Biological Assessment

West Sacramento, California
General Reevaluation Study and
Section 408 Permission

June 2014

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Acronyms and Abbreviations

BA	biological assessment
BMPs	best management practices
BSSCP	bentonite slurry spill contingency plan
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CHP	California Highway Patrol
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
dbh	diameter at breast height
DPS	distinct population segment
DSM	deep soil mixing
DWR	California Department of Water Resources
DWSC	Sacramento Deep Water Ship Channel
EFH	essential fish habitat
EIP	Early Implementation Project
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
ESU	evolutionary significant unit
ETL	Engineer Technical Letter
GRR	general reevaluation report
IWM	instream woody material
lf	linear feet
LPP	locally preferred plan
MBTA	Migratory Bird Treaty Act
MMP	Mitigation and Monitoring Plan
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1997
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	operations and maintenance
OHWM	ordinary high water mark
PL	public law

psi	pounds per square inch
RD	reclamation district
RM	river mile
RWQCB	Regional Water Quality Control Board
SAM	Standard Assessment Methodology
SCS	U.S. Soil Conservation Service
SPCCP	spill prevention, control, and counter-measure plan
SRA	shaded riverine aquatic
SRBPP	Sacramento River Bank Protection Project
SRFCP	Sacramento River Flood Control Project
SWPPP	stormwater pollution protection plan
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VELB	valley elderberry longhorn beetle
VVR	vegetation variance request
WRDA	Water Resources Development Act
WRI	weighted species response index
WSAFCA	West Sacramento Area Flood Control Agency

1.0 Introduction

The U.S. Army Corps of Engineers (Corps) is requesting consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Federal Endangered Species Act (ESA) on potential effects on listed threatened or endangered species and on designated critical habitat from implementation of flood risk management (FRM) improvements proposed under the West Sacramento General Reevaluation Study (West Sacramento Project). The West Sacramento Project's proposed action also includes FRM improvements proposed by the West Sacramento Area Flood Control Agency's (WSAFCA) Southport Sacramento River Early Implementation Project (EIP). WSAFCA is requesting permission from the Corps pursuant to Section 14 of the River and Harbors Act of 1899 (Title 33 of the United States Code [USC], Section 408, [33 USC 408]), for the alteration of the Federal flood management project.

The purpose of this Biological Assessment (BA) is to analyze the potential effects from the proposed project on listed threatened or endangered species and on designated critical habitat, within the project's area of effect (action area). The outcome of this BA and consultation with the USFWS and NMFS will determine the need for formal consultation or whether a determination of "not likely to adversely affect" is appropriate for listed species that may be affected. In addition, this BA intends to fulfill consultation requirements for the Magnuson-Stevens Fishery Conservation and Management Act of 1997 (NMFS 1997). This BA was prepared in accordance with the Corps' Engineering Regulation 1105-2-100 (Corps 2000a).

Section 7 of the ESA requires Federal agencies to conserve listed species and their critical habitat, and to consult with USFWS and NMFS (the Services) to ensure that actions they fund, authorize, or perform do not jeopardize the existence of any listed species or result in the destruction or adverse modification of their designated critical habitat. The actions covered in this BA are associated with future levee modifications proposed under the West Sacramento Project.

The Magnuson-Stevens Fishery Conservation and Management Act of 1997 (MSA) governs the conservation and management of commercially harvested ocean fisheries. The purpose of the Act is to take immediate action to conserve, protect, and manage U.S. coastal fishery resources, anadromous species, and Essential Fish Habitat (EFH). EFH is the aquatic habitat (water and substrate) that is necessary for fish to spawn, breed, feed, or mature, and that allows production levels needed to: (1) support a long-term, sustainable commercial fishery, and (2) contribute to a healthy ecosystem (NMFS 1997). Most, if not all, of the West Sacramento General Reevaluation Report (GRR) study area is designated as EFH habitat for Pacific salmon under Section 305(b)(2) of the MSA. Species to be addressed in this BA include:

- Fish species with designated EFH under the MSA
- Listed species under the Federal Endangered Species Act
- Species with designated critical habitat under the ESA

1.1 Action Area

The action area refers to the area directly or indirectly affected by the proposed action (50 CFR 402.02 and 402.14(b)(2)). This includes the project footprint and surrounding areas where covered species could be affected by project-related impacts. The action area for the West Sacramento project is shown in Figure 1 and includes the Sacramento River from the Sacramento Bypass down to the South Cross levee, the Sacramento Deep Water Ship Channel (DWSC) and Port of West Sacramento, and the Sacramento and Yolo Bypasses.

The Action Area includes perennial waters of the Sacramento River extending 200 feet perpendicular from the average summer-fall shoreline and 1,000 feet downstream from proposed in-water construction areas. This represents the potential area of turbidity and sedimentation effects based on the reported limits of visible turbidity plumes in the Sacramento River during similar construction activities (NMFS 2008).

Erosion repairs are proposed as part of the proposed action. These repairs are likely to somewhat reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment perspective, the bank material we are protecting 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. For velocity, the site specific designs will be constrained from allowing any velocity increases outside the erosion repair site.

In addition, the proposed Southport levee setback action would have hydraulic effects which would include slight changes in water surface elevations that extend for several miles upstream and downstream of the project area during flood events. However, hydraulic analyses indicate that potential effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River will be insignificant and unlikely to adversely affect listed species and designated critical habitat (ICF International 2013). Therefore the action area for the project would be directly related to the study area and not extend significantly outside where construction activities would occur. The action area is described in greater detail below and includes the following study areas.

1.1.1 West Sacramento Project Study Area

The West Sacramento project study area refers to the area that would be protected by the proposed levee improvements, including the city of West Sacramento itself and the lands within WSAFCA's boundaries, which encompass portions of the Sacramento River, the Yolo Bypass, and the Sacramento DWSC. The flood protection system associated with these waterways consists of over 50 miles of levees in Reclamation District (RD) 900, RD 537, DWR's Maintenance Area 4, and the DWSC. These levees completely surround the city, with the exception of intersecting waterways (the barge canal and DWSC). The city of West Sacramento is located in eastern Yolo County at the confluence of the American and Sacramento Rivers. The city lies within the natural floodplain of the Sacramento River, which bounds the city along the north and east. It is made up of a small amount of high ground north of Highway 50 along the Sacramento River, and reclaimed land protected from floods by levees and the Yolo Bypass system. The Yolo Bypass diverts flood flows around the city to the west. In addition to the area within the city limits (in Yolo County), the study area partially extends into Solano County on the extreme southwestern edge along the DWSC.

The DWSC provides a navigable passageway for commercial shipping to reach the Port of West Sacramento (formerly Port of Sacramento) from the Pacific Ocean via the San Francisco Bay, Delta, and connecting waterways. The DWSC water surface elevation is directly influenced by changes in water levels in the Delta at the south end of the Yolo Bypass and is relatively insensitive to stage in the Sacramento River. The study area is within the bounds of the Legal Delta as defined by the State of California under the Delta Protection Act (Section 12220 of the Water Code). The Legal Delta is further subdivided into a primary zone and secondary zone for land use planning and resource protection purposes. Most of West Sacramento is in the secondary zone, while the extreme northern part of the city is outside of any of these Delta planning areas. The study reach along the DWSC west levee is the only portion of the study area within the primary zone.

The DWSC and barge canal bisect the city into two subbasins, separating the developing Southport area from the more established neighborhoods of Broderick and Bryte to the north (City of West Sacramento 2000). The two subbasins are broken up into nine levee reaches based on location and fixes. The North Basin, which encompasses 6,100 acres, contains:

- Sacramento River north levee – 5.5 miles from the Sacramento Bypass south to the stone lock structure on the DWSC.
- Port north levee – 4.9 miles from the stone lock structure west to the Yolo Bypass levee.
- Yolo Bypass levee – 3.7 miles from the Port north levee north to the Sacramento Bypass.
- Sacramento Bypass Training levee – 0.5 miles west into the Yolo Bypass from the Sacramento Bypass levee.

The South Basin, which encompasses 6,900 acres, contains:

- Sacramento River south levee – 5.9 miles south along the Sacramento River from the DWSC stone lock structure to the South Cross levee (just north of the waste water treatment plant).
- South Cross levee – 1.2 miles across the South Basin from the Sacramento River to the DWSC.

- DWSC east levee – 2.8 miles from the South Cross levee north to the point where it bends east.
- Port south levee – 4.0 miles east from the bend in the DWSC east levee to the stone lock structure.
- DWSC west levee – 21.4 miles from the intersection of the Port north levee and the Yolo Bypass levee south to Miners Slough.

The West Sacramento Project study area and the problems identified for improvement are shown on Figure 1.

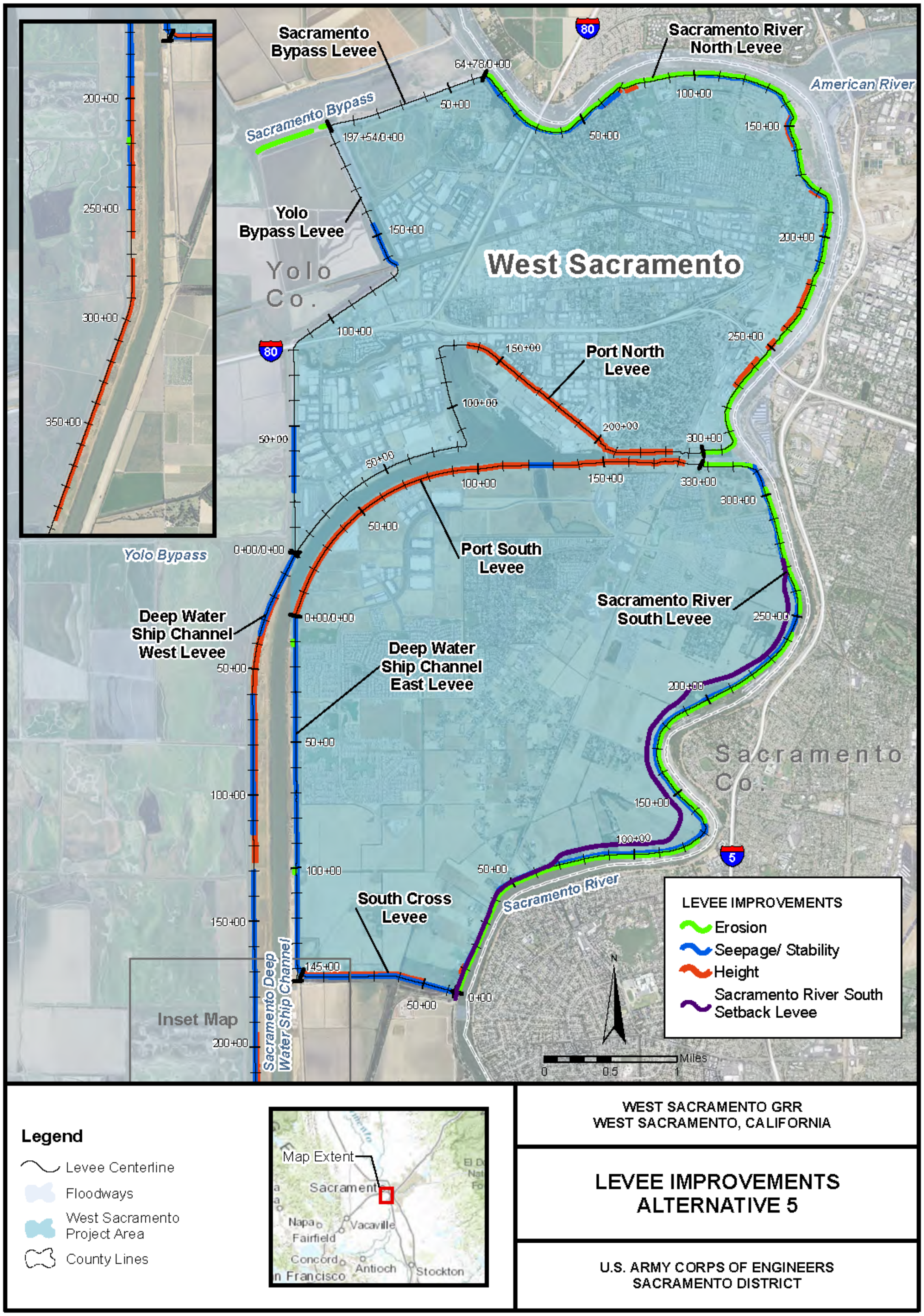

Figure 1. West Sacramento GRR Study Area with Individual Reach Identification.

1.1.2 Southport EIP Study Area

The Southport EIP study area is encompassed within the West Sacramento Project study area. Because the Southport EIP is further along in design, its action area is described in greater detail below. The construction footprint for the Southport EIP component of the West Sacramento Project extends approximately 5.6 miles along the Sacramento River South Levee from the southern end of the Corps Sacramento River Bank Protection Project (SRBPP) at River Mile (RM) 57.2 south to the South Cross levee at RM 51.6. It is comprised of a 3.6-square mile project area, which encompasses 5.8 miles of the existing levee structure along the Sacramento River corridor, the construction footprint in which flood risk–reduction measures would be constructed, the footprint of the Village Parkway extension and associated residential access roads, and potential soil borrow sites located throughout the Southport area of West Sacramento (Figure 2). Potential borrow sites make up large portions of the construction footprint, as soil may be extracted from these areas prior to or during construction of the flood risk–reduction measures. The project area covers all or portions of Sections 10, 15, 21, 22, 28, 29, and 32, Township 8 North, and Range 4 East, Mount Diablo Meridian, Yolo County, California.

South River Road runs along the top of the levee for the majority of this reach of the river. The road diverts off of the levee top and merges with Gregory Avenue and runs along the landside toe for a short distance to the southern end of the construction area. The landside of the levee is bordered mainly by private agricultural lands containing rural residences. Two small bodies of water referred to as Bees Lakes are located adjacent to the levee landside toe near the middle of the construction area, and two marinas and multiple boat docks are located on the waterside of the levee near Bees Lakes.

The Southport project area also includes several adjacent and nearby locations at which suitable borrow material may be available for use in constructing the project. As shown on Figure 2, potential borrow sites are located both close to the levee footprint, to the east and west of southern Jefferson Boulevard, and along the DWSC.

The project construction area was defined as the area in which flood risk–reduction measures—such as setback levees, seepage berms, and slurry cutoff walls—are likely to be constructed, the area in which Village Parkway and ancillary roadways would be constructed, as well as areas in which soil borrow activities may occur. All direct and indirect effects would occur within this area and the 200-foot buffer around this area.

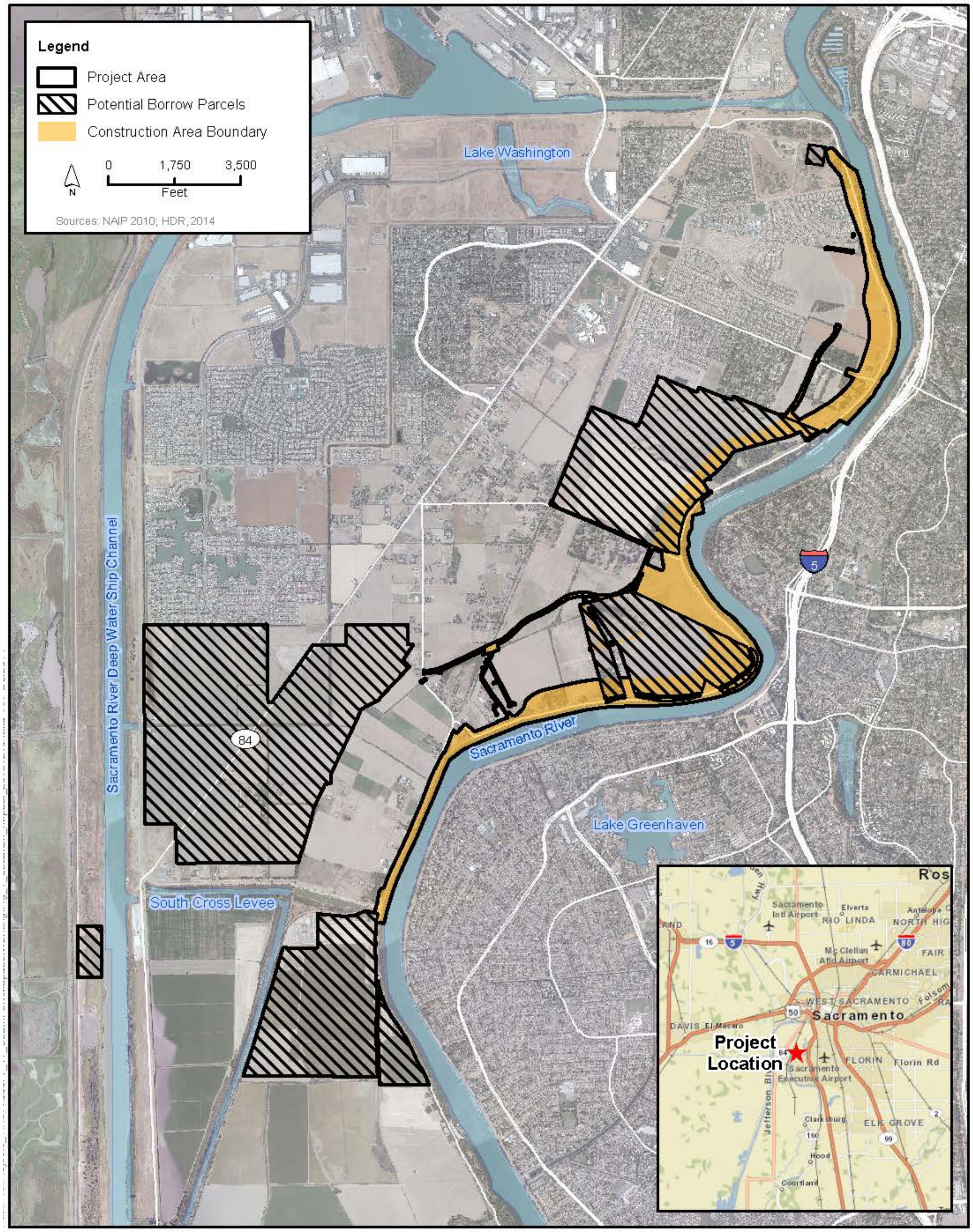

Figure 2. Southport EIP Project Area.

The Action Area includes the 3.6-square mile project area and a 200-foot buffer around this area. The project construction area was defined as the area in which flood risk reduction measures—such as seepage berms, relief wells, slurry cutoff walls, and potential soil borrow sites—are likely to be constructed, the area in which Village Parkway and ancillary roadways would be constructed, as well as areas in which soil borrow activities may occur. All direct and indirect effects would occur within this area and the 200-foot buffer around this area. To address potential construction-related impacts on Delta smelt and critical habitat resulting from in-water construction, the Action Area includes perennial waters of the Sacramento River extending 200 feet perpendicular from the average summer-fall shoreline and 1,000 feet downstream from the proposed in-water construction areas. This represents the potential area of turbidity and sedimentation effects based on the reported limits of visible turbidity plumes in the Sacramento River during similar construction activities (National Marine Fisheries Service 2008). Long-term effects of the Proposed Action include slight changes in water surface elevations that extend for several miles upstream and downstream of the project area during flood events. However, hydraulic analyses indicate that potential effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River will be insignificant and unlikely to adversely affect listed species and designated critical habitat (ICF International 2013).

1.2 Project Background and Authority

The current levees do not adequately protect the city of West Sacramento during a 100-year event (an event that has a 1 percent chance of occurring in any given year). Structural modifications to the levee are proposed to address seepage, slope stability, erosion, and height concerns along the existing West Sacramento levees and provide flood risk reduction.

The history of the Sacramento River Flood Control Project (SRFCP) dates back to the mid 1800s with the initial construction of levees along the Sacramento, American, Feather, and Yuba Rivers. The early history of the system was characterized by trial and error, with initial construction followed by a levee failure, followed by improvement (strengthening and/or raising), followed by another levee failure, etc. This continued until the California Legislature authorized a comprehensive plan for controlling the floodwaters of the Sacramento River and its tributaries in the Flood Control Act of 1911. Federal participation in the SRFCP began shortly after authorization in 1917 and continued for approximately 40 years.

Historically, from the mid 1800s onward, most hydraulic engineers at the Federal, State, and local level thought that the most effective way to control flood flows in the river system was to construct levees close to the main channel. The record floods of 1907 and 1909 forced a reevaluation of this historic approach. It was clear from the size of these flood events in relation to existing channel capacities that major bypass systems were needed to control excess flood flows. These bypasses were designed to divert flood flows away from urban centers. Throughout the SRFCP, the frequency that flow starts to divert from the Sacramento River to the bypass system varies between a 3-year to 5-year flood event.

The series of storms that struck California in February of 1986 resulted in the flood of record for many areas in northern and central California. The estimated peak flows associated with the 1986 flood were nearly equal or exceeded the design flows of the Sacramento River, Sacramento Bypass, and the Yolo Bypass in the vicinity of West Sacramento. As a result of the problems experienced during the 1986 flood, the Corps initiated a study of the levees comprising the SRFCP that were impacted by the flood. Due to the large scale of the study, the review was split into five phases. The first phase of this study included West Sacramento and was documented through an Initial Appraisal Report titled, Sacramento Urban Area Levee Reconstruction Project, California dated May 1988. This phase included the review of approximately 110 miles of levee and recommended the repair of 34 miles.

The 1986 flood also exposed structural problems and identified the inability of the existing levees to provide critical flood protection to the Sacramento metropolitan area. As a result, the Corps, in cooperation with the State of California, initiated the study titled, Sacramento Metropolitan Area, California, Feasibility Report. This report was published in February 1992 and indicated the existing flood control system in the study area provided significantly less than a 100-year level of protection. The study went on to recommend a program of improvements. The repairs recommended by the Sacramento Metropolitan Area, California, Feasibility Report were authorized in the Water Resources Development Act (WRDA) of 1992 (Public Law [PL] 102-580).

The Corps was preparing construction plans and specifications for the levee repairs authorized in the WRDA of 1992, when the 1997 New Year's Day Flood occurred. It was one of the largest experienced in northern California since the beginning of the measured record in 1906. In the wake of the 1997 flood, the Corps identified underseepage as an area of greater concern in the design and repair of levees. This resulted in a number of design revisions to the levee repairs recommended in the West Sacramento Project Design Memorandum. These design revisions and the associated increase to the total estimated project cost were captured in a supplemental authorization through the Energy and Water Development Appropriation Act of 1999 (PL 105-245).

The initial study authority for the West Sacramento area was provided through Section 209 of the Flood Control Act of 1962, PL 87-874. The West Sacramento Project was authorized in WRDA 1992, PL 102-580 Sec. 101 (4), as amended by the Energy and Water Development of 1999, PL 105-245. It was reauthorized on October 28, 2009 with a total project cost of $53,040,000 under WRDA 2010, PL 111-85.

1.3 Species Considered and Species Requiring Consultation

An official list of species with the potential to occur in the vicinity of the Proposed Action and federally listed as threatened, endangered, and proposed threatened or endangered was obtained from the Sacramento USFWS website for Yolo County (USFWS 2014) (Appendix A). The following federally endangered and threatened species were included on the USFWS species list and were considered for inclusion in this BA.

- Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB)—threatened.
- Conservancy fairy shrimp (*Branchinecta conservatio*)—endangered.
- Vernal pool fairy shrimp (*Branchinecta lynchi*)—threatened.
- Vernal pool tadpole shrimp (*Lepidurus packardi*)—endangered.
- Delta green ground beetle (*Elaphrus viridis*)—threatened.
- California freshwater shrimp (*Syncaris pacifica*)—endangered.
- Delta smelt (*Hypomesus transpacificus*)—threatened.
- California red-legged frog (*Rana draytonii*)—threatened.
- California tiger salamander (*Ambystoma californiense*)—threatened.
- Yosemite toad (*Anaxyrus canorus*)—threatened.
- Giant garter snake (*Thamnophis gigas*)—threatened.
- Western snowy plover (*Charadrius alexandrinus nivosus*)—threatened.
- Northern spotted owl (*Strix occidentalis caurina*)—threatened.
- Least Bell's vireo (*Vireo bellii pusillus*)—endangered.
- Palmate-bracted bird's-beak (*Cordylanthus palmatus*)—endangered.
- Colusa grass (*Neostapfia colusana*)—threatened.
- Keck's checker-mallow (*Sidalcea keckii*)—endangered.
- Solano grass (*Tuctoria mucronata*)—endangered.
- Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)—endangered.
- Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)—threatened.
- California Central Valley steelhead DPS (*Oncorhynchus mykiss*)—threatened.
- Southern DPS of North American green sturgeon (*Acipenser medirostris*)—threatened.

On-going coordination with the Services will occur as the project progresses to the preliminary engineering design phase to ensure compliance with Section 7. The Corps would coordinate potential design refinements with the Services to avoid, minimize, and compensate for affects to listed species and reinitiate consultation if necessary. The action area includes the protected species and critical habitat listed in Table 1, as well as fall-/late fall–run Chinook salmon, which has EFH within the study area.

Of the 22 federally listed species considered for inclusion in this BA, the 7 species (and their critical habitats) listed in Table 1 have the potential to occur in the Action Area and may be affected by the Proposed Action; accordingly, these species are the subject of this BA.

Table 1. Federally Protected Species and Critical Habitat Addressed in this Biological Assessment.

Common Name	Scientific Name	Federal Status
Threatened and Endangered Species		
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	T
Sacramento River winter-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	E/MSA
Central Valley spring-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	T/MSA
Central Valley steelhead DPS	*Oncorhynchus mykiss*	T
Delta Smelt	*Hypomesus transpacificus*	T
Green Sturgeon southern DPS	*Acipenser medirostris*	T
Giant garter snake	*Thamnophis gigas*	T
Critical Habitat		
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	
Sacramento River winter-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	
Central Valley spring-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	
Central Valley steelhead DPS	*Oncorhynchus mykiss*	
Delta Smelt	*Hypomesus transpacificus*	
Green Sturgeon southern DPS	*Acipenser medirostris*	

Note: ESU = Evolutionarily Significant Unit, DPS = Distinct Population Segment, T = Threatened, E = Endangered, MSA = Magnuson-Stevens Fishery Conservation and Management Act.

1.3.1 Other Species Considered but Eliminated from Further Evaluation

The Action Area does not contain suitable habitat (i.e., vernal or seasonal pools or swales) for conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, or Delta green ground beetle and is outside the geographic range of the California freshwater shrimp and the Yosemite toad. Therefore, it has been determined that the Proposed Action would have no effect on any of these species, and no further evaluation or consultation on these species is needed (50 Code of Federal Regulations [CFR] 402.12).

Seasonal and perennial wetlands in the Action Area are connected to the Sacramento River and the Sacramento DWSC (which contains predatory fish) and/or are surrounded by cultivated or developed areas; therefore, they do not provide suitable aquatic or upland habitat for California tiger salamander. California red-legged frog is considered extirpated from the floor of the Central Valley (USFWS 2002) and would not occur in the Action Area. Therefore, it has been determined that the Proposed Action would have no effect on California tiger salamander and California red-legged frog; no further evaluation or consultation on these species is needed (50 CFR 402.12).

There is no suitable nesting habitat for the western snowy plover which requires barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds, riverine sand bars, and sewage, salt-evaporation, and agricultural wastewater ponds. The least Bell's vireo historically nested in the Sacramento Valley, but no nesting has been documented north of Santa Barbara County since prior to 1970s. Two recent male sightings have been reported from Putah Creek in Yolo County in 2010 and 2011 but no confirmed nesting (CDFW 2013). The Action Area is outside the geographic range of the northern spotted owl. Therefore, it has been determined that the Proposed Action would have no effect on any of these species, and no further evaluation or consultation on these species is needed (50 CFR 402.12).

There are four Federally listed plants that could potentially occur in the region, including Palmate-bracted bird's-beak, Colusa grass, Keck's checker-mallow, and Solano grass. Palmate-bracted bird's-beak is not expected to occur because grasslands in the Action Area lack typical associates (iodine bush [*Allenrolfea occidentalis*]) and there is no suitable microhabitat (alkaline soils) present. Similarly, Colusa grass is not expected to occur in the Action Area because there are no vernal pools. In addition, habitat conditions are of poor quality for two species; Solano grass, which could occur in mesic annual grassland, and Keck's checker mallow, which could occur in annual grassland or valley oak woodland. Therefore none of these plants are expected to occur in the Action Area. Therefore, it has been determined that the Proposed Action would have no effect on any of these species and no further evaluation or consultation on these species is needed (50 CFR 402.12).

1.4 Consultation to Date

Prior consultation with the USWS and NMFS h s occurred independently on the West Sacramento Project and the Southport EIP. On April 21a, 2014 an interagency meeting was held to discuss the consultations for both actions. As a result of that meeting, the consultations were combined into one consultation because the two projects were determined to be too related to be considered in two separate consultations, and that both actions should be addressed in a single consultation. The following consultation history is provided that eventually led up to the recent decision to combine the consultations.

1.4.1 Southport EIP Consultation History

The Corps and WSAFCA, pursuant to the ESA, must consult with USFWS and NMFS with regard to any proposed actions that may affect the continued existence of a Federally listed species. Following is a summary of communications with USFWS and NMFS for the Proposed Action.

- January 2014—an updated species list for Yolo County was obtained from the USFWS website.

- December 18, 2013 – USFWS and NMFS staff participated in an environmental stakeholder group meeting on project design development
- December 11 and 18, 2013—USFWS and NMFS staff participated in public meetings on the Southport EIP Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR)
- September 30, 2013 – NMFS staff correspondence requested additional information from the Corps to support consultation
- August 27, 2013 – NMFS staff met with WSAFCA and Corps staff to discuss project design and BA comments
- June 4, 2013—Corps requested initiation of consultation with USFWS and NMFS
- March 28, 2013—USFWS and NMFS staff participated in National Environmental Policy Act/California Environmental Quality Act (NEPA/CEQA) scoping meeting
- January 3, 2013—a species list for Yolo County was obtained from the USFWS website.
- November 14, 2011—USFWS and NMFS staff participated in an environmental stakeholder group meeting on project alternatives development
- August 15, 2011—USFWS and NMFS staff participated in an informal meeting of the Southport EIP environmental stakeholder group and attended a field visit led by WSAFCA.
- May 26, 2011—USFWS and NMFS staff participated in the kick-off of an environmental stakeholder group for the Southport EIP
- 2008 through 2010—USFWS and NMFS staff participated in numerous site visits and meetings associated with WSAFCA's overall levee improvements program, leading to completed consultations for the I Street Bridge, The Rivers, and California Highway Patrol (CHP) Academy projects.

1.5 West Sacramento Project Future Consultation Approach

The West Sacramento Project is at a feasibility level of design and therefore an earlier stage of development than the Southport EIP. Due to the uncertainty of when and how the West Sacramento Project will be implemented, this BA analyzes the maximum affects to listed species using the largest foreseeable footprint. The Corps will consult on Alternative 5 which is the locally preferred plan (LPP). As the project moves into further design, design refinements will likely reduce the footprint and reduce the effects to listed species. This approach will allow the USFWS and NMFS to conduct the jeopardy analysis and to determine the level of take in an Incidental Take Statement. Coordination with the resource agencies will continue into the design phase to obtain input which can help to avoid, minimize, or compensate for affects to listed species. This future coordination would attempt to reduce any mitigation required for the project and also would determine if additional consultation is needed for the project.

2.0 Proposed Action and Project Evaluation Approach

2.1 Introduction

The Corps has identified a number of problems associated with the flood risk management system protecting the city of West Sacramento and surrounding areas. There is a high probability that flows in the American and Sacramento Rivers will stress the network of levees protecting West Sacramento 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.

