acoustic cameras will be deployed to monitor fish behavior in detail. The ARIS is the most common and readily available device for monitoring during storm conditions. The camera produces an image similar to a high-definition sonogram and records live movement in video format. Cameras use sound to create an image, so the camera can 'see' through turbid water and in the absence of light. Only underwater aeration or excessive movement (i.e., unstable or shaky mount platform) will cause the image to degrade.

The camera will be capable of detecting fish size and movement, but species identification will be challenging. Unless the fish is of moderate size and unique morphology, will it have a chance to be identified to species. Sub-adult and adult sturgeon may meet those requirements but differentiating green from white sturgeon will be difficult.

Cameras are anticipated to be deployed below each fish passage channel, at the top of the fish ladder, and at the entry to the fish passage facility on the Sacramento River side. Continuous footage will be collected and then manually reviewed by a technician where species characterization and behavior can be documented. Camera positioning may be altered with a mechanized rotator if conditions permit (cable length, power source, etc.). Cameras will be housed in cabinets and thus are fixed positions unless substantial modification occurs after the fact. It can be anticipated that cameras will be installed and positioned at the beginning of monitoring and then will not be moved until they are removed. Greater flexibility may occur but will be determined based on engineering and equipment requirements.

Data Collection and Reporting

Monitoring data will be downloaded at an interval that matches logistical feasibility. Hydrophones may be difficult to access during operation and thus only downloaded once after an operational season. PIT antennas and ARIS cameras are anticipated to have electronics readily accessible and, therefore, data can be downloaded weekly or accessed daily, if a situation calls for it. However, safety of staff is paramount and data downloads/collection may not occur until conditions are warranted safe.

Facility Post-Construction Review

Biological performance monitoring will occur over two over-topping events. Monitoring from these events will primarily be used to determine if the fish passage structure is serving its intended purpose and function, safe passage of NMFS-regulated species during operation. To determine if the fish passage structure is performing as intended, performance metrics have been established and the aforementioned post-construction evaluations will be performed. After two overtopping events have occurred, the management committee will review the evaluation data and recommend adjustments to long-term operations and maintenance activities received from the biology committee. If all data from both events confirm that the fish passage structure is performing as intended, post-construction evaluations will be suspended.

The purpose of the fish passage facility is to provide passage for any fish that is present, but is not intended to attract fish or provide a primary pathway for migration. In addition, other managed floodways within the Sacramento River watershed may attract fish by way of flow and velocity pathways, away from the Sacramento Weir Fish Passage facility. As a result, there is the potential for fish to not pass at the facility and lead to no detections of a fish passage event. In the event that no detections occur, but previously described testing shows that equipment is operating appropriately, there will not be any expectation or requirement for a minimum number of fish detection events.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designations of critical habitat for listed species use the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.1.1. Compensation Timing

As described in the proposed action, this project proposed compensation of unavoidable effects to species and impacts to their habitat. NMFS adopts the approach to compensation timing used for the analysis in the 2021 NMFS opinion. Under this approach, the timing for completed compensation should be to target avoiding exposure of more than one generation of a population with a multiple age class structure. Negative impacts extending beyond those years (Green sturgeon: 15 years: Chinook salmon, 5 years: Central Valley steelhead, 4 years) may have additional detrimental effects to the species. Beyond those timeframes, impacts would reduce the species survival and recovery in the wild, or substantially reduce the value of habitat for the conservation of the species, because the adverse effects (reduced growth and survival of individuals) would begin to reduce the number of reproducing individuals across multiple generations. As such, this opinion applies the following maximum timing for completed compensation as general targets for meeting the intended value of offsetting long-term effects of the proposed action:

- Chinook salmon, 5 years

- Central Valley steelhead, 4 years
- Green sturgeon: 15 years

The combination of on-site and off-site mitigation and associated timing included in the proposed action has a substantial portion of mitigation occurring either prior to or concurrent with construction, or immediately following, so as not to surpass the earliest of those targets (steelhead, 4 years).

We expect, with the combination of on-site mitigation, large offsite mitigation, research funding, and with the variety of minimization and conservation measures being implemented, the impacts to species and habitat will be offset over the course of the entire remaining construction timeline, as opposed to having all adverse effects occurring simultaneously, and lag in mitigation execution.

2.1.2. Description of Assumptions Used in this Analysis

For the purpose of the analysis of the habitat being affected by the proposed action, some reasonable assumptions were made for aspects with some uncertainty. One assumption made was due to the uncertainty of final designs for the sites. In coordination with USFWS (whose biological opinion also included riparian mitigation), and after discussions with the USACE, impacts to NMFS species are calculated from the OHWM and below for the purposes of calculating mitigation amounts. While NMFS analyzes all the likely effects of the project (whether above or below the OHWM), it is expected that by calculating the area of impact from the full rock placement (including rock placed at depths that would not generally be utilized by salmonids), that the calculation will be appropriate to provide an estimate of mitigation acreage for USACE's proposed compensation. If at any time this assumption proves to be inaccurate in determining the extent of effects, reinitiation will be required.

Another decision between multiple potential analytical methods for this opinion's analysis is in regards to the calculation of area of impact. For all impacts on banks/levees, NMFS considers the full measure of the actual acreage of impacts measured across the full slope where these effects are occurring. Another method proposed the use of the "lateral extent" of the repairs, which involves calculation of the area of a straight line from the top of the repair, horizontally out into the center of the channel, to the end of the repair. When comparing these methods, the "lateral extent" method ranged in accuracy with results overestimating impact by two to ten times the acres actually being impacted. This method has thus been deemed inaccurate and unacceptable as a form of effects analysis, and will not be used by NMFS as a method of analysis. NMFS will use the actual area of impact to determine habitat effects.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The opinion also examines the condition of designated critical habitat, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated critical habitat, and discusses the function of the PBFs that are essential for the species' conservation.

2.2.1. Sacramento River Winter-run Chinook Salmon

Introduction and Background

The Sacramento River (SR) winter-run Chinook salmon ESU includes winter-run Chinook salmon spawning naturally in the Sacramento River and its tributaries, as well as winter-run Chinook salmon that are part of the conservation hatchery program at the Livingston Stone National Fish Hatchery (LSNFH; 70 FR 37204).

Listing Classification and 5-year Reviews

In 1989, under an emergency interim rule, NMFS listed SR winter-run Chinook salmon under the ESA and classified it as a threatened species (54 FR 32085). This initial classification, as threatened, was reaffirmed in 1990 (55 FR 46515). The species was subsequently up-listed to endangered in 1994 (59 FR 440), and reaffirmed in 2005 (70 FR 37159). In the previous 5-year review, it was recommended that the SR winter-run Chinook salmon should remain listed as endangered (NMFS 2016; 81 FR 33468). Likewise, in the most recent 5-year review for SR winter-run Chinook salmon, NMFS again concluded that the species should remain listed as endangered (NMFS 2024).

Reasons for Decline of the Species

Factors leading to the listing included: (1) the continued decline and increased variability of run sizes since its first listing as a threatened species in 1989; (2) the expectation of weak returns in future years as the result of two small year classes (1991 and 1993); and (3) continued threats to the SR winter-run Chinook salmon. Despite the recent number of habitat improvements, there remain major concerns related to SR winter-run Chinook salmon habitat. Primary among these concerns is the continued lack of access to historical spawning habitats above Shasta and Keswick dams that relegate the species to a single spawning population below Keswick Dam (NMFS 2014). Starting in 2017, efforts were initiated to establish a second population of SR winter-run Chinook salmon in Battle Creek to add to the spatial diversity and abundance of the SR winter-run Chinook salmon ESU (USFWS 2020). Efforts are underway to restore the Battle Creek watershed and reintroduce [winter-run Chinook] salmon to the historical habitats therein (ICF International 2016). Disease and predation are persistent problems that continue to adversely affect SR winter-run Chinook salmon. However, updated information from the USFWS and the LSNFH indicates that the threat of disease may only pose a significant risk to SR winter-run Chinook salmon in drought years where conditions such as low flows and high temperatures in the Sacramento River predominate (Lehman et al. 2022). In addition to the threats of disease and predation, other related factors have emerged, such as invasive vegetation (Conrad et al. 2020) and chronic thiamine deficiency (Mantua et al. 2021), which are understood to negatively affect SR winter-run Chinook salmon survival.

Life History

SR winter-run Chinook salmon are unique to California's Central Valley because they spawn during summer months when air temperatures achieve their yearly maximum. As a result, SR winter-run Chinook salmon require access to reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in summer.

Adult SR winter-run Chinook salmon migrate upstream through the Delta and into the lower Sacramento River from December through July, with a peak in January through April (USFWS 1995). SR winter-run Chinook salmon hold for several months prior to spawning, to reach sexual maturity. Spawning occurs in the mainstem Sacramento River between Keswick Dam (River Mile [RM] 302) and the Red Bluff Diversion Dam (RBDD; RM 243), from late-April to mid-August, with a peak in June and July (Killam 2023). Embryo incubation in the Sacramento River can extend into October (Vogel and Marine 1991).

SR winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past RBDD occurring from July through November (Poytress *et al*. 2014), then continuing downstream through May in some years (Snider and Titus 2000).

Viable Salmonid Population Assessment

The four parameters of the "Viable Salmon Populations" (VSP) described by McElhany *et al.* (2000), are summarized below. For the full current analysis, refer to the most recent Viability Assessment (Johnson *et al.* 2023).

Spatial structure and diversity

The lack of population redundancy in the SR winter-run Chinook salmon ESU is the primary factor contributing to its high extinction risk. The "jumpstart" to the Battle Creek reintroduction efforts initiated in 2017 mark a significant milestone towards the goal of establishing a second SR winter-run Chinook salmon population (ICF International 2016; USFWS 2020), which is a priority recovery action identified in the recovery plan (NMFS 2014a). The most recent returns of 942, 167 and 127 (2020-2022) adult SR winter-run Chinook salmon to Battle Creek are another indication that reintroduction efforts are beginning to take hold (Azat 2023).

Spatial structure also promotes life-history diversity which has been shown to improve the resilience of salmon populations (Schindler *et al*. 2010, Johnson *et al*. 2017). Diverse habitats provide variation in localized temperature and food resources that influences growth and phenotypic diversity (size and timing of outmigration) in salmon populations. Recent work by Phillis *et al*. (2018) suggests that SR winter-run Chinook salmon may rely on more diverse rearing habitats than previously considered (NMFS 1993). In particular this work identifies the influence of non-natal Sacramento River tributaries and the Delta on juvenile rearing and survival (Phillis *et al*. 2018).

During the 2012-2016 drought, LSNFH increased the number of adults used in the supplementation program from a target of 120 adults to 164, 388, 257, 137 in 2013–2016, respectively (Azat 2023). This expanded production resulted in a significant increase in the proportion of hatchery-reared fish that returned to spawn (>80%) in 2017 and 2018 (Killam 2023). By comparison the numbers of natural-origin spawners in 2017 and 2018 were low (153 and 461 individuals), resulting in a significant increase in the relative contribution of LSNFH hatchery-origin fish to the genetic diversity of the population. Hatchery collection of adults was again increased to 191, 298 and 482 to address drought impacts in 2020-2022.
Projects to reintroduce into Battle Creek are on-going while reintroduction to historical habitats upstream of Shasta Reservoir are in the planning and early implementation phases. In the summer of 2020, juvenile salmon were observed in Battle Creek indicating the first successful spawning of winter-run Chinook salmon in Battle Creek in over 100 years. Further, assessments of habitat conditions in the McCloud River and achievable Chinook salmon smolt survival (70%) through the reservoir to Shasta Forebay show promise (Hansen et al. 2017; Hansen et al. 2018). If successful, the establishment of multiple self-sustaining populations of SRWRC would significantly benefit SRWRC.

Abundance and productivity

The abundance of the SR winter-run Chinook salmon ESU has declined during recent periods of unfavorable ocean conditions (2005–2006) and prolonged drought (2007–2009, 2012–2016, 2020-2022) (Johnson *et al*. 2023). The egg to fry survival estimate for brood year 2014 is 5%, which is a significant departure from the average of 26.4% for brood years 2002–2012 measured at RBDD (Poytress *et al*. 2014; Johnson *et al*. 2017). Warm temperatures in both freshwater and ocean ecosystems likely contributed to the low numbers of natural-origin adults observed in 2017 and 2018 (Killam 2023).

Based on the estimates and counts provided in the CDFW “GrandTab” escapement data (Azat 2023), SR winter-run Chinook salmon abundance has declined since 2006 with recent decadal lows of 795 of in-river spawners in 2017. Escapement improved in 2018 - 2021 such that both the current total population size (sum of last three years (2020– 2022); N: LSNFH = 971, Sacramento River = 21,640) and 3-year mean run sizes (Ne: LSNFH = 324, Sacramento River = 7,213) satisfy the low-risk abundance criterion (N > 2500) (Johnson *et al*. 2023).

As stated in Johnson et. al (2023), the point estimate for the 10-year trend in 3-year mean run size is 3.28, suggesting a 3-fold increase in the 3-year average run size over the last 10 years, bolstered by the relatively large escapement in 2019 - 2021 (average run size = 8,603). Although the recent maximum year-to-year decline in population size is 58.8% (2018) does not exceed the catastrophic decline criteria (>90% decline in one generation nor annual run size < 500 spawners)(Lindley et al. 2007), the 2012-2016 drought had a biologically significant effect on annual run sizes for natural-origin spawners in 2017 and 2018 (153 and 461 individuals) which would otherwise place the population at a moderate risk of extinction.

Recovery

On July 22, 2014 (79 FR 42504), NMFS completed the Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead (NMFS 2014a). The recovery criteria includes establishing 3 historical populations to viable status. In the most recent 5-year review for SR winter-run Chinook salmon (NMFS 2024), NMFS identified the most significant impacts to the species' persistence due to natural or man-made factors are those related to drought impacts and hatchery influence. Although complex, and interrelated to many other stressors, the factors of drought and hatchery influence pose an increasing threat to the SR winter-run Chinook salmon ESU.

Drought

Overall, rising atmospheric temperatures have exacerbated an already high evaporative demand in the region such that the region frequently experiences a significant moisture deficit. The moisture deficit results in low-flow and warm water temperatures in the Sacramento River that in turn limits successful spawning, egg incubation, fry development and emergence.

Hatchery Impacts

Hatchery programs can affect naturally produced populations of salmon and steelhead in a variety of ways, including competition (for spawning sites and food) and predation effects, disease effects, genetic effects (*i.e.*, outbreeding depression, hatchery-influenced selection), broodstock collection effects (*i.e.*, to population diversity), and facility effects (*i.e.*, water withdrawals, effluent discharge) (NMFS 2018). And while expansion of hatchery production of SR winter-run Chinook salmon at LSNFH was necessary to address the poor in-river conditions experienced during recent droughts, these actions have continued to affect the ESU (*i.e.*, increased hatchery influence).

Climate Change

Crozier *et al*. (2019) assessed climate change vulnerability for Pacific salmon species where it was found that several factors contribute to the overall ranking of the SR winter-run Chinook salmon ESU as "very highly vulnerable" to climate change. The poor population viability of this single population spawning outside of its historical range was the greatest risk, as the ESU is not thriving under current climate conditions which are expected to worsen.

Sacramento River Winter-run Chinook Salmon critical habitat

Designated critical habitat includes the Sacramento River from Keswick Dam RM 302 to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta); all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco Oakland Bay Bridge from San Pablo Bay to the Golden Gate Bridge. The designation includes the river water, river bottom and adjacent riparian zones used by fry and juveniles for rearing.

As a result of human-made barriers to migration, especially the construction of major dams, SR winter-run Chinook salmon have been confined to lower elevation river mainstems that historically only were used for migration. The greatly reduced spawning and rearing habitat has resulted in declines in population abundance. Additionally, the remaining habitat is of lower quality, in particular because of higher water temperatures in late summer and fall, reduced gravel recruitment, and lack of instream large woody material (LWM).

The critical habitat designation for SR winter-run Chinook salmon lists the essential physical and biological features ((58 FR 33212); June 16, 1993), which include:

1) Access from the Pacific Ocean to spawning areas;
2) Availability of clean gravel for spawning substrate;
3) Adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles;
4) Water temperatures at 5.8–14.1°C (42.5–57.5°F) for successful spawning, egg incubation, and fry development; riparian and floodplain habitat that provides for successful juvenile development and survival;
5) Access to downstream areas so that juveniles can migrate from spawning grounds to the San Francisco Bay and the Pacific Ocean.

The current condition of SR winter-run Chinook salmon critical habitat PBFs have been degraded from their historical condition within the action area. Although there are exceptions, the majority of streams and rivers in the ESU have impaired habitat. Additionally, critical habitat in the ESU often lacks the ability to establish essential features due to ongoing human activities. Water utilization in many regions throughout the ESU reduces summer base flows, which limits the establishment of several essential features, such as water quality and water quantity.

In the Sacramento River and adjacent tributaries, bank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014). SR winter-run Chinook salmon are only able to access large floodplain areas, such as the Yolo Bypass, under certain hydrologic conditions which do not occur in drier years. Levee construction involves the removal of riparian vegetation, resulting in reduced habitat complexity and shading, making juveniles more susceptible to predation. Additionally, loss of riparian vegetation reduces aquatic macroinvertebrate recruitment resulting in decreased food availability for rearing juveniles (Anderson and Sedell 1979; Pusey and Arthington 2003).

Although the current conditions of SR winter-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

Summary

Overall, the SR winter-run Chinook salmon ESU is at a high risk of extinction and will remain as such until additional populations are established. The overall viability of the ESU has been in decline since the 2015 viability assessment (Johnson and Lindley 2016). The spatial structure of the ESU remains limited to the single population found in the mainstem Sacramento River, and the genetic and life history diversity of the ESU may have been negatively affected by the increased hatchery production implemented to address drought conditions. The ESU also continues to face threats from disease; predation; habitat loss, alteration, and degradation; and is particularly susceptible to climate change and drought (NMFS 2024).

2.2.2. Central Valley Spring-run Chinook Salmon

Introduction and Background

In 1999 (64 FR 50394), NMFS listed Central Valley (CV) spring-run Chinook salmon under the Endangered Species Act (ESA) and classified it as a threatened species. This initial classification was reaffirmed in 2005 when the Feather River Fish Hatchery (FRFH) population was added to the ESU (70 FR 37159). Critical habitat for CV spring-run Chinook salmon was later designated in 2005 (70 FR 52488).

Life History

Generally, adult CV spring-run Chinook salmon fish migrate from the Pacific Ocean in a reproductively immature state and swim upstream into fresh water in the spring months (approximately March through June) using olfactory senses to locate their birth waters. The adult fish then hold over summer months (approximately June through September), and spawn in cold freshwater in the early fall months (approximately September through November). Larval fish, also known as 'alevins,' hatch from eggs and emerge from their gravel nests throughout the fall and early winter months (approximately October through December). Juvenile fish then rear and feed in freshwater from late fall through spring (approximately October through June); or may choose to rear for a full year (*i.e.*, October to subsequent October to December), and become 'yearling' juveniles when conditions are suitable.

As juvenile fish rear, they migrate downstream and eventually reach the Sacramento-San Joaquin River Delta, and then the San Francisco Bay estuary. Once juvenile fish have completed the physiological changes necessary to enter saltwater (called smoltification), they enter the Pacific Ocean and rear until adulthood for approximately three to four years, which is typical for Chinook salmon. Once adult fish are three or four years old, they migrate back upstream to freshwater to start the life cycle over again and create the next generation. All Chinook salmon are "semelparous" fish, meaning they reproduce once in their lifetime and then die shortly after spawning.

In general, wetter water years result in higher survival of juveniles out-migrating during the spring of the same year they emerged. In three to four years, the juvenile cohort that experienced wetter outmigration conditions, are more likely to result in a higher abundance of adults returning to freshwater to spawn. Drier water years generally result in low survival during spring outmigration and encourages a subset (roughly 10%) of juveniles to express the yearling life history strategy (Cordoleani *et al.* 2021). This results in a lower number of large juveniles out-migrating to the ocean much later in the year. When the dry condition cohort returns as adults, there are fewer adults because there was less survival during the large spring outmigration. Therefore, the number of adult spawners is likely to be lower from a juvenile cohort that experienced drought conditions in freshwater during their out-migration, in contrast to a juvenile cohort that experienced high river flows during a wet water year while out-migrating.

Viable Salmon Population Assessment

The viability of CV spring-run Chinook salmon has deteriorated since the NMFS 2016 Status Review, with weakening of all independent CV spring-run Chinook salmon populations (Johnson *et al*. 2023). The total estimated abundance of adult CV spring-run Chinook salmon for the Sacramento River watershed in 2019 was 26,553, approximately half of the population size in 2014 (N=56,023). Also, population sizes have hit decadal lows, of ~14,000 individuals recently (Johnson *et al*. 2023).

The CV spring-run Chinook salmon ESU includes all naturally spawned CV spring-run Chinook salmon originating from the Sacramento River and its tributaries (70 FR 37159, June 28, 2005). In 2014, FRFH broodstock was used to actively reintroduce CV spring-run Chinook salmon into the mainstem San Joaquin River as an ESA 10(j) experimental population (NMFS 2013). Since 2019, adults have been observed returning to the San Joaquin River and successfully spawning within the San Joaquin River Restoration Program Restoration Area. There have also been observations of CV spring-run Chinook salmon returning to the San Joaquin River tributaries. This ESU does not include Chinook salmon that are designated as part of the San Joaquin River experimental population (Johnson *et al*. 2023).

Historically, the CV spring-run Chinook salmon ESU was composed of four Diversity Groups: Basalt and Porous Lava, Northwestern California, Northern Sierra Nevada, and Southern Sierra Nevada. Recovery criteria outlined in the NMFS CV salmonid recovery plan (NMFS 2014a) are targeted on achieving, at a minimum, the biological viability criteria for each major diversity group in the ESU in order to have all four diversity strata at viable (low risk) status with representation of all the major life history strategies present historically, and with the abundance, productivity, spatial structure, and diversity attributes required for long-term persistence.

In order to meet the recovery criteria for this ESU and thereby delist the species, there must be at least nine populations at a low risk of extinction distributed throughout the Central Valley, as well as additional core 2 populations.

- One population in the Northwestern California Diversity Group at low risk of extinction
- Two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction
- Four populations in the Northern Sierra Nevada Diversity Group at low risk of extinction
- Two populations in the Southern Sierra Nevada Diversity Group at low risk of extinction

None of the four diversity groups currently meet the number of viable/independent populations at a low risk of extinction needed to meet recovery criteria (Johnson *et al*. 2023).