The majority of the Sacramento River north and south levee reaches within the study area require seepage, slope stability, height, and erosion improvements in order to meet Corps criteria. Construction of the levee improvement measures would require vegetation removal on the levee from approximately 15 feet landward of the landside toe to approximately half the height of the levee on the waterside slope. Where feasible, a Vegetation Variance Request (VVR) would be sought during the preliminary engineering and design phase before construction to allow vegetation to remain on the lower 2/3 of the water side slope and out 15 feet from the waterside toe. If granted, the variance would allow for vegetation to remain in these areas. In many cases along the Sacramento River levees, the levee is far enough back from the water's edge to allow vegetation providing shaded riverine aquatic cover to remain on the bank with no VVR necessary. However, in Sacramento River north reach, vegetation along the bank would be thinned in order to place rock on the bank for erosion protection. No woody vegetation would be permitted on the landside slope or within 15 feet of the landside toe for purposes of providing access for levee inspections and flood repair response.

This BA analyzes the effects of repairing the levees in the West Sacramento GRR North and South basins. A summary of the remediation measures proposed under this study are included in Table 2 below.

Table 2. Proposed Measures for the West Sacramento Project.

Waterway/Location	Extent of Action	Proposed Measure
North Basin		
Sacramento River North Levee *	5.5 miles from the Sacramento Bypass south to the stone lock structure on the DWSC.	• Construct bank protection • Install cutoff walls • Construct levee raise
West Sacramento Port North Levee **	4.9 miles from the stone lock structure west to the Yolo Bypass levee.	• Construct floodwalls
Yolo Bypass **	3.7 miles from the Port North levee north to the	• Install cutoff walls

Waterway/Location	Extent of Action	Proposed Measure
	Sacramento Bypass.	
Sacramento Bypass Training Levee **	1.1 miles from the Yolo Bypass levee to the Sacramento River.	• Construct bank protection
	South Basin	
Sacramento River South Levee *	5.9 miles south along the Sacramento River from the DWSC stone lock structure to the South Cross levee.	• Construct bank protection • Install cutoff walls • Construct levee raise • Construct seepage berm • Construct setback levee
South Cross Levee **	1.2 miles across the South Basin from the Sacramento River to the DWSC.	• Install cutoff walls • Construct seepage berms • Levee Raise
Deep Water Ship Channel East Levee **	2.8 miles from the South Cross levee north to the point where it bends east.	• Construct floodwalls • Levee raise • Construct bank protection
West Sacramento Port South Levee **	4.0 miles east from the bend in the DWSC east levee to the stone lock structure.	• Install cutoff walls • Construct levee raise
Deep Water Ship Channel West Levee **	21.4 miles from the intersection of the Port North levee and the Yolo Bypass levee south to Miners Slough.	• Install cutoff walls • Construct seepage berms • Levee raise • Construct bank protection • Construct closure structure
South Cross Levee **	1.2 miles across the South Basin from the Sacramento River to the DWSC.	• Install cutoff walls • Construct seepage berms • Levee Raise

* Would establish compliance with Corps vegetation requirements for upper 2/3 slopes of the levee, with a variance allowing the lower 1/3rd waterside vegetation to stay.

** Would establish compliance with Corps vegetation requirements. Engineering Technical Letter 1110-2-571.

The West Sacramento project is being completed in accordance with the principles that have been outlined in the Corps' SMART Planning Guide (Corps 2013). SMART Planning requires that all feasibility studies should be completed within a target of 18 months (to no more than three years at the greatest), at a cost of no more than $3 million, utilizing 3 levels of vertical team coordination, and of a "reasonable" report size. The SMART Planning methodology and framework were developed to facilitate more efficient, effective, and consistent delivery of Planning Decision Documents. All designs associated with this project use the largest footprint to evaluate affects to listed species. The larger footprint will look at the maximum extent the project could affect species in the project area. As design refinements occur, consideration will be given to designs that reduce affects to listed species where practicable.

2.2 West Sacramento Project Proposed Action

2.2.1 Measures Proposed for Alternatives

Levees in the project area require improvements to address seepage, slope stability, overtopping, and erosion concerns. The measures proposed to improve the levees are described below and consist of: (1) seepage cutoff walls, (2) seepage berms, (3) stability berms, (4) levee raises, (5) flood walls, (6) relief wells, (7) sheet pile walls, (8) jet grouting, and (9) bank protection. The above measures would be implemented by fixing levees in place, constructing adjacent levees, or constructing a setback levee. It is possible that sheet pile walls, jet grouting, and relief wells would be used at various locations so they are also described below. Figure 1 identifies the reaches where each measure would be required. Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. This would include slope flattening and/or crown widening, where required. The levee crown would be widened to 20 feet, and 3:1 landside and waterside slopes would be established where possible. If necessary, the existing levee centerline would be shifted landward in order to meet the Corps' standard levee footprint requirements.

<u>**Seepage and Slope Stability Measures**</u>

Cutoff Walls

To address seepage concerns, a cutoff wall would be constructed through the levee crown. The cutoff wall would be installed by one of two methods: (1) conventional open trench cutoff walls, or (2) deep soil mixing (DSM) cutoff walls. The method of cutoff wall selected for each reach would 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 approximately 85 feet. For cutoff walls of greater depth, the DSM method would be utilized.

Prior to construction of either method of cutoff wall, the construction site and any staging areas would be cleared, grubbed, and stripped. The levee crown would be degraded to approximately half the levee height to create a large enough working platform (approximately 30 feet) and to reduce the risk of hydraulically fracturing the levee embankment from the insertion of slurry fluids (Figure 3). Excavated and borrow material (from nearby borrow sites) would be stockpiled at staging areas. Haul trucks, front end loaders, and scrapers would bring borrow materials to the site, which would then be spread evenly and compacted according to levee design plans. The levee would be hydroseeded once construction was completed.

Conventional Open Trench Cutoff Wall

A trench approximately 3 feet wide would 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 would be filled with low density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench would be mixed nearby with hydrated bentonite, and in some applications cement. The soil bentonite mixture would be backfilled into the trench, displacing the temporary slurry. Once the slurry has hardened, it would be capped and the levee embankment would be reconstructed with impervious or semi-impervious soil.

Deep Soil Mixing Cutoff Wall

The DSM method would require large quantities of cement bentonite grout. This would necessitate the use of a contractor-provided, on-site batch plant and deliveries of concrete aggregate, concrete sand, bentonite, and cement. The batch plant would be powered by generators or electricity from overhead power lines and would be located within the project area or in an adjacent staging area. The batch plant area would consist of an aggregate storage system, aggregate rescreen system (if needed), rewashing facility (if needed), the batching system, cement storage, ice manufacturing, and the grout mixing and loading system. All aggregate used within the batch plant operations would be obtained from existing local commercial off-site sources and delivered to the site.

From the batch plant, the grout mixture would be transported through high-pressure hoses (8,000 pounds per square inch [psi]) to the location of construction. At the construction site, a crane supported set of two to four mixing augers would used to drill through the levee crown and subsurface to a maximum depth of approximately 140 feet. As the augers are inserted and withdrawn, the cement bentonite grout would be injected through the augers and mixed with the native soils. An overlapping series of mixed columns would be drilled to create a continuous seepage cutoff barrier. Once the slurry has hardened it would be capped and the levee embankment would be reconstructed with impervious or semi-impervious soil.

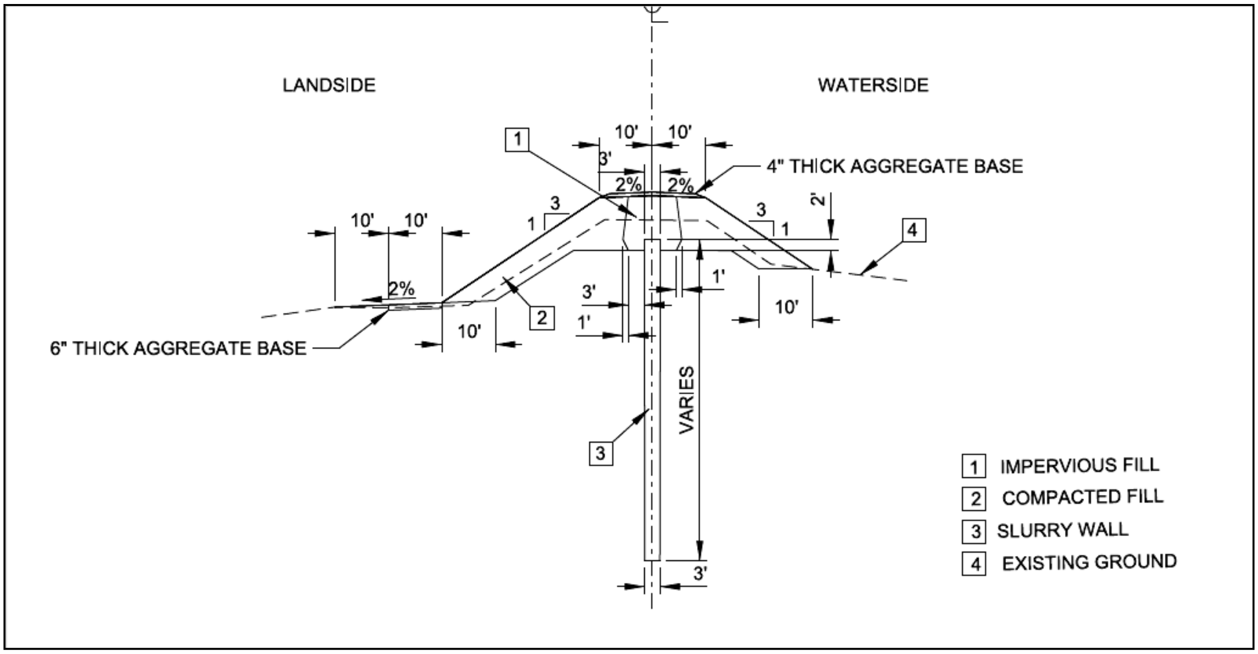

Figure 3. Levee Improvement with Slurry Wall.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeable to semi-pervious materials that resist accumulated water pressure and safely release seeping water. A seepage berm would be constructed in areas where it has been determined by geotechnical investigations that a seepage berm is more appropriate to address seepage than a cutoff wall. The seepage berm would extend out from the landside levee toe and would vary in width from 70 to 100 feet, tapering down from a five foot thickness, at the levee toe, to a three foot thickness, at the berm toe (Figure 4). The length of the seepage berm would depend on the seepage conditions along the levee reach.

Construction would consist of clearing, grubbing, and stripping the ground surface. Depending on the action alternative, soil used to construct a berm would be stockpiled from levee degradation, excavated from nearby borrow pits, or trucked on site from off-site locations (if on-site material is not adequately available). During the degrading, soil would be stockpiled at the proposed berm site. If constructing the alternative does not require levee degradation, all soil material used to construct a berm would come from nearby borrow sites. At the borrow sites, bulldozers would excavate and stockpile borrow material. Front-end loaders would load haul trucks, and the haul trucks would transport the borrow material to the site. The haul trucks would then dump the material, and motor graders would spread it evenly, placing approximately 3 to 5 feet of embankment fill material. Material used for berm construction would have greater permeability than the native blanket material. However, depending on material availability, a lower permeability material may be used. Adjustments to berm width would be made in such cases, as appropriate. During the embankment placement, material would be placed in a maximum of 1- to 2-foot loose lifts, thereby allowing the compactors to achieve the specified compaction requirements. Sheepsfoot rollers would compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction and reduction of fugitive dust emissions. The new seepage berm would be hydroseeded following construction.

Seepage berms may have an optional feature of a drainage relief trench under the toe of the berm. Drained seepage berms would include the installation of a drainage layer (gravel or clean sand) beneath the seepage berm backfill and above the native material at the levee landside toe. A drained seepage berm would likely decrease the overall footprint of the berm.

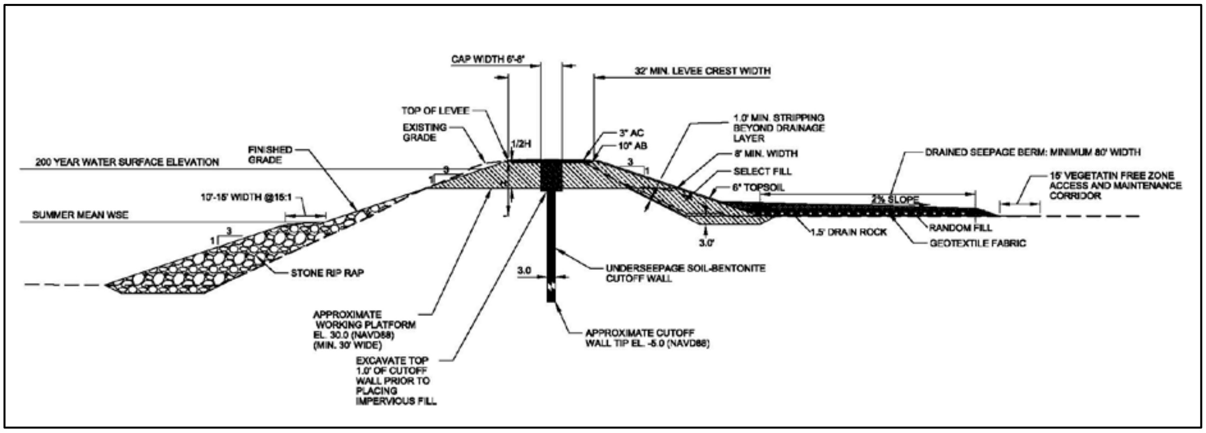

Figure 4. Fix in Place Levee Improvement with Seepage Berm.

Stability Berm

A stability berm would be constructed against the landside slope of the existing levee with the purpose of supplying support as a buttress. A stability berm is proposed along the South Cross levee as shown in Figure 5. The height of the stability berm would generally be 2/3 of the levee height, and would extend for a distance determined by the structural needs of the levee along that reach. Embankment fill material necessary to construct the berm is excavated by a bulldozer from a nearby borrow site. Front-end loaders would load haul trucks with the borrow material and the haul trucks would transport the material to the stability berm site. Motor graders would spread the material evenly according to design specifications, and a sheepsfoot roller would compact the material. Water trucks would distribute water over the material to ensure proper moisture for compaction. The new seepage berm would be hydroseeded after construction.

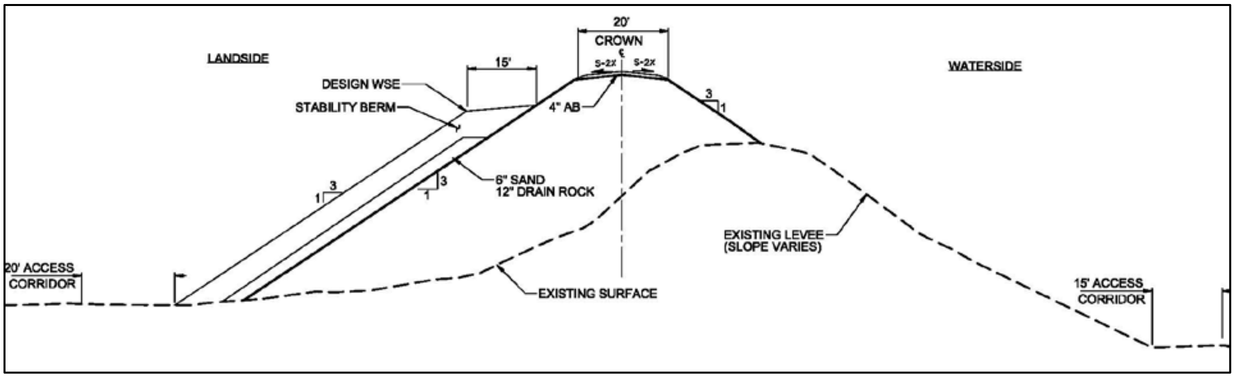

Figure 5. Levee Improvement with Stability Berm.

Adjacent Levee

Constructing an adjacent levee is one of the ways to improve levees and is proposed along some sections of the Sacramento River south levee. The adjacent levee essentially adds material to increase the cross section of the levee, thereby allowing the prescribed 3:1 landside slopes and 20-foot-wide crown to be established (Figure 6). The adjacent levee would be constructed on the landward side of the levee and would make it possible to leave all waterside vegetation in place.

The first construction phase would include clearing, grubbing, and stripping the work site and any construction staging areas, if necessary. A trapezoidal trench would be cut at the toe of the slope and the levee embankment may be cut in a stair-step fashion to allow the new material to key into the existing material. Bulldozers would then excavate and stockpile borrow material from a nearby borrow site. Front-end loaders would load haul trucks with the borrow material, and the haul trucks would subsequently transport it to the adjacent levee site. The haul trucks would dump the material, and dozers would spread it evenly. Sheepsfoot rollers would then compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction. The landside levee would be graded at a 3:1 slope, and the levee crown would be at least 20 feet wide. The slope may be track-walked with a dozer. The levee crown would be finished with an aggregate base or paved road, depending on the type and level of access desired. Either condition would require importation of material with dump trucks, placement with a loader and motor grader, and compaction. A paver would be required for asphalt placement.

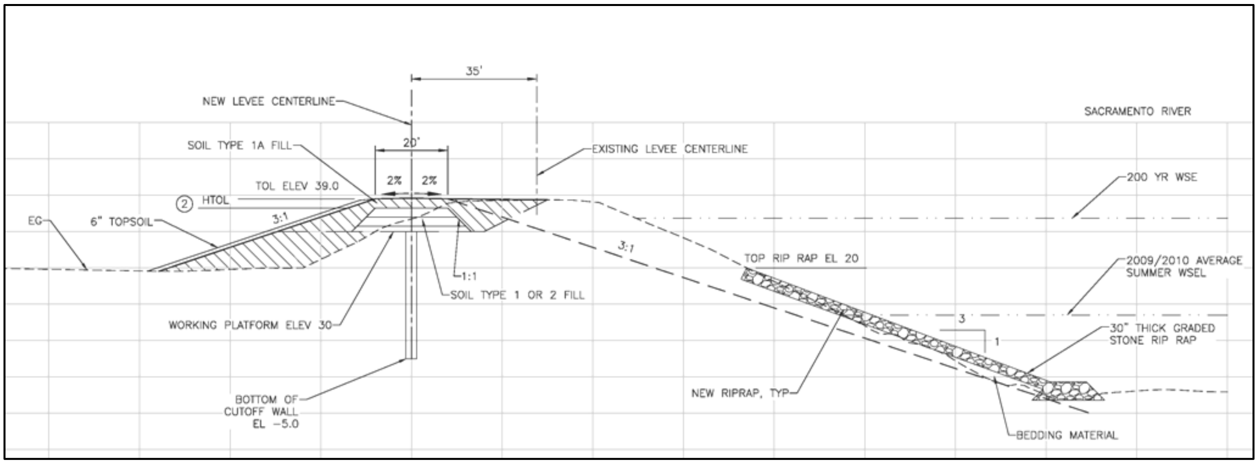

Figure 6. Adjacent Levee Improvement.

Sheet Pile Wall

A sheet pile wall is proposed at the Stone Locks to tie together the levees on either side of the Barge Canal (Figure 7). A trench would be excavated along the sheet pile alignment to allow the pile to be driven to the proposed depth (below the existing levee grade). A driving template fabricated from structural steel would be placed to control the alignment as the sheet pile is installed. A hydraulic or pneumatically operated pile driving head attached to a crane would drive the sheet pile into the levee crown to the desired depth (up to 135 feet). An additional crane or excavator would be used to facilitate staging of the materials. The conditions of the site, driving pressure, hydrostatic loads, and corrosion considerations would determine the thickness and configuration of the sheet piles. If conditions indicate that corrosion is an issue, the sheet piles could be coated, oversized to provide additional thickness as a corrosion allowance, and/or provided with a cathodic protection system.

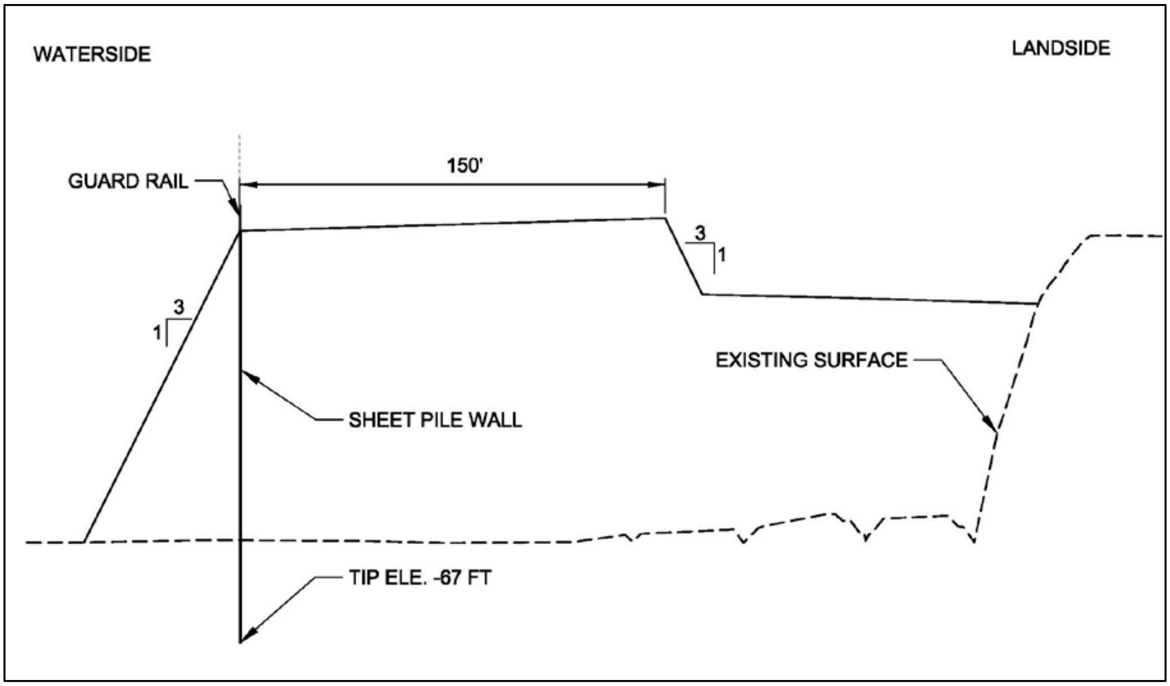

Figure 7. Sheet Pile Wall with Embankment Fill.

Jet Grouting

Jet grouting typically is used in constructing a slurry cutoff wall to access areas other methods cannot. In this regard, it is typically a spot application rather than a treatment to be applied on a large scale. Jet grouting would be used around existing utilities not proposed for removal, and at bridges along the West Sacramento levees. It involves injecting fluids or binders into the soil at very high pressure. The injected fluid can be grout; grout and air; or grout, air, and water. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass of low permeability.

Equipment required for jet grouting consists of a drill rig fitted with a special drill string; a high pressure, high flow pump; and an efficient batch plant with sufficient capacity for the required amount of grout and water, supporting generators and air compressors, holding tanks, and water tanks, with bulk silos of grout typically used to feed large mixers. The high-pressure pump conveys the grout, air, and/or water through pipelines that run the length of the site through the drill string to a set of nozzles located just above the drill bit. Smaller equipment can be used in combination with the single phase–fluid system and can be permanently trailer-mounted to permit efficient mobilization and easy movement at the job site. Jet-grouted columns range from 1 to 16 feet in diameter and typically are interconnected to form cutoff barriers or structural sections. One construction crew, consisting of a site supervisor, pump operator, batch plant operator, chuck tender, and driller under ideal conditions, can construct two 6-foot-diameter, 50-foot columns per day consisting of approximately 100 cubic yards of grout injected per 8-hour shift. Ideal conditions would be characterized by no technical issues, such as loss of fluid pressure, breakdown of equipment, or subsurface obstructions to drilling operations occurring at either the batch plant or the drilling site.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scrapper. Material would be scraped and stockpiled at a nearby stockpile area. Hauling at the work area would involve scraper runs along the levee to the staging area, and grout, bentonite, and water deliveries to the batch plant. To initiate jet grouting, a borehole would be drilled through the levee crown and foundation to the required depth (to a maximum depth of approximately 130 feet) by rotary or rotary-percussive methods using water, compressed air, bentonite, or a binder as the flushing medium. When the required depth is reached, the grout would be injected at a very high pressure as the drill string is rotated and slowly withdrawn. Use of the double, triple, and superjet systems create eroded spoil materials that would be expelled out of the top of the borehole. The spoil material would contain significant grout content and could be used as a construction fill.

Relief Wells

Relief wells would be used to address underseepage and would be applied only on a limited basis for site-specific conditions rather than a segment-wide application. They would be located along adjacent and setback levee toes in the South Basin and only in segments where geotechnical analyses have identified continuous sand and gravel layers and the presence of an adequate impermeable layer (Figure 8). Relief wells are passive systems that are constructed near the levee landside toe to provide a low-resistance pathway for under-seepage to exit to the ground surface in a controlled and observable manner. A low-resistance pathway releases water pressure under the upper impermeable layer, allowing underseepage to exit without creating sand boils or piping levee foundation materials.

Relief wells are constructed using soil-boring equipment to drill a hole vertically through the upper fine-grained layer (usually clays or silty clays), through the coarse-grained aquifer layer of sand or gravel, and into the lower fine-grained clay layer beneath. Pipe casings and gravel/sand filters are installed to allow water to flow freely while preventing transportation and removal of material from the levee foundation, which can undermine the levee foundation. The water then is collected and discharged into a drainage system using a series of ditches or an underground piping system.

Relief wells generally are spaced at 50- to 150-foot intervals, dependent on the amount of underseepage, and extend to depths of up to 150 feet. Areas for relief well construction are cleared, grubbed, and stripped. During relief well construction, a typical well-drilling rig would be used to drill to the required depth and construct the well (including well casing, gravel pack material, and well seal) beneath the ground surface. The drill rig likely would be an all-terrain, track-mounted rig that could access the well locations from the levee toe.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10 to 20 days. Additional time may be required for site restoration.

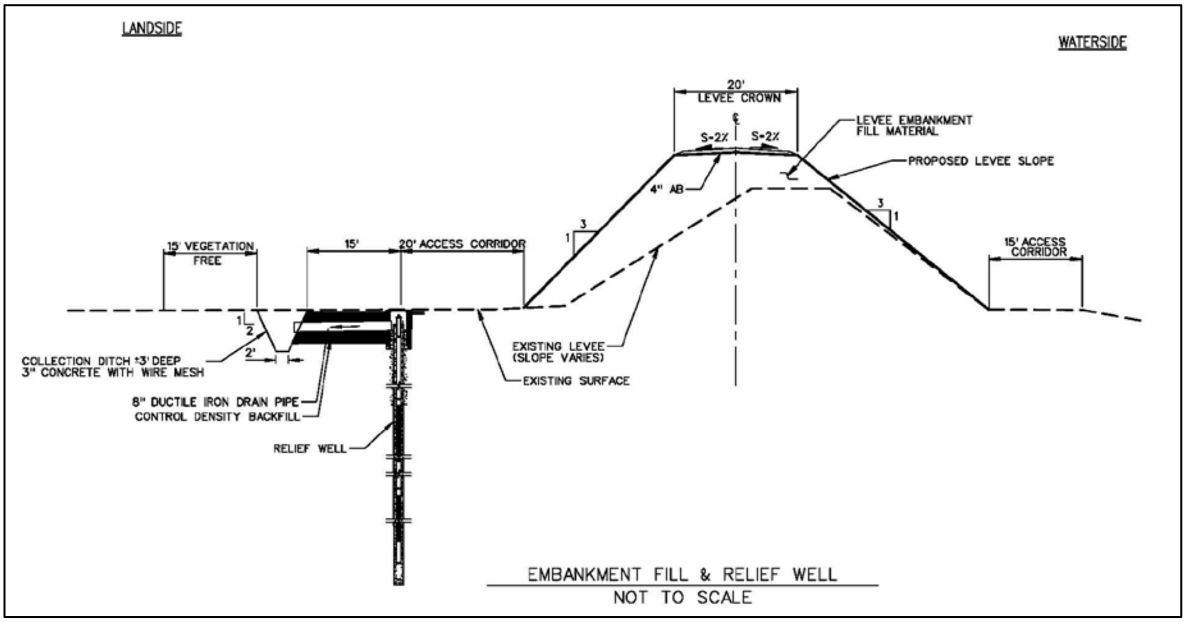

Figure 8. Fix in Place Levee Improvement with Relief Well.

<u>**Overtopping Remediation**</u>

Levee Height Raise

To address the height deficiencies, additional borrow material would be added after cutoff walls and levee reshaping improvements are completed (Figure 9). The additional material would be brought from nearby borrow sites, stockpiled in staging areas then hauled to the site with trucks and front end loaders. Material would be spread evenly and compacted according to levee design plans. The levee would be hydroseeded once construction was completed.

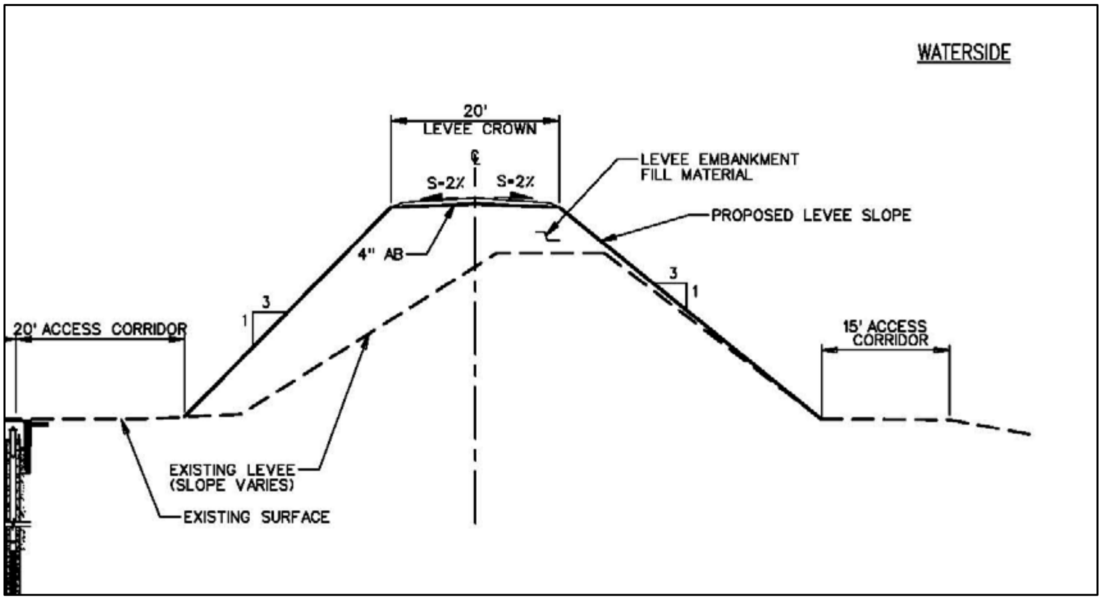

Figure 9. Levee Height Raise.

Floodwalls

Floodwalls are proposed along the waterside hinge point of the Port north levee and along the selected levee alignment around the Port of West Sacramento. Floodwalls are an efficient, space-conserving method for containing unusually high water surface elevations. They are often used in highly developed areas, where space is limited. To begin the floodwall construction, the area would be cleared, grubbed, stripped, and excavation would occur to provide space to construct the footing for the floodwall. The floodwall would primarily be constructed from pre-fabricated materials, although it may be cast or constructed in place, and would be constructed almost completely upright. Floodwalls mostly consist of relatively short elements, making their connections very important to their stability. The floodwalls would be designed to disturb a minimal amount of waterside slope and levee crown for construction (Figure 10). The height of the floodwalls varies from 1 to 4 feet, as required by water surface elevations. The waterside slope would be re-established to its existing slope and the levee crown would grade away from the wall and be surfaced with aggregate base

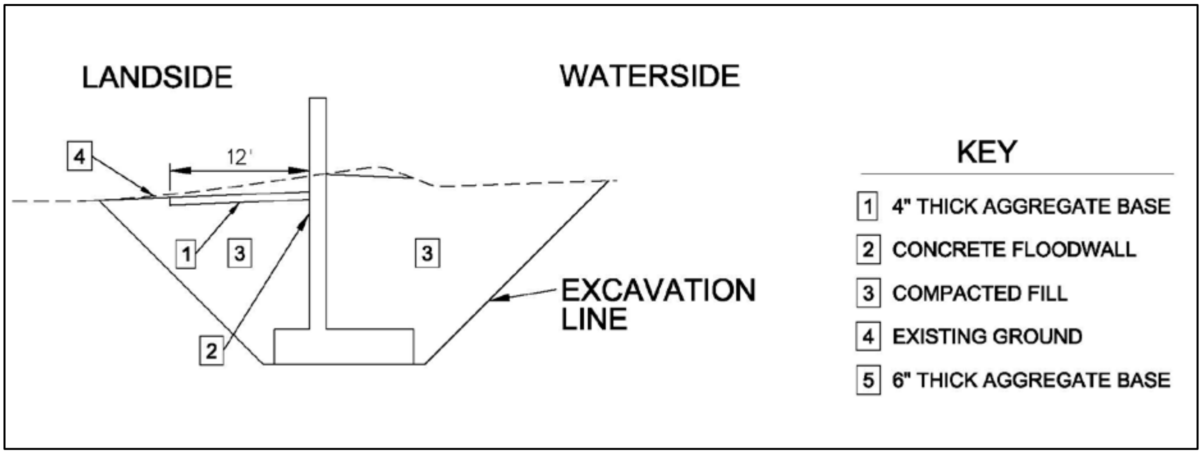

Figure 10. Floodwall Typical Design.

Erosion Protection Measures

Levee Bank Protection

The primary erosion protection measure consists of waterside armoring of the levees to prevent erosion and subsequent damage to the levee. This measure consists of placing rock revetment on the river's bank, and in some locations on the levee slope, to prevent erosion (Figure 11). The extent of the revetment would be based on site-specific analysis. Along the Sacramento Bypass Training levee, revetment would be placed on both sides of the levee slopes as shown in Figure 12. This would protect the levee in place when the Sacramento and Yolo Bypasses have water in them. When necessary, the eroded portion of the bank would be filled and compacted prior to the rock placement. The sites would be prepared by clearing and stripping the site prior to construction. Small vegetation and deleterious materials would be removed. Bank protection would be placed around existing trees on the lower portion of the slope. Trees on the upper portion of the slope would be removed during degrading of levees for slurry cutoff walls and bank protection would be placed following reconstruction of the levee. Temporary access ramps would be constructed, if needed, using imported borrow material that would be trucked on site.

Revetment would be imported from an offsite location via haul trucks or barges. Revetment transported by haul trucks would be temporarily stored at a staging area located in the immediate vicinity of the construction site. A loader would be used to move revetment from the staging area to an excavator that would place the material on site. Rock required on the upper portions of the slopes would be placed by an excavator located on top of the levee. Rock placement from atop the levee would require one excavator and one loader for each potential placement site.

Revetment transported by barges would not be staged, but placed directly on site by an excavator.   Rock required within the channel, both below and slightly above the water line at the time of placement, would be placed by an excavator located on a barge. The excavator would construct a large rock berm in the water up to an elevation slightly above the mean summer water surface. A planting trench would be established on this rock surface for revegetation purposes. Construction would require two barges: one barge would carry the excavator, while the other barge would hold the stockpile of rock to be placed on the channel slopes.

The bank protection would be placed via the methods discussed above on the existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After rock placement has been completed, a small planting berm would be constructed in the rock, when feasible, to allow for some revegetation of the site outside of the vegetation free zone as required by Engineer Technical Letter (ETL) 1110-2-571.

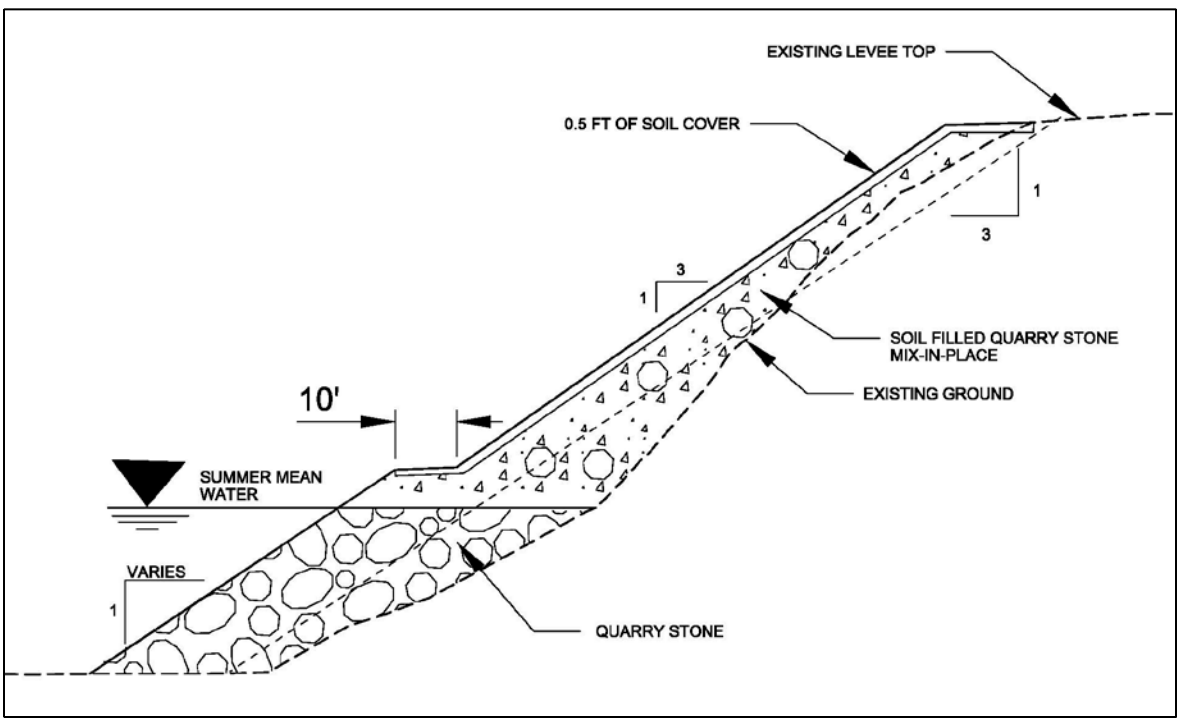

Figure 11. Bank Protection Typical Design.

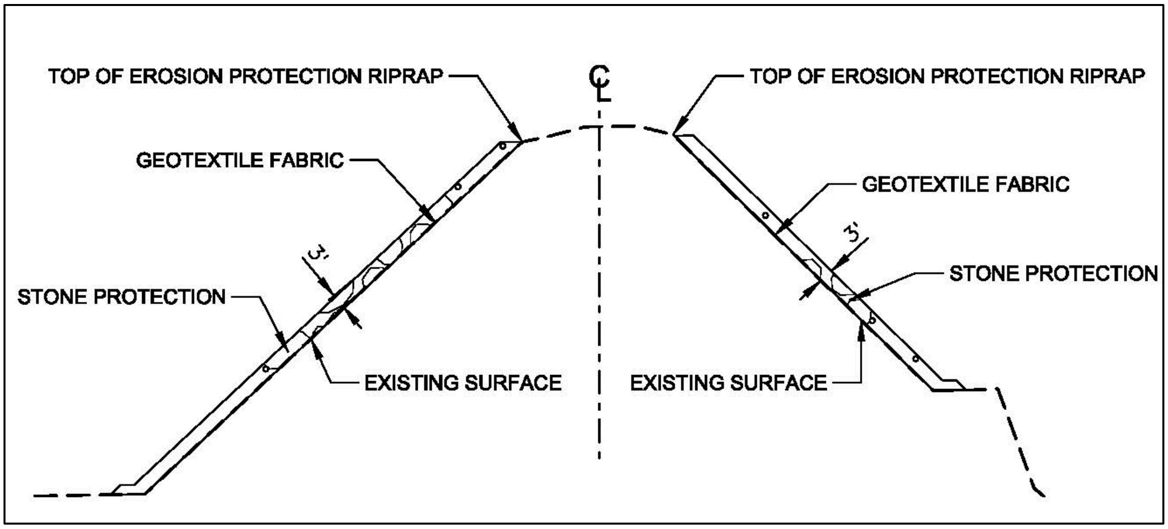

Figure 12. Bank Protection along Sacramento Bypass Training Levee.

Levee Biotechnical Measures

In addition to the bank protection measure, biotechnical measures have been proposed for several reaches. This remediation measure would be implemented for any of the proposed alternatives discussed in this document. This measure is being considered for lower velocity reaches to preserve existing vegetation. Under this measure, the Corps would use plant material and minimal amounts of rock to stabilize the eroded slope and prevent further loss of material.

Additional Construction Measures

In addition to the proposed levee improvements measures described above, the following measures and policies would apply to all of the alternatives, and would be addressed during construction:

- The Corps' standard levee footprint would be established during construction of structural improvements on all levees that are out of compliance. The standard levee footprint consists of a 20 foot crown width and 3:1 waterside and landside slopes. If the 3:1 landside slope is not possible based on site specific conditions then a minimum 2:1 landside slope would be established with supporting engineering analysis.
- A 20 foot landside and waterside maintenance access would be established. In areas where 20 feet cannot be obtained, 10 feet is allowable.
- Utility encroachments such as structures, certain vegetation, power poles, pump stations, and levee penetrations (e.g., pipes, conduits, cables) would be brought into compliance with applicable Corps policy or removed depending on type and location. This measure would include the demolition of such features and relocation or reconstruction as appropriate on a

case-by-case basis (or retrofit to comply with standards). Utilities replacements would occur via one of two methods: (1) a surface line over the levee prism, or (2) a through-levee line equipped with positive closure devices.

- Private encroachments shall be removed by the non-federal sponsor prior or property owner prior to construction.

Vegetation Removal/Vegetation Variance Request

Compliance with ETL 1110-2-571 vegetation requirements would be established. The vegetation requirements include a vegetation-free zone on the levee slopes and crown, 15 feet from both landside and waterside levee toes, and 8 feet vertically. Where feasible based on engineering analysis, a variance would be sought to allow vegetation to remain. If granted, the variance would allow for vegetation to remain on the lower two-third of the waterside slope and within the waterside 15 toe. No vegetation would be permitted on the landside slope or within 15 feet of the landside toe. A vegetation variance would be requested to provide compliance for the Sacramento River portion of the project as described in Section 2.1.

The levees within the study area require seepage, slope stability, height, and erosion improvements in order to meet Corps criteria. Construction of the levee improvement measures would require complete vegetation removal on the levee from approximately 15 feet landward of the landside toe to approximately one-third the height of the levee on the waterside slope. On the waterside, where construction does not remove vegetation, the vegetation on the lower one-third of the levee and waterward, would be left in place if allowed under a Vegetation Variance Request (VVR) sought by the Sacramento District. To show that the safety, structural integrity, and functionality of the levee would be retained, an evaluation of underseepage and waterside embankment slope stability was completed.

The preliminary analysis for the VVR was conducted for the index points at the Sacramento River West Levee Sta. 35+22 of the South Basin, and Sacramento River West Levee Sta. 96+00 of the North Basin. The analysis points were chosen for the VVR analyses because they were considered to be representative of the most critical channel and levee geometry, underseepage, slope stability conditions, and vegetation conditions of the respective basins. The cross-section geometry of the index points incorporated tree fall and scour by using a maximum depth of scour for cottonwoods as approximately 11.0 feet; the associated soil removed was projected at a 2:1 slope from the base of the scour toward both the landside, and waterside slopes. The base scour width was equal to the maximum potential diameter at breast height (dbh) of cottonwoods (12.0 feet) projected horizontally at a depth of 11.0 feet below the existing ground profile. The results show that the tree fall and scour did not significantly affect levee performance and that the levee meets Corps seepage and slope stability criteria considering the seepage and slope stability improvement measures are in place (“with project” conditions). Therefore, it is a reasonable conclusion that with a VVR to allow vegetation to remain as stated above, the safety, structural integrity, and functionality of the Sacramento River levee would be retained.

Borrow Sites

It is estimated that a maximum of 9 million cubic yards of borrow material could be needed to construct the project. Because this project is in the preliminary stages of design, detailed studies of each alternative borrow needs have not been completed. For the purposes of NEPA/CEQA a worst case scenario is being evaluated for the volume of borrow material needed. Actual volumes exported from any single borrow site would be adjusted to match demands for fill.

To identify potential locations for borrow material, soil maps and land use maps were obtained for a 20-mile radius surrounding the project area. The criteria used to determine potential locations were based on current land use patterns, soil types from U.S. Soil Conservation Service (SCS), and Corps' criteria for material specifications. These potential borrow locations are shown on the Borrow Site Map (Figure 13). Borrow sites would be lands that are the least environmentally damaging and would be obtained from willing sellers. The data from land use maps and SCS has not been field verified, therefore, to ensure that sufficient borrow material would be available for construction the Corps looked at all locations within the 20 miles radius for 20 times the needed material. This would allow for sites that do not meet specifications or are not available for extraction of material.

The excavation limits on the borrow sites would provide a minimum buffer of 50 feet from the edge of the borrow site boundary. From this setback, the slope from existing grade down to the bottom of the excavation would be no steeper than 3H:1V. Excavation depths from the borrow sites would be determined based on available suitable material and local groundwater conditions. The borrow sites would be stripped of top material and excavated to appropriate depths. Once material is extracted, borrow sites would be returned to their existing use whenever possible, or these lands could be used to mitigate for project impacts, if appropriate.

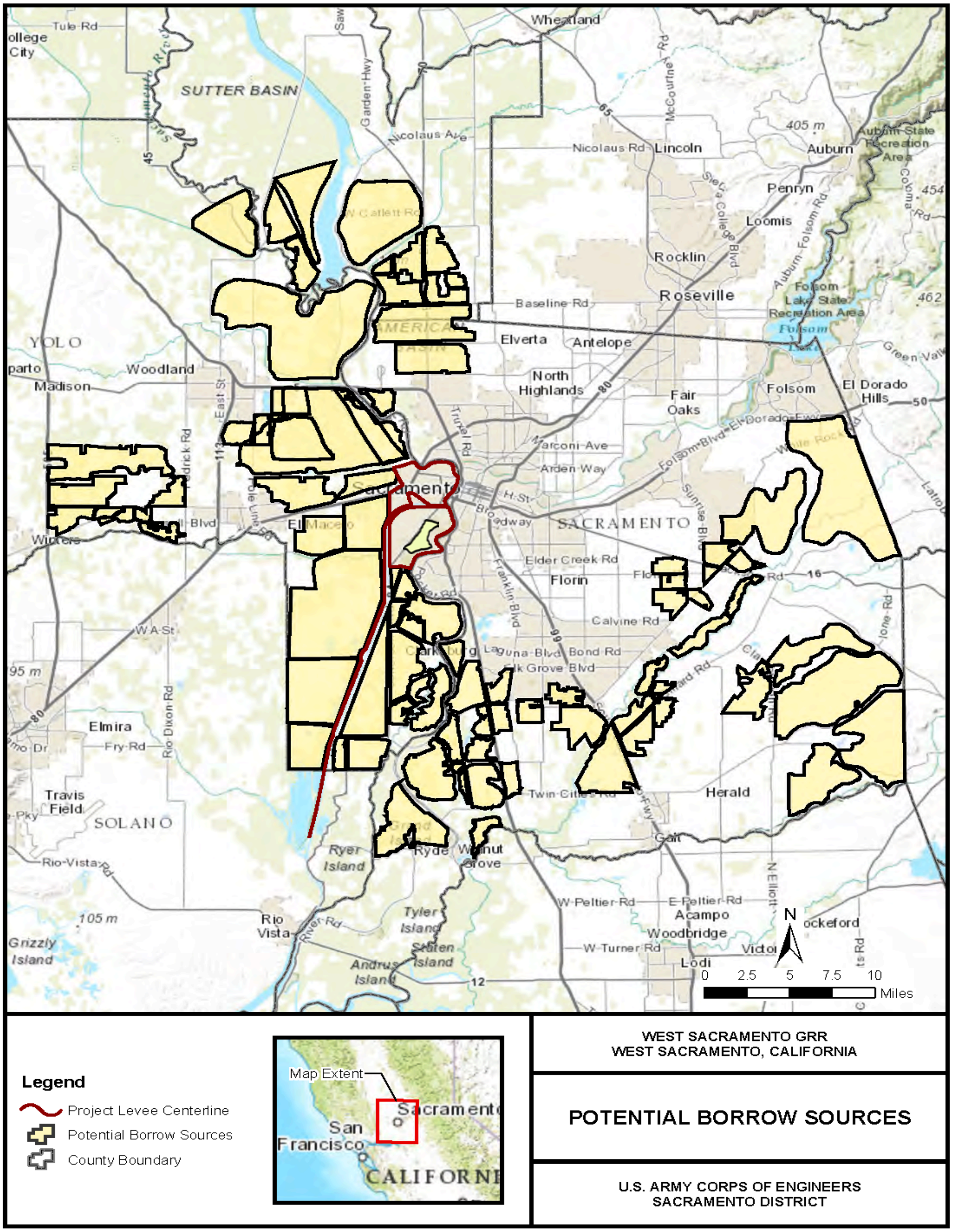

Figure 13. Potential Locations for Borrow Material for a 20-mile Radius Surrounding the Study Area.

2.2.2 Tentatively Selected Plan – Alternative 5 – Improve Levees with Setback Levee along Sacramento River South

The tentatively selected plan for the West Sacramento Project is Alternative 5 – Improve Levees with Setback Levee along Sacramento River South. Alternative 5 would include the construction of levee improvements to address: (1) seepage, (2) slope stability, (3) overtopping, and (4) erosion concerns identified for the Sacramento River, South Cross, DWSC, Port, Yolo Bypass, and Sacramento Bypass training levees. Figure 14 below identifies the reaches where each measure would be required under Alternative 5. Levees would be improved through a combination of fix in place and setback levee construction. A description of the measures identified and construction methods can be found above in Section 2.2.1. Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired. The levee remediation measures proposed under Alternative 5 are summarized in Table 3 below.

Table 3. Alternative 5 – Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
North Basin				
Sacramento River North	Cutoff Wall	Cutoff Wall	Levee raise	Bank Protection
Port North	---	---	Floodwall	---
Yolo Bypass *	Cutoff Wall	Cutoff Wall	---	---
Sacramento Bypass Training Levee	---	---	---	Bank Protection
South Basin				
Sacramento River South	Setback Levee, Cutoff Wall, Seepage Berm,	Setback Levee, Cutoff Wall, Seepage Berm	---	Setback Levee, Bank Protection
South Cross	Stability Berm, Relief Wells	---	Levee Raise	---
Deep Water Ship Channel East *	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Deep Water Ship Channel West*	Cutoff Wall	Cutoff Wall	Levee Raise	---
Port South*	Cutoff Wall	Cutoff Wall	Levee Raise	---

* The entire levee reach does not need remediation, only specific sections.

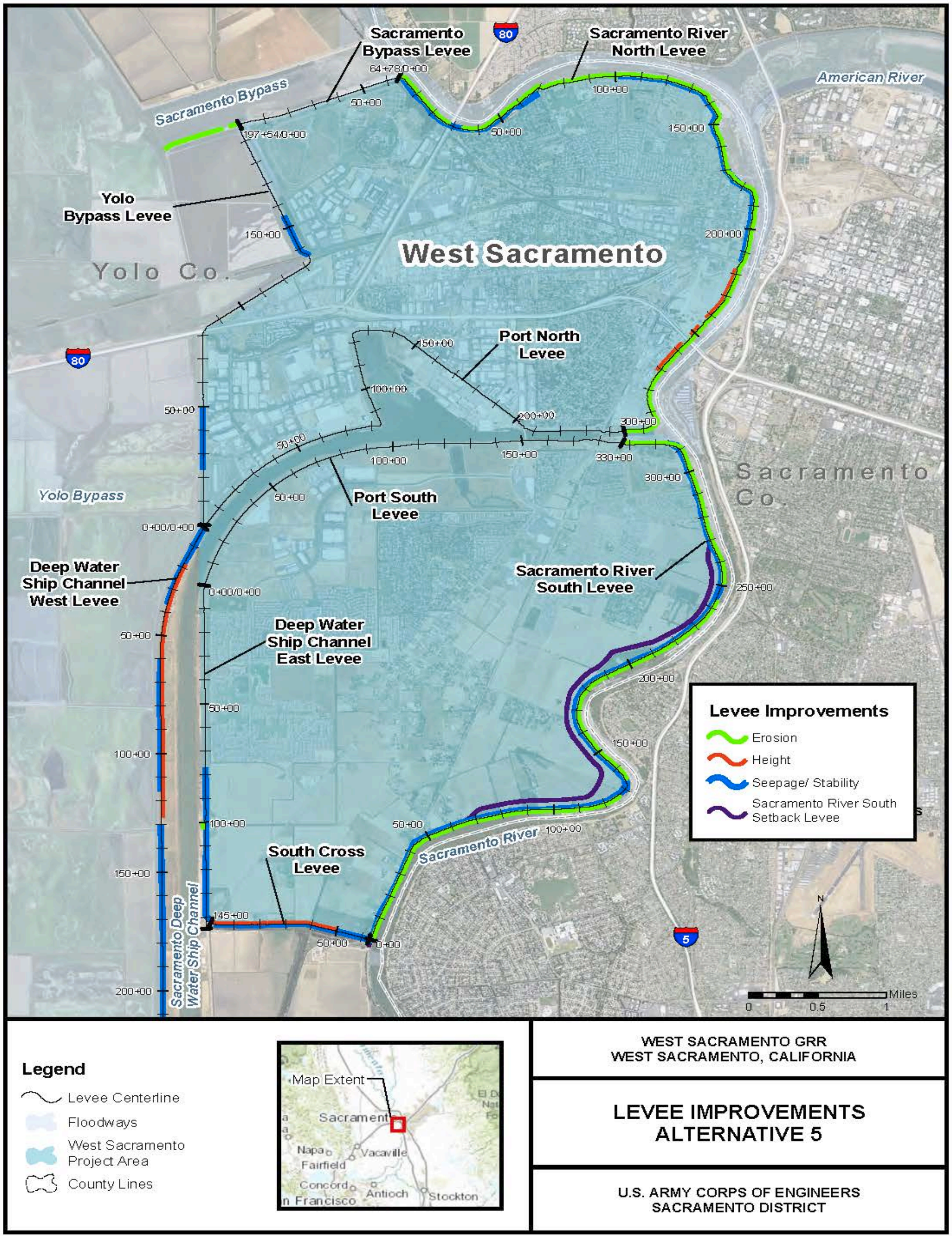

Figure 14. Map of Levee Improvements for Alternative 5.

It is estimated that 9 million cy of borrow material would be needed to construct Alternative 5. This includes 4 million cy of material for the setback levee. For the purposes of NEPA/CEQA, a worst case scenario is being evaluated for the volume of borrow material needed. Actual volumes exported from any single borrow sites would be adjusted to match demands for fill. Borrow sites for Alternative 5 would be the same as those identified in Section 2.2.1 above.

Construction of Alternative 5 is proposed to take approximately 19 years if each reach is constructed sequentially. The construction reaches have been prioritized based on a variety of factors, including the condition of the levee, the potential damages that would occur due to levee failure, and construction feasibility considerations, such as the availability of equipment at any given time. The tentative schedule of construction is shown in Table 4. The durations are for construction activities only, and do not include the time needed for design, right-of-way, utility relocation, etc.

Table 4. Alternative 5 – Construction Sequence and Duration.

Construction Sequence	Construction Duration
Sacramento River South Levee	4 years
Sacramento Bypass Training Levee	1 years
Sacramento River North Levee	2 years
Yolo Bypass	1 years
Deep Water Ship Channel West	3 years
Port South	1 years
Deep Water Ship Channel East	3 years
South Cross	2 years
Port North	2 years

Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired. The measures proposed for this alternative are described below.

West Sacramento North Basin

The primary issues in the North Basin, as identified on Figure 14, are seepage, slope stability, and erosion, with minimal levee height concerns. The measures that would be implemented under Alternative 5 for the levees in the North Basin would be: (1) installation of cutoff walls to address seepage and slope stability concerns; (2) levee raises to address height concerns; and (3) erosion protection to address erosion concerns. These measures are described above in Section 2.2.1. Table 5 shows the lengths of levee reaches, the measures for those reaches, and the approximate length of improvements for the North Basin.

Table 5. Alternative 5 – Construction Lengths and Measures by North Basin Levee Reach

Levee Reach	Length of Reach (feet)	Length of Measure (feet)	Improvement	Measure
Sacramento River North Levee	30,700	30,000	Erosion Protection	Bank Protection
		11,000	Seepage	30 Foot Deep Slurry Wall
		1,500	Seepage	80 Foot Deep Slurry Wall
		500	Seepage	45 Foot Deep Slurry Wall
		5,500	Seepage	110 Foot Deep Slurry Wall
		4,600	Height	Embankment Fill
Stone Locks	570	550		Embankment Fill, Sheet Pile Wall
Port North	23,225	8,500	Height	4 to 10 Foot High Floodwall
		14,000	Height	Embankment Fill
Yolo Bypass	19,749	2,500	Seepage	40 Foot Deep Slurry Wall
		2,000	Seepage	100 Foot Deep Slurry Wall
Sacramento Bypass Training Levee	3,000	3,000	Erosion Protection	Bank Protection

Sacramento Bypass Training Levee

The training levee that extends into the Yolo Bypass from the Sacramento Bypass levee was not repaired by the sponsors, and still has erosion concerns as shown on Figure 14. Under Alternative 5, bank protection is proposed to address erosion. Bank protection would be implemented as described in Section 2.2.1.

Sacramento River Levee

The Sacramento River north levee does not meet design requirements, and has seepage and stability concerns along most of the reach with erosion and height issues identified at various locations which are shown on Figure 14. The measures that would be implemented under Alternative 5 for the Sacramento River levee would be: (1) installation of cutoff walls to address seepage and slope stability concerns; (2) levee raises to address inadequate levee height; and (3) bank protection to address erosion concerns.

The Sacramento River north levee consists of 20-foot wide levee crown with 3:1 side slopes. The cutoff wall would be constructed through the levee crown to address seepage concerns. The cutoff wall would be installed by one of two methods discussed in Section 2.2.1, depending on the depth of the cutoff wall needed to address the seepage and stability issues. The conventional open trench method would be used to install a cutoff wall to a depth of approximately 85 feet. The DSM method would be utilized for cutoff walls that are installed to a depth greater than 85 feet.

Levee embankment grading, height improvements, and bank protection would be constructed in the same manner discussed in Section 2.2.1. Following construction, the levee would be reconstructed to current Corps standards as described above in Section 2.2.1.

In addition, a new levee with a sheet pile wall would also be constructed on the Sacramento River side of the Stone Locks to close the connection between the Sacramento River and the barge canal. The new levee would also connect the levee along the Sacramento River between the North Basin and South Basin. To construct the new levee, a coffer dam would be constructed on the river side of the construction footprint and that the new levee would be constructed in the dry area. Initially a sheet pile wall would be placed on the east side of the construction area as described in Section 2.2.1. The levee would be constructed west of the sheet pile wall as described under the setback levee heading in Section 2.2.1. Construction of the levee and sheet pile wall would require the removal of 1.7 acres of riparian habitat along the outlet of the Barge Canal. It would also require the relocation of three power poles and two storm drains, and the removal of concrete infrastructure.

Port North Levee

The primary issue in the Port north area is overtopping concerns as shown on Figure 14. Under Alternative 5, remediation measures were proposed to address the height concerns along the Port north reach. The measure implemented under Alternative 5 would be: (1) installation of flood walls to address height concerns. The flood wall description can be found above in Section 2.2.1.

Yolo Bypass Levee

Along the Yolo Bypass levee, seepage and slope stability problems were identified at various locations shown on Figure 14. The measures that would be implemented under Alternative 5 would be: (1) installation of a cutoff wall to address seepage and slope stability concerns. A conventional open trench cutoff wall would be constructed at these locations as described above in Section 2.2.1.

<u>West Sacramento South Basin</u>

The primary issues in the South Basin, as identified on Figure 14, are seepage, slope stability, and erosion with minimal levee height concerns. The measures that would be implemented under Alternative 5 for the levees in the South Basin would be: (1) installation of cutoff walls, stability berms, seepage berms, relief wells, or setback levees to address seepage and slope stability concerns; (2) levee raises to address height concerns; (3) erosion protection to address erosion concerns. These measures are described above in Section 2.2.1. Table 6 shows the lengths of levee reaches, the measures for those reaches, and the approximate length of improvements for the South Basin.

Table 6. Alternative 5 – Construction Lengths and Measures by South Basin Levee Reach.

Reach	Length of Reach (feet)	Length of Measure (feet)	Improvement	Measure
Sacramento River South Levee	31,000	31,000	Seepage/Erosion	80 Foot Deep Slurry Wall 70 Foot Berm Bank Protection
South Cross Levee	6,273	1,100	Stability/Height	Stability Berm and Embankment Fill
		5,000	Seepage/Height	Relief Wells and Embankment Fill
DWSC East Levee	17,171	1,500	Seepage	120 Foot Deep Slurry Wall
		7,100	Seepage	130 Foot Deep Slurry Wall
		6,000	Seepage	50 Foot Deep Slurry Wall
		2,600	Height	Embankment Fill
Port South	16,262	15,600	Height	Embankment Fill
		1,000	Seepage	70 Foot Deep Slurry Wall
DWSC West Levee	100,260	9,000	Height/Seepage	85 Foot Deep Slurry Wall
		7,000	Height/Seepage	50 Foot Deep Slurry Wall
		9,000	Height/Seepage	75 Foot Deep Slurry Wall
		75,300	Height	Embankment Fill
		100,000	Erosion Protection	Bank Protection

Sacramento River South Levee

The measures for the Sacramento River south levee would be consistent with Alternative 1, with the addition of the setback levee. Under Alternative 1, Sacramento River levee remediation measures were proposed to address seepage, slope stability, and erosion. Under Alternative 5 a setback levee would be constructed at the location shown on Figure 14. The measures that would be implemented under Alternative 5 for the Sacramento River south levee would be: (1) construction of a setback levee, adjacent levee, seepage berm, and fix in place to address seepage, slope stability, and erosion concerns; (2) installation of cutoff walls, sheet pile walls, jet grouting, and relief wells to address seepage and slope stability concerns; and (3) bank protection measures to address erosion concerns. The description of these measures can be found in Section 2.1.3 above.

The setback levees would be constructed between RM 57.00 and RM 52.75, separated by Bees Lake. The existing levee at Bees Lake would not be degraded, and flow through Bees Lake would be prohibited by road embankments on each end. The natural hydraulic connection through the existing levee would remain intact, maintaining the tidal connection with the Sacramento River. The north offset area setback levee is just over a mile in length, extending from about RM 56.8 to RM 55.7. The south offset area setback levee is a little more than two miles in length, extending from about RM 55.1 to RM 52.8. The typical offset distance of the setback levee from the existing levee is approximately 400 feet. Most of the existing levee would be degraded to an elevation of 30 feet (NAVD 88). Where necessary, bank protection would be added to the existing levee to protect the bank in place. In the north offset area, there are two locations where the existing levee would be completely degraded to original ground for a length of 800 to 1,000 feet. In the south offset area, there are three locations where the existing levee would be completely degraded to original ground for a length of about 800 feet. Both offset areas are degraded about 10 feet, in general. The complete degrades would require bank protection upstream and downstream to prevent erosion during high flows.

South Cross Levee

The primary issues along the South Cross levee are overtopping and seepage, as shown on Figure 14. The measures that would be implemented under Alternative 5 for the South Cross levee would be: (1) a stability berm to address seepage and slope stability concerns; (2) relief wells to address seepage concerns; and (3) a levee raise to address height concerns. These measures would be constructed as described above in Section 2.2.1.