Spatial Structure and Diversity

At the ESU level, the spatial diversity is increasing and CV spring-run Chinook salmon are present (albeit at low numbers in some cases) in all diversity groups. The reestablishment of CV spring-run Chinook salmon to Battle Creek and increasing abundance of CV spring-run Chinook salmon on Clear Creek observed in some years is benefiting the viability of CV spring-run Chinook salmon. Similarly, the reappearance of early migrating Chinook salmon to the San Joaquin River tributaries may be the beginning of natural dispersal processes into rivers where they were once extirpated. While the spatial diversity expanding is a positive indicator for the ESU, populations have still declined sharply in recent years to in most cases worryingly low levels of abundance.

The ESU is trending in a positive spatial direction towards achieving at least two populations in each of the four historical diversity groups necessary for recovery with the Northern Sierra Nevada region (NMFS 2014a). There have been recent observations of CV spring-run Chinook salmon returning to the San Joaquin River tributaries and creating redds. The ESU does not currently include Chinook salmon that are designated as part of the San Joaquin River experimental population, however strays from Sacramento River populations are part of the Central Valley ESU. Continuing to monitor these populations will provide valuable data to evaluate the status of CV spring-run Chinook salmon in the San Joaquin River and its tributaries. This monitoring would also provide a basis for evaluating whether the ESU boundary should be modified to account for CV spring-run Chinook salmon populations repopulating the San Joaquin River Basin and/or in CV habitats upstream of currently impassable barriers.

Abundance and Productivity
Most Core 2 CV spring-run Chinook salmon populations have been experiencing continued and, in some cases drastic, declines. In 2015, CV spring-run Chinook salmon showed strong signs of repopulating Battle Creek, home to a historical independent population in the Basalt and Porous Lava diversity group that had been extirpated for many decades (NMFS 2016, Johnson *et al*. 2023). Current viability metrics show a significant declining trend (23% decline per year) and low population size (N<250) for the Battle Creek spring-run Chinook salmon population, placing it at a high extinction risk (Johnson *et al*. 2023). Similarly, the CV spring-run Chinook salmon population in Clear Creek, previously identified as increasing in abundance, has experienced recent declines in population size (N=136) down from N=822 in 2015, placing it at a high risk of extinction (Johnson *et al*. 2023). Mill Creek and Deer Creek spring-run Chinook salmon populations reached low population sizes (N=590 and N=956, respectively) placing them at a moderate risk of extinction (Johnson *et al*. 2023). Yet, the low run sizes in consecutive years for Mill Creek spring-run Chinook salmon following the recent droughts (~150 individuals) and precipitous decline (16% over the decade) place Mill Creek at a high risk of extinction using the VSP criteria (Johnson *et al*. 2023). The highest risk score for any criterion determines the overall extinction risk for a given population. Recent declines of population size in all populations have been substantial and almost qualify as catastrophes under the criteria (>90% decline) with the main independent populations of CV spring-run Chinook salmon reaching all-time declines over one generation (Battle Creek = 77%, Butte Creek = 76%, Deer Creek = 84%, and Mill Creek = 68%) (Johnson *et al*. 2023).

Counteracting recent declines in the abundance of adults from dependent populations, CV spring-run Chinook salmon have continued to repopulate areas where they were once extirpated, including Battle and Clear Creeks, and more recently the San Joaquin River. Each of these watersheds have the potential to support independent and viable CV spring-run Chinook salmon populations (NMFS 2014a; Lindley *et al*. 2004). CV spring-run Chinook salmon ESU populations have experienced a series of droughts over the past decade. From 2007–2009 and 2012–2016, the Central Valley experienced drought conditions and low river and stream discharges, which are strongly associated with lower survival of Chinook salmon (Michel *et al.* 2015).

A new emerging threat to the CV spring-run Chinook salmon populations includes thiamine deficiency, which was responsible for early life stage mortality of FRFH spring-run Chinook salmon in the hatchery in recent years, initially being diagnosed in 2019 (Mantua *et al*. 2021). Direct mortality or latent effects that would lead to increased mortality in that cohort would not be able to begin being detected until the dominant age class of 3-year-olds from the affected years return to spawn (starting in 2022), and further data can be analyzed for annual adult escapements to determine further effects on the population and viability. Starting in 2019, significant numbers of juvenile mortalities were observed in the Feather River rotary screw trap, early in the juvenile out-migration season, consistent with thiamine deficiency complex (TDC) observed in the hatchery. In fact, significantly fewer juveniles were observed in 2019 (N=1149) compared to 2018 (N=30,334), and 45% of juveniles in 2019 were found dead compared to 1% observed in 2018 (Johnson *et al*. 2023). It is unclear the extent to which this was a basin-wide nutritional deficiency for all CV spring-run Chinook salmon spawning in 2019.

Central Valley Spring-run Chinook salmon critical habitat

Critical habitat was designated for the CV spring-run Chinook salmon ESU on September 2, 2005 (70 FR 52488). The geographical range of designated critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba, and American rivers; Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks; and the Sacramento River downstream to the Delta, as well as portions of the northern Delta (70 FR 52488).

As a result of human-made barriers to migration, especially the construction of major dams, CV spring-run Chinook salmon have been confined to lower elevation river mainstems that historically only were used for migration. The greatly reduced spawning and rearing habitat has resulted in declines in population abundances in these streams. Additionally, the remaining habitat is of lower quality, in particular because of higher water temperatures in late summer and fall, reduced gravel recruitment, and lack of instream large woody material (LWM).

The critical habitat designation for CV spring-run Chinook salmon lists the essential physical and biological features ((70 FR 52488); September 2, 2005), which include:

1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development,
2) Freshwater rearing sites with: (i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) water quality and forage supporting juvenile development; and (iii) natural cover, such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks,
3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover, such as submerged and overhanging

large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival, and

4) Estuarine areas free of obstruction and excessive predation with: (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The current condition of CV spring-run Chinook salmon critical habitat PBFs have been degraded from their historical condition within the action area. Although there are exceptions, the majority of streams and rivers in the ESU have impaired habitat. Additionally, critical habitat in the ESU often lacks the ability to establish essential features due to ongoing human activities. Large dams, like Shasta Dam on the Sacramento River, stop the recruitment of spawning gravels, which impact both an essential habitat type (spawning areas) as well as an essential feature of spawning areas (substrate). Water utilization in many regions throughout the ESU reduces summer base flows, which limits the establishment of several essential features, such as water quality and water quantity.

In the Sacramento River and adjacent tributaries, bank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014a). CV spring-run Chinook salmon are only able to access large floodplain areas, such as the Yolo Bypass, under certain hydrologic conditions which do not occur in drier years. Levee construction involves the removal of riparian vegetation, resulting in reduced habitat complexity and shading, making juveniles more susceptible to predation. Additionally, loss of riparian vegetation reduces aquatic macroinvertebrate recruitment resulting in decreased food availability for rearing juveniles (Anderson and Sedell 1979; Pusey and Arthington 2003).

Although the current conditions of CV spring-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

Summary

To conclude, the viability of the CV spring-run Chinook salmon ESU has deteriorated since it was listed under the ESA (NMFS 2016, Johnson et al. 2023). The largest impacts are likely due to the 2012-2015 and 2020-2022 freshwater drought conditions and unusually warm ocean conditions experienced by these cohorts. This ESU continues to face significant, unyielding threats that are likely to be exacerbated by the impacts of future climate change. According to the viability report, there has been a decrease in the viability and the ESU remains at a moderate to high risk of extinction (Johnson et al. 2023). The viability of the ESU has decreased, and the threats to the species' persistence remain high and are not improving (Johnson et al. 2023).

2.2.3. California Central Valley Steelhead

Introduction and Background

The California Central Valley (CCV) steelhead DPS includes CCV steelhead spawning naturally in the Sacramento and San Joaquin Rivers and their tributaries, as well as CCV steelhead that are part of the hatchery program at CNFH and FRFH (70 FR 37204).

In 1998, NMFS listed CCV steelhead under the ESA and classified it as a threatened species. In 2006, following the development of NMFS' Hatchery Listing Policy (70 FR 37204, June 28, 2005), we re-evaluated the status of this DPS and determined that the DPS continued to warrant listing as a threatened species. Furthermore, we determined that the CNFH and FRFH stocks of CCV steelhead should be part of the DPS.

CCV steelhead historically occurred naturally throughout the Sacramento and San Joaquin River basins, although stocks have been extirpated from large areas above dams or instream in both basins. In 1988 the California Advisory Committee on Salmon and Steelhead reported a reduction in freshwater CCV steelhead habitat from 6,000 linear miles historically to 300 linear miles of stream habitat.

Life History

CCV steelhead exhibit perhaps the most complex suite of life-history traits of any species of Pacific salmonid. Members of this species can be anadromous or freshwater residents and, under some circumstances, members of one form can yield offspring of another form.

Adult migration from the ocean to spawning grounds occurs during much of the year, with peak migration occurring in the fall or early winter. CCV steelhead generally begin spawning in December, continuing through March/April.

CCV steelhead spawn downstream of dams on every major tributary within the Sacramento and San Joaquin River systems. Due to water development projects, most spawning is now confined to lower stream reaches below dams. In a few streams, such as Mill and Deer creeks, CCV steelhead still have access to historical spawning areas (NMFS 2014a).

Spawning occurs mainly in gravel substrates (particle size range of about 0.2−4.0 inches). Adults tend to spawn in shallow areas (6−24 inches deep) with moderate water velocities (about 1 to 3.6 feet per second) (Hannon and Deason 2007). Unlike Chinook salmon, CCV steelhead may not die after spawning (McEwan and Jackson 1996). Some may return to the ocean and repeat the spawning cycle for two or three years. The percentage of adults surviving spawning is generally thought to be low for CCV steelhead, but varies annually and between stocks. Acoustic tagging of CCV steelhead kelts from the CNFH indicates survival rates can be high, especially for CCV steelhead reconditioned by holding and feeding at the hatchery prior to release. Some return immediately to the ocean and some remain and rear in the Sacramento River (NMFS 2009). Recent studies have shown that kelts may remain in freshwater for an entire year after spawning (Teo et al. 2013), but that most return to the ocean.

CCV adult steelhead eggs incubate within the gravel and hatch from approximately 19 to 80 days at water temperatures ranging from 60°F to 40°F, respectively (NMFS 2009). After hatching, the young fish (alevins) remain in the gravel for an extra two to six weeks before emerging from the gravel and taking up residence in the shallow margins of the stream.

Steelhead embryo incubation generally occurs from December through June in the Central Valley. Steelhead eggs reportedly have the highest survival rates at water temperature ranges of 44.6°F to 50.0°F (Myrick and Cech 2001). A sharp decrease in survival has been reported for O. mykiss embryos incubated above 57.2°F (Kamler and Kato 1983). After hatching, alevins remain in the gravel for an additional two to five weeks while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1986).

The newly emerged juveniles move to shallow, protected areas associated within the stream margin (McEwan and Jackson 1996). Productive juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or boulders. Cover is an important habitat component for juvenile CCV steelhead both as velocity refugia and as a means of avoiding predation (Bjornn and Reiser 1991). Older juveniles use riffles and larger juveniles may also use pools and deeper runs (Barnhart 1986 as cited in McEwan and Jackson 1996). However, specific depths and habitats used by juvenile rainbow trout can be affected by predation risk. An upper water temperature limit of 65°F is preferred for growth and development of Sacramento River and American River juvenile steelhead (NMFS 2014a).

Most juvenile CCV steelhead spend one to three years in fresh water before emigrating to the ocean as smolts (Shapovalov and Taft 1954). The primary period of CCV steelhead smolt outmigration from rivers and creeks to the ocean generally occurs from January to June (NMFS 2009). CCV steelhead successfully smolt at water temperatures in the 43.7°F to 52.3°F range (Myrick and Cech 2001). In the Sacramento River, juvenile CCV steelhead migrate to the ocean in spring and early summer at one to three years of age with peak migration through the Delta in March and April (Reynolds 1993).

CCV steelhead Viability Status Assessment

Good *et al.* (2005) found that the CCV steelhead DPS was in danger of extinction, with a minority of the Biological Review Team (BRT) viewing the DPS as likely to become endangered. The BRT's major concerns were the low abundance of natural-origin anadromous *O. mykiss,* the lack of population-level abundance data, and the lack of any information to suggest that the decline in CCV steelhead abundance evident from 1967–1993 dams counts had stopped.

Using data through 2005, Lindley *et al*. (2007) found that data were insufficient to determine the viability of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The proportion of hatchery-origin fish in the Battle Creek returns averaged 29% over the 2002–2010 period, elevating the level of hatchery influence to a moderate risk of extinction. The Chipps Island midwater trawl dataset of USFWS indicated that the decline in natural production of CCV steelhead had continued unabated through 2010, with the proportion of adipose fin-clipped steelhead reaching 95%. In 2015, population trend data showed significant increases in abundance of CNFH and FRFH populations, but data are still lacking to estimate trends in natural populations.

The Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014a) includes biological recovery criteria based on the viable salmonid population concept. The Central Valley Salmon and Steelhead Recovery Plan includes the following recovery criteria:

DPS level criteria:

- One population in the Northwestern California Diversity Group at low risk of extinction
- Two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction
- Four populations in the Northern Sierra Diversity Group at low risk of extinction
- Two populations in the Southern Sierra Diversity Group at low risk of extinction
- Maintain multiple populations at moderate risk of extinction

In order to meet the recovery criteria for this DPS and thereby delist the species, there must be at least nine populations at a low risk of extinction distributed throughout the Central Valley as outlined above, as well as additional populations at a moderate risk of extinction (NMFS 2014a). Currently, no CCV steelhead populations satisfy the low extinction risk criteria. For the 17 populations evaluated, 11 are at high extinction risk and 6 are at moderate extinction risk. The Battle Creek population is considered at Moderate risk of extinction (Johnson *et al*. 2023).

Abundance and Productivity

Population trend data remain extremely limited for the CCV steelhead DPS. The total hatchery populations from CNFH, FRFH, and MRH have significantly increased since the 2010 and 2015 viability assessments. In fact, CNFH returns have steadily increased 15% per year over the last decade.

The American River steelhead population has experienced a precipitous decline since 2003, resulting in a moderate risk of extinction. It should be noted that a significant proportion of steelhead redds on the American River are made by NH steelhead, which are not part of the DPS, and declined 8% per year over the last decade.

Looking broader than the individual population level, Chipps Island midwater trawl data provide information on the trend in abundance for the CCV steelhead DPS as a whole. Updated through 2019, the trawl data indicate that the production of natural-origin steelhead remains very low relative to hatchery production. The lack of improved natural production as estimated by juvenile migrants exiting the river systems at Chipps Island, and low abundances coupled with large hatchery influence is cause for concern.

Catch-per-unit effort has fluctuated and generally increased over the past decade, but the proportion of the catch that is adipose fin-clipped (100% of hatchery steelhead production have been adipose fin-clipped starting in 1998) has increased steadily, exceeding 90% in recent years and reaching 96% during the drought in 2015. This suggests that the vast majority of CCV steelhead out-migrating from the Sacramento-San Joaquin Delta (Delta) are of hatchery-origin.

Spatial Structure and Diversity

This DPS includes CCV steelhead populations spawning in the Sacramento and San Joaquin rivers and their tributaries. Populations upstream of migration barriers remain excluded from this DPS. Hatchery stocks within the DPS include CNFH, FRFH, and Mokelumne River Hatchery (MRH). Genetic analysis showed that the steelhead stock propagated in the MRH was genetically similar to the steelhead broodstock in the FRFH (Pearse and Garza 2015), consistent with documentation on the recent transfers of eggs from the FRFH for broodstock at the MRH. The Nimbus Hatchery (NH) steelhead remain genetically divergent from the Central Valley DPS lineages, consistent with their founding from coastal steelhead stocks, and remain excluded from the DPS (Pearse and Garza 2015).

As overall data remain extremely limited for the CCV steelhead DPS, it is difficult to ascertain if their spatial distribution has changed. From recent monitoring data, steelhead are not noted to have had any substantial changes in spatial distribution or diversity. Hatchery influence continues to be a high threat to diversity of the DPS, and the out of basin stock at Nimbus Hatchery poses significant genetic threat to CCV steelhead (Johnson *et al*. 2023).

California Central Valley steelhead critical habitat

On February 16, 2000, (65 FR 7764), NMFS published a final rule designating critical habitat for CCV steelhead. This critical habitat includes all river reaches accessible to listed CCV steelhead in the Sacramento and San Joaquin rivers and their tributaries in California. NMFS proposed new Critical Habitat for CCV steelhead on December 10, 2004, (69 FR 71880) and published a final rule designating critical habitat for these species on September 2, 2005.

Critical habitat for CCV steelhead includes stream reaches, such as those of the Sacramento, Feather, and Yuba Rivers; Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries; and the waterways of the Delta. Currently, the CCV steelhead DPS and critical habitat extends up the San Joaquin River up to the confluence with the Merced River. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line.

The critical habitat for CCV steelhead lists the essential PBFs ((70 FR 52488); September 2, 2005), which include:

1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development,
2) Freshwater rearing sites with: (i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) water

quality and forage supporting juvenile development; and (iii) natural cover, such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks,

3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival, and
4) Estuarine areas free of obstruction and excessive predation with: (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Historically, CCV steelhead spawned in many of the headwaters and upstream portions of the Sacramento River and San Joaquin River basins. Passage impediments have contributed to substantial reductions in the populations of these species by isolating them from much of their historical spawning habitat. The current condition of CCV steelhead critical habitat PBFs have been degraded from their historical condition within the action area. The majority of streams and rivers in the DPS have impaired habitat. Additionally, critical habitat often lacks the ability to re-establish essential features due to ongoing human activities. Water utilization in many regions throughout the DPS reduces summer base flows, which limits the establishment of several essential features such as water quality and water quantity.

Freshwater rearing and migration PBFs have been degraded from their historical condition within the action area. In the Sacramento and San Joaquin rivers, bank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014a). Similar to SR winter-run Chinook salmon, CCV steelhead are only able to access large floodplain areas, such as the Yolo Bypass, under certain hydrologic conditions that do not occur in drier years. Levee construction involves the removal of riparian vegetation, resulting in reduced habitat complexity and shading, making juveniles more susceptible to predation. Additionally, loss of riparian vegetation reduces aquatic macroinvertebrate recruitment resulting in decreased food availability for rearing juveniles (Anderson and Sedell 1979; Pusey and Arthington 2003).

Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento-San Joaquin River watershed and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery efforts.

Summary

Based upon the limited information available, the overall viability of the CCV steelhead DPS appears to be unchanged since the NMFS 5-year review (NMFS 2016). However, the majority (11 of 16) of populations for which data exists are at a high risk of extinction based on abundance and/or hatchery influence. No population is currently considered to be at a low risk of extinction. The lack of improved natural production estimates, and low abundances coupled with large hatchery influence are causes for continued concern (Johnson *et al*. 2023).

2.2.4. Southern Distinct Population Segment (sDPS) Green Sturgeon

Introduction and Life-History

In 2006 NMFS listed the Southern Disinct Population Segment of North American Green Sturgeon (*Acipenser medirostris)* under the ESA and classified it as threatened species (April 7, 2006, 71 FR 17757). Southern DPS green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. During late summer and early fall, subadults and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast (Emmett et al. 1991, Moser and Lindley 2006). Using polyploid microsatellite data, Israel et al. (2009) found that green sturgeon within the Central Valley of California belong to the sDPS. Additionally, acoustic tagging studies have found that green sturgeon found spawning within the Sacramento River are exclusively sDPS green sturgeon (Lindley et al. 2011). In waters inland from the Golden Gate Bridge in California, sDPS green sturgeon are known to range through the estuary and the Delta and up the Sacramento, Feather, and Yuba rivers (Israel et al. 2009, Cramer Fish Sciences 2011, Seesholtz et al. 2014). It is unlikely that sDPS green sturgeon utilize areas of the San Joaquin River upriver of the Delta with regularity, and spawning events are thought to be limited to the upper Sacramento River and its tributaries. There is no known modern usage of the upper San Joaquin River by sDPS green sturgeon, and adult spawning has not been documented there (Jackson and Eenennaam 2013).

Viability Status

Recent research indicates that the sDPS is composed of a single, independent population, which principally spawns in the mainstem Sacramento River and also breeds opportunistically in the Feather River and possibly the Yuba River (Cramer Fish Sciences 2011, Seesholtz et al. 2014). Concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. Whether sDPS green sturgeon display diverse phenotypic traits, such as ocean behavior, age at maturity, and fecundity, or if there is sufficient diversity to buffer against long-term extinction risk is not well understood. It is likely that the diversity of sDPS green sturgeon is low, given recent abundance estimates (NMFS 2023). Lindley et al. (2007), in discussing SR winter-run Chinook salmon, state that an ESU (or DPS) represented by a single population at moderate risk of extinction is at high risk of extinction over a large timescale; this would apply to the sDPS for green sturgeon.

The sDPS population estimate was developed by Mora et al. (2018) through Dual Frequency Identification Sonar (DIDSON) surveys of aggregation sites conducted from 2010-2015 in the upper Sacramento River. Mora et al. (2018) estimated the total population size to be 17,548 individuals (95% confidence interval [CI] = 12,614-22,482). The SWFSC recently updated the total population estimate to 17,723 (Dudley 2021). The DIDSON surveys and associated modeling will eventually provide population trend data. This estimate does not include the number of spawning adults in the lower Feather or Yuba rivers, where green sturgeon spawning was confirmed (Seesholtz et al. 2014). A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the south Delta pumping facilities of the Central Valley Project (CVP) and the State Water Project (SWP). These data should be interpreted with some caution. Operations and practices at the facilities have changed through time, which may affect salvage data. These data likely indicate a high production year versus a low production year qualitatively, but cannot be used to rigorously quantify abundance.

The parameters of sDPS green sturgeon population growth rate and carrying capacity in the Sacramento River Basin are poorly understood. Larval count data show enormous variance among sampling years. In general, sDPS green sturgeon year class strength appears to be highly variable, with overall abundance dependent upon a few successful spawning events (NMFS 2023). Other indicators of productivity such as data for cohort replacement ratios and spawner abundance trends are not currently available for sDPS green sturgeon.

The sDPS green sturgeon spawn primarily in the Sacramento River in the spring and summer. Since the ceasing of operations of seasonal gates at the Red Bluff Division Dam (RBDD), Southern DPS green sturgeon are able to access spawning habitat upstream of RBDD (Mora et al. 2018, Steel et al. 2019). Successful spawning of green sturgeon in other accessible habitats in the Central Valley (i.e., the Feather River) is limited, in part, by late spring and summer water temperatures (NMFS 2023). Similar to salmonids in the Central Valley, green sturgeon spawning in tributaries to the Sacramento River is likely to be further limited if water temperatures increase and higher elevation habitats remain inaccessible.