Deep Water Ship Channel East Levee

Along the DWSC east levee there are issues with seepage, slope stability, and height at various locations shown on Figure 14. The measures that would be implemented under Alternative 5 for the DWSC east levee would be: (1) installation of cutoff walls to address seepage and slope stability concerns and (2) a levee raise to address height concerns. Both cutoff wall methods would be constructed along this reach as described above in Section 2.2.1 to address the seepage and slope stability problems.

Levee raising would be implemented where required and would be constructed as described above in Section 2.2.1. The irrigation ditch at the toe of the levee would be relocated outside the levee footprint below the housing development and would be covered over with soil and replaced with two 48 inch diameter pipes that would be placed along the levee toe adjacent to the housing development. The construction methods described above in Section 2.2.1 would be used for the cutoff wall and raises and the levee would be brought into compliance with Corps standards.

Deep Water Ship Channel West Levee

The DWSC west levee has seepage, slope stability, height, and erosion problems at various locations shown on Figure 14. The measures that would be implemented under Alternative 5 for the DWSC west levee would be: (1) installation of cutoff walls and seepage berms to address seepage concerns; (2) a levee raise to address height concerns; and (3) bank protection to address erosion concerns. The conventional open trench cutoff wall would be constructed at locations shown on Figure 14 to address the seepage and slope stability concerns in that reach. At various locations from the South Cross levee south to Prospect Island in the Delta, a distance of roughly 19 miles, a cutoff wall and bank protection would be constructed. The bank protection would address erosion and would be placed along the Yolo Bypass side of the levee at identified locations, as described above in Section 2.2.1. The cutoff wall would also be constructed as described above in Section 2.2.1. Levee raises would be implemented where required, as identified on Figure 14, and would be constructed as described above in Section 2.2.1.

Port South Levee

The primary issues in the Port south area are overtopping, seepage, and slope stability at a few locations shown on Figure 14. The measures that would be implemented under Alternative 5 for the Port South levee would be: (1) installation of cutoff walls to address seepage and slope stability concerns and (2) a levee raise to address inadequate levee height. The cutoff wall would only be constructed along a small section adjacent to Lake Washington. The construction methods described above in Section 2.2.1 for cutoff walls and height improvements would be used to address these issues.

Operation and Maintenance

Operation and maintenance (O&M) of the levees in the West Sacramento area are the responsibility of the local maintaining agencies, including RD 900, RD 537, DWR's Maintenance Area 4, and the Corps. The applicable O&M Manual the West Sacramento levees is the Standard Operation and Maintenance Manual for the Sacramento River Flood Control Project. Typical levee O&M in the West 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 would be monitored using the piezometers.

2.3 Southport EIP Element of West Sacramento Project Proposed Action

The Southport EIP element of the Proposed Action is a blend of flood risk reduction measures selected based on their effectiveness in addressing deficiencies, compatibility with land uses, minimization of real estate acquisition, avoidance of adverse effects, and cost. The Proposed Action includes a combination of setback levees, cutoff walls, and seepage berms (along with other measures) (Table 7).

WSAFCA is proposing the Southport project to implement flood risk reduction measures along the Sacramento River South Levee in order to provide 200-year level of performance consistent with the state goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. The overall project involves the following elements.

- Construction of flood risk reduction measures, including seepage berms, slurry cutoff walls, setback levees, rock and biotechnical slope protection, and encroachment removal.
- Partial degrade of the existing levee, forming a "remnant levee."
- Construction of offset areas using setback levees.
- Construction of breaches in the remnant levee to open up the offset areas to Sacramento River flows.
- Offset area restoration.
- Road construction.
- Drainage system modifications.
- Utility line relocations.

2.3.1 Flood Risk Reduction Measures

In order to address levee deficiencies, several flood risk reduction measures would be constructed in the project area. These measures consist of setback levees, seepage berms, slurry cutoff walls, rock and biotechnical slope protection, and encroachment removal. The approximate linear length of each flood risk reduction and erosion control measure proposed for each segment is provided in Table 7, below, and is displayed in Figure 15.

The levee flood risk reduction measure footprint includes the following elements: a waterside operations and maintenance (O&M) easement (where available), the levee from toe to toe, a seepage berm (where specified), and the landside O&M easement. The waterside and landside O&M easements are assumed to be 20 feet wide and unpaved. The landside O&M easement follows the toe of the levee or the landside toe of seepage berms, where present. The utility corridor is included largely within the Village Parkway right-of-way. In Segment G, where existing residences are close to the existing levee, the landside O&M easement is assumed to vary from approximately a few feet to 100 feet between the proposed flood risk reduction measure toe and the existing residential lot lines. In Segment A the landside O&M easement is coincident with South River Road. For segments where a suitable impermeable tie-in layer was not identified from the geotechnical explorations, a seepage berm would be constructed. Where a tie-in layer was located, a cutoff wall at the associated depth would be constructed. For levee reaches where a seepage berm would be constructed to address underseepage, a shallow cutoff wall would also be installed in lieu of an inspection trench.

Table 7. Project Flood Risk Reduction and Erosion Control Measures.

Segment	Approximate Length (linear feet)	Measures
A	4,830	Slurry cutoff wall
B	115	Slurry cutoff wall
	1,955	Slurry cutoff wall and landside seepage berm
	3,490	Setback levee, slurry cutoff wall, landside seepage berm, and bank stabilization at breach S3
C	4,490	Setback levee, slurry cutoff wall, landside seepage berm, toe rock and bank stabilization at breaches S1 and S2.
	940	Setback levee, slurry cutoff wall, bank stabilization at Erosion Sites C1 and C2, and toe rock upstream and downstream of Erosion Sites C1 and C2.
D	1,985	Setback levee, slurry cutoff wall, and toe rock upstream of Erosion Sites C1 and C2
E	995	Setback levee and slurry cutoff wall
	2,297	Setback levee, slurry cutoff wall, and landside seepage berm
F	5,583	Setback levee, slurry cutoff wall, landside seepage berm, bank stabilization and toe rock at breach N1, and toe rock and bank stabilization at breach N2
G	2,795	Slurry cutoff wall and bank stabilization at Erosion Site G3

Each of the proposed flood risk–reduction and erosion control measures is described below. Post-construction, the levee slopes, areas used for construction staging, and any other disturbed areas would be hydroseeded with a native seed mix.

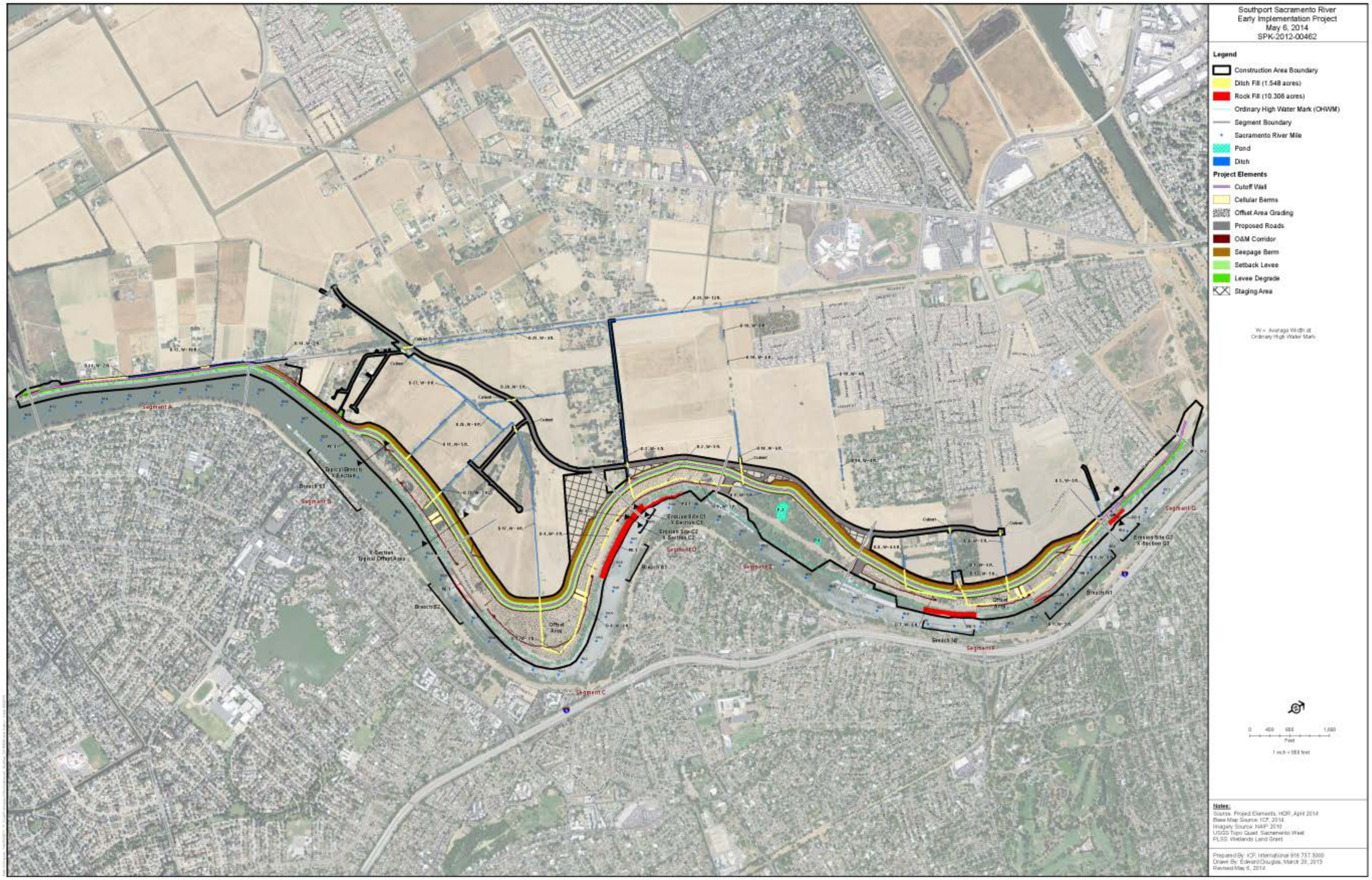

Figure 15. Southport EIP Project Plan.

Slurry Cutoff Wall

A slurry cutoff wall would be constructed throughout the alignment of the proposed Federal project levee. A slurry cutoff wall consists of impermeable material that is placed parallel to the levee, typically through the center of the levee crown. While slurry cutoff walls may be constructed using a variety of methods, this document considers two possible methods of construction: (1) conventional slot trench and (2) clamshell trench.

Shallow cutoff walls are those that extend through the levee embankment and a portion of the levee foundation. They do not finish into a low permeability aquitard but serve to “tie together” surface layers, causing them to function more as a blanket layer, and increasing the seepage path. Shallow cutoff walls also serve to cut off localized seepage pathways, such as high permeability crevasse splay deposits, root pathways, or other subsurface structures. As such, they replace the need for installing an inspection trench beneath or adjacent to new levees. The feasibility and design of these features is evaluated based on local conditions.

Fully penetrating conventional cutoff walls (open trench installation with track-hoe) extend through the levee embankment and levee foundation and finish into a low permeability aquitard. Fully penetrating conventional cutoff walls generally are preferred, if feasible to construct, because they are the least costly compared to cutoff walls installed using the DSM, trench cutting re-mixing, or clamshell technology, while still providing the advantage that all cutoff walls provide of minimizing construction disturbance outside the levee footprint. Where the low permeability aquitard is too deep for conventional cutoff wall, completion of the wall with a clamshell trench is proposed. By this method, the open trench is excavated by trackhoe to the limit of the excavator and is finished by a dragline with a clam shell.

If a fully penetrating wall is not feasible because of the foundation conditions (the lower impervious layer is nonexistent or at a depth impossible to reach with the existing equipment), shallow cutoff walls supplemented with seepage berms are proposed.

Conventional Slot Trench Method

To begin construction, the construction site and any necessary construction staging or slurry mixing areas would be cleared, grubbed, and stripped.

In the conventional slot trench method using a soil-bentonite wall, the levee would be degraded by one-third its height and a trench excavated through the levee center from the top of the levee and into subsurface materials. The size of the trench would be based on the depth of the low permeability aquitard, but is typically 3 feet wide and up to 85 feet deep. As the trench is excavated, it would be filled temporarily with soil, bentonite, and water slurry to prevent collapse of the trench. The soil from the excavated trench would be hauled to a nearby location and mixed with hydrated bentonite. The soil-bentonite mixture would then be returned to the levee and backfilled into the trench. This mixture hardens and creates the impermeable barrier wall in the levee.

Degradation of the levee crown would be required to prevent hydro-fracturing of the levee, or, in the case of a soil-bentonite wall, to prevent slope failures through the slurry wall caused by extremely low trench strength. Degradation would also provide a temporary work platform, typically a minimum of 40 feet wide, to accommodate seepage berm construction activities and allow equipment to reach lower impervious layers. The temporary work platform also provides access for haul trucks used to haul excavated degrade material to a nearby stockpile area for later use in reconstructing the levee crown, or in constructing seepage berms. The material may need to be hauled offsite and borrow material imported if the in-situ levee material is found to be unsuitable for current levee standards.

Following completion of the slurry cutoff wall, either borrow material or previously degraded levee material would be hauled and placed on the temporary working platform to reconstruct the levee with a 2:1 landside slope and a waterside slope that matches the existing slope. Front-end loaders or excavators would load haul trucks with the borrow material, and the haul trucks would transport it to the degraded levee site. The haul trucks would dump the material, and dozers spread it evenly. Sheepsfoot rollers would compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction. Topsoil would then be placed on the levee slopes.

One construction crew typically is able to construct 200 to 250 linear feet of slurry wall (approximately 70 to 80 feet deep) in an 8-hour shift. Equipment needed for the crew includes a long-reach track hoe, three or four dump trucks (15 cubic-yard capacity each), bulldozers, excavators, loaders, a rough terrain forklift, compactors, maintainers, and a water truck. Vertical clearance of about 40 feet would be needed for the excavator boom. Horizontal clearance of about 30 feet beyond the levee crest may be required for excavator swing when loading dump trucks.

A mixing area would be located at the construction staging area. The mixing area would be used to prepare the soil-bentonite mixture and supply bentonite-water slurry. The mixing area would be contained to avoid inadvertent dispersal of the mixing materials. Dump trucks would haul material between the excavator and the mixing area along the levee.

The construction equipment and materials necessary to construct a slurry cutoff wall by this method are listed in Table 8. Floodlights and generators would also be used for nighttime slurry wall construction. Post-construction, areas used for construction staging, mixing, the levee crown, slopes, and any other disturbed areas would be hydroseeded with a native seed mix.

Table 8. Conventional Slot Trench Slurry Wall – Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper	
Work platform and trench excavation	Excavator or track hoe Haul truck	Bentonite
Mixing/placement of soil-bentonite mix	Long-reach track hoe Haul trucks Bulldozer Rough terrain fork lift	Bentonite Water
Replacement of levee material	Excavator or track hoe Bulldozer Loader Scraper Haul truck Motor grader Sheepsfoot roller Water truck	Embankment fill material Water
Finish grading	Bulldozer Motor grader	
Site restoration and demobilization	Front end loader Haul trucks Motor grader Sheepsfoot roller Water truck	Miscellaneous construction support materials Embankment fill material Topsoil Hydroseed
Piezometer installation	Drill truck	Water Sand Cement Well Casing

Operations and Maintenance

Post-construction, the only permanent facilities would be the slurry cutoff wall and an aggregate base, levee-top patrol road for the purpose of levee inspection and emergency vehicle access, and the levee O&M corridors. Typical levee O&M in the Southport project 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 would be monitored using the piezometers.

Clamshell Method

The clamshell method is an alternative to the DSM method of constructing a slurry cutoff wall, and uses a dragline crane with a clamshell bucket. The initial trench would be excavated and backfilled as described above for the conventional slot trench method. When the trench exceeds the limit of the excavator's reach, a dragline with clamshell would be used to complete the excavation. As with the conventional slot trench method, soil-bentonite grout would be mixed with the native soil and placed in the trench as the clamshell is withdrawn. Cement may also be added to the mixture to increase strength and reduce curing time when needed. Levee degradation, trench placement, material stockpiling, and levee-top reconstruction would be completed as described for the conventional slot trench method. The equipment and materials necessary to construct a clamshell slurry wall are listed in Table 9. Post-construction, areas used for construction staging, the levee slopes, and any other disturbed areas would be hydroseeded with a native seed mix.

<u>Operation and Maintenance</u>

Operation and maintenance for a clamshell slurry cutoff wall would be the same as described above for the conventional slot trench method.

Table 9. Clamshell Method Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper	
Work platform and trench excavation	Excavator or track hoe Haul truck	
Mixing/placement of soil-bentonite mix	Long-reach track hoe Haul trucks Bulldozer Rough terrain fork lift	Bentonite Cement Water
Replacement of levee material	Excavator or track hoe Bulldozer Loader Scraper Haul truck Motor grader Sheepsfoot roller Water truck	Embankment fill material Water
Finish grading	Bulldozer Motor grader Compactor	
Site restoration and demobilization	Front end loader Haul truck Motor grader Sheepsfoot roller Water truck	Miscellaneous construction support materials Embankment fill material Topsoil Hydroseed
Piezometer installation	Drill truck	Water Sand Cement Well Casing

Setback Levee

A setback levee is an entirely new section of levee constructed at some distance behind the landside of the existing levee. The existing levee would remain in place or be removed or breached, depending on conditions. The new section of levee would be tied into the existing levee and then become the Federal project levee.

The new levee section would be constructed to meet current design standards, including height and slope requirements. To begin construction activities, the area required to construct the new levee would be cleared, grubbed, and stripped, and encroachments into the new levee footprint would be removed. To construct the new section of levee, bulldozers would excavate and stockpile borrow material from a nearby permitted borrow site. Front-end loaders or excavators would load haul trucks with the borrow material. The haul trucks would transport the material to the new levee site, where motor graders would spread it evenly. Sheepsfoot rollers would compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction. Once the foundation of the new setback is built up to a suitable elevation, a slurry cutoff wall would be constructed using either the conventional slot trench method or clamshell method, as described in Slurry Cutoff Wall. Following completion of the slurry cutoff wall, the top portion of the levee would be built up to an elevation of approximately +40 feet NAVD 88 for the entire length of the setback levee. Levee slopes would be graded to a 3:1 slope, and a crown at least 20 feet wide created. Topsoil would then be placed on the levee slopes and hydroseeded. For the purpose of levee inspection and emergency vehicle access, an aggregate base, all-weather levee-top patrol road would be constructed.

Equipment and materials necessary to construct a setback levee are listed in Table 10. Post-construction, construction staging areas, levee slopes, and any other disturbed areas would be hydroseeded with a native seed mix.

Table 10. Setback Levee Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper Bulldozer	
Embankment fill material placement	Excavator or tack hoe Dozer Loader Scraper Haul Truck Motor grader Sheepsfoot roller Water truck	Embankment fill Water
Finish grading	Bulldozer Motor grader Compactor	Aggregate base rock
Site Restoration and demobilization	Front-end loader Haul truck Motor grader Sheepsfoot roller Water truck	Topsoil Hydroseed

Operations and Maintenance

Post-construction, the only permanent facility would be the improved levee. O&M would be the same as for a typical levee, described under Slurry Cutoff Wall.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeability to semi-pervious materials that resist accumulated water pressure and safely release seeping water. Seepage berms proposed for the Southport project would extend outward from the landside levee toe and laterally along the levee as needed relative to the seepage conditions. A seepage berm addresses the levee deficiency of underseepage.

Seepage berms for the Proposed Action would vary from 50 to 100 feet in width. Berms typically would be a minimum of 5 feet in height at the levee landside toe, tapering to approximately 3 feet at the landside hinge with a 1.5–2% minimum grade to promote drainage, and then slope down to the berm toe at a 3:1 slope. Lateral length would depend on seepage conditions along the area of identified levee deficiency.

To begin construction, the construction site would be cleared, grubbed, and stripped. Soil used to construct a berm would be stockpiled from levee degradation, excavated from nearby borrow pits, or trucked onsite from offsite locations (if adequate onsite material is not available). During the degrading of the existing levee, soil would be stockpiled at the proposed berm sites or used to construct the berms. At the borrow sites, bulldozers would excavate and stockpile borrow material. Front-end loaders would load haul trucks that would transport the borrow material to the site. The haul trucks would dump the material and motor graders would spread it evenly, placing approximately 3 to 5 feet of embankment fill material. Material used for berm construction would have greater permeability than the native blanket material. However, depending on material availability, a lower permeability material may be used. Adjustments to berm width would be made in such cases, as appropriate. During the embankment placement, material would be placed in a maximum of 1- to 2-foot loose lifts, sheepsfoot rollers would compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction and to reduce fugitive dust emissions. Topsoil would then be placed on the berm and hydroseeded. No new drainage system would be associated with the seepage berms.

Equipment and materials necessary to construct a seepage berm are listed in Table 11. Areas used for construction staging, levee slopes, the berm, and any other disturbed areas would be hydroseeded with a native seed mix.

Table 11. Seepage Berm Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper Bulldozer	
Embankment fill material placement	Excavator or tack hoe Bulldozer Loader Scraper Haul Truck Motor grader Sheepsfoot roller Water truck	Embankment fill Water
Finish grading	Bulldozer Motor grader	
Site Restoration and demobilization	Front-end loader Haul truck Motor grader Sheepsfoot roller Water truck	Topsoil Hydroseed

Operation and Maintenance

The only post-construction permanent facility would be the berm. Maintenance of the berm would be similar to the typical O&M practices presently in place for maintenance of levee surfaces.

- 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.
- Visual inspection at least monthly by driving on the patrol road on the levee crown and O&M corridor at the toe of the seepage berm.

Bank Erosion Sites

Three bank erosion sites requiring repairs were identified in the project reaches along the Sacramento River; two sites are in Segment C and the third site is in Segment G (Figure 15). The Segment C sites would not be subject to the Corps vegetation policy, as they would be on the remnant levee; however, the Segment G site would be located on the Federal project levee and would comply with the vegetation policy. Therefore, the design of the Segment C sites differs from that of the Segment G site, as described below. The repairs at all three sites are designed to protect against erosional forces that threaten levee stability, such as wind, waves, boat wake, and fluvial forces.

Remnant Levee Sites

The two erosion sites on the remnant levee are Sites C1 and C2, which are adjacent to each other. Once the setback levees for the project are complete, the existing levee in Segment C would no longer be part of the Federal project levee. Site C1 has a top length of 160 linear feet and tapers near the bottom of the slope. The proposed repairs at Site C1 would address a scour hole that has formed on the slope between elevations of -33 feet NAVD 88 and +11 feet NAVD 88, as well as slumping that has occurred at the base of the slope. Site C2 would include repairs along 547 linear feet of Segment C. Repairs at Site C2 would address general erosion problems that have been created by wave erosion.
Design and Construction

Erosion site repairs on the remnant levee would be designed both to control erosion and to maintain existing vegetation and instream woody material (IWM). This would be accomplished by incorporating rock benches that serve as buffers against erosion while providing space for planting riparian vegetation and creating a platform to support aquatic habitat features (Appendix B, Figures 3a and 3b). Rock would be placed onto the levee slope from the waterside by means of barges; one barge would hold the stockpile of rock to be placed, and a second barge would hold the crane that would place the rock on the channel slopes. A backhoe would be used from the bank to shape the rock. Clean rock fill would be placed over existing riprap between elevations of -33 feet NAVD 88 and +5 feet NAVD 88, and type C graded stone would be placed over the clean rock fill in a 2.5-foot thick layer with a 2:1 slope from the toe of the slope to an elevation of +7 feet NAVD 88. The clean rock fill and graded stone at the top of the erosion site would be placed to form a planting bench at an elevation of +7 feet NAVD 88 in order to match the average annual low-water surface elevation, and the bench would have an average width of approximately 10 feet. At Site C1, stone would be placed at the upstream and downstream ends of the site in thickened sections in order to address problems created by a scour hole along the site. These sections would extend up and down the bank and would be approximately 5 feet thick and 12.5 feet wide, and would transition laterally to 2.5-foot thickness at a 1:1 slope.

Once the rock has been placed along the slope of the erosion sites, a 1-foot thick layer of 0.75-inch crushed clean rock would be placed at the upslope end of the stone bench to create a filter between the topsoil and the stone bench. Topsoil would then be placed above the newly constructed bench at a 3:1 slope to meet the existing bank, and coir fabric would be placed over the soil to keep it in place. Topsoil would be placed from a barge, similar to the process for placing the rock. Pole plantings would then be hand-placed in the planting bench between elevations of +7 feet NAVD 88 and +11.5 feet NAVD 88. Beaver fencing would be installed at the upslope and downslope extents of the topsoil installation. IWM would be anchored along the remnant levee erosion sites to achieve at least 40% shoreline coverage, and would be placed between 1 and 3 feet below the elevation of the average annual low water surface. IWM would likely come from trees removed in other portions of the project area, and would be selected based on suitability for the site. Existing vegetation and riprap at the erosion site would be retained.

The two erosion sites on the remnant levee are located on the outer bank of a bend in the river and are therefore subject to greater erosive forces. Given the location of these two erosion sites, rock would be placed along the toe of the bank (toe rock) at both sites, as well as upstream and downstream of the erosion sites to further protect the bank of the remnant levee. The toe rock would begin approximately 850 feet upstream of Site C1, would extend through both erosion sites, and would terminate approximately 300 feet downstream of Site C2. Portions of this area are currently riprapped, and the additional toe rock to be placed would be limited to areas where there is currently no rock below an elevation of +7 feet NAVD 88.

Equipment and materials necessary for bank erosion site repairs along the remnant levee are listed in Table 12.

Table 12. Bank Erosion Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Rock placement	Crane Barges Backhoe	Rock
Biotechnical element installation	Crane Barge Hand tools	Topsoil Coir fabric Pole cuttings Beaver fencing

Active Levee Erosion Site

Site G3 is located in Segment G and would be part of the Federal project levee. Site G3 would include 410 linear feet of repairs to the top of the erosion scarp and the creation of a planting bench and vegetated slope to protect against boat wake and fluvial erosion.

The design and construction equipment, methods, and materials for Site G3 would be similar to those described for Sites C1 and C2. However, Site G3 would require additional rock armoring and soil fill (up to elevation +25 feet NAVD 88) to repair the erosion scarp and meet Federal levee protection standards. The proposed design includes riprap toe protection, earth and rock fill to restore the levee prism between elevation -10 feet NAVD 88 and +25 feet NAVD 88, a soil-covered 10-foot-wide planting bench (10:1 slope) and bank (3:1 slope) planted with pole cuttings and large container plantings, and IWM anchored between 1 and 3 feet below the elevation of the average annual low water surface. The planting bench would be 15 feet outside the minimum levee template, per the Urban Levee Design Criteria.

Operations and Maintenance

Post-construction, only the rock slope protection, native vegetation, and other biotechnical features would be permanent. Anticipated O&M actions include regular visual inspections of the site, vegetation maintenance and irrigation for up to 3 years, and periodic repairs, as needed, to prevent or repair localized scour along the bank and rock toe of the site.

Encroachment Removal

Levee standards for vegetation and encroachments may require removing encroachments, such as structures, levee penetrations (e.g., pipes, conduits, cables), power poles, pump stations, and similar features, from the levee footprint. This measure would include the demolition of such features and relocation or reconstruction as appropriate on a case-by-case basis (or retrofit to comply with standards). Existing piling within the river at Oak Knoll Bend would also be removed.

Encroachment removal techniques would be implemented based on the needs of the specific encroaching feature. Smaller encroachments would be removed, relocated, or retrofitted by manual labor of small crews (approximately two to 10 workers) using hand tools. Larger encroachments would require machinery such as an excavator, skid-steer, and bulldozer. Piling removal would require a barge with a crane for removal or cutting off at or below the mud line. Dump trucks would be used for hauling and disposal of removed material at an offsite permitted commercial source. Encroachments that substantially penetrate the levee (like footings or large woody vegetation) would require levee reconstruction, discussed as a separate measure.

Equipment and materials necessary for encroachment removal are listed in Table 13. Relocations would require similar equipment. Post-construction, areas disturbed by the equipment would be hydroseeded.

Table 13. Encroachment Removal Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Encroachment removal and/or relocation	Excavator Skid-steer Bulldozer Loader Dump truck	Debris
Piling removal	Barge Crane Pump Torch	
Site restoration and demobilization	Haul truck Water truck	Hydroseed Water

Vegetation Policy Compliance

Vegetation removal under the Southport project would be limited to only vegetation removed from the project's flood risk–reduction measures footprint to address other deficiencies. New levees (such as setback levees) would be designed to be compliant with Corps levee vegetation policy. Consistent with the Central Valley Flood Protection Plan (CVFPP) guidance, vegetation would be removed to meet specific project objectives. Any vegetation removed as part of direct construction activities would not be replaced at that location, but may require offsite, in-kind mitigation, to be determined in consultation with the appropriate resource agencies.

In accordance with Corps guidance, WSAFCA would submit a detailed removal plan to the local Corps District Levee Safety Officer for review and comment prior to removal of vegetation. Methods for removing vegetation are identified below.

- By excavation, remove the trunk (or stem), stump, rootball, and all roots greater than 0.5 inch in diameter; all such roots in, or within 15 feet of, the flood risk–reduction structure will be completely removed.
- Ensure that the resulting void is free of organic debris.
- Cut poles to salvage propagation materials for replanting, such as willows and cottonwoods.
- Conduct hand clearing using chainsaws and trimmers.
- Conduct mass clearing using bulldozers.

Operations and Maintenance

O&M would be the same as for a typical levee. Any remaining or replaced encroachments would be maintained as they were pre-project.

Additional Construction Elements

Remnant Levee Degrade

With the construction of the setback levee, the existing levee in Segments B through F would no longer be part of the Federal project levee. Most of the existing levee in these areas would be degraded in order to provide additional borrow material for constructing seepage berms or for reclamation of other borrow areas. The remnant levee in Segment E would remain as-is in order to maintain access to Sherwood Harbor Marina and Sacramento Yacht Club. Also, in the portion of Segment F south of breach N2, the roadway would be removed up to the Sacramento Yacht Club access road but would not be degraded in order to help protect the marinas during high flow events (Figure 15).

Prior to excavation, the area to be degraded would be cleared, grubbed, and stripped. The remnant levee would be degraded to an elevation of +30 feet NAVD 88, with a crown width of 20 feet and a landside slope of 3:1. Front-end loaders would load haul trucks with the excavated material. Haul trucks would then transport the material to stockpile areas in the staging areas for later use for berms or to borrow areas for use in site restoration. Material used for borrow area restoration would be spread evenly using motor graders and compactors. The waterside slope would not be excavated, with the exception of the area above elevation +30 feet NAVD 88. Disturbed areas would then be planted as part of the offset area restoration plantings, and an unpaved O&M corridor would be established at the landside toe of the remnant levee.

Equipment and materials necessary to construct a setback levee are listed in Table 14.

Table 14. Remnant Levee Excavation Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper Bulldozer	
Embankment excavation	Bulldozer Loader Haul truck Motor grader Scraper	
Site restoration and demobilization	Haul truck Motor grader Sheepsfoot roller Water truck	Hydroseed Water

<u>Operations and Maintenance</u>

Post-construction, there would be no continued maintenance of the remnant levee. However, the remnant levee would be monitored periodically to ensure that future erosion does not jeopardize the flood risk–reduction measures. The landside toe O&M corridor would provide access for inspection and erosion repair, if needed.

Levee Breaches

Portions of the existing levee would be breached to allow Sacramento River flows into two separate offset areas during high flow events (Figure 15). The northern offset area breaches, from north to south, are N1 and N2 (both in Segment F), and the southern offset area breaches, from north to south, are S1 (Segment C), S2 (Segment C), and S3 (Segment B). Construction of the breaches would occur during the summer–fall period to take advantage of low flows in the Sacramento River and to comply with Central Valley Flood Protection Board (CVFPB) regulations.