According to Dudley et al. (2024), adult green sturgeon demonstrated an average spawning interval of 4.2 years for females and 3.8 years for all fish, meaning adults would return to spawn about every 4 years. A previous study by Mora et al. estimated the population size to be 17,548 individuals, with 2,106 adults, 11,055 subadults, and 4,387 juveniles (NMFS 2021). A more recent study by Dudley et al. (2024) estimated the total population size in 2018 to be 10,700 individuals (with a 95% highest density interval (HDI) between 5,300 and 18,400 individuals), with 2,400 adults (2197-2624 95% HDI).

sDPS Green Sturgeon Critical Habitat

The critical habitat designation for sDPS green sturgeon (74 FR 52300, October 9, 2009) lists the PBFs for both freshwater riverine systems and estuarine habitats as: food resources, water flow, water quality, migratory corridor, depth, and sediment quality. Additionally, substrate type or size is also a PBF for freshwater riverine systems. In addition, the PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas.

Currently, many of the PBFs of sDPS green sturgeon are degraded and provide limited high-quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, and presence of contaminants in sediment. Although the current conditions of sDPS green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in both the Sacramento-San Joaquin River watersheds, the Delta, and nearshore coastal areas are considered to have high intrinsic value for the conservation of the species.

Summary

The 5-year status review for sDPS green sturgeon found that some threats to the species have been eliminated, such as harvest from commercial fisheries and removal of some passage barriers (NMFS 2023). Since many of the threats cited in the original listing still exist, the threatened status of the DPS is still applicable (NMFS 2023). The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate (NMFS 2023). Although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2023).

2.2.5. Current Limiting Factors

The following are current limiting factors for the listed species' population numbers included in this consultation:

- Dams block access to historical spawning and summer holding areas along with altering river flow regimes and temperatures (up to 90 percent for SR winter-run and CV spring-run Chinook salmon).
- Water management/diversions/barriers
- Loss of floodplain rearing habitat (levees/bank protection)
- Urbanization and rural development
- Logging
- Grazing
- Agriculture
- Mining – historic hydraulic mining from the California Gold Rush era
- Estuarine modified and degraded, thus reducing developmental opportunities for juvenile salmonids
- Predation
- Dredging and sediment disposal
- Contaminants
- Altering prey base for fish
- Fisheries
- Hatcheries
- "Natural" factors (i.e., ocean conditions)
- Climate change exacerbating flow and water temperature related impacts (see below for more detail)

2.2.6. Global Climate Change

The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 1°C (1.8°F) from 1901 through 2016 (USGCRP 2018). The *IPCC Special Report on the Impacts of Global Warming* (IPCC 2023) noted that human-induced warming reached a global surface temperature of 1.1°C (2.0°F) above pre-industrial levels by 2020, and global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years. Overall, annual average temperatures have increased by 1.8°C (3.2°F) across the contiguous United States since the beginning of the 20th century, with Alaska warming faster than any other state and twice as fast as the global average since the mid-20th century (Jay et al. 2018). Global warming has also led to more frequent heat waves in most land regions and an increase in the frequency and duration of marine heatwaves (IPCC 2023). Average global warming up to 1.5°C (2.7°F) as compared to pre-industrial levels is expected to lead to regional changes in extreme temperatures and increases in the frequency and intensity of precipitation and drought (IPCC 2023).

From 2012 to 2016, California experienced the most extreme drought since instrumental records began in 1895. A growing body of evidence suggests that climate change has increased the likelihood of extreme droughts in California (Durrand et al. 2020). California experienced well below average precipitation during the 2012-2016 drought, as well as record high surface air temperatures in 2014 and 2015, and record low snowpack in 2015 (Williams et al. 2020). Paleoclimate reconstructions suggest the 2012-2016 drought was the most extreme in the past 500 to 1000 years (Williams et al. 2019, Williams et al. 2020, Williams et al. 2022). Anomalously high surface temperatures substantially amplified annual water deficits during 2012-2016. California entered another period of drought in 2020-2022, the effects of which are still being realized. These drought periods are now likely part of a larger drought event (Williams et al. 2022). This recent long-term drought, as well as the increased incidence and magnitude of wildfires in California, have likely been exacerbated by climate change (Williams et al. 2020, Williams et al. 2022, Durrand et al. 2020, Williams et al. 2019).

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of hydrograph patterns (Cohen et al. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). An altered seasonality results in runoff events occurring earlier in the year and of greater magnitude due to a shift in precipitation falling as rain rather than snow (Roos 1991, Dettinger et al. 2004). Specifically, the Sacramento river basin annual runoff amount for April to July has been decreasing since about 1950 (Roos 1987, 1991). Increased temperatures influence the timing and magnitude patterns of the hydrograph and strain the ability of reservoir water managers to control flood flows and downstream conditions.

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. Large spring snow water equivalent percentage changes late in the snow season are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (Vanrheenen et al. 2004). Factors modeled by Vanrheenen et al. (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring snow water equivalent (up to 100 percent in shallow snowpack areas). Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (Vanrheenen et al. 2004). The decrease in spring snow water equivalent (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the Central Valley, where snowpack is relatively shallow, and thereby reducing the spring/summer flows in that watershed.

For SR winter-run Chinook salmon, the embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, so this run is particularly at risk from climate warming. The only remaining population of SR winter-run Chinook salmon relies on the cold-water pool in Shasta Reservoir that buffers the effects of warm temperatures in most years. The exception occurs during drought years that are predicted to occur more often with climate change (Yates et al. 2008). Additionally, air temperature appears to be increasing at a greater rate than previously analyzed (Beechie et al. 2012, Dimacali 2013). These factors will compromise the quantity and/or quality of SR winter-run Chinook salmon habitat available downstream of Keswick Dam.

CV spring-run Chinook salmon adults are vulnerable to climate change, because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2012). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change.

CCV steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat. The effects may be even greater in some cases, as juvenile CCV steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile CCV steelhead, which range from 14°C to 19°C (57°F to 66°F).

Adult sDPS green sturgeon have been observed as far upstream as the Anderson-Cottonwood Irrigation District (ACID) Dam, which is considered the upriver extent of sDPS green sturgeon passage in the Sacramento River (Heublein et al. 2009). However, sDPS green sturgeon spawning occurs approximately 30 kilometers (18.6 miles) downriver of the ACID Dam where water temperature is warmer than at the ACID Dam during late spring and summer. If water temperatures increase with climate change, temperatures at spawning locations below the ACID Dam may be above tolerable levels for the embryonic and larval life stages of sDPS green sturgeon.

In summary, observed and predicted climate change effects are generally detrimental to all of the listed anadromous fish species, so unless offset by improvements in other factors, the status of the species and critical habitat is likely to further decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100 and, while there is uncertainty associated with the precision of projections, the increasing trend is certain (McClure et al. 2013).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Action Area for this section 7 consultation encompasses all areas that may be directly or indirectly affected as a result of activities for ARCF project and the broader area that, while outside the construction zone, may be directly or indirectly affected by implementation of the Proposed Action, such as vibrations, noise, increased turbidity, or sedimentation movement associated with the proposed cacheaction. This includes all areas that will be affected in the short-term and long-term, by the construction and maintenance for the remaining ARCF project. Locations for each of the remaining ARCF proposed project locations can be found in Figure 5.

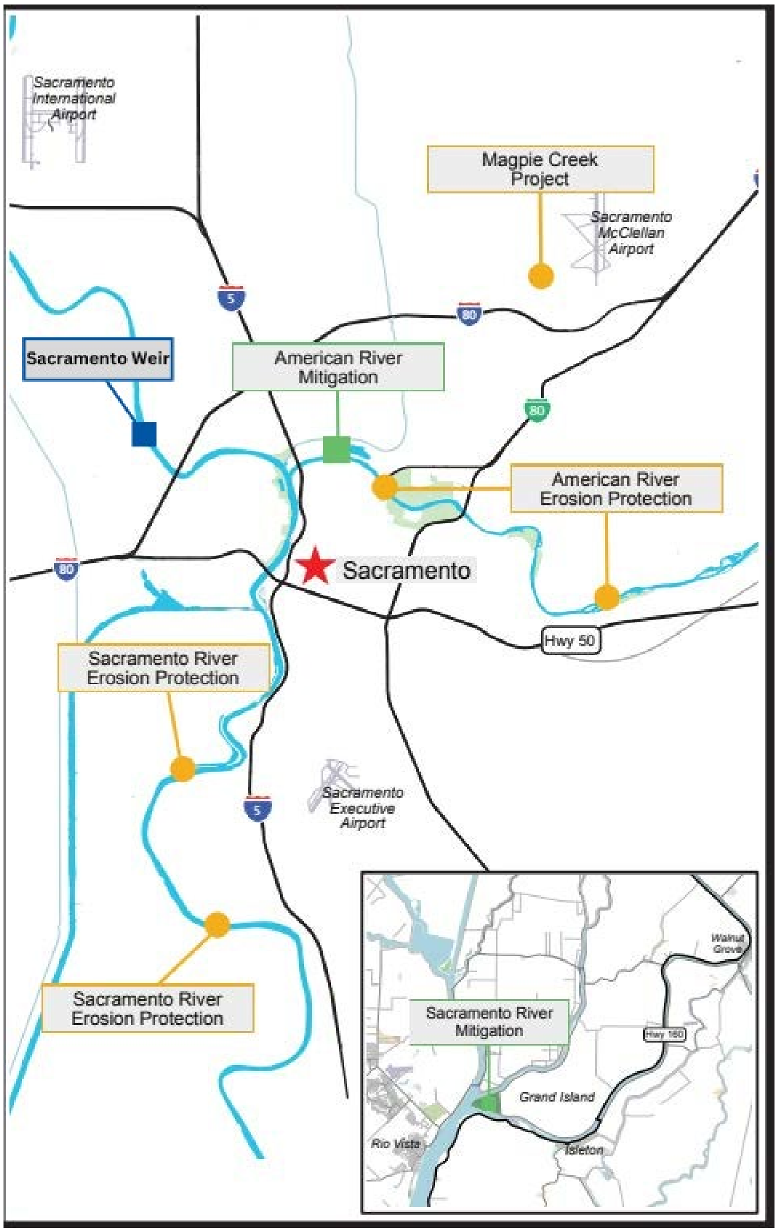


Figure 5. Locations of Remaining ARCF Proposed Actions (Source: USACE BA 2024)

The Action Area encompasses areas along the Sacramento River from the Sacramento Bypass downstream to RM 45, the Yolo Bypass south the confluence of the Sacramento Bypass, the lower American River RM 11 downstream to the confluence with the Sacramento River, and other haul, access, and borrow sites associated with construction activities. Vessel traffic for construction material hauling may extend as far west as San Francisco in order to transport material to sites along the Sacramento River.

The Action Area also includes any areas that may be affected by the implementation of conservation measures, including compensatory mitigation and planting areas. The ARMS action area (located at American River RM 1.0) is encompassed by the previously described action area within the lower American River. The SRMS action area encompasses the approximately 200-acre area of Grand Island located near Sacramento RM 15 at the confluence of Cache and Steamboat Sloughs and the adjacent waterways which may be subject to project effects.

In addition, the proposed action includes the potential purchase bank credits to offset permanent habitat impacts which may remain unmitigated following completion of the ARMS and SRMS sites. USACE has not specified from which bank credits will be purchased. Therefore, we include all mitigation banks that service the project locations and offer credits to offset these habitat types in the action area for the proposed action.

- North Delta Fish Conservation Bank: an 811-acre site located on Liberty Island within the Yolo Bypass that provides tidal marsh complex, tidal channel, open-water, tule SRA and riparian SRA habitat. The 811-acre restoration site is included in the action area of the proposed action.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from federal agency activities or existing federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

This section describes the physical conditions and general vegetation, wildlife, and fisheries resources present within the ARCF Action Area. These conditions are first presented generally throughout the ARCF Action Area and then site specific SRA is analyzed as well as affected species in the ARCF Action Area.

The Sacramento River watershed receives winter/early spring precipitation in the form of rain and snow (at higher elevations). Prior to the construction and operation of any reservoirs, winter rainfall events caused extensive flooding and spring snowmelt resulted in high flows during spring and early summer. Summer and fall flows were historically low. Currently, much of the total runoff is captured and stored in reservoirs for gradual release during the summer and fall months. High river flows occur during the winter and spring, but these are usually lower than during pre-European settlement times; summer and fall low flows are sustained by releases from upstream reservoirs.

Downstream from the American River confluence, the Sacramento River is moderately sinuous (average sinuosity of 1.3), with the channel confined on both sides by man-made levees enhanced by decades of man-made additions. The channel in this reach is of uniform width, is not able to migrate, and is typically narrower and deeper relative to the upstream reach due to scour caused by the concentration of shear forces acting against the channel bed (Brice 1977). Channel migration is similarly limited along the lower American River because of man-made levees and regulated flows from Folsom Dam.

The natural banks and adjacent floodplains of both rivers are composed of silt- to gravel-sized particles with poor to high permeability. Historically, the flow regimes caused the deposition of a gradient of coarser to finer material, and longitudinal fining directed downstream (sand to bay muds). The deposition of these alluvial soils historically accumulated to form extensive natural levees and splays along the rivers, 5 to 20 feet above the floodplain for as far as 10 miles from the channel (Thompson 1961). The present-day channels consist of fine-grained cohesive banks that erode due to natural processes as well as high flow events (USACE 2012).

Most existing habitat impacts are the result of development of the basin-wide flood control system, the SRFCP (Sacramento River Flood Control Project), and other human developments. The current system evolved from private efforts begun in 1850 into the joint Federal-State SRFCP, which was essentially completed in 1960. Because the SRFCP removed large acreages of riparian floodplain and overflow basins from the river system, the natural regeneration of riparian woodland communities was negatively impacted. Additional effects occurred to recruitment of large woody material to the river system, spawning and rearing of fish in floodplain and floodplain functions, and allochthonous (imported) input of nutrients and food to the aquatic system. The SRFCP largely eliminated the possibility of natural channel migration and habitat renewal over a considerable portion of the river system. Reaches throughout the action area historically provided both shallow and deeper water habitat. However, channel confining levees and upstream reservoirs that maintain year-round outflow have eliminated much of the adjacent shallow water floodplain habitat. The existing levees influence the natural meander and ecosystem of the Sacramento and American Rivers, included in the action area. Many native fish species are adapted to rear in flooded, shallow water areas that provide abundant cover from prey. As a consequence of habitat alterations, and introduction of non-native species and pollutants, some native fish species are now extinct while most others are reduced in numbers (Moyle 2002).

The Proposed Action is occurring in the Sacramento River and American River which serve as rearing habitat and migratory corridors for listed SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. As mentioned above, much of the Sacramento and American River watersheds have been substantially altered from human activities, and this has dramatically reduced the habitat value of the watersheds for listed fish species. However, despite the impaired status of the Sacramento River watershed in the proposed action area, the value of the area for listed fish species is high, as it provides some of the last remaining critical habitat for listed fish. The lower Sacramento River is the essential migratory corridor for all SR winter-run Chinook salmon, and the majority of CV spring-run Chinook salmon populations, CCV steelhead populations, and sDPS green sturgeon, and contains habitat elements that support the rearing and growth of juveniles and the successful upstream migration of adults. The same high value habitat can be attributed to the lower American River for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

Seasonal high flows enter the adjacent Yolo Bypass from this reach of the Sacramento River via the Sacramento Bypass (RM 63). Tidal influence emanating from Suisun Bay extends up the Sacramento River for 80 miles to Verona, with greater tidal variations occurring downstream during low river stages in summer and fall.

Vegetation in the Action Area

The Action Area consists of primarily riparian forest, valley oak woodland, riparian scrub-shrub habitat, and typically non-native annual grassland. Scrub-shrub generally refers to areas where the woody riparian canopy is composed of young trees or shrubs less than 20 feet high. Species that are typically found in riparian forest, valley oak woodland, and scrub habitats include cottonwood, several willow species, sycamore valley oak, black walnut, Oregon ash, white alder, boxelder, blue elderberry, buttonbush, Himalaya blackberry, wild grape, and poison oak. Understory vegetation may consist of an herbaceous layer of sedges, rushes, grasses, and forbs.

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, black walnut, black willow, or valley oak. Dominant species found in the sub canopy may also include alder, ash and box elder. Layers of climbing vegetation make up part of the subcanopy, with wild grape being a major component, but wild cucumber and clematis vines are also found in riparian communities. Several species of invasive non-native trees, shrubs and vines may be present in some riparian locations, predominantly red sesbania, Himalayan blackberry, tamarix, false bamboo, tree-of-heaven, eucalyptus, and ivy.

The herbaceous ruderal groundcover, primarily nonnative annual grassland, is found on most levees along the Sacramento River. It occurs on the levees and also within gaps in the riparian habitats. Plant species include wild oats, soft chess, ripgut brome, red brome, wild barley, Bermuda grass, and foxtail fescue. Common forbs include broadleaf filaree, red stem filaree, turkey mullein, clovers, and many others. The majority of these plants are not native to the Action Area.

Early riparian habitat may be called scrub-shrub. Scrub-shrub generally refers to areas where woody riparian canopy is composed of trees or shrubs approximately 20 feet high. Species that are typically found in these habitats include young cottonwood (*Populus trichocarpa*), willow (*Salix spp*.), elderberry (*Sambucus spp.*), buttonbush (*Cephalanthus occidentalis*), Himalaya blackberry (*Rubus armeniacus*), wild grape (*Vitis vinifera*), and poison oak (*Toxicodendron spp*.).

Riparian herbaceous cover includes herbland cover and gravel and sand bar community types. Areas are designated as riparian herbaceous cover if they are enclosed by riparian vegetation or the stream channel. Gravel and sand bar community types were included in this grouping by the the USACE, because these areas support annual and short-lived perennial species, including herbs, grasses and subshrubs that cover less than 50% of the area (Nelson 2000). Species that are typically found in these habitats include European annual and native perennial grasses; native perennials, such as Douglas' sagewort (*Artemisia douglasiana*), Santa Barbara sedge (*Carex barbarae*), smooth horsetail (*Equisetum laevigatum*), California pea (*Lathyrus jepsonii var. californicus*) and cudweed (*Gnaphalium sp*.); non-native forbs and grasses, such as garden asparagus and Bermuda grass (*Cynodon dactylon*); and invasive plants, such as yellow star-thistle (*Centaurea solstitialis*). Monospecific stands of the invasive exotic giant reed (*Arundo donax*) are also included in this vegetation type category.

Emergent marsh includes valley freshwater marsh and common reed plant community types. Common species found in emergent marsh habitat include cattails (*Typha* spp.) and tule (*Scirpus spp.)* with some sedge or associated broad-leaved aquatic species (such as *Verbena hastata*), and common reed (*Phragmites australis*), which can grow in inundated areas along the channel edge.

Other cover types found in the action area include bare ground (areas devoid of vegetation), agricultural, ruderal vegetation (areas with sparse to moderate herbaceous plant cover dominated by weedy upland species), and urban (including structures, roads and parks, but are usually located on the landward side of the levee).

Historical Human Resource Use and Current Riparian Vegetation

Historical precipitation and runoff patterns resulted in the Sacramento River being bordered by up to 500,000 acres of riparian forest, with valley oak woodland covering the higher river terraces (Katibah 1984). However, human activities of the 1800s and 1900s have substantially altered the hydrologic and fluvial geomorphic processes that create and maintain riparian forests within the Sacramento basin, resulting in both marked and subtle effects on riparian communities. Riparian recruitment and establishment models (Mahoney and Rood 1998; Bradley and Smith 1986) and empirical field studies (Scott et al. 1997, 1999) emphasize that hydrologic and fluvial processes play a central role in controlling the elevational and lateral extent of riparian plant species. These processes are especially important for pioneer species that establish in elevations close to the active channel, such as cottonwood and willows (*Salix* spp.). Failure of cottonwood recruitment and establishment is attributed to flow alterations by upstream dams (Roberts *et al.* 2001) and to isolation of the historic floodplain from the river channel. In addition, many of these formerly wide riparian corridors are now narrow and interrupted by levees and weirs. Finally, draining of wetlands, conversion of floodplains to agricultural fields, and intentional and unplanned introduction of exotic plant species have altered the composition and associated habitat functions of many of the riparian communities that are able to survive under current conditions.

Site-Specific Analysis of Riparian Vegetation

Analysis of total LF of SRA was conducted using Google Earth Pro for the reaches only associated with bank protection on the American and Sacramento Rivers in the ARCF Action Area (Table 2). However, site-specific conditions at proposed bank protection sites may evaluate SRA habitat values using the FHAST method of analysis to determine impacts and onsite compensation value based on actual designs. It is not anticipated that trees would need to be removed within the Sacramento Bypass as a result of the levee relocation effort, since the footprint of the expanded Bypass area is open farmland with no trees present. However, trees along the Sacramento River would be removed to construct the new 1,500-foot Sacramento Weir.

Below in Table 2 is the estimate of linear footage of existing riparian habitat along the reaches of the American and Sacramento Rivers where bank protection is expected to be constructed.

Table 2 Summary of Reach Specific SRA Analysis from ARCF BA (USACE 2020)

Reach	**American River**	**Sacramento River**
Linear Feet of SRA	45,367	51,804

2.4.1. Previous Flood Management within the Action Area

The environmental baseline also includes past and present flood management actions within the action area. This includes the portions of the ARCF project which have been constructed to date (described in Section 1.2.1). The action area is encompassed by levees built from around 1850 up through 1960. Several large-scale bank repair actions have occurred within the action area prior to this consultation. The largest are by far the Sacramento River Bank Protection Program (SRBPP) and the West Sacramento General Re-evaluation Study (West Sac GRS), a sister project to the ARCF proposed action.

The SRBPP was originally authorized by the Flood Control Act of 1960, in order to protect levees and flood control facilities of the SRFCP from erosion damage. The SRBPP has been thus far described in two phases: SRBPP Phase I and Phase II. Each phase includes flood risk management actions consisting mainly of bank protection and levee repairs to correct erosion problems and protect low-lying areas of the Sacramento Valley and Sacramento-San Joaquin Delta from damaging floods. Phase I was constructed from 1962 to 1975. Phase II was originally authorized in 1974 and consists of 405,000 LF of bank protection. An additional 80,000 LF was added to Phase II by the Water Resources Development Act (WRDA) of 2007, and 30,000 LF of this has been consulted on previously with NMFS.