The proposed breaches would be constructed in phases, with breaches S3 and N1 being constructed first, and the remaining breaches likely being constructed 2 years later in order to allow offset area restoration areas to establish before being exposed to flows. To construct the breaches, the existing levee would be degraded down to an elevation of +10 feet NAVD 88 using excavators. Existing revetment found to be in good condition would be retained up to an elevation of +10 NAVD 88.
Until breaches S1, S2 and N2 are constructed, culverts would be installed at their proposed locations in order to drain the offset area between the new Federal levee and the degraded remnant levee. These culverts would be used to equilibrate hydraulic pressure on both sides of the degraded levee (i.e., between the offset area and Sacramento River channel), as well as to provide drainage for the associated offset segment in order to minimize fish stranding and extended inundation of restored habitats. Each culvert would be 54 inches in diameter and approximately 140 feet long (Figure 4). The culverts would be placed at approximately +7 NAVD in order to fully drain the offset area behind them. Each culvert would utilize existing riprap located at the mouth of each structure on the Sacramento River.

Excavation to facilitate construction of culverts in the offset area would be to an elevation of +7 feet. In-water construction activities would be scheduled for between July 1 and October 31, when water elevations in the Sacramento River along the project area are typically at the average annual low water elevation of +6.7 feet to +7.1 feet. Installation of temporary cofferdams may be necessary prior to culvert installation in order to prevent river flows from entering the construction area. At a minimum, sandbags would be used to construct the cofferdam and water would be pumped out of the inundated construction area. Depending on water elevations in the river at the time of construction, the cofferdams may be constructed using sheet pile walls or other methods. In order to accommodate the use of construction equipment in constructing the culverts, the cofferdams would typically extend up- and downstream of the end of the culverts in order to provide a temporary work area.

The breach shoulders would be armored with rock from the top extent of the existing riprap at +10 NAVD 88 on the waterside, up and over the degraded remnant levee crown, and down the landside slope (Appendix B, Figure 5a). Along the alignment of the remnant levee, rock would be placed from the base of the inlet shoulder in the breach to the top of the degraded remnant levee, and would extend an additional 100 feet from the top edge of the shoulder on each side of the breach. A 25-foot riprap apron would then extend out from the landside toe of the breach shoulder at an elevation of roughly +10 NAVD 88, as well as from the toe of the shoulder in the breach. All rock for the shoulder and apron armoring would be placed in a layer approximately 2.5 feet thick.

The upstream shoulder of breach N1 and the downstream shoulder of breach S3 would have slightly different erosion control measures than the other breach shoulders, as both of these breaches would have transitions from the newly constructed setback levee to the existing levee (Appendix B, Figures 5b and 5c). Rock armoring would be placed on the slope of the waterside berm of the setback levee. Rock placement on these transition shoulders would be contiguous with the apron zone and riverbank zone protection measures.

On the waterside of the breaches, new riprap would be placed from the toe of the bank slope up to an elevation of +7 feet NAVD 88 in areas where the existing riprap is lacking. Breaches N1, N2, S1, and S2 would also have toe rock placed along portions of the base of the bank to further protect it from erosive forces. Coir fabric would be placed between elevations of +7 feet NAVD 88 and +10 feet NAVD 88, and this “riverbank zone” would be planted with species suitable for coppicing in order to create a vegetated bench. Coppicing is a method of woodland management in which young tree stems are repeatedly cut down to a predetermined height, which takes advantage of the fact that many trees make new growth from the remaining stumps. The vegetation in this area would be coppiced in order to maintain a region of nearly uniform hydraulic resistance and prevent erosion due to concentration of flows between clumps of trees. Coir fabric would also be placed in the “apron zone” between the edge of the +10 feet NAVD 88 elevation and the centerline of the breach, with jute netting continuing landward of the termination of the coir fabric for 100 feet. This area would be planted with cuttings, rootstock, or container plants. The final design of the breaches would be included in the draft Mitigation and Monitoring Plan (MMP), presently under preparation.

Rock would be placed onto the levee slope from atop the degraded levee, from the breach sill, from the waterside by means of barges, or by a combination of the three methods. Rock required within the channel, both below and slightly above the surface of the water at the time of placement, would be placed by a crane located on a barge and then spread by an excavator located on top of the levee or in the breach sill. Construction would require two barges—one barge to carry the crane and another to hold the stockpile of rock to be placed on the channel slopes—and one excavator located in the breach. Rock required on the upper portions of the slopes would be placed by an excavator located on top of the levee. Rock placement from atop the levee would require one excavator for each potential placement site. The loader would bring the rock from a permitted source within 25 miles of the project area and dump it within 100 feet of the levee breach. The excavator would move the rock from the stockpile to the waterside of the levee. Equipment and materials necessary for constructing the breaches are listed below in Table 15.

Table 15. Levee Breach Construction Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Breach excavation	Excavator	
Rock placement	Crane Barges Excavator	Rock
Biotechnical element installation	Hand tools	Jute netting Coir fabric Pole cuttings Container stock

Operations and Maintenance

O&M access to the breaches would be provided by O&M corridor roads that cross the cellular berms described in Offset Floodplain Area Restoration, below, and by the O&M corridor located along the landside toe of the remnant levee in the offset areas. Access to the N1 and S3 breaches would also be from where the setback levee transitions to the existing levee.

Offset Floodplain Area Restoration

The offset floodplain area refers to the two expanded floodways located between the proposed setback levee and the remnant levee that would be created when portions of the existing levee are breached to allow Sacramento River water to flow into the offset area (Figure 15). Project activities in this area would include floodplain and habitat restoration and borrow excavation. The offset areas would be planted to provide mitigation for vegetation removed as part of construction.

If appropriate for reuse, the excavated material would be used in construction of the setback levee and seepage berms. Following excavation, the offset area would be finished and graded to allow creation and restoration of riverine floodplain and riparian habitats. Excavation in the offset areas may require groundwater management, which would potentially be done by pumping water out of excavated areas. The offset areas and existing levee would be degraded, and the existing levee would be breached initially in two locations at such time as permitted to ensure completion of the setback levee before the flood season. The breaches would be constructed to allow for inlet and outlet of floodplain-inundating flows. The remaining three breaches would be constructed at a later time, as described in Levee Breaches, above.

The period between when the first two breaches are constructed and when the remaining three breaches are constructed is referred to as the “interim condition.” The interim condition would allow restoration plantings to establish in the offset areas during the fall, winter, and spring following construction Year 3 without exposure to through-flows from the Sacramento River, increasing the likelihood of long-term planting success. Following breaching of the existing levee in Segments B and F in Year 3, the offset areas would fill as the level of the Sacramento River rises and would drain through the single breach in each offset area, as well as through the culverts installed where breaches N2, S1, and S3 would eventually be constructed, as river stage decreases. Swales would be constructed in both offset areas, and the surrounding areas would be graded to encourage drainage to the swales as river stages decrease. Temporary and permanent erosion control measures such as jute netting, coconut fiber with net, live brush mattresses, and native turf would be selected as appropriate to protect graded areas.

Once breaches N2, S1, and S3 are constructed, permanent “cellular” berms would be built between the setback levee and the remnant levee downstream of breaches N1, S1, and S2 to reduce erosive conditions during flood events in the offset area. The cellular berms would create separate “cells” that would have independent drainage once water levels drop below the crest of the cellular berms. Material excavated from the breaches would be used to construct the cellular berms and construct terrain features. Berms would have a top elevation of +20 feet, top width of 20 feet, and side slopes no steeper than 10:1; they would overtop once water levels reach +20.0 feet NAVD 88. Offset areas upstream and downstream of the berms would be graded with positive drainage away from the berms and to the closest existing levee breach location.

The target habitats in the offset floodplain area are riparian forest, shaded riverine aquatic habitat, seasonal wetlands, and upland grasslands. Elevations in the offset floodplain area would vary from approximately +7.0 feet NAVD 88 to +20.0 feet NAVD 88 in order to provide broad habitat variability for a range of environmental and hydrodynamic conditions.

The target plant communities in the offset floodplain area would include emergent marsh, riparian willow scrub, riparian cottonwood forest, mixed riparian woodland, elderberry shrubs and associated plants for valley elderberry longhorn beetle habitat, and grassland. Botanical and tree surveys conducted within the project area provided guidance on plant material selection for the mitigation area. A vegetation stratification survey on the Southport levee conducted by ICF in March of 2012 helped further inform and refine the restoration target plant communities. In the survey, different species of plants were observed to favor different elevation ranges based on species preferences and adaptations. The restoration design intends to mimic this stratification of vegetation. Plants selected for establishment of each of the target plant communities were based on how the plants associate in nature, and the elevations at which these plants were observed growing along the Southport levee. Elevations showing the conceptual planting plan and plant palette for the mitigation area will be shown in the draft MMP.

Native riparian plant species could be installed as container plants and pole cuttings spaced at regular intervals throughout the offset floodplain area. Both overstory and understory species would be installed to mimic the natural structure of riparian forests along the Sacramento River. Supplemental irrigation would be provided for several years during the plant establishment period and then discontinued; irrigation water could possibly be pumped from the river or from an adjacent water supply by agreement with the owner. To avoid trampling or disturbing the plantings during the establishment period, signs would be posted at appropriate intervals providing notice that access to the restoration areas is not allowed. The CVFPB would likely not allow exclusionary fencing for these purposes.

Planting of the offset areas would take place in the fall following finish-grading operations and construction of the neighboring flood control features. Areas of the offset that are not finished in any given year would be kept free of vegetation in order to keep future construction areas clear.

A network of seasonal wetland swales would be excavated in the offset floodplain area and inundate during high-water events on the Sacramento River to provide habitat for special-status native fish species, including Chinook salmon, Sacramento splittail and steelhead. Excavation of the swales would also be phased to coincide with the construction of offset areas. To mimic some natural floodplain conditions that species like splittail depend on for spawning and rearing, the swales would be constructed at an elevation that provides shallow, low-velocity, off-channel habitat in the spring during smaller flood events. Swale margins would be gently sloping to maximize edge habitat during flood events. IWM structures could be installed in some of the swales to provide cover from predators. In larger flood events during the winter and spring, the upper riparian terraces would be inundated and provide additional areas of habitat for fish as well as contribute to the productivity of the ecological foodweb.

The created swales would have several connections to the main river channel at the breach locations in order to maximize connectivity and minimize potential stranding as floodwaters recede. The swales would, on average, fully dewater by the early summer in any given year in order to discourage use by nonnative fish.

Areas of upland grassland in the offset floodplain area would serve as potential floodplain rearing habitat for native fish during periods of high flows, as well as foraging habitat for raptors during periods of low water.

O&M access to the offset areas would be provided by O&M corridors at the waterside toe of the setback levee and by unpaved O&M roads that cross the cellular berms. At a minimum, turnaround areas would be located at the breach shoulders.

Offset Area and Remnant Levee Revegetation

Revegetation of the offset areas and remnant levee is proposed as a means to mitigate for construction impacts. The riparian willow scrub target plant community would be established where there is proper soil hydrology, between approximately the 8 foot and 10 foot elevation. In the offset area, the riparian willow scrub will be established just upslope from the constructed swales in a band width varying from approximately 10 to 150 feet following both sides of the swales near the middle of the offset floodplain area. On the remnant levee, the riparian willow scrub will be established in a narrow band varying from approximately 5 to 20 feet in width outside of the canopy of the existing trees to remain. The plants selected for the riparian willow scrub planting are intended to establish a self-sustaining mix of riparian scrub dominated by four species of willows. The plant material installed could be container grown plants, cuttings, or a mixture of both. The areas within the offset area will be seeded, and the areas on the remnant levee with established herbaceous cover will not be seeded.

Road Construction, Marina Access, and Bees Lakes

Village Parkway would be extended southward from its current intersection with Lake Washington Boulevard to Gregory Avenue near the project area’s southern extent, moving South River Road traffic to the landside of the Sacramento River South Levee and to the future Village Parkway alignment. The existing alignment of South River Road in Segment A would be retained, as would the railroad abutments at the southern end of Segment A. However, a detour or permanent realignment of South River Road would be constructed at the south end of Segment A to maintain access on South

River Road south of the project area during and after construction. Access roads would be built in Segment B to connect residences to the new Village Parkway alignment. Year 1 would include the construction of this section of the future Village Parkway and the associated residential and marina access roads (Figure 15). "No parking" signs would be installed at the new residential roads in Segment B. At the project's northern extent, South River Road would be demolished. Where practicable, culverts would be constructed in ditches that are crossed by proposed roadways. Drainage ditches would be constructed along both sides of the new Village Parkway alignment, with an average width of 5 feet.

In order to maintain access between Sherwood Harbor Marina and Sacramento Yacht Club, South River Road would continue in its current alignment on the existing levee at Segment E and a portion of Segment F. However, the existing levee structure would no longer serve a flood risk–reduction function. In order to maintain access to the marinas, two new roads would be constructed that would be routed over the levee crown, with embankment crests of +40 feet NAVD 88 and 3:1 side slopes. The first road would be constructed just north of the Bees Lake area, and the second would be constructed on the southern side of the Bees Lake area. The road embankments would link the setback levee and the existing levee. While these embankments would not be part of the flood risk–reduction features, they would prevent hydraulic surface connectivity between Bees Lakes and the Sacramento River. Linden and Davis Roads would be connected to the new Village Parkway alignment to restore traffic circulation, and a cul-de-sac would be added at the end of Linden Road, past the intersection with Village Parkway.

Dual access ramps would be constructed along the levee alignment to provide O&M and emergency access to the levee-top patrol road. There would be one ramp in Segment B where South River Road currently descends from the existing levee to meet Gregory Avenue; one ramp in Segment C; one ramp in Segment D at the terminus of Davis Road; one ramp In Segment F at the terminus of Linden Road; and one ramp in Segment G near the northern end of the project alignment. Access to the levee-top patrol road would also be provided where the Sherwood Harbor Marina and Sacramento Yacht Club access road embankments cross the proposed setback levee crown. Access ramps would be gated and would have "no parking" signs.

Construction Details

Construction Schedule

If WSAFCA is granted Section 408 permission to alter the Federal levee and construct the Southport EIP in advance of the West Sacramento GRR, then the following schedule would apply to the Southport action. Construction of the project would occur in more than one annual construction season, with construction of flood risk–reduction measures beginning in April of 2015, and likely finishing in 2017. Construction and restoration of the offset area would likely continue after 2017, with final remnant levee breaches constructed in 2020. A small portion of Village Parkway construction and utility relocations would possibly begin in fall of 2014, but most of the work for those portions of the project would be done in 2015. A description of construction activities by construction year is provided below.

Year 1

- Village Parkway construction and utility relocation would be completed.
- The entire length of the setback levee would be started in Year 1, beginning with the foundation and working platform. Construction of the cutoff wall would follow if weather allows.

Year 2

- The setback levee cutoff wall and remaining buildup of the setback levee would be constructed to a finished elevation of +40 feet NAVD 88.
- South River Road detour at south end of Segment A.
- Seepage berms would be constructed following completion of the setback levees.
- Segment A and the southern portion of Segment B would be degraded to an elevation of +32 feet NAVD 88, and in Segment G the levee would be degraded to an elevation of +34.5 feet NAVD 88. Cutoff walls would then be constructed in these segments, tying into the setback levee cutoff walls in Segments B and F. The levee crown in Segment A and the southern portion of Segment B would then be built back up to a finished elevation of +39 feet NAVD 88, and the levee in Segment G would be built back up to a finished elevation of +40 feet NAVD 88. The slurry cutoff wall toe would be at an elevation of -5 feet NAVD 88 through Segments A, B, C, and D; at 0 feet NAVD 88 for Segments E, F, and the southern portion of G; and would be at -67 feet NAVD 88 for the remainder of Segment G.
- The remnant levee in Segments B, C, D, and F would be degraded to an elevation of +30 feet NAVD 88, and would have a 20-foot-wide crown. Remnant levee degrading would be concurrent with setback levee and seepage berm construction.
- Offset area grading would begin.
- Erosion site repairs at C1, C2, and G3 would be constructed.

Year 3

- Offset area grading would be completed. Culverts would be installed through the remnant levee at breaches N2, S1, and S2 to allow water to flow into, and drain out of, the offset areas during the interim condition.
- Breaches N1 and S3 would be constructed.

- Offset area planting would begin and would continue through Year 6.

Year 4

- Offset area planting would continue.

Year 5

- The three remaining breaches and the offset area cellular berms would be constructed, and the southern offset area would be contoured.

Year 6

- Offset area planting would be completed.

Flood risk reduction measure construction activities would primarily occur during the typical construction season, April 15 to October 31, although extension of the CVFPB encroachment permit may be sought if weather conditions permit. All construction activities, including, but not limited to, structure and vegetation removal, roadway removal and replacement, revegetation, and utility removal and replacement, that may occur outside the primary construction season would be subject to the conditions of environmental and encroachment permits and authorizations to be issued by the California Department of Fish and Wildlife (CDFW), Central Valley Regional Water Quality Control Board (RWQCB), CVFPB, the Corps, USFWS, NMFS, Yolo County, City of West Sacramento, and others.

At the end of each primary construction season, the levee system would be restored, at a minimum, to the level of flood risk–reduction performance existing at the project outset. During construction Years 1 and 2, “tie-ins” would be built connecting the existing levee up- and downstream to the segments constructed that season, as needed. These tie-ins would be achieved by benching the existing levee and installing compacted lifts to completely bond the new and existing levee materials. During the flood season, maintenance of the flood risk–reduction structures would be undertaken by the maintaining agency, RD 900.

Sources of Borrow Material

To meet borrow material demands for constructing the flood risk–reduction measures, multiple sources are being considered, including the following.

- Embankment fill material excavated from the existing levee structure as part of construction.

- Material excavated from the offset areas.
- Material excavated from borrow sites located on open land within the city, or close to the city limits.
- Dredged material previously removed from the DWSC (presently stockpiled on high-terrace, upland benches adjacent to the west of the channel).
- Material purchased from permitted commercial borrow locations within 20 miles of the project site.

Embankment fill material excavated as part of construction would be evaluated for reuse, and that deemed suitable would be used as part of construction of the new levees and berms. Embankment fill material available for construction of the Proposed Action would include materials salvaged as a result of the proposed partial degrading of the existing levee and grading of the offset areas.

Ongoing borrow analysis has also identified potential borrow sites near the project site from which suitable borrow may be excavated (Figure 2). These potential borrow sites range in location from immediately adjacent to the levee construction to approximately a 7-mile round-trip haul distance from the area of construction. If local borrow sites are used, existing topsoil would be scraped and set aside, and borrow material excavated from the site. Excavation depths would vary, depending on landowner agreement; however, wherever feasible, depths of excavation would not encroach upon the water table. Following material extraction, Southport-area borrow sites would be graded to a depth of no greater than 3 feet. To maximize the use of local borrow sites, high plasticity clay may be used as deeply buried setback levee core fill material. Where feasible, excess embankment fill material deemed unsuitable for reuse could be placed in the borrow site pits and compacted, and the topsoil replaced. The borrow sites then would be reseeded and returned to vegetated conditions.

Also under evaluation for suitability as borrow is material previously dredged from the DWSC as part of routine maintenance, which is presently stockpiled along the western bank of the DWSC and located on the city's western border with unincorporated Yolo County. This possible borrow source, referred to as "dredge material," is located on a high-terrace, upland bench adjacent to the channel, placed during previous dredge events unrelated to this project. If suitable, dredge material would be loaded onto trucks and transported to the project site, an approximately 24-mile round trip. Use of dredge material would not require any postextraction borrow site activity.

Lastly, borrow also could be purchased and hauled onsite from a permitted commercial borrow location within 20 miles of the project site.

Management of Woody Vegetation

For woody vegetation remaining after construction, and until an alternative long-term compliance strategy is agreed upon (which ultimately may include a variance but not as part of this project), the levees would be maintained per the approved O&M manual applicable to this reach (subject to revision).

Structure and Road Demolition and Utility Relocation

Structure and road demolition activities would consist of removing standing structures within the flood risk–reduction measure footprints and removing sections of two-lane asphalt rural road in the project area. Construction activities would consist of removing and demolishing the facilities with the use of a bulldozer and excavator with a percussion hammer attachment for breaking up concrete foundations as needed. The contractor would load the rubble into waste containers using a front-end loader and then haul the waste to a permitted disposal site within 10 miles of the project area.

Vegetation Removal

Vegetation clearing activities would consist of removing larger woody vegetation, such as trees and shrubs. Grubbing activities would consist of removing roots, and stripping activities would consist of excavating approximately 6 inches of organic material from the levee surface. The vegetation on the existing Sacramento River levee would be retained where feasible, with the exception of the five breach locations, because the existing levee would no longer provide flood risk–reduction functions or be subject to the Corps vegetation guidelines. Some vegetation would be removed as part of construction of the new setback levee, seepage berms, and the landside utility O&M corridor.

Staging Areas and Equipment Access

As depicted on Figure 15, five staging areas would be used in the project area. These staging areas are located on the landside of the levee at Segments C, D, and E, and would occupy approximately 25.2 acres in total. These areas would be used for staging construction activities and to provide space to house construction equipment and materials before and during construction activities. Areas where seepage berms are proposed would also be used for staging until construction begins on the seepage berms.

To facilitate project construction, temporary earthen ramps would be constructed to permit equipment access between the levee crown and the staging area(s). The earthen ramps would not affect any delineated water bodies and would be removed when construction is complete.

2.4 Proposed Conservation and Mitigation Measures for the West Sacramento Project

2.4.1 Compensation Timing

Compensation timing refers to the time between the initiation of construction at a particular site and the attainment of the habitat benefits to protected species from designated compensation sites. In general, compensation time is the time required for on-site plantings to provide significant amounts of shade or structural complexity from instream woody material recruitment. Significant long-term benefits have often been considered as appropriate to offset small short-term losses in habitat for listed species in the past, as long as the overall action contributes to recovery of the listed species. The authority to compensate prior to or concurrent with project construction is given under WRDA 1986 (33 USC §§ 2201–2330); however, long-term compensation to offset short-term losses is generally not an option for the loss of critical habitats under the ESA (USFWS 1998).

Depending on the species of interest (e.g., delta smelt), the severity of the short-term habitat losses due to bank erosion repair actions may not be compensated by long-term gains, whereas longer lived species (e.g., steelhead, Chinook) have longer periods for compensation to be provided. The following compensation time periods (based loosely on life expectancy) should be considered as guidelines for compensation:

- Green sturgeon, 15 years;
- Chinook salmon, 5 years;
- Central Valley steelhead, 4 years; and
- Delta smelt, 2 years (Corps, 2012).

2.4.2 Valley Elderberry Longhorn Beetle (VELB) Conservation Measures

The following is a summary of measures based on the *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (USFWS 1999a). These measures will be implemented to minimize any potential effects on VELB or their habitat, including restoration and maintenance activities, long-term, protection, and compensation if shrubs cannot be avoided. Approximately 78 elderberry shrubs have the potential to be adversely affected due to construction of the West Sacramento project.

- When a 100-foot (or wider) buffer is established and maintained around elderberry shrubs, complete avoidance (i.e., no adverse effects) will be assumed.
- Where encroachment on the 100-foot buffer has been approved by the USFWS, 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.
- Contractors will be briefed on the need to avoid damaging elderberry shrubs and the possible penalties for not complying with these requirements.
- Signs will be erected every 50 feet along the edge of the avoidance area, identifying the area as an environmentally sensitive area.
- Any damage done to the buffer area will be restored.
- Buffer areas will continue to be protected after construction.
- No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used in the buffer areas.
- Trimming of elderberry plants may be subject to mitigation measures.
- Elderberry shrubs that cannot be avoided and can be accessed safely would be transplanted to an appropriate riparian area at least 100 feet from construction activities.
- If possible, elderberry shrubs would be transplanted during their dormant season (approximately November, after they have lost their leaves, through the first two weeks in February). If transplantation occurs during the growing season, increased mitigation ratios will apply.
- Any areas that receive transplanted elderberry shrubs and elderberry cuttings will be protected in perpetuity.
- The Corps will work to develop off-site compensation areas prior to or concurrent with any take of valley elderberry longhorn beetle habitat.
- Management of these lands will include all measures specified in USFWS's conservation guidelines (1999a) related to weed and litter control, fencing, and the placement of signs.
- Monitoring will occur for ten consecutive years or for seven non-consecutive years over a 15-year period. Annual monitoring reports will be submitted to USFWS.
- Off-site areas will be protected in perpetuity and have a funding source for maintenance (endowment).

2.4.3 Giant Garter Snake Conservation Measures

The following measures will be implemented to minimize effects on giant garter snake habitat that occurs within 200 feet of any construction activity. These measures are based on USFWS guidelines for restoration and standard avoidance measures included as appendices in USFWS (1997).

- Unless approved otherwise by USFWS, 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 participate in USFWS-approved worker environmental awareness program.
- A giant garter snake survey would be conducted 24 hours prior to construction in potential habitat. Should there be any interruption in work for greater than two weeks, a biologist would survey the project area again no later than 24 hours prior to the restart of work.
- Giant garter snakes encountered during construction activities 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.

If any giant garter snake habitat is impacted by construction, the following measures would be implemented to compensate for the habitat loss:

- Habitat (including aquatic and upland) temporarily impacted for one season (May 1–October 1) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants.
- Habitat temporarily impacted for two seasons will be restored and replacement habitat will be created at a 2:1 ratio (disturbed to created acres).
- Habitat temporarily impacted for more than two seasons will be replaced at a 2:1 ratio (or restored plus 2:1 replacement).
- Habitat permanently impacted will be replaced at a 3:1 ratio.
- Habitat permanently or temporarily impacted outside of the May 1-October 1 work window will be created at a 2:1 ratio.
- All replacement habitats will include both upland and aquatic habitat components at a 2:1 ratio (upland to aquatic acres).
- One year of monitoring will be conducted for all restored areas. Ten years of monitoring will be conducted for created habitats. A monitoring report with photo documentation will be due to USFWS each year following implementation of restoration or habitat creation activities.
- The Corps will work to develop appropriate mitigation prior to or concurrent with any disturbance of giant garter snake habitat.

- Habitat will be protected in perpetuity and have an endowment attached for management and maintenance.

2.4.4 Additional Minimization and Conservation Measures

- Seek an ETL-approved vegetation variance exempting sites from vegetation removal prior to final design and construction phase for the Sacramento River project area.
- Minimize the removal of existing vegetation in the proposed project area. Any disturbance or removal of vegetation will be replaced with native riparian vegetation, outside of the vegetation-free zone, as established in the ETL.
- Implement best management practices (BMPs) to prevent slurry seeping out to river and require piping system on land side only.
- Stockpile construction materials such as portable equipment, vehicles, and supplies, at designated construction staging areas and barges, exclusive of any riparian and wetlands areas.
- Stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 110% containment system.
- Erosion control measures (BMPs) including Storm Water Pollution Prevention Program and Water Pollution Control Program that minimize soil or sediment from entering the river. BMPs shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects to Federally listed fish and their designated critical habitat.
- Construction will be scheduled when listed terrestrial and aquatic species would be least likely to occur in the project area. If construction needs to extend into the timeframe that species are present, then coordination with the resource agencies will need to occur.
- 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.
- 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.
- Designating a Corps-appointed representative as the 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.

- Screen any water pump intakes, as specified by NMFS and USFWS 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.

Furthermore, the Corps will seek to avoid and minimize construction effects on listed species and their critical habitat to the extent feasible. A number of measures will be applied to the entire project or specific actions, and other measures may be appropriate at specific locations within the study area. Avoidance activities to be implemented during final design and construction may include, but are not limited to, the following:

- Identifying all habitats containing, or with a substantial possibility of containing, listed terrestrial, wetland, and plant species in the potentially affected project areas. To the extent practicable efforts will be made to minimize effects by modifying engineering design to avoid potential direct and indirect effects.
- Incorporating sensitive habitat information into project bid specifications.
- Incorporating requirements for contractors to avoid identified sensitive habitats into project bid specifications.
- Minimizing vegetation removal to the extent feasible.
- Minimizing, to the extent possible, grubbing and contouring activities.

2.4.5 Summary of Environmental Commitments

Items below present a general summary of environmental commitments that the Corps will adhere to as part of the West Sacramento project.

The Corps will consult with the Services on acceptable compensation for shaded riverine aquatic (SRA) habitat (See Section 4.1.2) either by project constructed compensation sites or in combination with purchase of credits at a Services-approved mitigation bank where appropriate.

- The Corps will seek an ETL-approved vegetation variance exempting the Sacramento River sites from vegetation removal in the lower one-third of the waterside of the levee prior to final construction and design phase. Construction may require removal of vegetation on the upper two-thirds of the waterside and landside slope. Full ETL compliance would occur on the Sacramento and Yolo Bypasses, Yolo Bypass Toe Drain, South Cross Toe Drain, and the DWSC, Barge Canal, and Port of West Sacramento levee reaches. This approval process is in alignment with the Corps' Levee Safety Program's goal of maintaining public safety as the primary objective and assuring application of consistent and well-documented approaches. Removal of vegetation is only one part of the overall strategy of assuring that the levees will provide a level of protection consistent with Corps policy.

- The Corps will use a rock soil mixture to facilitate re-vegetation of the project sites that require bank protection work. A (70:30) rock to soil ratio would be implemented. The soil-rock mixture would be placed on top of the of the rock revetment along the Sacramento River levees to allow native riparian vegetation to be planted to insure that SRA habitat lost is replaced or enhanced.
- In addition to an approved vegetation variance, the Corps will minimize the removal of existing vegetation in the proposed project area. Disturbance or removal of trees or larger woody vegetation will be replaced with native riparian species, outside of the vegetation-free zone, as established in the ETL.
- Construction will be scheduled when listed terrestrial and aquatic species would be least likely to occur in the project area. If construction needs to extend into the timeframe that species are present coordination with the resource agencies will occur.

2.5 Proposed Conservation and Mitigation Measures for the Southport EIP Project

If WSAFCA constructs the Southport EIP as a 408 action prior to construction of the overall West Sacramento Project, WSAFCA would implement the following conservation measures to avoid or minimize effects on Federally listed fish and wildlife species and their habitat. These measures would be included as conditions of any permissions granted by the Corps. Several additional conservation measures are proposed specifically for giant garter snake and VELB. To ensure their implementation, the following measures will be included in the project specifications.

2.5.1 General

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Requirements

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Action Area, a USFWS-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about federally listed species that could potentially occur onsite (VELB and giant garter snake). The training will include the natural history, representative photographs, and legal status of each federally listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to USFWS within 1 week of the training. If new construction personnel are added to the project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Requirements that will be followed by construction personnel are listed below.

- Where suitable habitat is present for listed species, WSAFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area.
- Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project area.
- No pets or firearms will be allowed in the project area.
- To prevent possible resource damage from hazardous materials, such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a federally listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify WSAFCA, who will provide verbal notification to the USFWS Sacramento Endangered Species Office and/or the local CDFW warden or biologist within 1 working day. WSAFCA will follow up with written notification to USFWS or CDFW within 5 working days. The biological monitor will follow up with WSAFCA to ensure that the wildlife agencies were notified.
- The biological monitor will record all observations of Federally listed species on CNDDB field sheets and submit to CDFW.

Conservation Measure 2: Prepare and Implement a Stormwater Pollution Prevention Plan

Because ground disturbance would be greater than 1 acre, WSAFCA will obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit. The Central Valley RWQCB administers the NPDES stormwater permit program in Yolo County. Obtaining coverage under the NPDES general construction activity permit generally requires that the project applicant prepare a stormwater pollution prevention plan (SWPPP) that describes the BMPs that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities.

The specific BMPs that will be incorporated into the erosion and sediment control plan and SWPPP will be site-specific and will be prepared by the construction contractor in accordance with the Central Valley RWQCB's Field Manual. However, the plan likely will include, but not be limited to, one or more of the following standard erosion and sediment control BMPs.