The West Sac GRS was consulted on in 2015 and has not yet been constructed. Based on information provided by the USACE, it is likely that construction will begin concurrently with the ARCF proposed action. The West Sac GRS will be constructing erosion repairs on the west side of the Sacramento River from the Sacramento Bypass, stretching down 11 miles as well as installing cut-off walls and further repairs within the Deep Water Ship Channel and levees within the Yolo Bypass. The construction will require the removal of most of the riparian vegetation from the levee temporarily, with up to 66% permanent vegetation loss possible. The construction was mitigated for locally through the Southport levee setback, a large floodplain construction action that was completed in 2018. This provided access to 120 acres of historic floodplain habitat to offset the impacts of the construction of the West Sac GRS action.

Although site-level impacts have been addressed from compensatory mitigation associated with the SRBPP and West Sac GRS, ecosystem impacts have largely been left unaddressed. Levees constructed as part of the SRBPP have replaced the naturally occurring shallow water habitat that existed along the banks of rivers and sloughs, which historically provided a spectrum of complex habitats. Shallow water habitats had a broad range of depths, water velocities, riparian vegetation, fallen trees and instream woody materials (IWM), and gave the river the ability to migrate across the floodplain to create additional complexity in the geometry of its cross section. Naturally flowing rivers were able to construct riverside benches and naturally formed levees during flood events. These benches could be up to 20 feet high and extended for considerable distances inland, creating suitable conditions for the establishment and successful development of structurally diverse riparian vegetation communities (The Bay Institute 1998). Large, continuous corridors of riparian forests and vegetation were present along major and minor rivers and streams in the Central Valley. Native fish species, including listed salmonids and green sturgeon, evolved under these environmental conditions.

The construction of levees and the "reclamation" of floodplains eliminated these riparian areas. Only remnant riparian forests exist in the action area today, as many of the levees are extensively riprapped with stone armoring. Only in a few areas where waterside benches exist outside of the levee toe and vegetation is allowed to grow, does naturally established vegetation exist. These stands of riparian vegetation are discontinuous and frequently very narrow in width, providing a fraction of the ecological benefits of their historical predecessors.

In particular, the loss of large wood recruitment and IWM on a large-scale is becoming increasingly concerning, as our understanding of the functionality of IWM for fish and other wildlife resources continues to develop. IWM is very important to fish, playing key roles in physical habitat formation, sediment and organic-matter storage, and in maintaining essential habitat complexity and refugia (USFWS 2004). Loss of IWM reduces habitat quality and carrying capacity (USFWS 2004). The act of riprapping river banks not only removes any existing IWM, but prevents recruitment of IWM along the riprapped banks and reduces the retention of IWM recruited from any upstream, non-armored areas (USFWS 2004). In fact, "the cumulative loss of IWM functioning for the lower Sacramento River is now likely at least 67-90%, or more, compared to pre-SRBPP conditions" (USFWS 2004).

Loss of IWM negatively impacts salmonids through multiple phases of their life history. Schaffter et al. (1983) showed that juvenile Chinook salmon densities along riprapped banks are one third that of natural banks with the presence of fallen trees and their root balls in the water. They concluded that traditional riprap methods of protection will likely cause decreases in the salmon numbers in the Sacramento River basin. USFWS (2000) reported that in studies conducted in the Sacramento River near the Butte Basin, the highest number of juvenile Chinook salmon were associated with the nearshore areas with woody material, sloping banks, and moderate velocities. Juvenile Chinook salmon catches (i.e., measured as catch per unit effort) were consistently lowest at riprapped sites and highest at natural bank sites with overhead cover and IWM, and intermediate in areas where experimental mitigation studies with artificially placed IWM. USFWS (2000) reported that additional studies conducted between Chico Landing and Red Bluff on the Sacramento River confirmed the low value of riprapped banks, the high value of natural banks with varying degrees of instream and overhead woody cover, and the intermediate value of mitigated sites.

In large mainstem streams and rivers such as the Sacramento River, the primary benefit of IWM occurs along channel margins. The woody materials act to deflect and break up stream flow, creating small eddies, pools, undercut banks, variability in channel depth, and back water areas conducive to rearing and growth (Murphy and Meehan 1991, Bisson et al. 1987). Sediment that is trapped by the woody material and stored along the channel margins contributes to the hydraulic and biologic complexity of the stream reach, particularly where organically rich materials are present (Bisson et al. 1987). These storage areas create new habitat complexity by trapping inorganic material that creates bars and holes and organic materials that contribute energy and carbon to the local food web of the stream reach (Murphy and Meehan 1991, Bisson et al. 1987). These breaks in the river flow also create ideal holding areas with plentiful food resources and the conditions where salmonids can hold with minimal energy expenditure and feed while rearing. These areas are also beneficial to a wide range of other species native to the system. Such refuges are critically important to the lower river reaches where levee construction and riprapping have disconnected the rivers from the adjoining floodplain where slow water refugia and rearing habitats formerly existed.

Riprapping affects the stability of IWM along the river channel margin. Stable wood retention is important for creating and maintaining good fish habitat (Bisson et al. 1987). Whole trees and their root balls are more important for long-term stability than smaller fragments, as they tend to stay in place for long periods of time. These large pieces of wood may remain in place for decades and in the process trap additional IWM, thus adding complexity to the overall bank structure. The longevity of IWM, however, may mask changes in the input of woody materials to the river. Since these large pieces of wood would normally be slow to decay, a decline in the woody material input may be masked. Riprapping of the upper river and Delta waterway banks prevents the normal input of upstream woody materials through erosion. The homogeneity and unvarying hydraulic roughness along the riprapped banks prevent pieces of woody materials from becoming anchored and remaining in place. The woody materials are transported downstream, but the riprapping of the lower river and Delta waterway banks further limit these pieces from becoming lodged on the banks and the woody material is lost to the system. There is a continuing reduction of IWM input from upstream and local waterways, so much so, that the presence of IWM in the Delta is becoming exceedingly rare. SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon must all migrate through the Delta in order to survive, and therefore the large-scale removal of IWM upstream affects listed species growth and survival. Existing pieces that are removed or break apart from decay are not being replenished from upstream.

Riprapping halts the accretion of point bars and other depositions where new riparian vegetation can colonize (DWR 1994 cited in USFWS 2004). Riprapping also halts the meander migration and reworking of floodplains, which eventually reduces habitat renewal, diversity, complexity, and heterogeneity (DWR 1994; Larson 2002; USFWS 2004). This, in turn, has adverse effects on aquatic ecosystems, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling 2001; USFWS 2004). Riprapping can also incise the thalweg of the river adjacent to the riprapped area, narrowing the low-flow channel width, resulting in decreased hydrological and biological diversity (DWR 1994, USFWS 2004). Riprapping decreases river sinuosity, which increases the river channel slope, increasing the bedload transport and possible bed degradation and scour near the toe of the riprapped bank

(USFWS 2004, Larson 2002). Riprapping alters the future channel planform of the river at the riprapped site as well as downstream from the site, which can cause more erosion of the channel bank downstream than if the riprap revetment were not present (USFWS 2004, Larson 2002).

Riprapping creates a relatively smooth surface along the riverbank, which is contrary to the habitat hydrodynamic complexity required for endangered salmonids (Lister 1995; NRC 1996; USFWS 2004). Riprap fills in sloughs, tributary channels, and oxbow lake areas, causing loss of nearby wetland habitat and diversity (USFWS 2004, DWR 1994). Riprap limits the lateral mobility of the river channel, decreasing general habitat complexity in the near-shore aquatic area and reducing complex lateral habitat, including small backwaters and eddies, which removes important refugia for plants, invertebrates, fish, birds, and mammals (USFWS 2004; Welcomme 1979). Riprapping also decreases near-shore roughness, which causes stream velocities to increase more rapidly with increasing discharge, further eliminating critical refugia areas for fish and other aquatic organisms during high flows and causing accelerated erosion downstream, which can in turn result in riprap creating the need for more riprap (Gregory 1991; USFWS 2004). Riprap also halts erosion and reduces habitat complexity, which in turn reduces the ability of near-shore areas to retain sediments and organic materials, and isolates the river from its watershed (Gregory 1991; USFWS 2004). Riprap impedes plant growth, resulting in vegetation being pushed far back from the shoreline, further reducing food resources for aquatic invertebrates that would have been provided from such vegetation (Murphy 1991; USFWS 2004).

The above effects of riprapping are well documented, but there are additional, complex, and relatively poorly understood and unaddressed effects of large-scale riprapping, which warrant additional study and consideration (USFWS 2004). Studies that seek to provide insights into presently poor understood effects of large-scale riprapping include those related to the effects of bank stabilization of channelization on rivers, and the effects of snagging and clearing operations (USFWS 2004).

Environmental Effects of the USACE Vegetation Policy

The continuation of the USACE Engineering Technical Letter (ETL) policy of no vegetation within 15 feet of the levee toe on both the waterside and landside of the levee greatly exacerbates the negative attributes of the currently armored levee habitat in the area. Removal of the vegetation on the waterside and landside of the levees prevents the input of allochthonous organic materials to adjacent waterways and severely reduces the function of riparian and nearshore habitat along the affected levee reaches. By preventing the input of organic materials that serves as a source of energy and organic carbon, aquatic and terrestrial food webs are negatively impacted and the quantity and quality of nearshore rearing habitat is measurably reduced. Removal of riparian vegetation has reduced the amount of overhead shade along significant stretches of the Sacramento River mainstem and tributaries.

Compliance with the ETL policies prevents the establishment of riparian vegetation communities. The ETL policy does not allow woody vegetation to become established that could eventually be recruited into the adjacent aquatic habitat through erosion or death of the woody plants. Allowance of only grasses, sedges, and small bushes to grow on the waterside banks of the levees will not create the full functionality of a riparian zone, or create the equivalent complexity of habitat that a full riparian vegetation community would possess.

The NMFS Salmonid Recovery Plan identifies loss of juvenile rearing habitat in the form of lost natural river morphology and function, and lost riparian habitat and instream cover as a "very high stressor" affecting the viability of salmon and steelhead in the Central Valley (NMFS 2014). The Recovery Plan also establishes a strategic approach to recovery, which identifies critical recovery actions for the Central Valley, as well as watershed- and site-specific recovery actions. Watershed-specific recovery actions address threats occurring in each of the rivers or creeks that currently support spawning populations of SR winter-run Chinook salmon ESU, the CV spring-run Chinook salmon ESU, or the CCV steelhead DPS. Site-specific recovery actions address threats to these species occurring within a migration corridor (e.g., Sacramento River [SAR], San Francisco Bay, or the Delta [Del], Feather River [FER], American River [AMR]). Relevant recovery actions proposed include:

CEV-1.8 (Priority 1): *Develop and implement State and National levee vegetation policies to maintain and restore riparian corridors.*

Del-1.4 (Priority 1): *Conduct landscape-scale restoration of ecological functions throughout the Delta to support native species and increase long-term overall ecosystem health and resilience.*

Del-1.7 (Priority 1): *Restore, improve and maintain salmonid rearing and migratory habitats in the Delta and Yolo Bypass to improve juvenile salmonid survival and promote population diversity.*

SAR-1.2 (Priority 1): *Restore and maintain riparian and floodplain ecosystems along both banks of the Sacramento River to provide a diversity of habitat types including riparian forest, gravel bars and bare cut banks, shade vegetated banks, side channels, and sheltered wetlands, such as sloughs and oxbow lakes following the guidance of the Sacramento River Conservation Area Handbook (Resources Agency of the State of California 2003).*

SAR-2.1 (Priority 2): *Ensure that riverbank stabilization projects along the Sacramento River utilize bio-technical techniques that restore riparian habitat, rather than solely using the conventional technique of adding riprap.*

SAR-2.8 (Priority 2): *Implement projects that promote native riparian (e.g., willows) species including eradication projects for non-native species (e.g., Arundo, tamarisk).*

SAR-2.11 (Priority 2): *Improve instream refuge cover in the Sacramento River for salmonids to minimize predatory opportunities for striped bass and other non-native predators.*

AMR-1.6 (Priority 1): *Implement a long-term wood management program to provide habitat complexity and predator refuge habitat.*

AMR-2.5 (Priority 2): *Develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the American River Watershed.*

AMR-2.7 (Priority 2): *Utilize bio-technical techniques that integrate riparian restoration for riverbank stabilization instead of conventional riprap in the American River.*

ETL compliance that reduces or eliminates the potential for establishing riparian communities along the program's levee reaches will significantly impair implementation of these key recovery actions and will make it difficult to recover the ecosystems upon which ESA-listed salmon and steelhead in the Central Valley depend. Furthermore, the ongoing requirement under the ETL to remove vegetation will typically require the application of herbicides to control vegetation on the levee faces. Herbicides and their additives, such as surfactants, can have negative or deleterious effects upon sensitive receptors of fishes, invertebrates, or plants, in the aquatic environment. Spraying of herbicides on "unwanted" vegetation can create situations where the herbicides drift into adjacent waters and contaminate those water bodies, or is contained in runoff from surface flow during rain events.

Future projects should focus on channel margin enhancement to protect and restore key migratory and rearing areas. Degradation of channel margins by retaining riprap and removing riparian and nearshore vegetation should be mitigated on-site first or at least elsewhere on the migratory corridor. Benefits from off-site mitigation should be carefully evaluated, as the species impacted from the program development may not benefit at all from mitigation conducted elsewhere, particularly if the mitigated area is removed from the migratory corridors of the impacted fish populations (i.e., the ESUs and DPSs of listed fish species).

The reduction in the quality and quantity of beneficial habitat through previous actions, and the continued maintenance of these poorly functioning habitats through discretionary actions of vegetation management results in the severely diminished habitat value for ESA-listed fish species.

2.4.2. Status and Recovery Needs for Species in the Action Area

The action area, which is described above, encompasses the mainstem and tributaries of the Sacramento River, from RM 45 to the Sacramento Weir and Bypass (RM 63), the lower 12 miles of the American River, and all associated floodplains and riparian areas at and adjacent to the proposed construction sites. These sites function as a migratory corridor for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The action area is also used for rearing and adult feeding.

Presence of SR winter-run Chinook salmon in the Action Area

The temporal occurrence of SR winter-run Chinook salmon smolts and juveniles within the action area are best described by a combination of the salvage records of the CVP and SWP fish collection facilities and the fish monitoring programs conducted in the northern and central Delta. Based on salvage records at the CVP and SWP fish collection facilities, juvenile SR winter-run Chinook salmon are expected in the action area starting in December. Their presence peaks in March and then rapidly declines from April through June. The majority of SR winter-run juveniles will enter the action area during February through June. Presence of adult Chinook salmon is interpolated from historical data. While no spawning population of SR winter-run exists within the American River, rearing juveniles have been captured at the screw traps at RM 9, and expected to be present within the Lower American River in similar time windows as their presence in the Sacramento River. Adult SR winter-run Chinook salmon are expected to enter the action area starting in January, with the majority of adults passing through the action area between February and April.

The action area contains CV SR winter-run Chinook salmon from the Basalt and Porous Lava Diversity group (i.e., mainstem Sacramento River below Keswick Dam). Within the action area, there are “Core 1” populations of SR winter-run Chinook salmon, as designated in the Recovery Plan for the species (NMFS 2014). Core 1 watersheds possess the known ability or potential to support a viable population. For a population to be considered viable, it must meet the criteria for low extinction risk for Central Valley salmonids (Lindley et al. 2007). The criteria include population size, population decline, catastrophic decline and hatchery influence.

Presence of CV spring-run Chinook salmon in the Action Area

CVP/SWP salvage records and the northern and Central Delta fish monitoring data indicate that juvenile CV spring-run Chinook salmon first begin to appear in the action area in December and January, but that a significant presence does not occur until March and peaks in April. By May, the salvage of juvenile CV spring-run Chinook salmon declines sharply and essentially ends by the end of June. The data from the northern and central Delta fish monitoring programs indicate that a small proportion of the annual juvenile CV spring-run emigration occurs in January and is considered to be mainly composed of older yearling CV spring-run juveniles based on their size at date. Adult CV spring-run Chinook salmon are expected to start entering the action area in approximately January. Low levels of adult migration are expected through early March. The peak of adult CV spring-run Chinook salmon movement through the action area is expected to occur between April and June with adults continuing to enter the system through the summer. Currently, all known populations of CV CV spring-run Chinook salmon inhabit the Sacramento River watershed.

The action area contains CV spring-run Chinook salmon from the Basalt and Porous Lava Diversity group, Northwestern California Diversity group, and the Northern Sierra Nevada Diversity group. Within the action area, there are both “Core 1”, “Core 2”, and “Core 3” populations of CV spring-run Chinook salmon, as designated for by NMFS recovery plan for the species (NMFS 2014). The Core 1 populations include Battle Creek, Clear Creek, Butte Creek, Deer Creek, and Mill Creek. Core 2 populations meet, or have the potential to meet, the biological recovery standard for moderate risk of extinction. The Core 2 populations within the actions area include the Mainstem Sacramento (below Keswick), Cottonwood/Beegum Creek, Yuba River, Big Chico Creek, and Antelope Creek. These watersheds have lower potential to support viable populations, due to lower abundance, or amount and quality of habitat. These populations provide increased life history diversity to the ESU/DPS and are likely to provide a buffering effect against local catastrophic occurrences that could affect other nearby populations, especially in geographic areas where the number of Core 1 populations is lowest. Core 3 watersheds have populations that are present on an intermittent basis and require straying from other nearby populations for their existence. These populations within the action area are Thomes Creek and Stony Creek. These populations likely do not have the potential to meet the abundance criteria for moderate risk of extinction. Core 3 watersheds are important because, like Core 2 watersheds, they support populations that provide increased life history diversity to the ESU/DPS and are likely to buffer against local catastrophic occurrences that could affect other nearby populations. Dispersal connectivity between populations and genetic diversity may be enhanced by working to recover smaller Core 3 populations that serve as stepping stones for dispersal.

Presence of CCV steelhead in the Action Area

The CCV steelhead DPS final listing determination was published on January 5, 2006 (71 FR 834) and included all naturally spawned populations of steelhead (and their progeny) downstream of natural and manmade barriers in the Sacramento River and its tributaries. FRFH steelhead are also included in this designation. Depending on the year, there is potential spawning habitat present within the action area in the American River. There is also rearing and migration habitat present in the action area. Juveniles use rearing and migration habitat rear year-round in the mainstem Sacramento River and tributaries. Juveniles and smolts are most likely to be present in the action area during their outmigration, which begins in November, peaks in February and March, and ends in June.

Adult CCV steelhead originating in the Sacramento River watershed will have to migrate through the action area in order to reach their spawning grounds and to return to the ocean following spawning. Likewise, all CCV steelhead smolts originating in the Sacramento River watershed will also have to pass through the action area during their emigration to the ocean. The waterways in the action area also are expected to provide some rearing benefit to emigrating CCV steelhead smolts. The CCV steelhead DPS occurs in both the Sacramento River and the surrounding watersheds.

The action area contains CCV steelhead from the Basalt and Porous Lava Diversity group, Northwestern California Diversity group, and the Northern Sierra Nevada Diversity group. Within the action area, there are both “Core 1”, “Core 2”, and “Core 3” populations of CCV steelhead, as designated by NMFS Recovery Plan for the species (NMFS 2014). Core 1 populations include Battle Creek, Clear Creek, Deer Creek, Mill Creek, and Antelope Creek. Core 2 populations include Cow Creek, Mainstem Sacramento (below Keswick), Little Sacramento, Redding Area Tributaries, Putah Creek, Thomes Creek, Cottonwood/Beegum Creek, American River, Auburn Ravine, Feather River, Yuba River, Big Chico Creek, and Butte Creek. Core 3 populations are Stony Creek, Dry Creek, and Bear River.

Presence of sDPS Green Sturgeon in the Action Area

The Sacramento River is an important migratory corridor for larval and juvenile sturgeon during their downstream migration to the San Francisco Bay Delta and Estuary. Detailed information regarding historic and current abundance, distribution and seasonal occurrence of sDPS green sturgeon in the action area is limited due to a general dearth of sDPS green sturgeon monitoring. The action area is located on the main migratory route for adults moving upstream to spawn, post spawn adults migrating back to the ocean, juvenile outmigrants, and rearing subadults (NMFS, 2018). Juvenile sDPS green sturgeon are routinely collected at the CVP and SWP salvage facilities throughout the year. Based on the salvage records, sDPS green sturgeon may be present during any month of the year, and have been particularly prevalent during July and August. Adult sDPS green sturgeon begin to enter the Delta in late February and early March during the initiation of their upstream spawning run. The peak of adult entrance into the Delta appears to occur in late February through early April with fish arriving upstream in April and May. Adults continue to enter the Delta until early summer (June-July) as they move upriver to spawn. It is also possible that some adult sDPS green sturgeon will be moving back downstream in April and May through the action area, either as early post spawners or as unsuccessful spawners. Some adult sDPS green sturgeon have been observed to rapidly move back downstream following spawning, while others linger in the upper river until the following fall. It is possible that any of the adult or sub-adult sturgeon that inhabit the Delta may enter the American River.

2.4.3. Status of Critical Habitat within the Action Area

The Action Area encompasses areas along the Sacramento River from the Sacramento Bypass downstream to RM 45, the Yolo Bypass south the confluence of the Sacramento Bypass, the lower American River RM 11 downstream to the confluence with the Sacramento River, and other haul, access, and borrow sites associated with construction activities. Vessel traffic for construction material hauling may extend as far west as San Francisco in order to transport material to sites along the Sacramento River. Designated critical habitat for SR winter-run Chinook salmon (June 16, 1993, 58 FR 33212), CV spring-run Chinook salmon (September 2, 2005, 70 FR 52488), CCV steelhead (September 2, 2005, 70 FR 52488) and sDPS green sturgeon (October 9, 2009, 74 FR 52300) occur in the ARCF action area.

The PBFs of critical habitat essential to the conservation of SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead are physical habitat, water quality and quantity, available forage required to maintain habitat for spawning, larval and juvenile transport, rearing, and adult migration. PBFs for Chinook salmon and CCV steelhead within the action area include freshwater rearing habitat and freshwater migration corridors. The PBFs essential to the conservation of SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead include the following: sufficient water quantity and floodplain connectivity to form and maintain physical habitat conditions necessary for salmonid development and mobility, sufficient water quality, food and nutrients sources, natural cover and shelter, migration routes free from obstructions, no excessive predation, adequate forage, holding areas for juveniles and adults, and shallow water areas and wetlands. Habitat within the action area is primarily utilized for freshwater rearing and migration by CCV steelhead and Chinook salmon juveniles and smolts and for adult freshwater migration. CCV steelhead also utilize the parts of the American River within the action area for spawning habitat.