- **Timing of construction.** The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season.
- **Staging of construction equipment and materials.** To the extent possible, equipment and materials will be staged in areas that have already been disturbed. No equipment or materials would be stored in the floodway during the flood season.
- **Minimize soil and vegetation disturbance.** The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- **Stabilize grading spoils.** Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- **Install sediment barriers.** The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area.
- **Stormwater drain inlet protection.** The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- **Permanent site stabilization.** The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control native seed mix. Implementation of a SWPPP will substantially minimize the potential for project-related erosion and associated adverse effects on water quality.

Conservation Measure 3: Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, WSAFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contactor prepares the plan, it will be subject to approval by the Corps, NMFS, and WSAFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out (short for “fracture-out event”) associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and minimum-effect response in the event of a frac-out and release of excavation fluid (bentonite). The BSSCP will require, at a minimum, the following measures.

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, CDFW, and the Central Valley RWQCB will be notified immediately of any spills and will be consulted regarding clean-up procedures. A Brady barrel will be on site and used if a frac-out occurs. Containment materials, such as straw bales, also will be on site prior to and during all operations, and a vacuum truck will be on retainer and available to be operational on site within 2 hours’ notice. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks), as needed.
- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1 foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that potentially would suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out; coordinating personnel, response, cleanup, and regulatory agency notification and coordination to ensure proper clean-up; coordinating disposal of recovered material; and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available (onsite) and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out prior to commencement of excavation operations.

Conservation Measure 4: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. WSAFCA or its contractor will develop and implement an SPCCP to minimize the potential for and effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with state and Federal water quality regulations. The SPCCP will describe spill sources and spill pathways in addition to the actions that will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as double-walled tanks, containment berms, emergency shutoffs, drip pans, fueling procedures, and spill response kits. It will describe how and when employees are trained in proper handling procedure and spill prevention and response procedures.

WSAFCA will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. WSAFCA will notify its contractors immediately if there is a noncompliance issue and will require compliance.

The Federal reportable spill quantity for petroleum products, as defined in 40 CFR 110, is any oil spill that:

- Violates applicable water quality standards.
- Causes a film or sheen on or discoloration of the water surface or adjoining shoreline.
- Causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor’s superintendent will notify WSAFCA, and WSAFCA will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases must be submitted to the Central Valley RWQCB. This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.

If an appreciable spill occurs and results determine that project activities have adversely affected surface or groundwater quality, a detailed analysis will be performed by a registered environmental assessor or professional engineer to identify the likely cause of contamination. This analysis will conform to American Society for Testing and Materials standards and will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, WSAFCA and its contractors will select and implement measures to control contamination, with a performance standard that surface water quality and groundwater quality must be returned to baseline conditions.

Conservation Measure 5: Monitor Turbidity in Adjacent Water Bodies

WSAFCA or its contractor will monitor turbidity in the adjacent water bodies, where applicable criteria apply, to determine whether turbidity is being affected by construction and ensure that construction does not affect turbidity levels, which ultimately increase the sediment loads.
The Water Quality Control Plan for the Central Valley RWQCB (Basin Plan) contains turbidity objectives for the Sacramento River. Specifically, the plan states that where natural turbidity is between 5 and 50 nephelometric turbidity units (NTUs), turbidity levels may not be elevated by 20% above ambient conditions. Where ambient conditions are between 50 and 100 NTUs, conditions may not be increased by more than 10 NTUs (Central Valley RWQCB 2009).

WSAFCA or its contractor will monitor ambient turbidity conditions upstream during construction and adhere to the Surface Water Quality Ambient Monitoring Program requirements for turbidity monitoring. Monitoring will continue approximately 300 feet downstream of construction activities to determine whether turbidity is being affected by construction. Grab samples will be collected at a downstream location that is representative of the flow near the construction site. If there is a visible sediment plume being created from construction, the sample will represent this plume. Monitoring will occur hourly when construction encroaches into the Sacramento River. If construction does not encroach into the river, the monitoring will occur once a week on a random basis.

If turbidity limits exceed Basin Plan standards, construction-related earth-disturbing activities will slow to a point that results in alleviating the problem. WSAFCA will notify the Central Valley RWQCB of the issue and provide an explanation of the cause.

Conservation Measure 6: Prepare and Implement a Mitigation and Monitoring Plan

A draft MMP for the restoration areas is being developed and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the project. The restoration objectives of the plan are listed below.

- Provide compensatory mitigation credits for impacts on protected land cover types and to special-status species and potential habitat for these species.
- Maximize SRA cover/nearshore habitat, over and above current erosion stabilization efforts using biotechnical methods.
- Enhance setback ecological values using topographic and vegetation/habitat heterogeneity.

- Restore portions of the historic Sacramento River floodplain (i.e., waters of the United States).
- Restore riparian and oak woodland habitat on the restored floodplain that will create continuous habitat corridors for fish and wildlife movement.
- Design habitat features to minimize future maintenance obligations (e.g., reduce opportunities for sediment and debris accumulation).
- Design floodplain planting and vegetation management schemes to avoid undesirable hydraulic and sediment transport impacts to the offset levee and offset area.
- Comply with current Corps levee vegetation policy to balance habitat needs with flood management objectives.

The monitoring objectives of the plan are listed below.

- Monitor and evaluate the hydrologic and hydraulic performance of the restored floodplain relative to the ecological design criteria for the target species.
- Monitor and evaluate the success of the riparian/wetland plantings and other habitat features (e.g., IWM) in compensating, restoring, or enhancing fish and wildlife habitat values on the levee slopes and offset areas.
- Monitor and evaluate the effectiveness of the grading and drainage features in preventing fish stranding (see Fish Stranding below).
- Monitor the occurrence and extent of potential sedimentation and scour that may compromise the success of the habitat restoration and mitigation components of the project.

The MMP will include representative plans and cross sections of the Proposed Action elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. The existing O&M requirements and practices will also be incorporated into the plan. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

2.5.2 Valley Elderberry Longhorn Beetle

Conservation measures for VELB are based on USFWS's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Conservation Guidelines) (USFWS 1999a).

<u>Conservation Measure 7: Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction</u>

Elderberry shrubs and clusters (*Sambucus* spp.) within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/VELB experience), under contract with WSAFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by USFWS. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet along the perimeter of the buffer area fencing. The signs will contain the following information:

> *This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment.*

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet high, commercial-quality woven polypropylene, and orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and USFWS.

<u>Conservation Measure 8: Conduct Stem Counts Prior to Elderberry Shrub Transplantation</u>

Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The biologist will survey the area surrounding the shrub to be transplanted to ensure that there aren't additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem and examining elderberry shrubs for the presence of VELB exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to USFWS. Elderberry seedlings/cuttings and associated native plants will be planted prior to transplantation of elderberry shrubs. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements are being exceeded or if additional plantings are necessary. Because the Proposed Action would be constructed potentially over a 3-year period, elderberry survey data for each year will be used to rectify any discrepancies in compensation and to ensure full mitigation of impacts on VELB.

Conservation Measure 9: Water Down Construction Area to Control Dust

The construction contractor will ensure that the project construction area will be watered down as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Conservation Measure 10: Compensate for Direct Effects on Valley Elderberry Longhorn Beetle Habitat

Before construction begins, compensation will be implemented for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to a USFWS-approved conservation area (described below). Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) would be replaced in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or nonriparian area. Stock of either seedlings or cuttings would be obtained from local sources (including the Action Area, if acceptable to USFWS). At the discretion of USFWS, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access problems, may be exempted from transplantation. In cases in which transplantation is not possible, minimization ratios would be increased to offset the additional habitat loss.

The relocation of the elderberry shrubs will be conducted according to USFWS-approved procedures outlined in the Conservation Guidelines (USWFS 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase (November through the first 2 weeks of February). A qualified biological monitor will remain onsite while the shrubs are being transplanted.

During field surveys, 106 elderberry shrubs were identified in the study area, but only 41 elderberry shrubs were identified in the Action Area (Appendix B, Figure 6 and Appendix C). Eighteen shrubs would be directly affected and the remaining 23 shrubs would be indirectly affected (see Table 22 in Chapter 3). Property inaccessibility and the high density of vegetation surrounding several elderberry shrubs limited the number of elderberry shrubs that could be surveyed for exit holes and stem counts. For this reason, compensation for the removal of shrubs 33, 39b, 41a, and 41b was estimated based on the average number of stems in each stem diameter range for the shrubs that could be surveyed. In addition, an assumption was made that there were exit holes in the four shrubs that could not be surveyed. Table 16 shows the stem counts for elderberry shrubs directly affected in the Action Area. The stem averages are as follows.

- Number of stems ≥1 inch and ≤3 inches = 16.
- Number of stems >3 inches and <5 inches = 4.
- Number of stems ≥5 inches = 3.

Table 17 shows the estimated compensation.

Table 16. Summary of Stem Counts for Elderberry Shrubs Directly Affected by the Southport EIP.

	Presence of Exit Holes?	**Riparian Habitat?**	**1-3 Inches**	**3-5 Inches**	**> 5 Inches**
6	N	Y	60	5	9
7	N	Y	33	10	18
8	N	Y	8	5	2
9	N	Y	30	2	8
10	Y	Y	8	4	2
23	Y	Y	3	3	1
32	N	N	3	1	1
33 [1]	Y	N	16	4	3
34	Y	N	12	6	10
39a	N	N	3	0	0
39b [2]	Y	N	16	4	3
41a [2]	Y	N	16	4	3
41b [2]	Y	N	16	4	3
41c	Y	N	5	7	2
52	Y	Y	6	1	1
53	Y	N	29	17	3
98	N	Y	4	0	0
100	Y	Y	8	2	0
Direct Total			**276**	**79**	**69**

[1] Shrubs could not be surveyed because there was no property access. Number of stems was estimated based on average of all counted stems. See text for a description. In addition, exit holes were assumed to be present in shrub 33.
[2] Shrubs that could not be surveyed because they were covered in grapevines or poison oak. Number of stems was estimated based on average of all counted stems. See text for a description. In addition, exit holes were assumed to be present in shrubs 39b, 41a, and 41b.

Table 17. Estimated Compensation for Elderberry Shrubs Removed for the Southport EIP.

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios (multiply number of stems by)	Elderberry Plantings	Native Ratios	Associated Native Plantings
Non-riparian	1-3 Inches	N	6	1	6	1	6
		Y	135	2	270	2	540
Non-riparian	3-5 Inches	N	1	2	2	1	2
		Y	22	4	88	2	176
Non-riparian	> 5 Inches	N	1	3	3	1	3
		Y	37	6	222	2	444
Riparian	1-3 Inches	N	110	2	220	1	220
		Y	25	4	100	2	200
Riparian	3-5 Inches	N	46	8	138	1	138
		Y	10	6	60	2	120
Riparian	> 5 Inches	N	27	4	108	1	108
		Y	4	8	32	2	64
Totals			**424**		**1,249**		**2,021**

Based on the information in Table 17, the conservation area will be at least 13.5 acres in size to accommodate up to 18 elderberry shrubs, 1,249 elderberry cuttings or seedlings, and 2,021 native plants. The conservation area in which the transplanted elderberry shrubs and seedlings are planted will be protected in perpetuity as habitat for VELB.

Evidence of VELB occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. WSAFCA will be responsible for funding and providing monitoring reports to USFWS in each of the years in which a monitoring report is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.

To meet the success criteria specified in the Conservation Guidelines, a minimum survival rate of 60% of the original number of elderberry replacement plantings and associated native plants must be maintained throughout the monitoring period.

<u>Proposed Conservation Area</u>

Approximately 120 acres of habitat floodplain habitat will be restored or enhanced as part of the project implementation. The required portion of these acres of riparian habitat will be used as VELB mitigation.

2.5.3 Giant Garter Snake

Conservation measures for giant garter snake were developed using portions of the *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California* (USFWS 1997).

Conservation Measure 11: Conduct Construction Activities during the Active Period for Giant Garter Snake

To the maximum extent possible, all construction activity within giant garter snake aquatic and upland habitat within 200 feet of aquatic habitat will be conducted during the snake's active period (May 1–October 1). During this time frame, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. Construction of the setback levee in Segments B through F would begin in Year 1. The setback levee and the remaining flood risk – reduction measures for all segments would be completed in Year 2. Some preparation of construction may occur during the 2014 construction season, but no changes would be made to the existing levee prism. The construction season is typically from April 15 to October 31, subject to conditions. Because construction may extend into the giant garter snakes dormant period (October 2 to April 30), additional protective measures will be implemented at these locations (see Conservation Measure 14 below).

Conservation Measure 12: Install and Maintain Construction Barrier Fencing around Suitable Giant Garter Snake Habitat

To reduce the likelihood of giant garter snakes entering the construction area, exclusion fencing and orange barrier fencing will be installed along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and barrier fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during this activity.

The construction specifications will require a provision to retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The barrier fencing will consist of 4-foot-tall erosion fencing buried at least 6–8 inches below ground level. The barrier fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The exclusion fencing will be commercial-quality, woven polypropylene, orange in color, and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities and weekly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around giant garter snake habitat throughout construction. Biological inspection reports will be provided to the project lead and USFWS.

Conservation Measure 13: Minimize Potential Impacts on Giant Garter Snake Habitat

The following measures will be implemented to minimize potential impacts on giant garter snake habitat.

- Staging areas will be located at least 200 feet from suitable giant garter snake habitat.
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary. Avoided giant garter snake habitat within or adjacent to the Action Area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

Conservation Measure 14: Conduct Preconstruction Surveys and Monitoring for Giant Garter Snake

Prior to ground-disturbing activities within 200 feet of suitable habitat, a USFWS-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the USFWS-approved biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If unable to move away on their own, trapped or injured giant garter snakes will only be removed by the USFWS-approved biological monitor and will be placed in the nearest suitable habitat that is outside of the construction area. The biological monitor will immediately report these activities to USFWS by phone and will provide a written account of the details of the incident within 24 hours.

Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to USFWS within 1 week of each monitoring visit.

Conservation Measure 15: Provide Escape Ramps or Cover Open Trenches at the End of Each Day

To avoid entrapment of giant garter snake, thereby preventing injury or mortality resulting from falling into trenches, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. If any individuals have become trapped, the USFWS-approved biological monitor will be contacted to relocate the snake, and no work will occur in that area until approved by the biologist.

Conservation Measure 16: Implement Additional Protective Measures during Work in Suitable Habitat during the Giant Garter Snake Dormant Period

The following additional protective measures will be implemented during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality.

- A full-time USFWS-approved biological monitor will be onsite for the duration of construction activities.
- All emergent vegetation and vegetation within 200 feet of suitable aquatic habitat will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1).
- Exclusion and barrier fencing will be installed around the perimeter of the work area and across suitable aquatic habitat where activities associated with levee slope flattening and

pipe reconstruction activities would occur. The fencing should enclose the work area to the maximum extent possible to prevent giant garter snakes from entering the work area. Fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The USFWS-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The barrier fencing will consist of 3- to 4-foot-tall erosion fencing buried at least 6 to 8 inches below ground level. The barrier fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area (between canal and existing levee).

Portions of the construction area that are temporarily disturbed during construction will be revegetated with emergent vegetation and adjacent disturbed upland habitat will be revegetated with native grasses and forbs after construction is complete.

Conservation Measure 17: Restore Temporarily Disturbed Aquatic and Upland Habitat to Pre-project Conditions

Upon completion of the Proposed Action,155 acres of suitable upland habitat will be restored in the borrow areas for giant garter snake to pre-project conditions. There would be no temporary loss of aquatic habitat. All of the temporary habitat impacts will occur in the borrow areas. The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials.

Suitable upland habitat for giant garter snakes consists of fallow agricultural fields and nonnative annual grassland. Cultivated and disked agricultural fields were not considered suitable upland habitat for giant garter snake because they are frequently disturbed during farming activities. Temporarily affected upland habitat would be restored to pre-project conditions within a maximum of one season (a season is defined as the calendar year between May 1 and October 1 [USFWS 1997]) to avoid requirements for compensation. Restoration of upland habitat will be detailed in a mitigation and monitoring plan that will be reviewed and approved by USACE and USFWS prior to the start of construction.

Conservation Measure 18: Compensate for Direct Effects on Giant Garter Snake

The permanent loss of 2.24 acres of upland habitat would be compensated for by restoring habitat onsite or by purchasing credits from a USFWS and CDFW approved mitigation bank. There would be no permanent loss of aquatic habitat.

3.0 Federally Protected Species and Critical Habitat

Federally protected species and critical habitat that may be affected by the proposed action within the West Sacramento project study area were determined through consultation with USFWS and NMFS. The Central Valley fall-/late fall–run Chinook salmon, which is an Evolutionarily Significant Unit (ESU) of special concern but is not Federally listed, is included because the project's effects on EFH must also be assessed.

3.1 Valley Elderberry Longhorn Beetle

Status and Distribution

The valley elderberry longhorn beetle is listed as a threatened species under the ESA (USFWS 1980). USFWS has undertaken a comprehensive study, known as a 12-month review, to determine whether or not to propose the beetle for delisting (USFWS 2011). According to the USFWS, delisting may be warranted because many new locations of the beetle have been identified since its listing, destruction of habitat has slowed greatly, and efforts have resulted in the protection of significant acreage of habitat (Talley et al. 2006).

The valley elderberry longhorn beetle's range extends from southern Shasta County to Fresno County (Talley et al. 2006). Along the eastern edge of the species' range, adult beetles have been found in the foothills of the Sierra Nevada at elevations up to 2,220 feet, and beetle exit holes have been located on elderberry plants at elevations up to 2,940 feet. Along the western edge of the species' range, adult beetles have been found on the eastern slopes of the Coast Ranges at elevations of up to 500 feet, and beetle exit holes have been detected on elderberry plants at elevations up to 730 feet (Barr 1991).

Several CNDDB (CDFW 2013a) records of VELB are reported to occur in the study area along the Sacramento River North and South Levee reaches. Though not reported to occur in other levee reaches within the study area, VELB has potential to occur wherever elderberry shrubs with branches sized 1 inch or greater at ground level occur.

Life History and Habitat Requirements

Because historic loss of riparian habitat in the study area has already occurred, the rate of riparian habitat loss has slowed significantly over the last 30 years. During this period, incidental take of habitat has been authorized primarily for urbanization, transportation, water management, and flood control, on the order of 10,000 to 20,000 acres. Several habitat conservation plans are being developed to allow for continued urbanization of the Sacramento Valley (Talley et al. 2006).

Approximately 50,000 acres of existing riparian habitat in the Central Valley, primarily in the Sacramento Valley, have been protected by Federal, State, and local agencies as well as private organizations. Additionally, restoration of more than 5,000 acres of habitat has been initiated throughout the beetle's range (Talley et al. 2006). Mitigation needed for the West Sacramento project would be performed in place or there would be purchasing of mitigation credits from nearby banks.

Valley elderberry longhorn beetle is only found in close association with its host plant, elderberry shrubs (*Sambucus* spp.). Elderberry shrubs are found in or near riparian and oak woodland habitats. The valley elderberry longhorn beetle's life history is assumed to follow a sequence of events similar to those of related taxa. Female beetles deposit eggs in crevices in the bark of living elderberry shrubs. Presumably, the eggs hatch shortly after they are laid, and the larvae bore into the pith of the trunk or stem. When larvae are ready to pupate, they move through the pith of the plant, open an emergence hole through the bark, and return to the pith for pupation. Adults exit through the emergence holes and can sometimes be found on elderberry foliage, flowers, or stems or on adjacent vegetation. The entire life cycle of the valley elderberry longhorn beetle is thought to encompass 2 years, from the time eggs are laid and hatch until adults emerge and die (USFWS 1984).

The presence of exit holes in elderberry stems indicates previous valley elderberry longhorn beetle habitat use. Exit holes are cylindrical and approximately 0.25 inch in diameter. Exit holes can be found on stems that are 1 or more inches in diameter. The holes may be located on the stems from a few inches to about 9 to 10 feet above the ground (Barr 1991).

<u>Factors Affecting Abundance</u>

The valley elderberry longhorn beetle distribution decline is most likely related to the extensive loss of riparian forests in the Central Valley, which has reduced the amount of available habitat for the species, and has most likely decreased and fragmented the species' range (USFWS 1984).

Insecticide drift from cultivated fields and orchards adjacent to elderberry plants may affect valley elderberry longhorn beetle populations, if drift occurs at a time when adults are present on the shrubs (Barr 1991). Herbicide drift from agricultural fields and orchards can likewise affect the health of elderberry plants, thereby reducing their quantity and quality as valley elderberry longhorn beetle habitat.

The invasive Argentine ant (*Linepithema humile*) has been spreading in riparian habitats and may affect survival of the valley elderberry longhorn beetle. Argentine ants may predate valley elderberry longhorn beetle eggs although this interaction needs further exploration (Huxel 2000). The spread of invasive exotic plants (e.g., giant reed [*Arundo donax*] may also negatively affect the valley elderberry longhorn beetle by affecting supporting riparian habitats. The presence of giant reed promotes a more frequent fire cycle and homogenous plant community (Talley et al. 2006).

3.2 Fish Species

Six fish species' ESUs or Distinct Population Segments (DPSs) and critical habitats are addressed below. These include Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, Central Valley fall-/late fall–run Chinook salmon ESU, Central Valley steelhead DPS, delta smelt, and green sturgeon southern DPS.

3.2.1 Sacramento River Winter-Run Chinook Salmon Evolutionarily Significant Unit

Status and Distribution

The Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) was listed as threatened under the Federal ESA on August 4, 1989 (NMFS 1989). NMFS subsequently upgraded the Federal listing to endangered on January 4, 1994 (NMFS 1994). NMFS designated critical habitat for Sacramento River winter-run Chinook salmon on June 16, 1993 (NMFS 1993a). The ESU includes all naturally spawned populations of winter-run Chinook in the Sacramento River and its tributaries, as well as populations from two artificial propagation programs, one at the Livingston Stone National Fish Hatchery and the other at Bodega Marine Laboratory (NMFS 2005a).

Prior to construction of Shasta Dam, winter-run Chinook salmon spawned in the upper reaches of the Sacramento River, the McCloud River, and the lower Pit River. Spawning is now restricted to approximately 44 miles of the mainstem Sacramento River, immediately downstream of Keswick Dam (Yoshiyama et al. 1998). The abundance of winter-run Chinook salmon in the Sacramento River before Shasta Dam was constructed, is unknown. Some biologists believe the run was relatively small, possibly consisting of a few thousand fish (Slater 1963). Others, relying on anecdotal accounts, believe the run could have numbered more than 200,000 fish (NMFS 1993b). During the mid-1960s, more than 20 years after the construction of Shasta Dam, the population exceeded 80,000 fish (USBR 1986). The population declined substantially during the 1970s and 1980s.

In 1989, winter-run Chinook salmon escapement was estimated at 696 adults. Escapement continued to decline, diminishing to an estimated 430 fish in 1990 and 211 fish in 1991 (CDFW 2013b). The rapid decline in escapement during the late 1980s and early 1990s prompted listing of the winter-run Chinook salmon as endangered under the California ESA and the Federal ESA. Escapement in 1992 was estimated to be 1,240 fish, indicating good survival of the 1989 class. NMFS data indicates that the population has increased during the late 1990s through 2001. In 1996, returning spawners numbered 1,337 fish and in 2001, returning adults were estimated to be 8,224 (CDFW 2013b). Despite increased efforts to maintain and enhance the population of winter-run Chinook salmon by various entities, in their final listing determination of June 28, 2005, NMFS again found "that the Sacramento River winter-run Chinook salmon ESU in total is in danger of extinction throughout all or a significant portion of its range" and concludes that the ESU continues to warrant listing as an endangered species under the Federal ESA (NMFS 2005a).

Life History

Winter-run Chinook salmon spend 1 to 3 years in the ocean. Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from December through July with peak migration in March. Adults spawn from mid-April through August (Moyle 2002). Egg incubation continues through October. The primary spawning habitat in the Sacramento River is above Red Bluff Diversion Dam at RM 243, although spawning has been observed downstream as far as RM 218 (NMFS 2001). Spawning success below RBDD may be limited primarily by warm water temperatures (Hallock and Fisher 1985; Yoshiyama et al. 1998).

Downstream movement of juvenile winter-run Chinook salmon begins in August, soon after fry emerge. The peak abundance of juveniles moving downstream at Red Bluff occurs in September and October (Vogel and Marine 1991). Juvenile Chinook salmon move downstream from spawning areas in response to many factors, which may include inherited behavior, habitat availability, flow, competition for space and food, and water temperature. The numbers of juveniles that move and the timing of movement are highly variable. Storm events and their resulting high flows and turbidity appear to trigger downstream movement of substantial numbers of juvenile Chinook salmon.

Winter-run Chinook salmon smolts (i.e., juveniles that are physiologically ready to enter seawater) may migrate through the Delta and San Francisco Bay to the ocean from November through May (Yoshiyama et al. 1998). The Sacramento River channel is the main migration route through the Delta. However, the Yolo Bypass also provides significant outmigration passage during higher flow events. During winter in the Sacramento–San Joaquin system, juveniles rear on seasonally inundated floodplains. Sommer et al. (2001) found higher growth and survival rates of juvenile Chinook salmon reared on the Yolo Bypass floodplain, than those that reared in the mainstem Sacramento River.

Factors Affecting Abundance

One of the main factors in the decline of Chinook salmon is habitat loss and degradation. On the Sacramento River, Shasta Dam blocked access to historical spawning and rearing habitat. Other factors affecting abundance include the effects of reservoir operations on water temperature, harvesting and fishing pressure, entrainment in diversions, contaminants, predation by non-native species, and interaction with hatchery stock (Corps 2000b).

In the Sacramento River, operation of the Central Valley Project and State Water Project influences river flow. Low flows can reduce habitat area and adversely affect water quality. The resulting warm water temperatures and low dissolved oxygen levels can stress incubating eggs and rearing juvenile winter-run Chinook salmon. Low flow may affect migration of juveniles and adults through increased water temperature or reduced velocity that slows downstream movement of juveniles. Low flow, in combination with diversions, may result in higher entrainment losses at the State and Federal pumping plants in the south Delta (Corps 2000b).

In the Delta, flow drawn through the Delta Cross Channel and Georgiana Slough transports some percentage of downstream migrating salmon into the central Delta. The number of juveniles entering the DCC and Georgiana Slough is assumed to be proportional to the flow volume diverted from the Sacramento River (CDFG 1987). Survival of juvenile Chinook salmon that are drawn into the central Delta is lower than survival of juvenile Chinook salmon that remain in the Sacramento River channel.

Critical Habitat/Essential Fish Habitat

Within the study area, the Sacramento River is considered to be critical habitat for winter-run Chinook salmon. Critical habitat includes the water column, river bottom, and adjacent riparian zone which fry and juveniles use for rearing (NMFS 2006b). The conservation value of critical habitat in the study area is high because it supports both recruitment and survival of juveniles and adults (NMFS 2006a).

EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All levee reaches within the West Sacramento GRR study area are considered to be essential fish habitat for winter-run Chinook salmon except for the South Cross toe drain.

3.2.2 Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit

Status and Distribution

The Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) was Federally listed as threatened on September 16, 1999 (NMFS 1999). Its threatened status was reaffirmed in NMFS's final listing determination issued on June 28, 2005 (NMFS 2005a). Critical habitat for Central Valley spring-run Chinook salmon was designated by NMFS on September 2, 2005 (NMFS 2005b). The ESU includes all naturally spawned spring-run Chinook salmon in the Sacramento River and its tributaries. Naturally spawned fish of hatchery origin in the Feather and Yuba Rivers as well as hatchery spawned fish in the Feather River are also included as a part of this ESU (NMFS 2005a).

Spring-run Chinook salmon may have once been the most abundant of Central Valley Chinook salmon (Mills and Fisher 1994), historically occupying the upstream reaches of all major river systems in the Central Valley where there were no natural barriers. Central Valley spring-run Chinook salmon are now restricted to the upper Sacramento River downstream of Keswick Dam; the Feather River downstream of Oroville Dam; the Yuba River downstream of Englebright Dam; several perennial tributaries of the Sacramento River (e.g., Deer, Mill, and Butte creeks); and the Delta.

The abundance of Central Valley spring-run Chinook salmon escapement, as measured by the number of adults returning to spawn from 1960 to 2010, averaged 9,248 adults for in-river natural spawners and 2,361 average adults returning to hatcheries (CDFW 2013b). Spring-run Chinook salmon spawn in the early fall and have interbred with fall-run Chinook salmon in the Sacramento and Feather Rivers. Genetically uncontaminated populations may exist in Deer Creek, Mill Creek, Butte Creek, and other eastside tributaries of the Sacramento River.

Life History

Adult spring-run Chinook salmon enter the mainstem Sacramento River from March through September, with the peak upstream migration occurring from May through June (Yoshiyama et al. 1998). Adults generally enter tributaries from the Sacramento River between mid-April and mid-June (Lindley et al. 2006 as cited in NMFS 2006b). Spring-run Chinook salmon are sexually immature during upstream migration, and adults hold in deep, cold pools near spawning habitat until spawning commences in late summer and fall. Spring-run Chinook salmon spawn in the upper reaches of the mainstem Sacramento River and tributary streams (USFWS 1995), with the largest tributary runs occurring in Butte, Deer, and Mill Creek's (Yoshiyama et al. 1998). Spawning typically begins in late August and may continue through October. Juveniles emerge in November and December in most locations but may emerge later when water temperature is cooler. Newly emerged fry remain in shallow, low-velocity edgewater (CDFG 1998).

Juvenile spring-run Chinook salmon typically spend up to one year rearing in fresh water before migrating to sea as yearlings, but some may migrate downstream as young-of-year juveniles. Rearing takes place in their natal streams, the mainstem of the Sacramento River, inundated floodplains (including the Sutter and Yolo bypasses), and the Delta. Based on observations in Butte Creek and the Sacramento River, young-of-year juveniles typically migrate from November through May. Yearling spring-run Chinook salmon migrate from October to March, with peak migration in November (Cramer and Demko 1997; Hill and Webber 1999). Downstream migration of yearlings typically coincides with the onset of the winter storm season, and migration may continue through March (CDFG 1998).

Factors Affecting Abundance

Main factors in the decline of spring-run Chinook salmon populations are habitat loss and degradation. Dams have blocked access to historical spawning and rearing habitat. Other factors affecting abundance of spring-run Chinook salmon include harvest, entrainment in diversions, contaminants, predation by non-native species, and interbreeding with fall-run Chinook salmon and hatchery stocks (Corps 2000b).

In the Sacramento River and its major tributaries, operation of the CVP and SWP controls river flow. Low flows limit habitat area and adversely affect water quality, such as warm water temperature and low dissolved oxygen that stress incubating eggs and rearing juveniles. Low flow may affect migration of juveniles and adults through inadequate water depth to support passage, or through reduced velocity that slows the downstream movement of juveniles. Low flow, in combination with diversions, may result in higher entrainment losses (Corps 2000b).

In the Delta, flow drawn through the Delta Cross Channel and Georgiana Slough transports some portion of downstream migrants into the central Delta. The number of juveniles entering the Delta Cross Channel and Georgiana Slough is assumed to be proportional to the flow volume diverted from the Sacramento River (CDFG 1987). Survival of juvenile Chinook salmon that are drawn into the central Delta is lower than survival of juvenile Chinook salmon that remains in the Sacramento River channel.

Critical Habitat/Essential Fish Habitat

Critical habitat for spring-run Chinook salmon in the study area includes all river channels and sloughs within the West Sacramento project study area (NMFS 2006b). Critical habitat includes the stream channels and the lateral extent as defined by the ordinary high-water line or bank-full elevation. Primary constituent elements of critical habitat in the study area include: (1) freshwater rearing sites that have adequate water quality and quantity, floodplain connectivity, and natural cover that supports juvenile growth and mobility; and (2) freshwater migration corridors that support adequate water quantity and quality as well as natural cover to provide food and migration pathways for juveniles as well as adults (NMFS 2005e, 2006b). The conservation value of critical habitat in the study area is high because it supports both recruitment and survival of juveniles and adults (NMFS 2006a).

EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All levee reaches within the West Sacramento project study area are considered to be EFH for spring-run Chinook salmon except for the South Cross toe drain.

3.2.3 Central Valley Fall-/Late Fall–Run Chinook Salmon Evolutionarily Significant Unit

Status and Distribution

The Central Valley fall-/late fall-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) is not listed under the Federal ESA. On March 9, 1998, NMFS issued a proposed rule to list fall-run Chinook salmon as threatened (NMFS 1998a). However, on September 16, 1999, NMFS determined that the species did not warrant listing (NMFS 1999). On April 15, 2004, NMFS classified Central Valley fall-/late fall-run Chinook salmon as a species of concern (NMFS 2004). However, EFH is designated for this species.

The Central Valley fall-/late fall-run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the Sacramento and San Joaquin river basins and their tributaries. Central Valley fall-/late fall-run Chinook salmon are currently the most abundant and widespread salmon runs in California (Mills et al. 1997), representing about 80% of the total Chinook salmon produced in the Sacramento River drainage (Kjelson et al. 1982). The most abundant spawning populations of fall-/late fall-run Chinook salmon occur in the Sacramento, Feather, Yuba, and American rivers (Mills and Fisher 1994). Fall-run Chinook salmon in the Sacramento, Feather, and American Rivers have a relatively large hatchery component, from 1952 to 2010 the average was 54,815 fish. The average escapement in-river on the Sacramento and San Joaquin system from 1960 to 2010 was 231,009 (CDFW 2013b).

Life History

Adult fall-run Chinook salmon migrate into the Sacramento River and its tributaries from June through December in mature condition and spawn from late September through December, soon after arriving at their spawning grounds (Yoshiyama et al. 1998). The spawning peak occurs in October and November. Emergence occurs from December through March, and juveniles migrate downstream to the ocean soon after emerging, rearing in fresh water for only a few months. Smolt outmigration typically occurs from March through July (Yoshiyama et al. 1998).

Late fall-run Chinook salmon migrate upstream before they are sexually mature, and hold near spawning grounds for 1 to 3 months before spawning. Upstream migration takes place from October through April and spawning occurs from late January through April, with peak spawning in February and March (Yoshiyama et al. 1998). Fry emerge from April through June. Juvenile late fall-run Chinook salmon rear in their natal streams during the summer, and in some streams they remain throughout the year. Smolt outmigration can occur from November through May (Yoshiyama et al. 1998).

Factors Affecting Abundance

Factors affecting abundance of fall-/late fall-run Chinook salmon are similar to factors affecting abundance of winter- and spring-run Chinook salmon, i.e., habitat loss and degradation. Fall-run Chinook salmon, however, typically use spawning habitat farther downstream than the spawning habitat used by spring- and winter-run Chinook salmon. The effect of dams on spawning habitat area for fall-run Chinook salmon is not as severe as for other runs, although access to substantial spawning habitat area has been blocked by dams.

Critical Habitat/Essential Fish Habitat

Critical habitat is not designated for fall-/late fall-run Chinook salmon. EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All levee reaches within the West Sacramento project study area are considered to be EFH for fall-/late fall-run Chinook salmon except for the South Cross toe drain.

3.2.4 Central Valley Steelhead Distinct Population Segment

<u>Status and Distribution</u>

The Central Valley steelhead (*Oncorhynchus mykiss*) DPS was Federally listed as threatened on March 19, 1998 (NMFS 1998b). The threatened status of Central Valley steelhead was reaffirmed in NMFS's final listing determination on January 5, 2006 (NMFS 2006a); at the same time NMFS also adopted the term DPS, in place of ESU, to describe Central Valley steelhead and other population segments of this species. NMFS originally designated critical habitat for Central Valley steelhead on February 16, 2000 (NMFS 2000). However, following a lawsuit (*National Association of Home Builders et al. v. Donald L. Evans, Secretary of Commerce, et al.*), NMFS decided to rescind the listing and re-evaluate how to classify critical habitat for several DPSs of steelhead.

Critical habitat for Central Valley steelhead was re-designated by NMFS on September 2, 2005 (NMFS 2005b). The DPS includes all naturally spawned populations of steelhead in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. Artificially propagated fish from the Coleman and Feather River hatcheries are included in the DPS (NMFS 2006a).

Steelhead ranged throughout the tributaries of the Sacramento and San Joaquin Rivers prior to dam construction, water development, and watershed perturbation dating from the 19^{th} and 20^{th} centuries. Wild stocks are now mostly confined to the upper Sacramento River downstream of Keswick Dam; upper Sacramento River tributaries such as Deer, Mill, and Antelope Creeks; and the Yuba River downstream of Englebright Dam. Populations may also exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). The abundance of naturally reproducing Central Valley steelhead, as measured by the number of adults returning to spawn, is largely unknown. Natural escapement in 1995 was estimated to be about 1,000 adults each for Mill and Deer Creeks and the Yuba River (S. P. Cramer and Associates 1995). Hatchery returns have averaged around 10,000 adults (Mills and Fisher 1994). The most recent annual estimate of adults spawning upstream of Red Bluff Diversion Dam is less than 2,000 fish (NMFS 2006a).

<u>Life History</u>

Central Valley steelhead have one of the most complex life histories of any salmonid species, exhibiting both anadromous and freshwater resident life histories. Freshwater residents typically are referred to as rainbow trout, and those exhibiting an anadromous life history are called steelhead (NMFS 1999). Steelhead exhibit highly variable life history patterns throughout their range but are broadly categorized into winter and summer reproductive ecotypes. Winter steelhead are the most widespread reproductive ecotype and the only type currently present in Central Valley streams (McEwan and Jackson 1996). Winter steelhead become sexually mature in the ocean, enter spawning streams in summer, fall or winter, and spawn a few months later in winter or late spring (Meehan and Bjornn 1991; Behnke 1992).

In the Sacramento River, adult winter steelhead migrate upstream during most months of the year, beginning in July, peaking in September, and continuing through February or March (Hallock 1987). Spawning occurs primarily from January through March, but may begin as early as late December and may extend through April (Hallock 1987). Individual steelhead may spawn more than once, returning to the ocean between each spawning migration.

Juvenile steelhead rear a minimum of one and typically two or more years in fresh water before migrating to the ocean as smolts. Juvenile migration to the ocean generally occurs from December through August. The peak months of juvenile migration are January to May (McEwan 2001). The importance of main channel and floodplain habitats to steelhead in the lower Sacramento River and upper Delta is not well understood. Steelhead smolts have been found in the Yolo Bypass during the period of winter and spring inundation (Sommer 2002), but the importance of this and other floodplain areas in the lower Sacramento River and upper Delta is not yet clear.

Factors Affecting Abundance

The decline in steelhead populations is attributable to changes in habitat quality and quantity. The availability of steelhead habitat in the Central Valley has been reduced by as much as 95% or more due to barriers created by dams (NMFS 1996a). Populations have been most severely affected by dams blocking access to the headwaters of all major tributaries; consequently, most runs are maintained through artificial production. The decline of naturally produced Central Valley steelhead has been more precipitous than that of hatchery stocks. Populations in the range's southern portion have experienced the most severe declines (NMFS 1996b). Other factors contributing to the decline of steelhead in the Central Valley are mining, agriculture, urbanization, logging, harvest, hatchery influences, flow management (including reservoir operations), hydropower generation, and water diversion and extraction (NMFS 1996a).

Critical Habitat/Essential Fish Habitat

Habitat for endangered or threatened anadromous fish is designated as critical habitat under the ESA and as EFH under the MSA. No EFH has been designated for steelhead. Critical habitat for Central Valley steelhead includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-waterline or bank-full elevation. Primary constituent elements of critical habitat are as described for spring-run Chinook salmon (NMFS 2006b).

3.2.5 Delta Smelt

Status and Distribution

Delta smelt (*Hypomesus transpacificus*) was Federally listed as threatened on March 5, 1993 (USFWS 1993) and critical habitat was designated on December 19, 1994 (USFWS 1994). Population trends and abundance of Delta smelt are poorly understood due to their short life span (1 year). Based on data from 21 years of monthly sampling in Suisun Marsh, Delta smelt appear to be experiencing long-term declines (Matern et al. 2002). Summer tow-net and fall/mid-water trawl data show fluctuating annual abundance from 1991 through 1996, with an increasing trend in the late 1990s, followed by an overall decline in abundance since 1999 (Bryant and Souza 2004).

Life History

Delta smelt are endemic to the Sacramento-San Joaquin estuary and are found seasonally in Suisun Bay and Suisun Marsh. They typically are found in shallow water (less than 10 feet) where salinity ranges from 2 to 7 parts per thousand (ppt), although they have been observed at salinities between 0 and 18.4 ppt. Delta smelt have relatively low fecundity and most live for 1 year. They feed on planktonic copepods, cladocerans, amphipods, and insect larva (Moyle 2002).

Delta smelt are semi-anadromous. During their spawning migration, adults move into the freshwater channels and sloughs of the Delta between December and January. Spawning occurs between January and July, with peak spawning from April through mid-May (Moyle 2002). Spawning locations in the Delta have not been identified and are inferred from larval catches (Bennett 2005). Larval fish have been observed in Montezuma Slough; Suisun Slough in Suisun Marsh; the Napa River estuary; the Sacramento River above Rio Vista; and Cache, Lindsey, Georgiana, Prospect, Beaver, Hog, Sycamore, and Barker sloughs (Wang 1986, Moyle 2002, Stillwater Sciences 2006, and USFWS 1996). Spawning was also observed in the Sacramento River up to Garcia Bend (RM 51) during drought conditions, as a result of increased saltwater intrusion that moved Delta smelt spawning and rearing farther inland (Wang and Brown 1993).

Laboratory experiments have found eggs to be adhesive, demersal, and usually attached to substrate composed of gravel, sand, or other submerged material (Moyle 2002, Wang 1991). Hatching takes approximately 9 to 13 days, and larvae begin feeding 4 to 5 days later. Newly hatched larvae contain a large oil globule that makes them semi-buoyant and allows them to stay near the bottom. As their fins and swim bladder develop, they move higher into the water column and are transported downstream to the open waters of the estuary (Moyle 2002).

Factors Affecting Abundance

Diversions and Delta inflow and outflow may affect survival of Delta smelt. In water exported at the South Delta Central Valley Project and State Water Project export facilities, estimates of Delta smelt entrainment suggest a population decline in the early 1980s, mirroring the decline indicated by mid-water trawl, summer tow-net, Kodiak trawl, and beach seine data (Bennett 2005). Diversions and upstream storage, including operation of the Central Valley Project and State Water Project, control Delta inflow and outflow during most months. Reduced Delta flow may inhibit or slow movement of larvae and juveniles to estuarine rearing habitat and into deeper and narrower channels of the Delta, resulting in lower prey availability and increased mortality from predators (Moyle 2002). Low Delta flow also may increase entrainment in diversions, including entrainment at the Central Valley Project and State Water Project export pumps (Moyle 2002). Additional factors affecting Delta smelt abundance include extremely high river outflow that increases entrainment at export facilities, changes in prey abundance and composition, predation by nonnative species, toxic substances, disease, and loss of genetic integrity through interbreeding with the introduced Wagasaki smelt (Moyle 2002; CDFG 2000; Bennett 2005).

Critical Habitat/Essential Fish Habitat

There is no EFH designated for Delta smelt. 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). Primary constituent elements of critical habitat determined to be essential to the conservation of the species include: physical habitat, water, river flow, and salinity concentrations required to maintain Delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (USFWS 2006a).

3.2.6 Green Sturgeon Southern Distinct Population Segment

Status and Distribution

On January 23, 2003, NMFS determined that green sturgeon (*Acipenser medirostris*) are comprised of two populations, a northern and a southern DPS (NMFS 2003). The northern DPS includes populations extending from the Eel River northward, and the southern DPS includes populations south of the Eel River to the Sacramento River. The Sacramento River supports the southernmost spawning population of green sturgeon (Moyle 2002). On April 6, 2005, NMFS determined that the northern DPS does not warrant listing under the ESA, but it remains on the Species of Concern List (NMFS 2005c). On April 7, 2006, NMFS determined that the southern DPS of green sturgeon was threatened under the

Federal ESA (NMFS 2006c). On October 9, 2009, NMFS (74 CFR 52300) designated critical habitat for the green sturgeon southern DPS throughout most of its occupied range.

Green sturgeon were classified as a Class 1 Species of Special Concern by the California Department of Fish and Game (CDFG) in 1995 (Moyle et al. 1995). Class 1 Species of Special Concern are those that conform to the State definitions of threatened or endangered and could qualify for addition to the official list. On March 20, 2006, emergency green sturgeon regulations were put into effect by CDFG requiring a year-round zero bag limit of green sturgeon in all areas of the state (CDFG 2006).

Life History

The green sturgeon is anadromous, but it is the most marine-oriented of the sturgeon species and has been found in near shore marine waters from Mexico to the Bering Sea (NMFS 2005c). The southern DPS has a spawning population in the Sacramento River (NMFS 2005d) and more recently spawning has been observed in the Feather River, a tributary of the Sacramento River (Seesholtz, Alicia.2014. Personal communication). Adults typically migrate upstream into rivers between late February and late July. Spawning occurs from March to July, with peak spawning from mid-April to mid-June. Green sturgeon are believed to spawn every 3 to 5 years, although recent evidence indicates that spawning may be as frequent as every 2 years (NMFS 2005c). Little is known about the specific spawning habitat preferences of green sturgeon. Adult green sturgeon are believed to broadcast their eggs in deep, fast water over large cobble substrate, where the eggs settle into the interstitial spaces (Moyle 2002). Spawning is generally associated with water temperatures from 46 to 57 degrees Fahrenheit (°F). In the Central Valley, spawning occurs in the Sacramento River upstream of Hamilton City, perhaps as far upstream as Keswick Dam (Adams et al. 2002).

Green sturgeon eggs hatch in approximately 8 days at 55°F (Moyle 2002). Larvae begin feeding 10 days after hatching. Metamorphosis to the juvenile stage is complete within 45 days of hatching. Juveniles spend 1 to 4 years in fresh and estuarine waters and migrate to salt water at lengths of 300 to 750 millimeters (mm) (NMFS 2005c).

Little is known about movements, habitat use, and feeding habits of green sturgeon. Green sturgeon have been salvaged at the state and Federal fish collection facilities in every month, indicating that they are present in the Delta year-round. Juveniles and adults are reported to feed on benthic invertebrates, including shrimp and amphipods, and small fish (NMFS 2005c).

Factors Affecting Abundance

The historical decline of the southern DPS of green sturgeon has been largely attributed to the reduction of spawning habitat area. Keswick and Shasta Dams on the Sacramento River and Oroville Dam on the Feather River are impassable barriers that prevent green sturgeon from accessing what were likely historical spawning grounds upstream of these dams. Other potential migration barriers or impediments include the Sacramento Deep Water Ship Channel locks, Fremont Weir, Sutter Bypass, the

Delta Cross Channel, and Shanghai Bench and Sunset Pumps on the Feather River. Other factors that have been identified as potential threats to green sturgeon are reductions in freshwater outflow in the Delta during larval dispersal and rearing, high water temperatures during spawning and incubation, entrainment by water diversions, contaminants, predation and other impacts by introduced species, and poaching (NMFS 2005c).

Critical Habitat/Essential Fish Habitat

There is no EFH designated for green sturgeon. Designated critical habitat for the southern DPS of green sturgeon includes the Sacramento River downstream of Keswick Dam, 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. Freshwater habitat of green sturgeon varies in function, depending on location within the Sacramento River watershed. Spawning areas currently are limited to accessible reaches of the Sacramento River upstream of Hamilton City and downstream of Keswick Dam (CDFG 2002). Preferred spawning habitats are thought to contain large cobble in deep and cool pools with turbulent water (CDFG 2002; Moyle 2002; Adams et al. 2002). Sufficient flows are needed to sufficiently oxygenate and limit disease and fungal infection of recently laid eggs (Deng et al. 2002). Within the Sacramento River, spawning appears to be triggered by large increases in water flow during spawning (Brown and Michniuk 2007).

3.3 Reptile Species

One Federally listed reptile species was identified in the USFWS database records as utilizing parts of the West Sacramento project study area: the giant garter snake (*Thamnophis gigas*).

3.3.1 Giant Garter Snake

Status and Distribution

The giant garter snake (*Thamnophis gigas*) is Federally listed as a threatened species under the ESA. Currently, this species is only known from 13 isolated population clusters within the Central Valley, from Chico to an area just southwest of Fresno (USFWS 1997).

There are no CNDDB (CDFW 2013a) records for giant garter snakes within the study area, although there are several occurrences within 10 miles of the study area. The closest of these occurrences is located approximately 3 miles from the study area in a drainage canal. This record is labeled as sensitive, and therefore, provides no specifics on location or type of observation. Other recorded occurrences within 10 miles of the study area include records for one juvenile located in a drainage canal 1.5 miles south of Del Paso Road, one adult found within the Yolo Bypass 0.75 mile south of I-80, and numerous other records that are labeled as sensitive (CDFW 2013a). Within the study area, emergent wetlands and open water areas in sloughs, canals, or vegetated ditches in the Yolo and Sacramento Bypasses, within the Yolo Bypass toe drain, DWSC and areas of the South Cross toe drain have the highest potential to support giant garter snakes. Water areas with little to no aquatic or upland vegetation could provide marginal or seasonal habitat. Throughout the study area, other emergent wetlands and open water areas could provide suitable aquatic habitat and the upland areas adjacent to these aquatic habitats could provide winter hibernacula and dry refugia required by this snake.

Life History

The giant garter snake inhabits agricultural wetlands and associated waterways, including irrigation and drainage canals, rice fields, marshes, sloughs, ponds, low- gradient streams, and adjacent uplands. They have also been observed to use revetment as cover (Wylie et al. 2002). Giant garter snakes are believed to be most numerous in rice-growing regions (USFWS 1999b). Giant garter snakes are typically absent from the larger rivers; wetlands with sand, gravel, or rock substrates; and riparian areas lacking suitable basking sites or suitable prey populations (Hansen and Brode 1980; Brode 1988; USFWS 1999b). The giant garter snake hibernates from October to March in abandoned burrows of small mammals located above prevailing flood elevations (Fisher et al. 1994), and breeds during March and April.

Factors Affecting Abundance

Giant garter snakes have been reduced in distribution and abundance due to habitat loss and degradation throughout the Central Valley. Several factors may degrade habitat for giant garter snakes, including upstream watershed modifications, water storage and diversion projects, and urban and agricultural development. Contamination from agricultural runoff may also have detrimental effects. On-going agricultural practices such as tilling, grading, harvesting and operation of other equipment may also result in mortality and increased rates of predation. Clearing and maintenance of irrigation canals and draining of rice fields may also result in mortality and degradation of habitat (USFWS 1999b).

3.4 Birds

Special status bird species with the potential to occur near or in the West Sacramento project study area are listed below (Table 18), Species protected under the Migratory Bird Treaty Act (MBTA) such as the bald eagle (*Haliaeetus leucocephalus*) may occur transiently during the winter months, although suitable nesting habitat is not present. CNDDB (CDFW 2013a) data for actual species present in the North and South Basin study area’s are located below in Figures 16 and 17.

Table 18. California Natural Diversity Database Species List for Yolo and Sacramento County.

Common Name	Scientific Name	Status[a] Federal/State
white-tailed kite	*Elanus leucurus*	-/FP
Swainson's hawk	*Buteo swainsoni*	-/T
loggerhead shrike	*Lanius ludovicianus*	-/SSC
bank swallow	*Riparia riparia*	-/T
tricolored blackbird	*Agelaius tricolor*	-/SSC
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	-/SSC
purple martin	*Progne subis*	-/SSC
northern harrier	*Circus cyaneus*	-/SSC
western burrowing owl	*Athene cunicularia hypugea*	-/SSC

[a] Status explanations:

– = no listing

E = listed as endangered under the California Endangered Species Act

T = listed as threatened under the California Endangered Species Act

FP = fully protected under the California Fish and Game Code

SSC = species of special concern in California

Figure 16. Special Status Bird Species in the West Sacramento North Basin, August 26, 2013.

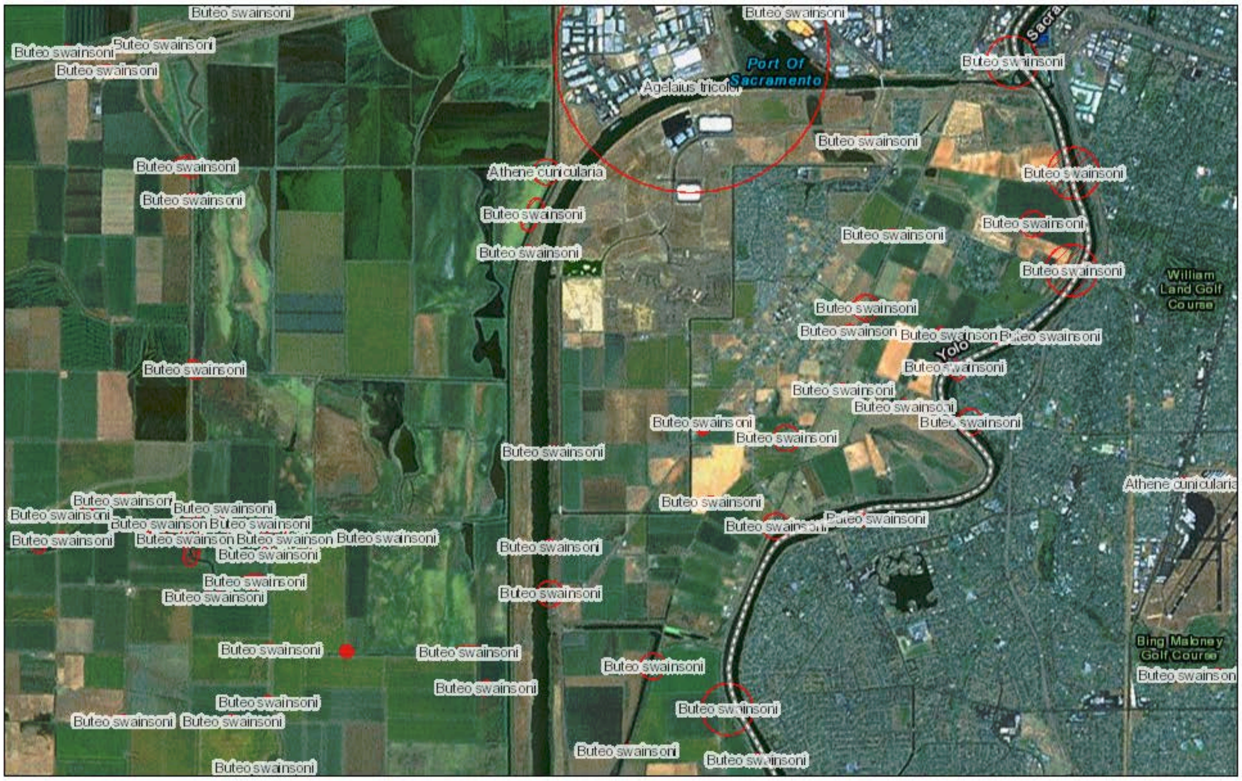

Figure 17. Special Status Bird Species in the West Sacramento South Basin, August 26, 2013.

3.5 Mammals

Special status mammal species with the potential to occur near or in the West Sacramento GRR North and South Basin study area are listed below (Table 19). CNDDB (CDFW 2013a) data for actual species present in the North study area are located below in Figure 18. CNDDB (CDFW 2013a) indicates that there were no special status species present in the South Basin of the study area.

Table 19. California Natural Diversity Database Species List for Yolo and Sacramento County.

Common Name	Scientific Name	Status[a] Federal/State
hoary bat	*Lasiurus cinereus*	-/SSC
pallid bat	*Antrozous pallidus*	-/SSC
western red bat	*Lasiurus blossevillii*	-/SSC

[a] Status explanations:
– = no listing
E = listed as endangered under the California Endangered Species Act
T = listed as threatened under the California Endangered Species Act
FP = fully protected under the California Fish and Game Code
SSC = species of special concern in California

Figure 18. Special Status Mammal Species in the West Sacramento North Basin, August 28, 2013.

4.0 Environmental Baseline

This section describes the physical conditions and special status species habitat and presence within the West Sacramento project and Southport EIP study areas. These conditions are first presented generally throughout the West Sacramento project study area and then site specific SRA is analyzed as well as affected species in the West Sacramento project study area. The environmental baseline provides information necessary to determine if the proposed action would jeopardize the continued existence of species being considered, and if the project can support long-term survival of these species in the study area.

For the Southport EIP, the environmental baseline is described in consideration of "the past and present impacts of all Federal, state, or private actions and other human activities in an Action Area, the anticipated impacts of all proposed Federal projects in an 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" (50 CFR §402.02). This section describes the general physical conditions and associated vegetation, wildlife, and fisheries resources in the lower Sacramento River and Action Area.

The West Sacramento project study area includes the mainstem Sacramento River 11.4 miles from the Sacramento Bypass south to the South Cross Levee. The study area also includes the Yolo Bypass, DWSC, Barge Canal, Port of West Sacramento, upper Yolo Bypass toe drain, and the South Cross toe drain. The Southport EIP study area is focused on the Sacramento River reach south of the Barge Canal.

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).

The natural banks and adjacent floodplains of the Sacramento River 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 river, 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 (Corps 2012).

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.

Descriptions of baseline conditions are based on information published in peer-reviewed scientific literature, resource agency publications, as well as aerial photography viewed in Google Earth Pro within the project area. Baseline conditions are described with a focus on features that affect habitat conditions for threatened and endangered species, including Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, delta smelt, green sturgeon, giant garter snake, and the valley elderberry longhorn beetle.

4.1 West Sacramento GRR Baseline

The West Sacramento project study area consists of primarily riparian scrub-shrub habitat. Early riparian habitat may be called scrub-shrub. Scrub-shrub generally refers to areas where the woody riparian canopy is composed of trees or shrubs approximately 20 feet high. Species that are typically found in these habitats include young cottonwood, willow, elderberry, buttonbush, Himalaya blackberry, wild grape, and poison oak. In very dense stands there may be no understory; however, in open canopies, understory vegetation may consist of an herbaceous layer of sedges, rushes, grasses, and forbs. Provided disturbance of the area is low, the scrub-shrub may acquire enough overstory cover to become riparian forest within 20 years.

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, or valley oak. Species found in the scrub-shrub would make up the sub canopy and could also include white alder 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 are also found in riparian communities.

The herbaceous ruderal habitat 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, 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 project area.

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 linear feet (lf) of SRA was conducted using Google Earth Pro for the levee reaches on the Sacramento River North and South and Port North and South areas (Table 20). The Sacramento Bypass Training levee, Yolo Bypass, and South Cross levee reaches were not evaluated because there is minimal, if any, SRA associated with these reaches. There also could be the potential for habitat removal in the Sacramento Bypass during the widening process but will wait for analysis once future designs are presented.

The Corps would need to remove some SRA habitat in order to place rock along the river bank, but more than half of the existing SRA habitat along the 11 miles of Sacramento River levees would remain in place. A variance would also be sought for these levee reaches, allowing 34 acres of riparian habitat on the lower one-third of the slope to 15 feet waterward of the waterside levee toe to remain in place. As a result, the SRA habitat along the river would continue to grow at a natural rate and overall would increase over time.

Table 20. Summary of Reach-Specific SRA Analysis[1].

REACH	LINEAR FEET (lf) of SRA	REACH	LINEAR FEET (lf) of SRA
Port North Levee	2,468	Sac. River North Levee	27,241
Port South Levee	2,602	Sac. River South Levee	16,047
Total SRA for Study Area: 48,358 lf			

[1] Numbers were obtained using aerial photography and are estimates. Numbers are rounded.

4.2 Southport EIP Baseline

4.2.1 Lower Sacramento River in the 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.

The Action Area is located in Region 1b of the SRBPP regional planning area, which includes the mainstem Sacramento River from Isleton (RM 20) to the Feather River confluence at Verona. Downstream from the Feather River confluence, the Sacramento River channel is moderately sinuous (average sinuosity of 1.3) and confined on both sides by natural and man-made levees that restrict further channel migration. The channel in this reach is uniform in width and typically narrower and deeper relative to the upstream reach due to scour caused by lateral confinement and the concentration of shear forces on the channel bed (Brice 1977).

The natural banks and adjacent floodplains 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, 5–20 feet above the floodplain for as far as 10 miles from the channel (NMFS 2008). The present day channels are flanked by fine-grained cohesive banks with erosion due to both mass failures and fluvial erosion (Harvey 2002).

Within this portion of the Sacramento River, bank erosion and lateral migration of the channel is generally limited to a distance of 50 to 100 feet between the levee and river bank. These areas may be occupied by a narrow strip of riparian forest or riparian scrub/shrub. Based on aerial photo-interpretation of 1-foot resolution Digital Globe imagery (2008), many areas between the channel edge and closely set levees support either very little vegetation or a low density cover of weedy herbaceous plants (ruderal species). Bank revetments currently account for two-thirds of the region-wide shorelines based on data obtained from the Corps' revetment database (USFWS 2002; Corps 2006). The bank revetment composition includes medium to large (quarry) rock, rubble, and cobbles. The majority of revetments present at the erosion sites and along the banks without erosion sites is large (>20 inches) rock. The presence of levees and bank revetments and the loss of wide expanses of riparian forest currently limit IWM recruitment, bank erosion, and point bar formation, which in turn limit habitat diversity that would normally result from such natural processes.

Reaches throughout the SRBPP planning 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. Many native fish species are adapted to rear in flooded, shallow water areas that provide abundant cover and prey. As a consequence of habitat alterations, and the introduction of non-native species and pollutants, some native fish species are now extinct while most others are reduced in numbers (Moyle 2002).
Levee repair and bank protection projects conducted recently by the Corps and the California Department of Water Resources (DWR) in the SRBPP planning area have included onsite and offsite elements to compensate for the loss of SRA cover, riparian, and floodplain habitat to address the specific conservation and recovery needs of listed fish and wildlife species. These elements include setback levees, riparian and wetland planting benches, and IWM installation.

The quantification of existing SRA cover nearshore and floodplain habitat conditions in the project reach, as measured by the Standard Assessment Methodology (SAM), is described in Appendix C.

4.2.2 Land Cover Types

Sixteen land cover types were identified in the project area. Table 21 includes the mapped acreages for each land cover type. Nine of the land cover types are considered natural communities: all four riparian habitats, emergent marsh, valley oak woodland, walnut woodland, nonnative annual grassland, pond, and perennial drainage. The other cover types are associated with human activities: all three agricultural field types, walnut orchard, agricultural ditch, and developed/landscaped. Because land cover types were not mapped to include the Action Area, acreages of land cover for the entire Action Area are not shown in this table. Each of the land cover types is discussed below.

Table 21. Land Cover Types and Acreage in the Action Area.

Southport EIP Land Cover Type	Acreage in the Action Area
Cottonwood riparian woodland	29.48
Valley oak riparian woodland	5.66
Walnut riparian woodland	2.19
Riparian scrub	13.23
Valley oak woodland	42.06
Walnut woodland	0.71
Emergent wetland	6.28
Nonnative annual grassland	57.15
Cultivated agricultural field	297.53
Disked/plowed agricultural field	144.50
Fallow agricultural field	1,112.82
Walnut orchard	12.03
Perennial drainage (Sacramento River)	63.65
Ditch	21.02
Developed/landscaped	113.56
Total project area	**1,921.87**

Riparian Communities

Riparian communities in general are some of the richest community types in terms of structural and biotic diversity of any plant community found in California. Riparian vegetation provides three important functions in addition to that of wildlife habitat: (1) acts as a travel lane between the river and adjacent uplands, providing an important migratory corridor for wildlife; (2) filters out pollutants, thus protecting water quality; and (3) helps to reduce the severity of floods by stabilizing riverbanks. Despite widespread disturbances resulting from urbanization, agricultural conversion, and grazing, riparian forests remain important wildlife resources because of their scarcity regionally and statewide and because riparian communities are used by a large variety of wildlife species.