The PBFs essential to the conservation of sDPS green sturgeon are physical parameters needed for spawning, larval and juvenile transport, rearing, and adult migration. The action area includes the following sDPS green sturgeon PBFs: adequate food resources for all life stages; water flows sufficient to allow adults, subadults, and juveniles to orient to flows for migration and normal behavioral responses; water quality sufficient to allow normal physiological and behavioral responses; unobstructed migratory corridors for all life stages; a broad spectrum of water depths to satisfy the needs of the different life stages; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The substantial degradation over time of several of the PBFs in the action area has diminished the function and condition of the freshwater rearing and migration habitats in the area. The action area now only has rudimentary functions compared to its historical status. The channels of the lower Sacramento and American Rivers have been replaced with coarse stone riprap on artificial levee banks and have been stabilized in place to enhance water conveyance through the system. The extensive riprapping and levee construction has precluded natural river channel migrations. The natural floodplains have essentially been eliminated, and the once extensive wetlands and riparian zones have been "reclaimed" and subsequently drained and cleared for agriculture.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its value remains high for the conservation of CV spring-run Chinook salmon, SR winter-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Many of the factors affecting these species throughout their range are discussed in the Rangewide Status of the Species and Critical Habitat section of this opinion, and are considered the same in the action area. This section describes all factors that have resulted in the current state of critical habitats in the action area, particularly focusing on factors most relevant to the proposed action. During dry years, all out-migrating individuals from the Sacramento River and tributaries will travel through the action area, as this section is the bottleneck prior to opening into the Delta. During wet years, access to the Yolo Bypass allows fish to bypass the action area. The ARCF action area encompasses a very important portion of the remaining critical habitat for these species, and it is therefore critical to maintain the habitat functionality of what remains of the riparian corridors in the action area.

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs affecting listed salmonids in the action area. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices require peak flood discharges to be held back and released over a period of weeks to avoid overwhelming the flood control structures downstream of the reservoirs (i.e., levees and bypasses). Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize gravel and clean sediment from the spawning reaches of the river channel.

High water temperatures also limit habitat availability for listed salmonids in the lower Sacramento River. High summer water temperatures in the lower Sacramento River can exceed 72°F (22.2°C), and create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson 1982). In addition, water diversions for agricultural and municipal purposes have reduced in-river flows below the dams. These reduced flows frequently result in increased temperatures during the critical summer months which potentially limit the survival of holding/spawning adults, incubating eggs, emerging fry, and juvenile salmonids (Reynolds 1993). The elevated water temperatures compel many salmon juveniles to migrate out of the valley floor systems quickly and forgo adequate rearing time before summer heat creates temperatures unsuitable for salmonids. Those fish that remain either succumb to the elevated water temperatures or are crowded into river reaches with suitable environmental conditions.

Levee construction and bank protection have affected salmonid habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA cover. Individual bank protection segments of the overall proposed action typically range from a few hundred to a few thousand LF in length. Such bank protection generally results in two levels of impacts to the environment: (1) site-level impacts which affect the basic physical habitat structure at individual bank protection sites; and (2) reach-level impacts which are the cumulative impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach. Revetted embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat. Impacts at the reach level result primarily from halting erosion and eliminating riparian vegetation. Reach-level impacts which cause significant impacts to fishes are reductions in habitat complexity, changes to sediment and organic material storage and transport, reductions of primary food-chain production, and reduction in IWM and SRA habitat.

The use of rock armoring limits recruitment of IWM (i.e., from non-riprapped areas), and greatly reduces, if not eliminates, the retention of IWM once it enters the river channel. Riprapping creates a relatively homogeneous surface, which diminishes the ability of IWM to become securely snagged and anchored by sediment. IWM tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological functioning aspects are thus greatly reduced, because wood needs to remain in place to generate maximum values for fish and wildlife. Recruitment of IWM is limited to any eventual, long-term tree mortality and whatever abrasion and breakage may occur during high flows. Juvenile salmonids are likely being impacted by reductions, fragmentation, increased predation, and general lack of connectedness of remaining nearshore refuge areas.

Point and non-point sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within the action area. The effects of these impacts are discussed in detail in the Rangewide Status of the Species and Critical Habitat section. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (i.e., green sturgeon, (Klimley 2002)). Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high heavy metals concentrations may deleteriously affect early life-stage survival of fish in the Sacramento River (USFWS 1995). Principle sources of organic contamination in the Sacramento River are rice field discharges from Butte Slough, Reclamation District 108, Colusa Basin Drain, Sacramento Slough, and Jack Slough (USFWS 1995). Other impacts to adult migration present in the action area, including migration barriers, water conveyance factors, water quality, are discussed in the Rangewide Status of the Species and Critical Habitat section.

The transformation of the Sacramento River from a sinuous, meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes has resulted in homogenization of the river. These impacts include the removal of valuable pools and holding habitat for sDPS green sturgeon. In addition, channelization and removal of riparian vegetation and IWM have greatly reduced access to floodplain and off-channel rearing habitat. It has also diminished the quantity and quality of benthic habitat and the abundance of prey items in rearing, foraging, and holding habitats. A major factor in the decline of sDPS green sturgeon, and the primary reason for listing this species was the alteration of its adult spawning and larval rearing habitat in California's Sacramento River Basin (71 FR 17757, April 7, 2006).

Rapid reductions in flow create isolation or stranding within the existing Sacramento Weir stilling basin and bypass during rapid reductions in flow. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce. Juveniles seek slower flow habitat as resting stops when the bypass is inundated, which can cause high numbers of strandings. Adults will also seek deeper pools to avoid rapidly reducing flows and be caught within deeper pools and scour holes. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (Email communication, Shig Kubo June 21, 2019). Stranding within the weir stilling basin and Sacramento Bypass have been documented to occur every 10 years or so, and was most previously documented in 2023.

2.4.4. Mitigation Banks and the Environmental Baseline

While USACE is proposing on-site and off-site mitigation to offset impacts from the proposed action, mitigation bank credits may be purchased to offset impacts. There is currently one conservation bank approved by NMFS with a service area that includes the action area considered in this opinion. This bank occurs within critical habitat for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

North Delta Fish Conservation Bank: Established in 2013, North Delta Fish Conservation Bank is an 811-acre site located in Yolo County and is approved by NMFS to provide credits for impacts to SR winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are salmonid preservation and salmonid enhanced and created credits that are anticipated to be available prior to construction under the proposed action. All features of this bank are designated critical habitat for the species analyzed in this opinion.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.02).

The Proposed Action includes activities that are likely to adversely affect SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, sDPS green sturgeon, and their associated critical habitats. The following is an analysis of the potential effects to the species and their critical habitat that are reasonably certain to occur as a result of the implementation of this project.

Of the 43,000 LF of proposed erosion protection work along the Sacramento River, up to 32 acres of SRA and benthic habitats are expected to be degraded within the Action Area by construction of rock revetment or placement of other materials associated with site-specific designs. This calculation is based on measurements from the river's OHWM down to the end of the repair area that is expected to be degraded by construction activities. Similarly, of the 31,000 LF within the construction footprint along the lower American River, up to 28 acres of SRA and benthic habitats are expected to be modified or altered by construction activities. These acreages were derived from applying a uniform assumption, based on best available information, that impacts would occur 100 to 200 feet from the OHWM down into the wetted channel to where the rock placement ends. As stated in the USACE 2020 BA, the OHWM elevation is based on an 18,500 cfs 2-year reoccurrence interval flow scenario (determined from the Folsom Dam Water Control Manual period of record analysis). While these assumptions were used to estimate the extent of habitat impacts, actual site designs may vary. The accounting plan will verify that tracking of impacts as site designs are developed to ensure the level of adverse effects does not extend beyond what is analyzed here.

Ancillary to erosion protection, site-specific designs will aim to avoid or minimize effects to federally listed species and designated critical habitat to the extent feasible, and will implement on-site and off-site compensation actions as necessary to offset the loss of vegetated habitat along the rivers. Depending on the effects from erosion protection measures, a site design may incorporate various features to compensate for the loss of habitat. The sites will be designed in coordination with the resource agencies (NMFS and USFWS), in a manner to ensure the USACE is minimizing effects to listed species and critical habitat and maximizing on-site mitigation for each site.

2.5.1. Effects to Listed Fish Species

The Lower American River portion of the Action Area is a National Wild and Scenic River, and managed by the National Park Service. In an effort to allow the National Park Service to separate the effects analysis within this opinion between watersheds, effects that will occur within the Lower American River will be indicated within each section. For the majority of the effects described below, they are similar between the species unless addressed in a more species-specific manner.

Physical Disturbance

Physical disturbance effects are expected within the entirety of the Action Area, including the Lower American River.

Physical disturbance in aquatic habitat will occur during construction activities, such as placement of materials (rock, soils, etc.), which have the potential to affect the juvenile and adult life stages of salmonids and green sturgeon through displacement, disruption of their normal behaviors, and direct injury or death from crushing during rock placement.

Instream construction activities may cause mortality and reduced abundance of benthic aquatic macroinvertebrates within the erosion footprint, due to the placement of rock over the existing streambed. These effects to aquatic macroinvertebrates are expected to be long-term as permanent bank armoring alters the natural streambed (USFWS 2004). The amount of food available for adult and juvenile salmonids and green sturgeon in the Action Area is therefore expected to be permanently decreased in the areas where submerged riprap is being placed.

During construction activities, both juvenile and adult fish may be able to detect areas of active disturbance and avoid those portions of the project footprint where equipment is actively operated or a turbidity plume occurs, particularly adults. Juveniles may also stay and hunker down in the activity zone. Occasionally, feeding juvenile salmonids and green sturgeon may be attracted to activity stirring up sediment, but are generally expected to avoid areas disturbed by active equipment. Juveniles will have opportunities to move to other portions of the channel where they can avoid potential injury or mortality. Adult salmonids and green sturgeon are expected to move out of the area to adjacent suitable habitat before equipment enters the water, or before gravel or boulders are placed over them due to the disturbance caused by vibrations on land. Some level of injury and death from crushing by construction equipment and rock placement is expected due to the large scale of the project footprint, but will be reduced through avoidance and minimization measures.

Due to the large project footprint of this Proposed Action, it is expected that a small number of juveniles of each species will be injured or killed as a result of the physical disturbance and rock placement. Though adults are more likely able to avoid rock placement, a few adults will also likely be injured or killed due to the large scale of the Proposed Action.

Proposed O&M at the levees and Sacramento Weir will cause intermittent small-scale physical disturbance over the long-term. Small disturbances from levee O&M may cause localized behavioral disturbances resulting in temporary displacement. These are not expected to cause any injury or mortality to species.

Increased Turbidity and Suspended Sediment

Increased turbidity effects are expected within the entirety of the Action Area, including the Lower American River.

All activity within the Action Area with waterside repairs have the potential to temporarily increase turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is an effect of construction equipment disturbances and rock entering the river. Increased exposure to elevated levels of suspended sediments have the potential to result in physiological and behavioral effects on fish.

The severity of these effects depends on the extent of the disturbance, duration of exposure, and sensitivity of the affected life stage.

Salmonids have been observed avoiding streams that are chronically turbid (Lloyd 1987) or moving laterally or downstream to avoid turbidity plumes (Sigler et al. 1984). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). Less is known about the specific detrimental physical and physiological effects of sedimentation and turbidity to sturgeon. However, it is thought that high levels of turbidity can generally result in gill fouling, reduced temperature tolerance, reduced swimming capacity and reduced forage capacity in lotic fishes (Wood and Armitage 1997).

Elevated turbidity and suspended sediment levels have the potential to adversely affect salmonids during all freshwater life stages. Specifically, increased turbidity can clog or abrade gill surfaces, adhere to eggs, hamper fry emergence (Phillips and Campbell 1961), bury eggs or alevins, scour and fill in pools and riffles, reduce primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affect intergravel permeability and dissolved oxygen levels (Lisle and Eads 1991; Zimmermann and Lapointe 2005).

Fish behavioral and physiological responses indicative of stress include: gill flaring, coughing, avoidance, and increased blood sugar levels (Berg and Northcote 1985; Servizi and Martens 1992). Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995). Changes in turbidity and suspended sediment levels associated with water operations may negatively impact fish populations temporarily when deposition of fine sediments fills interstitial substrate spaces in food-producing riffles, reducing the abundance and availability of aquatic insects and cover for juvenile salmonids (Bjornn and Reiser 1991). Suspended solids and turbidity generally do not acutely affect aquatic organisms unless they reach extremely high levels (i.e., levels of suspended solids reaching 25 mg/L). At these high levels, suspended solids can adversely affect the physiology and behavior of aquatic organisms and may suppress photosynthetic activity at the base of food webs, affecting aquatic organisms either directly or indirectly (Alabaster and Lloyd 1980; Lloyd 1987; Waters 1995).

Increased turbidity can also affect fish by reducing feeding efficiency or success and stimulating behavioral changes. Sigler et al. (1984b) found that turbidities between 25 and 50 Nephelometric Turbidity Units (NTU) reduced growth of juvenile Coho salmon and steelhead, and Bisson and Bilby (1982) reported that juvenile Coho salmon avoid turbidities exceeding 70 NTUs. Turbidity likely affects Chinook salmon in much the same way it affects juvenile steelhead and Coho salmon because of similar physiological and life history requirements between the species. Newcombe and Jensen (1996) also found increases in turbidity could lead to reduced feeding rate and behavioral changes such as alarm reactions, displacement or abandonment of cover, and avoidance, which can lead to increased predation and reduced feeding. At high-suspended sediment concentrations for prolonged periods, lethal effects can occur. Juvenile salmonids are expected to be particularly susceptible to the effects of turbidity and predation.

Based on similar projects conducted by DWR and the USACE (i.e., levee repair work and placement of riprap), construction activities are expected to result in periodic increases in localized turbidity levels up to or exceeding 75 NTUs. In the past, levee protection work on the Sacramento River has produced turbidity plumes that travel for several hundred feet downstream of the activity. However, once construction stops, water quality is expected to return to background levels within a few hours, depending on how high the percentage of fines in the material are. Adherence to erosion control measures and avoidance and minimization measures will minimize the amount of disturbed sediment from construction activities and will minimize the potential for post-construction turbidity changes should precipitation events occur after construction has been completed.

Generally, we expect that most fish will actively avoid the elevated turbidity plumes when possible, during construction activity. For those fish that do not or cannot avoid the turbid water, exposure is expected to be brief (i.e., minutes to hours) and is not likely to cause injury or death from reduced growth or physiological stress. This expectation is based on the general avoidance behaviors of salmonids and the proposal to suspend construction when turbidity exceeds Central Valley Regional Water Quality Control Board standards (2020 USACE BA). Proposed O&M at the levees and Sacramento Weir will also cause intermittent small-scale increases in turbidity over the lifetime of the proposed action. Small increases in turbidity are expected to result in minor, brief localized behavioral disturbances, and not expected to cause any injury or mortality to species.

However, some juveniles that are exposed to turbidity plumes may be injured or killed by predatory fish that take advantage of disrupted normal behavior. Once fish move past the turbid water, normal feeding and migration behaviors are expected to resume. A low proportion of fish that are exposed to the area of increased turbidity are expected to be adversely affected by increased predation resulting in injury or death due to displacement and the lowered visibility caused by the suspended sediment.

Acoustic Impacts during Construction Activities

Acoustic effects are expected within the entirety of the Action Area, including the Lower American River.

Noise, motion, and vibrations produced by heavy equipment operation are expected at each site. The use of heavy equipment will occur outside the active channel, in addition to the infrequent, short-term use of heavy equipment in the wetted channel. Most listed fishes will be expected to move away and avoid interaction with instream machinery by temporarily relocating either upstream or downstream into suitable habitat adjacent to the worksite. As a result, we anticipate minimal localized effects to listed fishes from instream machinery acoustic impacts. Due to the large span of the project, the aggregated acoustic effects are expected to have adverse effects to a moderate proportion of fish in the area such that these effects may result in injury or death to a small number of listed fish.

The excavation and placement of rock below the waterline will produce noise and physical disturbance, which could displace juvenile and adult fish into adjacent habitats. Similarly, construction activities carried out in close proximity to the river channel have the potential to transfer kinetic energy through the adjoining substrates, disturb the water column, and cause behavioral changes to fish in the nearby area, resulting in increased predation and decreased feeding. These effects are expected to occur during construction activities and to cease once rock placement is completed.

Multiple studies have shown responses in the form of behavioral changes in fish due to human produced noise (Wardle et al. 2001, Slotte et al. 2004, Popper and Hastings 2009). Instantaneous behavioral responses may range from slight variations, a mild awareness, to a startle response. Fish may also vacate their normally occupied positions in their habitat for short or long durations. Depending on the behavior that is being disrupted, the short- and long-term negative effects could vary. Behavioral effects are likely to affect juvenile fish more than adults, as there are essential behaviors to their maturation and survival, such as feeding and sheltering, as adults generally use the action area only for migration and potentially spawning. Overall, construction could disrupt behavior in some instances, which may result in behavioral response leading to injury or death, but because the proposed timing of activities resulting in underwater noise disturbances would be high when the fewest fish and least sensitive life stages are present, effects would be minimal. Proposed operations and maintenance will cause intermittent small-scale increases in noise over the lifetime of the proposed action, but will also occur during windows where fish are unlikely to be present.

Acoustic Impacts during Pile-Driving Activities

Pile-driving activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Pile driving will occur both within the channel for cofferdam installation, and outside the channel for construction and monitoring efforts. Large posts will need to be driven to support walls of cofferdams, attach monitoring equipment to, and as supports for the Sacramento Weir. Piles that are driven into riverbed substrate propagate sound through the water, which can damage a fish's swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder (Gisiner 1998, Popper et al. 2006). The swim bladder is the primary physiological mechanism that controls a fish's buoyancy. A perforated or hemorrhaged swim bladder has the potential to compromise the ability of a fish to orient itself both horizontally and vertically in the water column. This can result in diminished ability to feed, migrate, and avoid predators. Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish's viscera (Gaspin 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings et al.1996). It is important to note that acute injury resulting from acoustic impacts should be scaled based on the mass of a given fish. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper and Hastings 2009). Fish can also be injured or killed when exposed to lower sound pressure levels for longer periods of time. Hastings (1996) found death rates of 50% and 56% for gouramis (*Trichogaster* sp.) when exposed to continuous sounds at 192 decibel (Db) (re 1 µPa) at 400 Hz and 198 dB (re 1 µPa) at 150 Hz, respectively, and 25% for goldfish (*Carassius auratus*) when exposed to sounds of 204 dB (re 1 μPa) at 250 Hz for 2 hours or less. Hastings (1995) also reported that acoustic "stunning," a potentially lethal effect resulting in a physiological shutdown of body functions, immobilized gourami within 8 to 30 minutes of exposure to the aforementioned sounds. While the effects to salmonids and sturgeon may not be identical, it is assumed that these effects would be similar for salmonids and sturgeon.

USACE proposes to implement Interim Criteria for Injury of Fish Exposed to Pile Driving Operations (Popper 2006). These criteria use a combined interim single strike criterion for pile driving received level exposure; a sound exposure level (SEL) of 187 dB re: 1 μPa^2•sec and a peak sound pressure of 208 dB re: 1 μPapeak as measured 10 m from the source. Using these criteria is expected to reduce the potential for permanent and lethal impacts to fish that are within the area and may be exposed to pile driving activities. Fish that are exposed to the area where pile driving is occurring are expected to be adversely affected by behavioral modification during increases in noise and vibration within the water column, including relocation/displacement. While this will be a short-term effect for most fish, some injury or mortality is expected to occur due to the use of pile driving over 5 or more construction seasons, and over such a large span of habitat. While pile-driving noise is expected to cause localized behavioral disturbances to a moderate number of fish, injury or lethal effects are expected to occur to only a few juvenile fish (of each species) each year for the course of project implementation.

Cofferdam Installation and Dewatering

Cofferdam installation and dewatering activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Installation of cofferdams may be necessary during construction of a small proportion of sites, though the exact number is uncertain because full designs are not completed for all sites. We assume no more than 50 percent of sites would need to use cofferdams, based on the information provided. Sites that may require cofferdams are generally sites that have soil being placed at low water areas to keep a more natural bank line or install a planting bench (as it is very difficult to place soil underwater). Cofferdams will be installed during the proposed work windows when fish will be less prevalent and would be in place for a single construction season. Cofferdams will remain closed during construction, eliminating the ability for fish to re-enter the area. Cofferdams will be either constructed of sand bags (placed by hand), or sheet pile (requiring pile driving, effects of which are described above), depending on the level of dewatering needed for construction.

Dewatering activities within the cofferdam areas would cause adverse effects to any fish isolated within the area. The amount of fish trapped within the area initially would be minimized with BMPs, but there is still the chance of a few juvenile fish being entrained within the cofferdam area. Dewatering activities pose the risk of increased turbidity, stress, desiccation, and possible impingement from pumping activity. Capture/relocation efforts are described below.

Fish that evade capture and remain within the cofferdam in the construction area would likely be injured or killed from construction activities. This includes desiccation if fish remain in the dewatered area or death if fish are crushed by personnel or equipment. However, because experienced biologists will be collecting fish, most are expected to be removed from the area before construction. While BMPs will reduce effects, injury and mortality of a few fish within each cofferdam are expected over the entirety of construction due to the large scale of this project over several years of construction.

Fish Capture and Relocation Effects

Fish capture and relocation activities and associated effects are expected within the entirety of the Action Area, including the Lower American River

Fish relocation may need to occur during implementation of the Proposed Action. Relocation will be needed during activities that require a cofferdam, and during rescue efforts within the Sacramento Weir. For cofferdam installation, fish will first be gently “herded” out of the area before any direct handling occurs. If fish cannot be herded, they will be collected using seining or dip netting. Any adults present are expected to move out of the area of activity and avoid capture. Juveniles are more likely to be entrained or isolated in the coffer dammed work areas and any that avoid herding, would require capture and relocation prior to dewatering and construction activities. Cofferdams will be constructed immediately after fish are “herded” out of the area, with netting continuing to occur as the area is dewatered.

Fish relocation activities pose a risk of injury or mortality since any fish relocation or collection gear has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish relocation varies widely depending on the method used, ambient conditions, and the experience of the field crew. Elevated air and water temperatures during handling may cause added fish stress and increased mortality. Potential sub-lethal temperature effects on juvenile salmonids include slowed growth, delayed smoltification, desmoltification, and extreme physiological changes, which can lead to disease and increased predation (Myrick and Cech 2004). Since fish relocation activities will be conducted by qualified fisheries biologists following NMFS guidelines, injury and death is expected to be minimized. As multiple relocations may need to occur each year throughout implementation of the Proposed Action, a small proportion of juvenile fish injury and mortality is expected to occur at each work site that requires relocation. Currently relocation efforts are expected at 1 to 2 sites on the Sacramento River, the Arden Pond site on the American River, and at the location for the new Sacramento Weir. Proposed operations and maintenance may require intermittent fish rescues over the lifetime of the proposed action. For example, if there is a debris blockage within the fishway, fish may need to be captured and relocated if the debris cannot be quickly removed to restore passage. Based on past occurrences, we expect a small number fish to be injured or killed during relocation efforts depending on the size of the stranding areas in intermittent years when those efforts occur.

Impingement

Impingement effects resulting from pumping activities are expected within the entirety of the Action Area, including the Lower American River.

Pumping activities are being proposed both for dewatering activities and for irrigation purposes during the Proposed Action construction and long-term maintenance and monitoring. Impingement is expected to occur when the approach velocity of a fish screen exceeds the swimming capability of a fish, creating substantial body contact with the surface of a fish screen.

Injury resulting from impingement may be minor and create no long-term harm to the fish, or result in injuries leading to mortality either immediately or at some time in the future after contact with the screen, including predation or infections from wounds and abrasions associated with the screen contact.

NMFS' screening criteria (NMFS 2023) will be followed for all pumping activities of the Proposed Action. The NMFS' criteria are such that they will reduce exposure time of fish to a screen and, therefore, the potential for impingement as fish move past it. Other aspects of the criteria include appropriate screen mesh sizing to prevent entrainment of juvenile salmonids. The efficacy of the screening criteria is untested on juvenile green sturgeon, however. As pumping activities will only be occurring in the action area which is on the downsteam area of the river system, larval green sturgeon are unlikely to be present and therefore exposure to pumping that will risk impingement or entrainment is extremely unlikely.

As the pumping activities will adhere to NMFS screening guidelines, injury to fish caused by impingement will be minimized. However, pumping activities may occur for several years during construction across large spans of the action area. A small portion of fish exposed to the pumping activities (small numbers) are expected to be injured or killed each year from impingement. Pumping activities will only occur during the initial planting period and are not proposed beyond the first 5 years of planting.

Stranding

Stranding effects are expected to occur within the Sacramento Weir and Bypass, and at Contract 4A on the Lower American River.

Rapid reductions in flow can adversely affect fish. Juvenile salmonids are particularly susceptible to isolation or stranding during rapid reductions in flow. Isolation can occur when the rate of reductions in stream flow inhibits an individual's ability to escape an area that becomes isolated from the main channel or dewatered (U.S. Fish and Wildlife Service 2006). The effect of juvenile isolation on production of Chinook salmon and steelhead populations is not well understood, but isolation is frequently identified as a potentially important mortality factor for the populations in the Sacramento River and its tributaries (Jarrett and Killam 2014; National Marine Fisheries Service 2009; U.S. Bureau of Reclamation 2008; U.S. Fish and Wildlife Service 2001; Water Forum 2005).

Juveniles typically rest in shallow, slow-moving water between feeding forays into swifter water. These shallower, low-velocity margin areas are more likely than other areas to dewater and become isolated with flow changes (Jarrett and Killam 2015). Accordingly, juveniles are most vulnerable to isolation during periods of high and fluctuating flow when they typically move into inundated side channel habitats. Isolation can lead to direct mortality when these areas drain or dry up or to indirect mortality from predators or rising water temperatures and deteriorating water quality.

Isolation is currently a potential stressor in the Sacramento Bypass. Juveniles seek slower flow habitat as resting stops when the bypass is inundated by higher flows. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (Shig Kubo 2019). The dependence of isolation risk on factors, such as rate of snowmelt and timing and rate of flood flows makes the quantification of stranding risk difficult. While stranding risk may be increased with the expansion of the Sacramento Weir and Bypass, the proposed fish passage facility is expected to increase the amount of adults able to return to the Sacramento River, and juveniles able to reach the Tule Canal.

As the new stilling basin is designed to drain fully, no stranding is expected to occur within it. However, stranding is possible within the less hardened areas of the new bypass and fish transport channel where some scour and elevation change may occur over time. Sacramento Weir O&M procedures include regular inspections and maintenance to identify and resolve potential stranding locations. Rescues will be performed by the USACE or DWR as often as conditions allow. Conditions that may not allow rescues include elevated flows or rain events that would make it dangerous for personnel to enter the bypass. Cases of stranding adults and juveniles of all species are still likely to occur for the life of this project structure due to the natural process of erosion and creation of deeper pools within the bypass.

The design of the fish passage facility is expected to minimize potential stranding risk within the bypass and allow a longer period of time for adults to make their way back into the mainstem river. The proposed changes to the existing Sacramento Weir stilling basin is expected to greatly reduce juvenile stranding within the current weir’s stilling basin. While the expansion of the bypass and weir may cause increased stranding risk, it is expected that the other aspects of the weir’s design and O&M activities will reduce impacts and minimize overall stranding within the bypass and stilling basin. Despite the expected fish passage improvements, a small number of juvenile and adult fish are still expected to be stranded, resulting in injury or death, related to the existence of the Sacramento Weir and associated levee systems surrounding the Sacramento Bypass.

Work associated with Contract 4A on the Lower American River includes the construction of a berm for the realigned Jedediah Smith Memorial Trail. The berm will result in the disconnection of a 5-acre area of an existing floodplain at periodic higher flow (AEP 1/9) above elevation at 28 NAVD88-ft. The entire existing floodplain area is known to potentially strand fish (Sacramento County Parks 2023). In order to address the existing drainage and stranding issue in this area it would be necessary to address both the elevation issues in the stormwater channel on the north of the site, and the floodplain depression at the center of the site. As it exists, there are numerous fish passage barriers such as debris and undercut culverts within the stormwater channel which prevent fish from returning to the American River. The American River Parkway Natural Resources Management Plan (Sacramento County 2023) identifies the need to address fish stranding, including this location. It is likely that stranding and passage within this floodplain area will be addressed holistically through a County restoration project in the future.

Construction of the berm is likely to reduce fish stranding during overtopping in the floodplain between elevation 28 NAVD88-ft, as it will separate the stormwater channel from the greater floodplain area. As flows recede, fish would be more likely to exit the floodplain area to the American River rather than the stormwater channel. While some fish may be stranded in the 5-acre area when elevations exceed 28 NAVD88-ft, it does not create a new stranding risk on this floodplain. It is expected that the construction of the berm will reduce stranding overall in the floodplain area. Continued stranding of a small number of juveniles is expected approximately every ten years, when the area is flooded, resulting in mortality of a small number of juvenile salmonids.

Chemical Contamination

Chemical contamination effects could occur within the entirety of the Action Area, including the Lower American River.

Equipment refueling, fluid leakage, concrete pouring, and maintenance activities within and near the stream channel pose some risk of contamination and potential impacts to listed fish species. Concrete work will be performed during certain aspects of the Project. Contact with uncured concrete may cause significant increase in the pH of the surrounding waters, negatively affecting aquatic life. Lime is a major component of cement and concrete work. It easily dissolves in water and drastically changes the pH of water increasing the alkalinity (pH 11-13), which causes burns on fish and kills other aquatic life. Project activities that cause concrete to contact water include raw concrete spills, disposal of concrete, dampening freshly laid concrete, and washing equipment. However, all projects will include the minimization measures outlined above in Section 1.3.15 Fisheries Conservation Measures, which address and minimize pollution risk from equipment operation. Therefore, water quality degradation from toxic chemicals associated with the rehabilitation projects is expected to be improbable. Chemical contamination effects could occur within the entirety of the Action Area, but is improbable and not expected to occur.

Increased Vessel Traffic in the Action Area

Effects resulting from construction-related increased vessel traffic are expected within the Sacramento River portions of the Action Area, but not within the Lower American River.

The proposed action would significantly increase vessel traffic during times where riprap is being transported to the construction sites. The impacts from construction-related vessel traffic may lead to mortality or may induce changes in behavior that impair feeding, rearing, migration, and/or predator avoidance. The Proposed Action requires barge usage to transport riprap from as far away as the San Francisco Bay up to and throughout the Action Area on the Sacramento River. The increase in barge traffic to the multiple erosion protection sites will concurrently increase the number of salmonids and green sturgeon that will have possible encounters with the propellers of the tugboats pushing the barges.

As construction operations will be occurring at times to avoid peak migration of all listed species, the interactions with the project-related barge traffic will be minimized to the extent possible. As barges will be traveling within the Delta and mainstem Sacramento Rivers, the channel width and depth should allow adult fish the opportunity to swim out of the path of the propellers and avoid injury. Smaller fish may not have the swimming capacity to evade the propeller and may be injured or killed. As barge trips could total up to 2,325 trips from the San Francisco area up to the action area and back down over a total of 5 years of construction, there will be an increased chance for injury or death to fish encountered in those areas. A small number of juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are expected to be injured or killed each year during the construction phases of the Proposed Action due to propeller strikes caused from proposed action barge traffic.

Fish Passage Facility Operations

Fish passage effects are expected to be limited to the Sacramento River and Bypass.

Operation of the proposed fish passage structure will provide improved connectivity for ESA-listed fish species to enter the Sacramento River from the Yolo Bypass. As the Sacramento bypass has had a historic occurrence of stranding both adult and juvenile fish (Johnston et al. 2020), the facility and connection of the fish passage channel to Tule canal is expected to reduce both adult and juvenile stranding. This enhanced connectivity should increase individual survival, as well as potentially increase spawning success of fish that migrate through the Yolo Bypass. While the fish passage facility is not likely to completely remedy the existing stranding occurrences along the Sacramento Weir and Bypass, it is expected to considerably improve conditions and greatly reduce stranding. As such, fish rescues are anticipated to be less of a need as a result of this project component.

The fish passage facility is designed to reduce the frequency and likelihood of stranding that has historically occurred on these types of fish passage structures. The slide gate closure may cause impingement in rare cases, but as the gates will only be closed at very low water levels, fish are expected to generally be able to swim away from the gates during closing. While cases may be low, because this facility is expected to be operated for the next 50 years or longer, it is expected that a small number of adults and juveniles would be impinged on a gate at the new fish passage facility over the life of the project.

Potential issues that may occur with the facility include gate failures, debris blockages, or other damage that may fail to allow the facility to operate as intended. While the proposed O&M actions are expected to resolve these issues, adverse effects to fish may occur in the time it takes for such issues to be safely corrected. In these types of situations, passage delays through the facility are expected. Delays may include adults and juveniles becoming stranded within the Bypass. Risks to juveniles in this situation include impingement on debris/blockage if the facility is clogged with debris, and possible stranding if the facility is not operating correctly (Gregory et al. 1992). These situations may cause death or severe injury when they occur. For adults delayed by malfunction of the facility, they may have an opportunity to turn around and attempt passage through the Fremont Weir if it is operating. If the blockage is not able to be cleared in a timely manner, it may cause severe delays in spawning, death, straying, or inability to reach spawning grounds. While these types of occurrences are not expected annually, the Sacramento River has a high debris load, so this type of blockage is likely to happen several times, resulting in injury or preventing spawning for small numbers of adult fish over the life of the project (50 years or longer).

USACE's proposed action includes the adaptive management of the facility in order to reduce adverse effects, and maximize passage. The adaptive management plan includes flexible operations of the gates in coordination with NMFS technical staff, and is not expected to have any additional effects to species other than those described above.

2.5.2. Effects to Designated Critical Habitat

Critical habitat has been designated within the Action Area for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The general PBFs of critical habitat within the Action Area are rearing and migratory corridors. Spawning habitat PBFs are present on the American river for CCV steelhead.

Placement of Riprap

Effects from Riprap placement activities are expected within the entirety of the Action Area, including the Lower American River.

The continual input of riprap into the Sacramento and American rivers will permanently degrade rearing and migration critical habitat PBFs in the system. Garland et al. (2002) found that juvenile salmonids are significantly less likely to be found in riprap habitats versus unaltered habitats. The study found that as substrate size decreased, likelihood of fish presence increased (until reaching sand substrate). Placement of riprap is expected to adversely affect the value of freshwater migratory and rearing habitat PBFs for juvenile salmonids and reduce the amount of accessible rearing habitat. Placement of riprap is also expected to adversely affect the amount of salmonid spawning habitat available within the American River. No spawning habitat is present within the Sacramento River portions of the Action Area. Placement of riprap will also reduce sediment quality for green sturgeon and change the substrate type or size in areas it is placed, which could reduce food availability and affect water quality and flow. Instream rock placement will cause impacts to rearing habitat quality from reduced abundance of benthic aquatic macroinvertebrates within the footprint of the repairs, due to the placement of rock over the existing streambed. Increased sediment size also creates more habitat for predators to hide and ambush prey from, causing an increase in juvenile predation. These effects to aquatic macroinvertebrates are expected to be long-term as permanent bank armoring alters the natural streambed (USFWS, 2004). The amount of food available for adult and juvenile salmonids and sturgeon in the Action Area is therefore expected to be permanently decreased (habitat quantity and quality) where submerged riprap is placed.

In some areas, riprap will be buried and formed into a launchable trench to protect the levee in case of future erosion. While this type of construction is not anticipated to have negative impacts on salmonid habitat initially, it is designed to launch rock down the bank to protect it in case of scour. These designs are intended to launch over the next 50 years, and vary in their durability to launch on a 10-year flood or higher flow in some scenarios. Due to expected changing water conditions from climate change (described in Section 2.6.5 below), high flow events are expected to occur more frequently, making the launching of these sites even more likely. Once launched, these sites will permanently lose exposed native soil, riparian vegetation, and native habitat function. This will cause permanent reduction in the quality of migratory and rearing habitat. As sites may span for long distances (over 1 mile), or back up right to another site to span several miles, this reduction in quality of habitat may substantially reduce food availability throughout the entirety of the action area.

Another form of rock protection being used is launchable toe rock. This rock, while buried mostly under the planting benches, is also designed to launch to protect the levee from scour. The launching of this type of stone is likely to result in the loss of some of the mitigation planting bench. As this bench is being created to offset the loss of habitat and create some relief habitat among riprap, it is of high value in a system that is so constrained by levees already. As these benches are being constructed to offset the impacts of habitat loss, the lack of durability of this mitigation is concerning. As it cannot be accurately determined at what future time this planting bench will be damaged from launchable rock, the overall long-term benefit of the mitigation becomes less certain. It is assumed that there will be some temporal benefits as opposed to without the bench, but no new habitat will be created and maintained permanently.

Within the Sacramento River, up to 32 acres of permanent degradation of salmonid and sturgeon critical habitat from riprap placement is expected. Within the lower American River, approximately 28 acres will have permanent habitat degradation due to rock placement. Due to the close proximity of all the sites, the degradation of rearing and migratory corridor habitat PBFs in the action area will result in reduced growth, reduced survival, and reduced fitness. While effects will be minimized by the use of BMPs such as soil-filled rock, replanting disturbed areas, and minimizing vegetation removal overall, USACE also proposes to mitigate unavoidable habitat impacts with a combination of on-site planting bench creation, off-site mitigation, or purchase of conservation bank credit.

Toxic Substance Spills

Toxic substance effects could occur within the entirety of the Action Area, including the Lower American River.

Operation of power equipment, such as an excavator, in or near aquatic environments increases the potential for toxic substances to enter the aquatic environment and have negative effects on ESA-listed anadromous fish species and designated critical habitat (Feist et al. 2011). Spills of toxic substances could negatively affect the freshwater migratory corridor and freshwater rearing habitat PBFs.

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential impacts to listed fish species. The Proposed Action includes the development of a hazardous materials spill prevention and countermeasures plan. The Proposed Action includes daily inspections of all heavy equipment for leaks. With inclusion of these measures, the potential effects from hazardous materials entering the aquatic environment and adversely affecting designated critical habitat are not expected to occur.

Loss of Riparian Habitat Functions and Vegetation

Degradation of rearing and migratory habitat will occur, resulting from riparian habitat loss within the entirety of the Action Area, including the Lower American River.

During the development of the Recovery Plan for Central Valley Chinook Salmon and Steelhead (NMFS 2014), loss of riparian habitat and instream cover was identified as a primary stressor affecting the recovery of the species. This threat primarily affects the juvenile rearing and outmigration life stage of these species, from the upper reaches of their watershed of origin through the Delta.

Woody debris and overhanging vegetation within shaded riverine aquatic habitat provide escape cover for juvenile salmonids from predators as well as thermal refugia. Aquatic invertebrates are dependent on the organic material provided by a healthy riparian habitat and many terrestrial invertebrates also depend on this habitat. Studies by the California Department of Fish and Wildlife (CDFW) as reported in NMFS (NMFS 1997) demonstrated that a significant portion of juvenile Chinook salmon diet is composed of terrestrial insects, particularly aphids which are dependent on riparian habitat.

The Proposed Action will remove and reduce riparian habitat within designated critical habitat for spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon in the Action Area. While not all SRA habitat will be disturbed during project activities, a significant portion is likely to be impacted. These modifications to designated critical habitat are expected to reduce the PBFs of rearing habitat (reduced quantity and quality, increased predation, reduced cover, and reduced benthic invertebrate production), and will also adversely affect the PBFs of migratory habitat by decreasing the habitat quality. Potential adverse impacts to PBFs of rearing habitat include reduced benthic invertebrate production, disrupted migration, and/or displacement (resulting in increased predation).

Impacts to rearing habitat and migratory corridor PBFs are expected to occur through reduced riparian vegetation, both temporary and permanent. Loss of riparian vegetation is expected to result from maintaining temporary access points to the river, and covering vegetation with gravel/rock. While vegetation removal will be minimized to the maximum extent possible, large-scale riparian vegetation removal will be needed throughout the course of the construction sequences. The impacts to rearing habitat and migratory corridor PBFs from loss of riparian habitat, including that which provides SRA functions, is expected to cause short- and long-term loss in quality habitat. Degraded SRA habitat will affect migrating and rearing fish through loss of food input, cover, and cooling from shade. This is expected to result in reduced feeding/growth, increased predation, and reduced survival. Unavoidable adverse effects will be compensated through a combination of on-site, off-site, and/or mitigation bank credit purchases.

Fish being exposed to the areas losing riparian habitat may be more susceptible to predators due to loss of cover and have changes to their food foraging behavior. Windell et al. (2017) focused on the growth and condition of juveniles as being affected by access to riparian habitats. Habitats that provide refuge from high water velocity or predators, without depleting food supply, function to increase growth rates by reducing energy demand to obtain a given food supply. Growth rate may then influence migration timing and success, where a higher growth rate is associated with earlier smoltification and faster downstream migration [increasing survival] (Beckman et al. 2007).

Impacts to existing vegetation will be avoided to the extent practicable. The loss of riparian vegetation may occur creating and maintaining temporary access points to the river, and placement of riprap or other bank armor. As the overall spatial aspect of the Proposed Action is extensive, the total loss of riparian vegetation is expected to be substantial. With the amount of vegetation potentially needing to be removed throughout such a long stretch of migratory corridor, the ability of the PBFs to support listed fish will diminish. Proposed O&M will cause intermittent small-scale removal of riparian vegetation to maintain maintenance roads over the lifetime of the proposed action. Proposed operations and maintenance will cause intermittent small-scale vegetation removal and trimming over the lifetime of the proposed action. Vegetation removal and trimming will only occur to maintain the access roads as described in the engineering designs for each site. No vegetation removal is anticipated beyond what is described in the proposed action.

Permanent habitat loss is expected to occur at sites where rock is being placed within existing riparian habitat and where rock is replacing or being added onto existing levee banks. On-site and off-site mitigation is proposed to offset impacts that are both temporary and permanent. Planned repair sites are spaced out, such that preferable rearing and migratory corridor PBFs are available between bank repair sites, providing support for listed fish. In areas where bank repair occurs for longer reaches, on-site planting benches will provide support for rearing and migratory habitat through the action area. Degradation of rearing and migratory corridor PBFs of critical habitat will occur, resulting from riparian habitat loss of up to 121 acres within the entirety of the Action Area.

Increased Mobilization of Sediment

Effects of sediment mobilization are expected to occur within the entirety of the Action Area, including the Lower American River.

All project sites with waterside repairs will have temporary increases in turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is expected to occur from construction equipment and rock entering the river. The deposition of sediment is expected to temporarily reduce food availability and feeding efficiency due to the natural substrate being coated with a new layer of sediment. Short-term increases in turbidity and suspended sediment levels associated with construction may negatively impact rearing habitat PBFs temporarily through reduced availability of food and reduced feeding efficiency. Short-term increases in turbidity and suspended sediment will also disrupt the ability of rearing habitat to support feeding fish resulting in avoidance or displacement from preferred habitat.

Incorporation of the BMPs described above in section 1.3.2.6 is expected to minimize the extent of adverse effects to critical habitat PBFs to a minimal level. Proposed operations and maintenance at levees and the Sacramento Weir will cause intermittent small-scale increases in turbidity over the lifetime of the proposed action. While small increases in turbidity may cause some short-term, localized disturbances to habitat resulting in temporary adverse effects, it is not expected to cause any long-term impacts resulting in adverse effects to critical habitat.

Acoustic Impacts

Effects of acoustic disturbance to critical habitat are expected within the entirety of the Action Area, including the Lower American River.

Impacts to freshwater rearing habitat and migratory corridor PBFs are expected to occur due to pile-driving activities. As a result, we anticipate some localized reduction in the quality of habitat within the Action Area during construction activities. Similarly, construction activities carried out in close proximity to the river channel have the potential to transfer kinetic energy through the adjoining substrates, disturb the water column, and temporarily generate increased turbulence and turbidity in the river (Kemp et al. 2011), affecting the ability of rearing and migratory PBFs to support fish.

Any excessive noise or vibrations may temporarily reduce usage of the habitat within the Action Area. Suitable habitat adjacent to the worksite either upstream or downstream will likely be less utilized if machinery noise is present. Critical habitat effects from noise, motion, and vibration are expected to be temporary and minimal. Proposed O&M will cause intermittent small-scale increases in noise over the lifetime (at least 50 years) of the proposed action. While small increases in noise may cause some localized behavioral disturbances, they are not expected to result in adverse effects to critical habitat PBFs.

Inaccessible Floodplain for Rearing

Inaccessible floodplain habitat effects are expected within the entirety of the Action Area, including the Lower American River.

The Proposed Action includes large-scale bank armoring within the Action Area. Bank armoring halts the meander migration and reworking of floodplains, which eventually reduces habitat renewal, diversity, complexity, and heterogeneity. This, in turn, has adverse effects on aquatic ecosystems, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling 2001; USFWS 2004). Riprapping decreases river sinuosity, which increases the river channel slope, increasing the bedload transport and possible bed degradation and scour near the toe of the riprapped bank (USFWS 2004).

Loss of floodplain habitat and loss of wetland function have been identified as primary stressors affecting the recovery of Central Valley salmonid species (NMFS 2014), and green sturgeon

(NMFS 2018). This threat primarily affects the PBFs of juvenile rearing and outmigration life stage of these species, from the upper reaches of their watershed of origin through the Delta. Effects of the action that contribute to the Loss of Floodplain Habitat are likely to result in a probable change in fitness of reduced growth and/or reduced survival probability.

Although riverine floodplains support high levels of biodiversity and productivity, they are also among the most converted and threatened ecosystems globally (Opperman et al. 2010). In California, more than 90% of wetlands have been lost since the mid-1800s (Hanak et al. 2011, Garone 2013). Loss of Floodplain Habitat within the Central Valley is a result of controlled flows and decreases in peak flows, which have reduced the frequency of floodplain inundation resulting in a separation of the river channel from its natural floodplain. Channelizing the rivers and Delta has also resulted in a loss of river connectivity with the floodplains that otherwise provide woody debris and gravels, that aid in establishing a diverse riverine habitat, and that provide juvenile salmonid rearing habitat.

The importance of connectivity for juvenile Chinook salmon to floodplain rearing habitat has been observed in several river systems. Research on the Yolo Bypass, the primary floodplain on the lower Sacramento River, indicates that floodplains are key juvenile rearing habitats supporting significantly higher drift invertebrate consumption and therefore faster growth rates (Sommer et al. 2001, Katz et al. 2017). Otolith microstructure studies near the City of Chico recorded increased fall-run Chinook salmon growth, higher prey densities, and warmer water temperatures in off-channel ponds and non-natal seasonal tributaries compared to the main-channel Sacramento River (Limm and Marchetti 2009). Research of juvenile Chinook salmon on the Cosumnes River noted that ephemeral floodplain habitats supported higher growth rates for juvenile Chinook salmon than more permanent habitats in either the floodplain or river (Jeffres et al. 2008). This growth is important to first year and estuarine survival, factors that may be key influences of a Chinook cohort's success (Kareiva et al. 2000).

The Proposed Action will extend the useful life of over 20 miles of levees within listed species critical habitat, continuing blocking of access to historic floodplain rearing habitat PBFs. Although the proposed repairs include compensatory mitigation for permanent impacts at each repair site, extending the useful life of levees in the Action Area results in continued degraded quality and quantity of rearing habitat PBFs for juveniles.

Beneficial and Compensatory Effects of Proposed Mitigation Activities

Beneficial and compensatory effects of proposed mitigation effects are expected within the entirety of the Action Area, including the Lower American River.

The Proposed Action includes several aspects that will either restore lost habitat on-site, create new habitat off-site, or otherwise improve habitat for salmonids and green sturgeon. While many of these aspects will require construction and have impacts described above, there will be benefits to the habitat as well. The associated timing of the different aspects of mitigation proposed in the BA are planned to minimize temporal effects. As described above in section 2.1.1 Compensation Timing, reducing impacts ensures a single generation is not exposed to project effects multiple times in their lifetime. Ensuring that the riparian vegetation within migration corridors are returned to a functional level prior to, or within a few years of impacts occurring, ensures that fish exposed to impacts as juveniles, will not be exposed again as returning adults, which could compound the effects and significantly reduce growth and survival.

Planting benches with woody riparian vegetation and lower Tule vegetated benches are being included with the proposed action design when space within the levee prism (entirety of the levee) allows for it. These benches will allow for functional habitat within the levee repair, alleviate some of the effects of the riprap placement, and reduce the overall loss of riparian vegetation. This can provide improved PBFs, when compared to a bare rock slope alternative, for migratory corridor and juvenile rearing.

Beyond the on-site replanting, local mitigation sites are being proposed to compensate for unavoidable permanent effects. The ARMS location being proposed is converting a mine pit into accessible floodplain habitat that will be used for juvenile rearing and migration. This site will create 66 acres of high-quality salmonid habitat that was previously inaccessible. The SRMS location will create 20 acres of habitat containing tidal channels and wetlands that will be used for juvenile rearing and migration.

While designs are not yet final, effects of construction based on the bounds of the described sites can be anticipated. Returning a large site to floodplain habitat can be expected to cause localized increases in turbidity during excavation and grading activities, increased noise, potential cofferdam placement, and other activities as described above. As the sites are likely going to be dry during construction, effects to critical habitat are expected to be temporary and minimal.

Another component of the USACE mitigation proposal is a research grant in the sum of $5 million. This grant funds the on-going green sturgeon research at UC Davis to determine juvenile screening criteria, and begin the process of developing adult green sturgeon passage criteria. By determining accurate juvenile screening criteria, juvenile migratory habitat will greatly increase in safety, as pumping activities will not cause as high of a risk for rearing and migratory corridor PBFs. Being able to accurately determine successful passage mechanisms will increase the PBFs for passage and adult migration by ensuring proper criteria and minimizing delays to migration.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation [50 CFR 402.02]. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4).

2.6.1. Water Diversions and Agricultural Practices

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the California Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, their tributaries, and the Delta, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous species (Mussen et al. 2013, 2014). In 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). More recent data show that over 95 percent of the now over 3,700 water diversions on the Sacramento and San Joaquin rivers, their tributaries, and the Delta, remain unscreened (CalFish 2019). The impacts from unscreened water diversions have improved due to the anadromous fish screen program, part of CVPIA, as well as DWR's fish screening program (Meier 2013). While private irrigation diversions in the Delta are mostly unscreened, the total amount of water diverted onto Delta farms has remained stable for decades (Culberson et al. 2008). A study of a dozen unscreened diversions in the Sacramento River, all relatively deep in the channel, reported low entrainment for listed salmonids and steelhead (Vogel 2013).

Agricultural practices may negatively affect riparian and wetland habitats through upland modifications that lead to increased siltation or reductions in water flow in stream channels flowing into the action area, including the Sacramento River, Stanislaus River, San Joaquin River, and Delta. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed fish species by increasing erosion and sedimentation. These practices introduce nitrogen, ammonia, and other nutrients into the watershed, which then flow into receiving waters (Lehman et al. 2014). Ammonia introduction from agricultural activities can be additive with much larger sources, such as wastewater treatment discharges.

Salmonids and sturgeon exposure to contaminants is inherent in the Delta, ranging in the degree of effects. Stormwater and irrigation discharges related to agricultural activities contain numerous pesticides, herbicides, and other contaminants that may disrupt various physiological mechanisms and negatively affect reproductive success and survival rates of listed anadromous fish (Dubrovsky 1998, Scott and Sloman 2004, Whitehead et al. 2004, Scholz et al. 2012). Agricultural operations outside the action area can result in discharges that flow into the action area and contribute to cumulative effects of contaminant exposure. The State of California issues waste discharge requirements to dischargers, including irrigators, dairy operations, and cattle operations, that require the implementation of best management practices designed to protect surface water quality, with benefits for listed fish species. Agricultural operations have monitoring and reporting requirements associated with those waste discharge requirements that ensure compliance with best management practices.

2.6.2. Increased Urbanization and Municipal Water Treatment

California's current population is approximately 39.1 million people. California's population declined during the COVID-19 era, with the largest decrease during the first year (-0.75 percent in fiscal year 2020–2021). Despite the effect of COVID-19, the California Department of

Finance projects that California's population will increase to 40.2 million in 2044, and then decrease to 39.6 million by 2060 (California Department of Finance 2023). The increase between now and 2044 will likely be accompanied by increases in urbanization and housing developments. The Delta, East Bay, and Sacramento regions include portions of Alameda, Sacramento, San Joaquin, Solano, Stanislaus, Yolo, and Yuba counties. Population growth rate was highest in Yuba County (0.76 percent; California Department of Finance 2023).

Increases in urbanization and housing developments can impact habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads, highways, and public utilities. Some of these actions, particularly those situated away from waterbodies, will not require federal permits and thus will not undergo review through ESA section 7 consultations.

Negative effects on listed fish species and their critical habitats may result from urbanization-induced point and non-point source chemical contaminant discharges within the action area. These contaminants, which include, but are not limited to, ammonia and free ammonium ion, numerous pesticides and herbicides, and oil and gasoline product discharges, may disrupt various physiological mechanisms and may negatively affect reproductive success and survival rates of listed anadromous fish (Dubrovsky 1998, Scott and Sloman 2004, Whitehead et al. 2004, Scholz et al. 2012).

Wastewater treatment plants have received special attention because of their discharge of ammonia into the Sacramento River. The EPA published revised national recommended ambient water quality criteria for the protection of aquatic life from the toxic effects of ammonia in 2013. However, few studies have been conducted to assess the effects of ammonia on Chinook salmon, steelhead, or sturgeon. Studies of ammonia effects on various fish species have shown numerous effects, including membrane transport deficiencies, increases in energy consumption, immune system impairments, gill lamellae fusions deformities, liver hydropic degenerations, glomerular nephritis, and nervous and muscular system effects leading to mortality (Eddy 2005, Connon et al. 2011).

Werner et al. (2008, 2009, 2010) analyzed the acute effects of Sacramento Regional Wastewater Treatment Plant effluent on Delta smelt, rainbow trout, and fathead minnow. The studies found that at ammonia/um concentrations reported downstream of the discharge, on average below 1 milligrams per liter ammonia/um, lethal toxicity effects are not expected. In general, this lack of toxicity was attributed to the fact that the lethal concentration at which 50 percent of individuals exposed die (i.e., LC50 values) was much higher than ammonia concentrations reported in environmental sampling. However, the studies did not assess sublethal toxicity. Sublethal ammonia toxicity at concentrations similar to what had been reported downstream of Sacramento Regional Wastewater Treatment Plant (less than 1 milligrams per liter) has been demonstrated in fish. In a study of coho salmon and rainbow trout exposed to ammonia, Wicks et al. (2002) showed a decrease in swimming performance due to metabolic challenges and depolarization of white muscle, and found that ammonia was significantly more toxic for active fish. Furthermore, fish exposed to sublethal concentrations of ammonia/um have exhibited increased respiratory activity and heart rate, loss of equilibrium, and hyper-excitability (Eddy 2005). None of these studies assessed the chronic effects of ammonia/um exposure that may occur at lower concentrations on the behavior, reproduction, or long-term survival of ESA-listed or surrogate species. However, Werner et al. (2009) concluded that “ammonia/um concentrations detected in the Sacramento River below the Sacramento Regional Wastewater Treatment Plant are of concern with respect to chronic toxicity to Delta smelt and other sensitive species.”

The Sacramento Regional Wastewater Treatment Plant, in order to comply with Order no. R5-2013-0124, began implementing compliance measures to reduce ammonia discharges. Construction of treatment facilities for three major projects required for ammonia and nitrate reduction was initiated in March 2015 (Sacramento Regional County Sanitation District 2015). The order was modified in October 2013 by the Central Valley Regional Water Quality Control Board to impose new effluent limitations, requiring effluent limits for ammonia of 2.0 milligrams per liter per day from April to October, and 3.3 milligrams per liter per day from November to March (Central Valley Regional Water Quality Control Board 2016). However, the board concluded that compliance with these effluent limitations was not feasible, and put the plant in non-compliance with the ammonia final effluent limitations. In September 2020, the Sacramento Regional Wastewater Treatment Plant requested a Time Schedule Order to extend the compliance schedule to allow additional time to complete upgrades to the Facility. Time Schedule Order R5-2020-0904 was issued on December 4, 2020, which provided a schedule to achieve compliance with final effluent limitations for ammonia by June 1, 2022 (Central Valley Regional Water Quality Control Board 2020). As of spring 2023, the Sacramento Regional Wastewater Treatment Plant completed extensive upgrades, and the treatment process now removes 99 percent of ammonia.

2.6.3. Non-Federal Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur throughout the action area. For example, most of the levees have roads on top of the levees that are maintained either by the county, reclamation district, owner, or by the state. Landowners may utilize and modify roads at the top of the levees to access part of their agricultural land. The effects of such actions result in continued fragmentation of existing high-quality habitat, and conversion of complex nearshore aquatic to simplified habitats that affect salmonids in ways similar to the adverse effects associated with this project.

2.6.4. Global Climate Change

Warming attributed to climate change is expected to affect Central Valley anadromous salmonids and sDPS green sturgeon more than it already has. Because the Central Valley salmon, steelhead, and green sturgeon runs are restricted to low elevations as a result of impassable dams, if the climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon and sDPS green sturgeon populations can persist (Williams 2006, NMFS 2018). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951 to 1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the Central Valley are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats can support salmonid life stages. Projected 33 percent salinity increases in the Sacramento river basin in the 21st century due to climate change may result in declining habitat quality and food web productivity; climate change will alter the salinity and prey base in sDPS green sturgeon juvenile rearing habitat and adult migration corridors (CH2M HILL 2014, NMFS 2018).

There is also a high threat posed by altered water temperatures due to climate change. In the Sacramento river basin, climate change models predict increased air temperatures in the Central Valley and surrounding mountains (Ficklin et al. 2012), altered precipitation patterns with a higher frequency of dry years, reduced spring snowpack, and reduced spring flows (Knowles and Cayan 2002, CH2M HILL 2014). Water temperatures in the Sacramento river basin could also increase (CH2M HILL 2014). A warming climate with continued changes in precipitation patterns may influence reservoir operations and thus influence water temperature and flow that fish experience in the Central Valley.

Growth and survival rates of salmon in the California Current off the Pacific Northwest can be linked to fluctuations in ocean conditions related to Pacific Decadal Oscillation and the El Nino-Southern Oscillation conditions and events, as well as the recent northeast Pacific marine warming phenomenon (also known as "the blob"; Wells et al. 2008, Peterson et al. 2017). Evidence exists that suggests early marine survival for juvenile salmon is a critical phase in their survival and development into adults.

In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Feely 2004, Brewer and Barry 2008, Osgood 2008, Turley 2008, Abdul-Aziz et al. 2011, Doney et al. 2012). Some of these changes, including an increased incidence of marine heat waves, are likely already occurring, and are expected to increase (Frolicher et al. 2018).

The correlation between various environmental indices that track ocean conditions and salmon productivity in the Pacific Ocean, both on a broad and a local scale, provides an indication of the role they play in salmon survival in the ocean. Moreover, when discussing the potential extinctions of salmon populations, climate patterns would not likely be the sole cause, but could certainly increase the risk of extinction when combined with other factors, especially in ecosystems under stress from humans (Francis and Mantua 2003).

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

Summary of the Status of the Species, Environmental Baseline and Cumulative Effects

The viability of the SR winter-run and CV spring-run Chinook salmon, and CCV steelhead ESUs have deteriorated in recent years (NMFS 2016; Johnson et al. 2023). The largest impacts are likely due to the 2012-2015 and 2020-2022 freshwater drought conditions and unusually warm ocean conditions experienced by these cohorts. The ESUs continue to face significant, unyielding threats that are likely to be exacerbated by the impacts of future climate change (Crozier et al. 2019). Based on the current 5-year reviews and more recent data, the ESUs remains at a moderate to high risk of extinction (Johnson et al. 2023, NMFS 2024a, NMFS 2024b). In the action area, water diversions/agriculture, fish hatcheries, and urbanization will continue to affect listed salmon ESUs and the green sturgeon DPS.

Salmon, steelhead, and green sturgeon use the action area as an upstream and downstream migration corridor and for rearing. Within the action area, the essential features of freshwater rearing and migration habitats for salmon, steelhead and green sturgeon have been transformed from a meandering waterway lined with a dense riparian vegetation, to a highly leveed system under varying degrees of constraint of riverine erosional processes and flooding. Levees have been constructed near the edge of the river and most floodplains have been completely separated and isolated from the Sacramento River. Severe long-term riparian vegetation losses have occurred in this part of the Sacramento River, and there are large open gaps without the presence of these essential features due to the high amount of riprap. The change in the ecosystem as a result of halting the lateral migration of the river channel, the loss of floodplains, the removal of riparian vegetation, contribution from the riparian vegetation into the aquatic system, and IWM have likely affected the functional ecological processes that are essential for growth and survival of salmon, steelhead and green sturgeon in the action area.

Summary of the Effects of the Proposed Action to Listed Species

Effects of the levee repair on aquatic resources included both short- and long-term impacts. Short-term impacts are those that will occur annually during construction activities to build and repair features, including:

- Physical disturbance: a small number of juveniles of each species will be injured or killed as a result of the physical disturbance and rock placement. Though adults are more likely able to avoid rock placement, a few adults will also be injured or killed due to the large scale of the Proposed Action.
- Increased turbidity: exposure to increased sedimentation and turbidity is expected to be brief and not likely to result in direct mortality but may result in behavioral effects increasing susceptibility to predation.
- Acoustic impacts: a moderate number of fish are expected to be exposed to acoustic noise resulting in localized behavioral disturbances. Injury or lethal effects are expected to occur to a few juvenile fish of each species each year for the course of construction.
- Dewatering and fish relocation: Injury or mortality is expected for a small number of fish related to cofferdam dewatering, pump impingement, and handling/relocation stress.
- Impingement: A small number of juvenile fish exposed to pumping activities for site irrigation are expected to be injured or killed each year from impingement.
- Barge traffic: exposure to increased barge traffic will result in small numbers of each species to be injured or killed each year due to propeller strikes.

Long-term impacts are those which will continue into the future following completion of construction, including:

- Continued blockage to the floodplain: extending the useful life of over 20 miles of levees within listed species critical habitat will continue blocking access to historic floodplain rearing habitat resulting in continued degraded quality and quantity of habitat for juveniles, contributing to reduced growth, survival, and fitness of the species.
- Stranding: a small number of fish are expected to be stranded at the Sacramento Weir/Sacramento Bypass and the berm located at contract 4A on the Lower American River, resulting in injury or death.
- Long-term operations and maintenance: a small number of juvenile and adult fish may experience migration delays, injury, or death related to the operations and maintenance of the Sacramento Weir fish passage structure.

As described above, the risk to SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon posed by the proposed action is evaluated in the aggregate context of the species' status, the environmental baseline, cumulative effects, and effects from other activities that would not occur but for the Proposed Action and also reasonably certain to occur. As the Sacramento River portion of the Action Area is the main migratory corridor for all of the species' established populations in the Sacramento River watershed, any reduction in habitat quality can be highly detrimental to the ESUs. The Action Area is the migratory corridor that is used by both adults and juveniles, and continued blockage of access to historical floodplain habitat is a stressor that will be reinforced by the implementation of proposed action.

Summary of the Effect of the Proposed Action to Critical Habitat

Within the action area, the general relevant PBFs of the designated critical habitat for listed salmonids are spawning habitat, migratory corridors, and rearing habitat, and for green sturgeon, the six PBFs include food resources, water flow, water quality, migratory corridor, depth, and sediment quality.

As described in the project description, this consultation analyzed a number of repair designs, which involve vegetation removal, bank fill stone protection installation of rock revetment, and potentially limited replacement of on-site habitat features, resulting in loss of SRA habitat and IWM at the project sites. These actions are expected to temporarily or permanently reduce the quality of habitat for rearing and migrating juvenile salmonids, due to the removal of SRA habitat and IWM. SRA habitat and IWM are important for rearing and out-migrating juvenile salmonids, because they enhance the aquatic food webs and provide high-value feeding areas for juvenile salmonids. Removal of SRA habitat and IWM is expected to temporarily reduce the growth and survival for juvenile salmonids exposed to the project sites.

Similarly, SRA habitat and IWM are critical in providing shade and cooling water temperatures for salmonids. Therefore, the removal of SRA habitat and IWM associated with the repairs will degrade freshwater rearing and migratory corridors for listed salmonids by temporarily increasing temperatures. The removal of IWM will also increase the risk of predation for juvenile salmonids. The Proposed Action further perpetuates the confinement of rivers within their banks, reducing river connectivity with adjacent floodplains, which serve as optimal rearing habitat. The severity of these effects and whether they are temporary or permanent is dependent on the repair type chosen at each site.

Green sturgeon PBFs of food resources are expected to be adversely affected by the proposed program, as program features will cover the soft benthic substrate where green sturgeon forage for food with riprap, reducing food availability. The lack of scientific information regarding bank protection actions on green sturgeon makes the extent of effects difficult to quantify. Ongoing efforts through the green sturgeon HMMP will develop methodology for quantifying and mitigating these effects.

Up to 65.5 acres of permanent degradation of salmonid and green sturgeon critical habitat from riprap placement is expected. This will result in reduced growth, reduced survival, and reduced fitness of the species. Permanent habitat loss is expected to occur at sites where rock is being placed within existing riparian habitat and where rock is replacing or being added onto existing levee banks. Degradation of rearing and migratory corridor PBFs of critical habitat will occur, resulting from riparian habitat loss of up to 65.5 acres within the entirety of the Action Area.

Based on the proposed action, unavoidable impacts will be offset/mitigated at no less than a 1:1 ratio for each acre impacted.

Risk to the ESU/DPSs and Critical Habitats at the Designation Level

Based on reach-specific analysis of long-term project-related impacts to each analyzed species we determine that there will be appreciable adverse effects to each species in nearly all reaches and water surface elevations. Adverse effects at various water surface elevations, regions, and life stages are expected to last in many cases for several decades, affecting a high proportion and multiple generations of the species analyzed in this opinion.

Most of the effects are related to long-term impacts to riparian habitat and IWM, as well as the continued lack of access to floodplain habitat. The perpetuating effects of the USACE Levee Vegetation Policy and riprap placement are clearly driving those effects.

Depending on final site designs, the effects of the proposed action could exacerbate stressors/threats to SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Through conscientious design in coordination with NMFS and the mitigation procedures included in the proposed program, these impacts are expected to be minimized, with unavoidable impacts mitigated. Considering that site-specific actions will occur along primary migratory corridors of the Sacramento River, we expect that all Sacramento River Basin populations of these species have the potential to be exposed and adversely affected by program actions. With the nature and potential duration of the effects, we expect the proposed action to temporarily reduce the productivity of a portion of each species exposed to a project site during construction for the first five years as revegetation occurs. However, based on the proposed action, unavoidable impacts will be mitigated, such that the project is not expected to reduce appreciably the likelihood of both the survival and recovery of the species, nor appreciably diminish the value of designated critical habitat as a whole for the conservation of the species.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, sDPS North American green sturgeon or destroy or adversely modify their designated critical habitat.

2.9. Incidental Take Statement

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1. Amount or Extent of Take

While individual fish are expected to be present in the Action Area at the time of construction, and during seasonal rearing and migration, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the proposed action. This is due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the Action Area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of habitat disturbance, which includes the loss of SRA cover and riparian habitat through the placement of rock revetment and removal of vegetation. This degradation is expected to result in reduction in the growth and survival of individuals from predation, or by causing fish to relocate and rear in other locations and reduction of the quantity and quality of the existing habitat.

Incidental take, in the form of harm resulting in behavioral modifications or fish responses to habitat disturbance are described as follows. Increased predation (decreased survival) is expected to occur during the construction phase due to construction-related disturbance and shoreline activity. Long-term behavioral modifications and increased predation vulnerability resulting from loss and degradation of shoreline riparian habitat and shallow water habitat is also expected to occur throughout the life of the levee. Quantification of the number of fish exposed to noise, shoreline activities, and increases in predation vulnerability is not currently possible with available monitoring data. Observations of individual fish within the river channel are not possible due to water clarity and depth. However, all fish passing through or otherwise present in the Action Area during construction activities or over the long term during their adult and juvenile rearing and migratory life history stages will be exposed to the disturbed shoreline habitat created by the rehabilitation sites. Thus, the footprint of each rehabilitation site defines the area in which projected incidental take will occur for this project due to the effects of construction actions and the long-term habitat disturbance associated with each site. NMFS anticipates incidental take will be limited to the following:

1) Harm to rearing and migrating juveniles is expected within the project footprint for areas below the OHWM due to rock placement within the channel. Rock placement is expected to result in injury or death to a small number of juvenile fish each year in the action area where riprap placement is occurring below OHWM. Harm to rearing juvenile SR winter-run, CV spring-run Chinook salmon, and CCV steelhead, and adult and juvenile green sturgeon from the repair will be limited to a total habitat impact of 65.5 acres below the OHWM. Therefore, anticipated take will be exceeded if rock placement below the OHWM exceeds 31.4 acres within the Sacramento River projects area (mouth of the American River down to the bottom of the action area), 27.61 acres within the American River, or 6.5 acres within the Sacramento Weir and Bypass.

2) Harm to rearing juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon from increased turbidity in the footprint of the proposed project from construction activities, extending upstream and downstream 1,000 feet from the footprint of each individual site and 100 feet from the extent of the repair into the river channel. This disturbed habitat will affect the behavior of fish, including displacement, which is reasonably certain to result in increased predation, decreased feeding, and increased competition. Quantification of the number of fish exposed to turbidity is not currently possible with available monitoring data. Observations of individual fish within the river channel are not possible due to water clarity and depth. However, all fish passing through or otherwise present during construction activities at the rehabilitation sites will be exposed to construction related turbidity events, particularly when the turbidity curtains are removed. Thus, the waterside footprint of each rehabilitation site plus the additional area of river channel where turbidity effects are expected to be observed defines the area in which projected take will occur for this project due to the effects of construction related turbidity. Anticipated take will be

exceeded if turbidity measured 1,000 feet downstream of the extent of the site exceeds double the upstream of site turbidity measurement.

3) Take in the form of harm, injury and death to listed fish, is expected due to pile driving. Activities will affect adults and juveniles through direct stress, injury, or death. Activities would also cause harm through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if the single strike criteria exposure; a SEL of 187 dB re: 1 μPa^2•sec and a peak sound pressure of 208 dB re: 1 μPapeak as measured 10 m from the source is exceeded.

4) Take in the form of harm, injury and death to listed fish, is expected due to dewatering, fish capture, and relocation activities. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if an excess of 2% of a species of fish handled annually are directly killed due to dewatering, capture and relocation activities.

5) Take in the form of harm, injury and death to listed fish, is expected due to fish impingement during pumping activities for riparian irrigation. Activities will affect juveniles through increased stress, injury, or death. Harm from stress or injury is also expected to cause displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if pumping activities occur outside the timeframes indicated below, or above the amounts of water indicated in Table 3.

Table 3 Estimated Maintenance Schedule for Riparian Habitat.

Monitoring Year	**Watering** (Years 1 & 2: March 15 – November 15) (Year 3 – 5: April 1 – October 31)
Year 1	50 gallons per plant or 3-inches of spray applied precipitation every 10 to 14 days
Year 2	30 gallons per plant or two inches of spray applied precipitation every week to 10 days
Years 3 - 5	10 gallons per plant or one inch of spray applied precipitation twice a week

6) Take in the form of injury or death to adults and juvenile CV spring-run, Sacramento River winter-run Chinook salmon, CCV steelhead, and sDPS green sturgeon due to stranding on the declining hydrograph within the 660 acres of the widened bypass. This take is expected to occur when flows are at or above the 2-year flow level, following the spilling of river water and as the flood flows recede stranding these species in the Sacramento Bypass. Anticipated take will be exceeded if stranding of any fish occurs more than every two years within the expanded side of the bypass.

7) Take in the form of harm, injury and death to listed fish, is expected due to fish rescue and relocation within the expanded Sacramento Bypass. Stranding will affect juveniles and adults through increased stress, injury, or death, including from attempted relocation. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if an excess of 2% of a species of fish handled annually are killed due to handling subsequent to stranding.

8) Take in the form of harm, injury and death to listed fish, is expected due to increased barge traffic in the Sacramento River. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if total barge trips exceed 2,325 round trips through construction activities.

9) Take in the form of harm, injury and death to listed fish, is expected due to fish passage gate closure at the Sacramento Adult Fish Passage Facility. Activities will affect juveniles and adults through increased stress, injury, or death. Anticipated take will be exceeded if gate closures cause the death of more than one ESA listed fish during each water year.

10) Take in the form of harm, injury and death to listed fish, is expected due to normal operations and maintenance of the Sacramento Adult Fish Passage Facility. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Harm to adults is also expected through delays in spawning and straying. Anticipated take will be exceeded if operations issues are not restored within 24 hours of it being safe to do so (during times when the facility would be operating), or prior to the facility operating (for maintenance needing to be done in the dry season).

11) Harm to rearing juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and adult and juvenile green sturgeon from the loss of up to 65.51 acres of riparian habitat. This loss will affect juveniles through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Table 4 describes the anticipated area of disturbed habitat representing the ecological surrogate of incidental take at each site location for known project designs within the three main areas of the proposed action. Anticipated take will be exceeded if impacts exceed 31.4 acres within the Sacramento River projects area (mouth of the American River down to the bottom of the action area), 27.61 acres within the American River, or 6.5 acres within the Sacramento Weir and Bypass.

Table 4 Maximum Acreages to be impacted in different Project Areas

Project Area	Permanent Acreages Impact below OHWM
Sacramento River	31.4 acres
American River	27.61 acres

Sacramento Weir and Bypass	6.5 acres
Total:	65.51 acres

2.9.2. Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" refer to those actions the Director considers necessary or appropriate to minimize the impact of the incidental take on the species (50 CFR 402.02).

1) Measures shall be taken to minimize the impacts of the proposed bank protection construction.

2) Measures shall be taken to ensure necessary monitoring and Management Plans are developed.

3) Measures shall be taken to ensure that contractors, construction workers, and all other parties involved with these projects implement the projects as proposed in the biological assessments and this opinion.

4) Measures shall be taken to monitor incidental take of listed fish and the survival of on-site plantings, reporting of annual repair status, purchase of mitigation credits, and submission of site-specific designs.

2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1: "*Measures shall be taken to minimize the impacts of the proposed bank protection construction.*"

    a. USACE shall continue to participate in the existing Interagency Working Group (IWG) and Bank Protection Working Group (BPWG) to coordinate stakeholder input into future flood risk reduction actions associated with the American River Common Features GRR. The BPWG will hold technical deliberations over proposed bank protection, including the need (basis of/for design), purpose and proposed designs (emphasis on avoidance and fish-friendly designs). Membership in the BPWG will be subject to agency decisions to participate, but should at a minimum include participation from resource agency staff (USFWS, NMFS, CDFW) and local sponsors (CVFPB and SAFCA.)

b. USACE shall coordinate with NMFS during site designs as future flood risk reduction actions are designed to ensure conservation measures are incorporated and projects are designed to maximize ecological benefits.

c. USACE shall minimize the removal of existing riparian vegetation and IWM to the absolute minimum needed to achieve flood risk management. Where appropriate, removed IWM will be anchored back into place or if not feasible, new IWM will be anchored in place.

d. USACE shall install IWM along all projects associated with the American River Common Features GRR at 40% to 80% shoreline coverage at all seasonal water surface elevations in coordination with the IWG or the BPWG, where site engineering allows for it. The purpose is to maximize refugia and rearing habitat for juvenile fish while promoting natural recruitment of vegetation.

e. USACE shall vary the elevation of planting benches and IWM to accommodate a wide variety of water years and ensure there is ample shoreline habitat in different flow scenarios.

f. USACE shall monitor turbidity during in-water work activities to ensure levels stay below the allowable thresholds (turbidity measured 1,000 feet downstream of the extent of the site is not to exceed double the upstream of site turbidity measurement).

2. The following terms and conditions implement reasonable and prudent measure 2: "*Measures shall be taken to ensure necessary monitoring and management plans are developed.*"
   a. USACE shall develop an HMMP for each on-site and off-site mitigation location, consistent with the 2020 American River Common Features Strategic Approach to Mitigation with the overall goal of mitigating for the impacts to the ecological function and value of the existing levee system within the GRR study area. USACE shall coordinate HMMPs with NMFS prior to the construction of any projects related to the GRR.

   b. USACE shall update the O&M manual to incorporate details regarding the adaptive management plan for operations of the Sacramento Weir that allows for operations of flows in a manner to minimize fish stranding in the Sacramento Bypass.

c. USACE shall ensure all water diversions associated with the O&M of the Sacramento Weir and Bypass are protected by a screen of appropriate size and mesh consistent with NMFS 2023 West Coast Region Anadromous Salmonid Passage Design Manual.

d. Each HMMP measures shall be monitored by USACE for ten years following construction and USACE shall update their O&M manual to ensure the HMMP is adopted by the local sponsor to ensure the goals and objectives of the conservation measures are met for the life of the project.

e. Each HMMP shall include specific goals and objectives and a clear, NMFS-approved strategy for achieving full compensation for all project-related impacts on the affected species described above.

f. Each HMMP shall include a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with future American River Common Features GRR projects as described in the proposed action.

g. USACE shall continue to coordinate with NMFS during all phases of construction, implementation, and monitoring by hosting annual meetings and issuing annual reports throughout the construction period as described in the HMMP.

h. USACE shall host an annual meeting and issue annual monitoring reports for five years following completion of project construction. The purpose is to ensure that conservation features of the project are developing consistent with the HMMPs.

i. USACE shall update their O&M Manual to ensure that the mitigation elements are meeting the criteria established in the HMMP.

j. USACE shall provide NMFS a detailed O&M plan for all aspects of the proposed action, to ensure all sites are properly managed and the Design Deviation allowing vegetation to remain is followed. This plan shall be incorporated into the O&M manual for each site to ensure vegetation removal does not occur in the future.

k. USACE shall provide NMFS a Long-Term Management Plan outlining the maintenance of all on-site and off-site mitigation. The plan shall include performance goals, monitoring plans, replanting plans, and an adaptive management plan for how mitigation will be addressed if the mitigation sites fail.

3. The following terms and conditions implement reasonable and prudent measure 3: *"Measures shall be taken to ensure that contractors, construction workers, and all*

other parties involved with these projects implement the projects as proposed in the biological assessments and this opinion"

a. USACE shall provide a copy of this opinion, or similar documentation, to the prime contractor, making the prime contractor responsible for implementing all applicable requirements and obligations included in these documents and to educate and inform all other contractors involved in the project as to the requirement of this opinion. A notification that contractors have been supplied with this information will be provided to the reporting address below.

b. A NMFS-approved Worker Environmental Awareness Training Program for construction personnel shall be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program shall provide workers with information on their responsibilities with regard to federally listed fish, their critical habitat, an overview of the life history of all the species, information on take prohibitions, protections afforded these animals under the ESA, and an explanation of the relevant terms and conditions of this opinion. Written documentation of the training must be submitted to NMFS within 30 days of the completion of training.

4. The following terms and conditions implement reasonable and prudent measure 4: "*Measures shall be taken to monitor incidental take of listed fish and the survival of on-site plantings, reporting of annual repair status, purchase of mitigation credits, and submissions of site-specific designs."*

   a. USACE shall monitor conditions on each side of the new Adult Fish Passage Facility (both the channel and the ladder) to ensure NMFS passage criteria are being met.

   b. USACE shall initiate an interagency PIT Tag collaborative meeting to occur after each overtopping event at the fish passage facility. The goal of this meeting will be to establish a group where collected PIT tag data may be shared. This meeting shall commence prior to the first operation of the new Sacramento Weir Fish Passage Facility. The planning and initial meeting shall be coordinated with CDFW and NMFS

   c. USACE shall ensure that, when conditions are safe to do so, the Sacramento Bypass is surveyed every year after overtopping events and repair any large scour holes or erosion that may cause stranding risk or increase the likelihood of stranding within the expanded Sacramento Bypass.

d. USACE shall provide to NMFS (at the address below) a vegetation monitoring report at years 1, 2, 3, 5, and 8 post-construction no later than December 31st of each reporting cycle. This report shall provide information as to the success of the revegetation program and whether the conservation goals are being met at each site. If goals are not being met, then the report shall indicate what actions are being implemented to meet those goals.

e. USACE shall submit a report to NMFS of any incidental take that occurs as part of the project. This report shall be submitted no later than July 31 of each reporting cycle.

f. USACE shall contact NMFS within 24 hours of the new expanded Sacramento Weir overtopping for the first five years.

g. USACE shall ensure that the NMFS Central Valley Office is involved with the discussions, development, and tracking of the FHAST model development and the UC Davis green sturgeon research.

h. All reports for NMFS shall be sent to:

Cathy Marcinkevage
California Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento California 95814
FAX: (916) 930-3629
Phone: (916) 930-3600
ccvo.consultationrequests@noaa.gov

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, “conservation recommendations” are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1) USACE should integrate the 2017 California Central Valley Flood Protection Plan’s Conservation Strategy into all flood risk reduction projects they authorize, fund, or carry out.

2) USACE should prioritize and continue to support flood management actions that set levees back from rivers and in places where this is not technically feasible, repair in place actions should pursue landside levee repairs instead of waterside repairs.

3) USACE should consult with NMFS in the review of ETL variances for future projects that require ETL compliance.

4) USACE should develop ETL vegetation variances for all flood management actions that are adjacent to any Central Valley anadromous fish habitat.

5) USACE should use all of their authorities, to the maximum extent feasible to implement high priority actions in the NMFS Central Valley Salmon and Steelhead Recovery Plan. High priority actions related to flood management include setting levees back from riverbanks, increasing the amount and extent of riparian vegetation along reaches of the Sacramento River Flood Control Project.

6) USACE should encourage cost-share sponsors and applicants to develop floodplain and riparian corridor enhancement plans as part of their projects.

7) USACE should continue to work with NMFS and other agencies and interests to support the improved growth, survival and recovery of native fish species in the Yolo Bypass and other bypasses within the Sacramento River Flood Control Project, including restoring/improving fish passage.

8) USACE should consider implementing post-construction bathymetry to monitor changes in benthic habitat.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

2.11. Reinitiation of Consultation

This concludes formal consultation for the American River Watershed Common Features General Reevaluation Report Reinitiation 2024.

Under 50 CFR 402.16(a): “Reinitiation of consultation is required and shall be requested by the federal agency, where discretionary federal involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action.”

3. Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Section 305(b) of the MSA directs federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species’ contribution to a healthy ecosystem. For the purposes of the MSA, EFH means “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the associated physical, chemical, and biological properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects may result from actions occurring within EFH or outside of it and may include direct, indirect, site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH (50 CFR 600.905(b))].

This analysis is based, in part, on the EFH assessment provided by the United States Army Corps of Engineers and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fisheries Management Council and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Proposed Action

The proposed project occurs within EFH for various federally managed fish species within the Pacific Salmon FMP. The geographic extent of freshwater EFH is identified as all water bodies currently or historically occupied by Council-managed salmon as described in Amendment 18 of the Pacific Coast Salmon Plan (PFMC 2014). In the estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the Exclusive Economic Zone (EEZ) (200 nautical miles or 370.4 km) offshore of Washington, Oregon, and California north of Point Conception. The proposed project occurs in the area identified as "freshwater EFH", as it is above the tidal influence where the salinity is below 0.5 parts per thousand.

In addition, the project occurs within, or in the vicinity of (1) complex channels and floodplain habitat and (2) thermal refugia, which are designated as a habitat areas of particular concern (HAPCs) for various federally managed fish species within the Pacific Coast salmon FMP. HAPCs are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under the MSA; however, federal projects with potential adverse impacts on HAPC will be more carefully scrutinized during the consultation process.

3.2. Adverse Effects on Essential Fish Habitat

NMFS determined the proposed action would adversely affect EFH as follows:

1) Bank Stabilization and Protection – The proposed project has components that will entail bank stabilization and protection activities in the Action Area which includes freshwater EFH. These activities include placement of rock armoring and removal of riparian vegetation. The alteration of riverine and estuarine habitat from bank and shoreline

stabilization, and protection from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. Human activities removing riparian vegetation, armoring, relocating, straightening and confining stream channels and along tidal and estuarine shorelines influences the extent and magnitude of stream bank erosion and down cutting in the channel. In addition, these actions have reduced hydrological connectivity and availability of off-channel habitat and floodplain interaction. Armoring of shorelines to prevent erosion and maintain or create shoreline real estate simplifies habitats, reduces the amount of intertidal habitat, and affects nearshore processes and the ecology of a myriad of species (Williams and Thom 2001). As described in Amendment 18 in PFMC 2014, a river confined by adjacent development and/or flood control and erosion control structures can no longer move across the floodplain and support the natural processes that: 1) maintain floodplain connectivity and fish access that provide velocity refugia for juvenile salmon during high flows; 2) reduce flow velocities that reduce streambed erosion, channel incision, and spawning redd scour; 3) create side channels and off-channel areas that shelter rearing juvenile salmon; 4) allow fine sediment deposition on the floodplain and sediment sorting in the channel that enhance the substrate suitability for spawning salmon; 5) maintain riparian vegetation patterns that provide shade, large wood, and prey items to the channel; 6) provide the recruitment of large wood and spawning gravels to the channel; 7) create conditions that support hyporheic flow pathways that provide thermal refugia during low water periods; and 8) contribute to the nutrient regime and food web that support rearing and migrating juvenile salmon in the associated mainstem river channels. These activities are expected to adversely affect HAPCs for (1) complex channels and floodplains, and (2) thermal refugia.

2) Flood Control Maintenance – The proposed project will continue to prevent access to historic floodplain habitat by maintaining the levees constructed for flood protection. The protection of housing communities from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitats. Maintaining the flood control levees results in the addition of rock armoring after any erosion event, regular (sometimes yearly) herbicide application, removal of riparian vegetation from the shoreline (also sometimes yearly), and other potentially harmful maintenance activities. Managing flood flows with flood control structures such as levees can disconnect a river from its floodplain eliminating off-channel habitat important for salmonids. Floodplains serve as a natural buffer to changes in water flow: retaining water during periods of higher flow and releasing it from the water table during reduced flows. These areas are typically well vegetated, lowering water temperatures, regulating nutrient flow and removing toxins. Juvenile salmon use these off-channel areas because their reduced flows, greater habitat complexity, increased food availability, and shelter from predators may increase growth rates and their chance of survival. Artificial flood control structures have similar effects on aquatic habitat as does the efforts to stabilize banks and remove woody debris. The function of natural stream channels and associated riparian areas and the effects of flood control structures such as levees has been discussed in section 2.4.1 of this opinion. The HAPCs adversely affected include (1) complex channels and floodplains, and (2) thermal refugia.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the adverse effects of the proposed action on EFH.

1) Bank Stabilization and Protection
    - Minimize the loss of riparian habitats as much as possible.
    - Bank erosion control should use vegetation methods or "soft" approaches (such as beach nourishment, vegetative planting, and placement of IWM) to shoreline modifications whenever feasible. Hard bank protection should be a last resort and the following options should be explored (tree revetments, stream flow deflectors, and vegetative riprap).
    - Re-vegetate sites to resemble the natural ecosystem community.
    - Replace in-stream fish habitat by providing root wads, deflector logs, boulders, rock weirs and by planting shaded riverine aquatic cover vegetation.
    - Use an adaptive management plan with ecological indicators to oversee monitoring and ensure mitigation objectives are met. Take corrective action as needed.
    - Minimize alteration of floodplains and wetlands in areas of salmon EFH.
    - Determine cumulative effects of all past and current floodplain and wetland alterations before planning activities that further alter wetlands and floodplains.
    - Promote awareness and use of the United States Department of Agriculture (USDA)'s wetland and conservation reserve programs to conserve and restore wetland and floodplain habitat.
    - Promote restoration of degraded floodplains and wetlands, including in part reconnecting rivers with their associated floodplains and wetlands and invasive species management.

2) Flood Control Maintenance
    - Retain trees and other shaded vegetation along the earthen levees and outside levee toe.
    - Ensure adequate inundation time for floodplain habitat that activates and enhances near-shore habitat for juvenile salmon.
    - Reconnect wetlands and floodplains to channel/tides.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon HAPCs.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, USACE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH conservation recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH conservation recommendations unless NMFS and the federal agency have agreed to use alternative time frames for the federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

3.5. Supplemental Consultation

USACE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920(l)).

4. Data Quality Act Documentation and Pre-Dissemination Review

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the USACE. Other interested users could include DWR, SAFCA, USFWS, and CDFW. Individual copies of this opinion were provided to USACE. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR part 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. REFERENCES

Federal Register Cited

FR 114. 1993. Designated Critical Habitat; Sacramento River Winter-Run Chinook Salmon. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register, Pages 33212-33219.

FR 2. 1994. Endangered and Threatened Species; Status of Sacramento River Winter-Run Chinook Salmon. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register, Pages 440-450.

63 FR 11482-11520. March 9, 1998. Endangered and Threatened Species: Proposed Endangered Status for Two Chinook Salmon ESUs and Proposed Chinook Salmon ESUs; Proposed Redefinition, Threatened Status, and Revision of Critical Habitat for One Chinook Salmon ESU; Proposed Designation of Chinook Salmon Critical Habitat in California, Oregon, Washington, Idaho.

FR 13347. March 19, 1998. Final Rule: Notice of Determination. Endangered and Threatened Species: Threatened Status for Two ESUs of Steel head in Washington, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register, Volume 63 pages 13347-13371.

FR 50394. November 15, 1999. Final Rule: Threatened Status for Two Chinook Salmon Evolutionary Significant Units in California. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register, Volume 64 pages 50394-50415.

FR 7764-7787. February 16, 2000. Final Rule: Designated Critical Habitat: Critical Habitat for 19 Evolutionarily Significant Units of Salmon and Steelhead in Washington, Oregon, Idaho, and California. United States Department of Commerce, National Oceanic and

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