Cottonwood Riparian Woodland

Cottonwood riparian woodland occurs on the sides of the Sacramento River levee, primarily on the water side, and also surrounds the Bees Lakes area. It also occurs along some agricultural ditches. The project area contains a total of 29.48 acres of cottonwood riparian woodland. The dominant overstory species are Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), Goodding's black willow (*Salix gooddingii*), valley oak (*Quercus lobata*), and northern California black walnut (*Juglans hindsii*). The shrub layer is relatively open and contains small valley oaks, box elder (*Acer negundo* var. *californicum*), and tree tobacco (*Nicotiana glauca*). Blue elderberry (*Sambucus nigra*) shrubs also occur in several areas of this woodland. Representative species observed in the herbaceous understory are mugwort

(*Artemisia douglasiana*), rough cocklebur (*Xanthium strumarium*), and cudweed (*Gnaphalium luteo-album*).

Some of the trees in the cottonwood riparian woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Riparian woodland (Great Valley cottonwood riparian) is identified as a sensitive natural community by the CNDDB (CDFG 2003). CDFW has adopted a no-net-loss policy for riparian habitat values, and the USFWS mitigation policy identifies California's riparian habitats in Resource Category 2, for which no net loss of existing habitat value is recommended (46 FR 7644).

Valley Oak Riparian Woodland

Valley oak riparian woodland occurs on the water side of the Sacramento River levee and along larger irrigation ditches in the project area. Approximately 5.66 acres of valley oak riparian woodland are present in the project area. Plant species associated with valley oak riparian woodland include valley oak, sandbar willow (*Salix exigua*), red willow (*Salix laevigata*), poison-oak and Himalayan blackberry.

As described above for the cottonwood riparian woodland, some of the trees in the valley oak riparian woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance, and CDFW and USFWS policies support protection of riparian habitats. Valley oak riparian woodland (Great Valley valley oak riparian) is identified as a sensitive natural community by the CNDDB (CDFG 2003).

Walnut Riparian Woodland

Walnut riparian woodland occurs along an agricultural ditch in the project area. Approximately 2.19 acres of walnut riparian woodland is in the project area. The dominant overstory species are northern California black walnut and valley oak. The understory is dominated by Himalayan blackberry.

As described above for the cottonwood riparian woodland, some of the trees in the valley oak riparian woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance, and CDFW and USFWS policies support protection of riparian habitats. Naturally occurring California walnut woodland is identified as a sensitive natural community by the CNDDB (CDFG 2003), although the walnut riparian woodland in the project area was most likely planted along the parcel border where it occurs.

Riparian Scrub

Riparian scrub occurs intermittently on the water side of the Sacramento River levee and along some ditches in the project area. Approximately 13.23 acres of riparian scrub are in the project area. The dominant overstory species are willows and saplings of riparian trees found in the riparian woodland land cover types, and elderberry shrubs also occur along some ditches. Woody vegetation in this community is lower-growing than that found in the woodland communities. Some areas of riparian scrub occur where rock has been placed on the levee for erosion control.

Most of the trees in the riparian scrub community are too small to meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Although riparian scrub is not specifically identified as a sensitive natural community by the CNDDB (CDFG 2003), it may represent an early successional stage of the mature riparian woodland communities. CDFW has adopted a no-net-loss policy for riparian habitat values, and the USFWS mitigation policy identifies California's riparian habitats in Resource Category 2, for which no net loss of existing habitat value is recommended (46 FR 7644).

Nonriparian Woodland Communities

Valley Oak Woodland

Valley oak woodland occurs in stands ranging in size from a few trees to several acres and covers approximately 42.06 acres in the project area. This cover type is distinguished from the oak riparian type by not being associated with a drainage. The dominant overstory species is valley oak, although other tree species are present, including interior live oak (*Quercus wislizeni*) and northern California black walnut. Understory shrub species include Himalayan blackberry and elderberry, and herbaceous grassland species are also present.

Some of the trees in the valley oak woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Valley oak woodland is identified as a sensitive natural community by the CNDDB (CDFG 2003).

Walnut Woodland

One approximately 0.71-acre grove of walnut woodland occurs in the project area north of Linden Road near the intersection with South River Road. The trees are northern California black walnut and are not associated with any drainage. Although native stands of northern California black walnut are considered special-status species (California Native Plant Society [CNPS] List 1B.1) and California walnut woodland is identified as a sensitive natural community by the CNDDB (CDFG 2003), the grove of trees in the project area most likely is planted and not a native occurrence. The trees, therefore, would not be considered special-status species. However, some of the trees in the walnut woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance.

<u>Wetland Community</u>

Emergent Wetland

Emergent wetland vegetation occurs in undredged agricultural ditches, in the southernmost borrow area, and in patches along the DWSC in the project area and covers approximately 6.28 acres. The agricultural ditches included in the emergent wetland category support 50% or more cover of wetland vegetation. Ditches that had minimal wetland vegetation at the time of the field survey are discussed below in Open Water Areas. It should be noted that annual maintenance of ditches and the DWSC may cause the location and extent of emergent wetland to vary.

Where present, wetland vegetation along the majority of irrigation ditches in the project area consisted of cattails (*Typha* sp.), bulrush (*Schoenoplectus* sp.), and Himalayan blackberry. These irrigation ditches likely would be considered waters of the United States by the Corps because they are hydrologically connected to the Main Drain, which carries water from the Sacramento River that is pumped back into the DWSC.

Emergent wetlands in the DWSC are vegetated by tule (*Schoenoplectus acutus*), narrow-leaved cattail (*Typha angustifolia*), knotweed (*Persicaria* [*Polygonum*] *hydropiperoides*), and monkeyflower (*Mimulus guttatus*), as well as English plantain (*Plantago lanceolata*) and dallisgrass (*Paspalum dilatatum*). Some emergent wetlands were vegetated almost entirely by tule and narrow-leaved cattail.

<u>Herbaceous Community</u>

Nonnative Annual Grassland

Nonnative annual grassland occurs throughout the project area on levee slopes, along roadsides, and in undeveloped parcels. Two areas of pasture associated with residences are primarily annual grasses that are grazed by horses and were mapped as nonnative annual grassland. Similar vegetation occurs in the fallow agricultural fields, described below, but those areas are larger and are subject to intermittent cultivation. The project area contains 57.15 acres of nonnative annual grassland.

The nonnative annual grassland is dominated by naturalized annual grasses with intermixed perennial and annual forbs. Grasses commonly observed in the project area are foxtail barley (*Hordeum murinum* ssp. *leporinum*), ripgut brome (*Bromus diandrus*), Italian ryegrass (*Lolium multiforum*), and soft chess (*Bromus hordeaceus*). Other grasses observed were wild oats (*Avena* spp.), Bermuda grass (*Cynodon dactylon*), and rattail fescue (*Vulpia myuros* var. *myuros*). Forbs commonly observed in annual grasslands in the project area are yellow star-thistle (*Centaurea solstitialis*), prickly lettuce (*Lactuca serriola*), bristly ox-tongue (*Picris echioides*), sweet fennel (*Foeniculum vulgare*), Italian thistle (*Carduus pycnocephalus*), horseweed (*Conyza canadensis*), black mustard (*Brassica nigra*), fireweed (*Epilobium brachycarpum*), broad-leaf pepper grass (*Lepidium latifolium*), common sunflower (*Helianthus annuus*), pigweed (*Chenopodium* sp.), cheeseweed (*Malva parviflora*), bindweed (*Convolvulus arvensis*), and telegraph weed (*Heterotheca grandiflora*). The annual grasslands in the project area contain a relatively large proportion of ruderal species, likely because of substantial disturbance from human activities. Elderberry shrubs occur in several areas of nonnative annual grassland.

Agricultural Communities

Cultivated Agricultural Field

Cultivated agricultural field includes large parcels of wheat, ryegrass, and row crops that were in active cultivation at the time of the 2011 and 2012 field surveys. These areas could be transitioned to either fallow or disked/plowed conditions at other times. Cultivated agricultural field covers approximately 297.53 acres in the project area.

Disked/Plowed Agricultural Field

Disked or plowed agricultural field includes large parcels that were in active cultivation but were not vegetated at the time of the 2011 field surveys. These areas could be transitioned to either fallow or cultivated conditions at other times. Disked/plowed agricultural field covers approximately 144.50 acres in the project area.

Fallow Agricultural Field

Fallow agricultural fields occur in large parcels throughout the project area where cultivation is inactive but could be reinitiated. Approximately 1,112.82 acres of fallow agricultural field occur in the project area. The dominant species in these fields are essentially the same as those described for nonnative annual grassland, but fallow fields cover larger areas than the noncultivated grasslands in the project area. Elderberry shrubs occur in several areas of fallow agricultural field.

Walnut Orchard

Three areas of walnut orchard occur in the southern half of the project area, comprising approximately 12.03 acres. Two of the orchards are in the River Park area and the third is on the west side of the Yolo Shortline Rail Corridor. Walnut orchards are distinguished from the walnut woodland in several respects—the trees are usually English walnut grafted onto a black walnut rootstock and planted in rows for cultivation and harvesting, and the orchard is generally managed intensively, with understory layers that are often unvegetated and sprayed with herbicides or disked.

Open Water Areas

Perennial Drainage

Perennial drainage occurs in the project area in the Sacramento River. The Sacramento River forms the eastern project area boundary and comprises approximately 63.65 acres in project area. The perennial drainage land cover type is unvegetated, but the river is bordered along much of its length in the project area by riparian woodland or scrub vegetation, as described above. The Sacramento River is a traditional navigable water, considered a water of the United States.

Ditch

Ditches occur throughout the project area and cover approximately 21.02 acres. Ditches in this category include unvegetated agricultural ditches used to irrigate fields and several roadside ditches used to drain runoff. The unvegetated ditches are more highly maintained than the ditches that support emergent wetland vegetation, which are discussed above. Some unvegetated ditches support riparian scrub or riparian woodland habitat along the banks.

The Main Drain in the project area is included as a blue-line feature on the U.S. Geological Survey quadrangle. This ditch averages 90 feet in width. The bank of the ditch is vegetated by an emergent wetland community dominated by cattails (*Typha* sp.), bulrush (*Schoenoplectus* sp.), and Himalayan blackberry, but the majority of the ditch is open water. RD 900 currently controls the flow, which is dependent on water pumped from the Sacramento River and is used for irrigation. At its end, water is pumped from the ditch into the DWSC.

Other irrigation ditches branch off the Main Drain to supply water to individual fields in the project area. These additional ditches are generally narrower (widths of approximately 15 feet and 40 feet) and convey water from the Main Drain to individual fields. Agricultural ditches in the Action Area are considered waters of the United States. Smaller agricultural ditches that are excavated in upland areas and are temporary features generally are not regulated by state or Federal agencies and were not included on the land cover mapping.

Developed/Landscaped

The developed/landscaped cover type was applied to residential parcels that include houses and other structures and where the vegetation is mostly landscaped, horticultural species and to roads and large paved areas, including RD 900’s pumping plant on the landside of the DWSC levee. This cover type comprises approximately 113.56 acres and occurs throughout the project area.

Waters of the United States, Including Wetlands

The project area contains waters of the United States consisting of the Sacramento River, emergent wetland, pond, and ditches. A preliminary delineation was conducted and submitted to the Corps to determine their jurisdiction in the project area. A site visit was conducted to verify the Corps jurisdiction. Waters of the United States and any non-jurisdictional wetlands and ditches in the project area also may qualify as waters of the state.

4.3 Affected Species in the Action Area

4.3.1 Valley Elderberry Longhorn Beetle

West Sacramento Project

Documented occurrences of VELB are present along the Sacramento River North and South, Sacramento Bypass, Port South, DWSC East and West, and the South Cross levee reaches. Surveys were conducted in 2009, 2012, and 2013 of the levee systems within the study area. The survey area consisted of the levee structures and 15 feet on both the waterside and landside; where access was available. The surveys found the greatest amount of clusters on the Port South levee reach and determined that both basins contain shrubs. All shrubs are considered to be in a riparian zone. Approximately 78 shrubs have the potential to be adversely impacted by the West Sacramento project.

Southport EIP

There are two CNDDB (2014) records of VELB occurrence in the Southport Action Area. Suitable habitat for VELB is located at numerous places in the Action Area along the levee and borrow construction footprints. A total of 106 shrubs/shrub clusters were identified during the 2011–2013 surveys in the Action Area. Forty-one of these shrubs are in the Action Area (Table 22). Stem counts and examination of shrubs for VELB exit holes could only be conducted for 14 of the 18 shrubs/shrub clusters directly affected in the Action Area because of property inaccessibility and the high density of California grape and Himalayan blackberry along portions of the Sacramento River riparian corridor. As described under Conservation Measure 10: Compensate for Direct Effects on Valley Elderberry Longhorn Beetle Habitat, compensation for the removal of shrubs 33, 39b, 41a, and 41b was estimated based on the average number of stems in each stem diameter range for the shrubs that could be surveyed. In addition, an assumption was made that there were exit holes in the four shrubs that could not be surveyed. See Table 16 for a summary of stem counts for elderberry shrubs directly affected in the Action Area and Table 22 for shrubs potentially affected by the proposed action.

Table 22. Summary of Elderberry Shrubs Potentially Affected by the Southport EIP.

Shrub	Presence of Exit Holes?	Riparian Habitat?	Number of Stems (by Diameter)			Effect on Shrub (Direct or Indirect)
			1-3 Inches	3-5 Inches	>5 Inches	
2	Y	Y	0	1	1	Indirect
3	Y	Y	13	5	5	Indirect
4	N	Y	19	2	2	Indirect
5	N	Y	18	0	1	Indirect
6	N	Y	60	5	9	Direct
7	N	Y	33	10	18	Direct
8	N	Y	8	5	2	Direct
9	N	Y	30	2	8	Direct
10	Y	Y	8	4	2	Direct
23	N	Y	3	3	1	Direct
31 [1]	Y	N	16	4	3	Indirect
32	N	N	3	1	1	Direct
33 [1]	Y	N	16	4	3	Direct
34	Y	N	12	6	10	Direct
37 [2]	N/A	Y	N/A	N/A	N/A	Indirect
38 [2]	N/A	Y	N/A	N/A	N/A	Indirect
39a	N	N	3	0	0	Direct
39b [2]	Y	N	16	4	3	Direct
41a [2]	Y	N	16	4	3	Direct
41b [2]	Y	N	16	4	3	Direct
41c	Y	N	5	7	2	Direct
45	N	Y	1	0	9	Indirect
47	Y	Y	42	8	2	Indirect
49	N	N	0	0	1	Indirect
50	Y	N	16	7	7	Indirect
51	Y	N	14	4	7	Indirect
52	Y	Y	6	1	1	Direct
53	Y	N	29	17	3	Direct
54	N	Y	17	1	0	Indirect
80 [2]	N/A	Y	N/A	N/A	N/A	Indirect
81 [2]	N/A	Y	N/A	N/A	N/A	Indirect
82 [2]	N/A	Y	N/A	N/A	N/A	Indirect
84 [2]	N/A	Y	N/A	N/A	N/A	Indirect
85 [2]	N/A	Y	N/A	N/A	N/A	Indirect
92	N	Y	10	15	8	Indirect
93 [2]	N/A	Y	N/A	N/A	N/A	Indirect
94 [2]	N/A	Y	N/A	N/A	N/A	Indirect
95 [2]	N/A	Y	N/A	N/A	N/A	Indirect
98	N	Y	4	0	0	Direct
100	Y	Y	8	2	0	Direct

N/A = Not Available

[1] Shrubs could not be surveyed because there was no property access

[2] Shrubs could not be surveyed because they were covered in grapevines or poison oak

4.3.2 Chinook Salmon and Steelhead

Factors such as levee construction and bank armoring have altered habitat for Chinook salmon and steelhead and their critical habitat. These factors reduce floodplain habitat, change river bank substrate size, and decrease the amount of riparian and SRA habitat, which in turn, reduce habitat availability and quality (NMFS 2006a). These changes have affected primarily adult and juvenile migration as well as juvenile rearing.

Bank armoring projects that have been conducted recently by the Corps and DWR, some of which are on-going, have incorporated design elements to offset the loss of habitat that generally results from placement of river bank protection materials. The creation of setback levees, and the restoration of floodplain, riparian, and SRA habitat have been implemented to improve conditions for listed salmon and steelhead in the action area (Corps 2012).

During the intermittent years when the Yolo Bypass is flooded in the winter and spring all four runs of juvenile Chinook salmon and steelhead can potentially use the floodplain and toe drain for rearing and migration.

4.3.3 Green Sturgeon

Channelization of the action area has resulted in the removal of riparian and IWM, which simplify ecosystem functions. Simplification results in reduced food input and pollutant and nutrient processing (NMFS 2006a). These factors have degraded habitat quality for larvae and post-larvae and to a lesser extent, rearing and migrating juvenile and/or adult green sturgeon (NMFS 2006b).

As described for Chinook salmon and steelhead, incorporation of riparian plantings and SRA habitat into recent bank protection projects, and development of setback levees, have been implemented to improve conditions for green sturgeon in the action area (Corps 2012)

4.3.4 Delta Smelt

<u>West Sacramento Project</u>

As discussed for Chinook salmon and steelhead, levee construction has altered waterside bank habitat resulting in the destruction of spawning and refugia areas for delta smelt. Loss of riparian habitat and overall habitat simplification also reduces food input and pollutant and nutrient processing (NMFS 2006b), which may impair individuals. Revetment also fragments areas of high quality habitat and accelerates water velocity, which affects use of those areas by delta smelt and other native fishes (USFWS 2006b).

Incorporation of riparian plantings and SRA habitat into recent bank protection projects, as well as development of setback levees, has been implemented to improve conditions for delta smelt and their critical habitat in the action area (Corps 2012).

Southport EIP

Delta smelt adults, eggs, and larvae may occur in the Action Area from January through July. Critical habitat for Delta smelt includes the Action Area of the Southport EIP.

4.3.5 Giant Garter Snake

West Sacramento Project

Much, if not all, of the Sacramento River area is unlikely to provide giant garter snake aquatic habitat because it consists of larger rivers and flood control features, often surrounded by riparian vegetation and steep banks. Areas of the Yolo Bypass are currently being farmed as rice. Rice fields and their adjacent irrigation and drainage canals serve an important role as aquatic habitat for giant garter snake as is the case adjacent to and within the Sacramento Bypass, Yolo Bypass, and the South Cross toe drain. The upland areas adjacent to rice fields and canals associated with grasslands provide basking habitat for the snakes also.

Southport EIP

There are no CNDDB (2014) records for giant garter snakes in the Action Area, although there are 55 occurrences within 10 miles of the Action Area. No giant garter snakes were observed during the field surveys, but this does not eliminate the possibility that they inhabit the site. The Action Area is within the current range of giant garter snake (USFWS 1999b). The closest reported occurrence of giant garter snake is approximately 3 miles west of the Action Area in the Yolo Bypass (CDFW 2013).

In the Action Area, the Main Drain, some of the irrigation ditches, and emergent marshes provide suitable aquatic habitat for giant garter snake. Although Bees Lakes is outside of the Action Area, it creates suitable upland habitat for giant garter snake within the Action Area. The water creating the habitats is from precipitation or the activities of RD 900. Water is pumped into the Main Canal from the Sacramento River and then flows into several adjoining irrigation ditches that are used to irrigate agricultural fields in the Action Area. The flow of water through these ditches is variable and depends on the need for irrigation water. Most of the canals in the Action Area were wet at the time of the spring field surveys due to precipitation. However, most of the active fields in the Action Area are fallowed or planted in wheat, which does not require irrigation; therefore these ditches were not considered suitable for giant garter snake because they are dry during the snake’s active season.

Upland basking and overwintering habitat is also present in the Action Area. Upland habitat consists of nonnative annual grasslands and fallow agricultural lands within 200 feet of suitable aquatic habitat. The aquatic habitat provided by Bees Lakes is not within the Action Area; however, suitable upland habitat associated with Bees Lakes is within the Action Area.

4.4 Effects from Changing Environmental Baseline

The environmental baseline for these two projects is further impacted by the potentially concurrent activities associated with the Corps' American River Common Features project and SRBPP. Concurrent construction of these four projects could contribute to adverse effects on the listed species analyzed in this BA. Due to the cumulative nature of these impacts, they are discussed below in Section 5.7.2, Federal Cumulative Effects Analysis.

5.0 Effects of the Proposed Actions

5.1 Valley Elderberry Longhorn Beetle

5.1.1 West Sacramento Project

Effects to valley elderberry longhorn beetle may occur if elderberry shrubs are incidentally damaged by construction personnel or equipment. Impacts may also occur if elderberry shrubs need to be transplanted because they are located in areas that cannot be avoided by construction activities. Potential impacts due to damage or transplantation include direct mortality of beetles and/or disruption of their lifecycle.

Long-term effects of the project may include reduced viability of elderberry shrubs due to the placement of project area materials. Temporal loss of habitat may also occur due to transplantation of elderberry shrubs. Although compensation measures include restoration and creation of habitat, mitigation plantings will likely require five or more years to become large enough to provide supporting habitat. Furthermore, associated riparian habitats may take 25 years or longer to reach their full value.

Removal of plants may also fragment remaining habitats, which may make dispersal more difficult. However, levee repairs may also have beneficial effects by protecting elderberry plants from being damaged or washed out due to slope failure.

Project actions have the potential to occur within one mile of critical habitat for the valley elderberry longhorn beetle. Protocol-level surveys were conducted for a number of shrubs on November 27 and 29, 2012, and January 4, 16, and 17, 2013. Information was recorded for each shrub that could be directly or indirectly affected by the proposed project, including number of stems between 1 and 3 inches, 3 and 5 inches, and greater than 5 inches in diameter; whether each stem 1 inch or more in diameter is located in a riparian or upland area; and presence of VELB exit holes. Within the area surveyed approximately 78 of the 97 blue elderberry shrubs identified during the spring 2011–2013 surveys in the study area could be adversely affected due to construction activities such as removal of the plant, heavy equipment vibration, and dust covering the elderberries.

The most likely impacts that may affect but not adversely affect elderberry shrubs will be on the Sacramento River north and south levee reaches, involving bank erosion protection measures. Additional impacts could occur on the South Cross levee due to compliance with the Corps vegetation requirements. Currently, there are several blue elderberries found growing at the South Cross levee that would be adversely affected by fixing this levee in place. Measures to help with these impacts are detailed in Section 2.6.2 above.

5.1.2 Southport EIP

Direct Effects

Construction activities (e.g., excavation, grading, recreation trails) associated with the Proposed Action could result in the loss of VELB and removal or disturbance of a number of elderberry shrubs, the host plant for VELB. Direct effects include removal or transplantation of VELB habitat for all shrubs within 20 feet of construction activities. Up to 18 elderberry shrubs or groupings of shrubs could be directly affected during construction (Table 22).

Property inaccessibility and the high density of vegetation surrounding elderberry shrubs 33, 39b, 41a, and 41b in the Action Area limited the number of elderberry shrubs that could be surveyed to 14 of the 18 shrubs that would be directly affected. For this reason, compensation for the removal of the 4 shrubs that would be directly affected and were not counted was estimated based on the average number of stems in each stem diameter range for the 14 shrubs that could be surveyed (Appendix C). In addition, an assumption was made that there were exit holes in the 4 shrubs that could not be surveyed. Those averages are as follows.

- Number of stems ≥1 inch and ≤3 inches = 16.
- Number of stems >3 inches and <5 inches = 4.
- Number of stems ≥ 5 inches = 3.

Removal of habitat (elderberry) and potential injury or mortality of VELB associated with construction of the Proposed Action would be considered direct effects on VELB. Trimming of elderberry branches that are 1 inch or greater in diameter could also result in injury or mortality of VELB. Because VELB larvae may feed on the roots of elderberries, disturbance of elderberry roots within the shrub dripline could also result in injury or mortality of individuals. Where root damage is expected to be extensive, elderberry shrubs would be removed. Where damage is limited (few roots affected) and roots are expected to grow back, impacts would be considered temporary. Because incidental take of VELB would be difficult to detect or quantify, effects on elderberry shrubs will be used as a proxy for measuring take.

Elderberry shrubs within the construction area that cannot be protected will be removed in accordance with to USFWS-approved procedures outlined in the Conservation Guidelines (USFWS 1999a). Shrubs will be transplanted to the proposed Conservation Area, as described in Conservation Measure 10. Transplanted shrubs will be moved prior to construction when the plants are dormant, approximately November through the first 2 weeks in February, after they lose their leaves. Transplanting during the dormant period will reduce shock to the plant and increase transplantation success. However, transplanted elderberry shrubs may experience stress, a decline in health, or death due to changes in soil, hydrology, microclimate, or associated vegetation.

Elderberry shrubs that can be avoided at the dripline of the shrub or greater distance will be protected with fencing and/or k-rail as described in Conservation Measure 7. Figure 6 (Appendix B) shows the approximate locations of elderberry shrubs.

As described in Conservation Measure 8, surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements are being exceeded, or if additional plantings are necessary. Because the Proposed Action would be constructed over several years, elderberry survey data for each year will be used to rectify any discrepancies in compensation for the previous year, and ensure that impacts to VELB have been fully mitigated.

Indirect Effects

Loss of Connectivity to Adjacent Habitat

Loss of connectivity between elderberry shrubs may result when elderberries or associated vegetation is removed. Removal of such vegetation could result in gaps in vegetation that are too wide for VELB to travel across due to their fairly limited movement distances (Talley et al. 2006b), resulting in separation of individuals or reducing the possibility of colonization of adjacent areas. Removal of associated vegetation may result in an altered habitat structure or microclimate that could affect behaviors of VELB in response to these changes in unforeseen ways (USFWS 2003).

Although more research is needed, VELB has been observed to fly a mile or more in contiguous or fairly contiguous habitat, and exit holes have been observed on isolated shrubs that are a minimum of 0.25 mile from the next nearest elderberry (Arnold 2011). Within the American River Basin, evidence suggests that local beetle movements are farther within the riparian corridor (141±144 feet) than in the adjacent non-riparian scrub (82±52 feet) (average±1 standard deviation nearest neighbor distances between recent exit holes) illustrating that VELB population extents may also be habitat-specific (Talley et al. 2006b).

As described above, approximately 18 elderberry shrubs are expected to be removed as part of the Proposed Action, and 23 elderberry shrubs would remain in the Action Area and continue to provide habitat for VELB. Given the distance VELB has been observed to fly, and the amount of elderberry shrubs that will remain in the Action Area, VELB is not expected to be indirectly affected by a loss of connectivity to adjacent habitat.

Soil Disturbance Adjacent to Roots

Ground disturbance within 20 feet of an elderberry shrub's dripline could result in disturbance of roots. Root damage could result in stress or reduced vigor of elderberry shrubs. Because construction of the Proposed Action may result in disturbance within 20 feet of the dripline of elderberry shrubs, indirect effects on these shrubs may result. Elderberry shrubs will be fenced and/or protected with k-rail, as described in Conservation Measure 7, to minimize soil disturbance adjacent to roots. With this measure in place, and because elderberry shrubs are hearty and frequently resprout after damage, this indirect effect is not expected to substantially affect VELB.

Dust

Vehicle travel on roads adjacent to elderberry shrubs during construction of the Proposed Action could result in dust becoming airborne and settling on elderberries. Construction of the Proposed Action would increase the amount of dust in the Action Area as a result of ground-disturbing activities and an increase in the frequency of vehicles driving on roads. The amount of dust in the Action Area would be minimized through dust control measures, as described in Conservation Measure 9. Additionally, according to Talley et al. (2006a) in an experiment along the American River Parkway, conditions of elderberry shrubs related to dust from nearby trails and roads (paved and dirt) did not affect the presence of VELB. Additional work by Talley and Holyoak (2009) found no effect on elderberries from dust accumulations. Because dust has not been found to greatly affect elderberry shrubs and because dust control measures would be implemented during construction, this indirect effect is not expected to substantially affect VELB.

Altered Hydrology

Reduction of water to elderberry shrubs as a result of altered of hydrology from changes in topography or compaction of soil could result in reduced shrub vigor/vitality and an associated decrease in shoot, leaf, and flower production and ultimately reduce the suitability of the shrubs to provide habitat for VELB. In most portions of the Action Area, the levee will be degraded and rebuilt within the same footprint, and would not modify the hydrology of the surrounding area where elderberries may be present. There may be a few instances where the slope is modified or there are other changes that may affect the hydrology in the Action Area. These situations are expected to be rare. Therefore, altered hydrology as a result of the Proposed Action is not expected to substantially affect VELB.

Existing Elderberry Shrubs in the Conservation Area

As described in Conservation Measure 10, elderberry shrubs to be removed will be transplanted to the proposed Conservation Area, which contains existing elderberry shrubs. Although transplantation activities may occur within 100 feet of existing elderberry shrubs, it is unlikely that they would be indirectly affected by transplantation activities, as the transplantations would be conducted by qualified individuals who would be knowledgeable about elderberry shrubs and the existing conditions within the conservation area.

Temporal Loss of Habitat

It generally takes 5 or more years for newly planted elderberry cuttings/seedlings to become large enough to support beetles, and it generally takes 25 years or longer for riparian habitats to reach their full value (USFWS 1999a). Because elderberry shrubs within the Action Area will be transplanted to the proposed Conservation Area, which is immediately adjacent to the Action Area, no temporal loss of habitat for VELB is expected. Additional elderberry plantings in the conservation area will provide additional and/or replacement habitat for VELB in future years.

Effects of Operation and Maintenance Activities

Post-construction setback levees, adjacent levees, strengthening in place (slope flattening), seepage berms, slurry cutoff walls, riprap bank stabilization, and relief wells would be subject to typical O&M. O&M activities in the project area are conducted per the approved USACE O&M manual applicable to this reach.

Effects on VELB and its habitat include hand and mechanical (mower) removing weeds, spraying of weeds with approved pesticides, minimal tree or shrub trimming all up to four times a year, and reconditioning of levee slope and road with a bull dozer as needed. These effects were determined to have no potential to affect VELB and its habitat as a result of the Proposed Action. Specifically, the following determinations were made.

- There would be no increased use of herbicides and/or pesticides from pre-project conditions as a result of the Proposed Action. Vegetation control would remain the same as existing conditions—typically twice per year. Herbicide use would also be at the same frequency as existing conditions.

The Proposed Action would not result in adverse effects on VELB and its habitat due to an increase in vehicles traveling to the project components to conduct maintenance activities. Inspections are infrequent (flood control facilities four times per year; relief wells once per year, plus inspections after high water events), and travel would be along the existing levee road and paved roads to the levee. Patrol road recondition activities would typically be performed once per year and would include placing, spreading, grading, and compacting aggregate base or substrate.

5.2 Fish Species

5.2.1 West Sacramento Project

The assessment of effects on fish considers the potential occurrence of protected species and life stages relative to the location, magnitude, timing, frequency, and duration of project actions. Species habitat attributes potentially affected by project implementation include spawning habitat area and quality, rearing habitat area and quality, migration habitat conditions, and water quality.

Short-term construction related effects on fish species include effects on individuals (e.g., displacement, disruption of essential behaviors, mortality) and immediate, short-term effects on habitat. These short-term effects are evaluated qualitatively and generally mitigated through the use of construction BMPs and limitations on construction windows.

Long-term effects typically last months or years, and generally involve physical alteration of the bank and riparian vegetation adjacent to the water's edge, with consequent impacts upon SRA cover, nearshore cover, and shallow water habitat (Fris and DeHaven 1993).

<u>Sacramento River Winter-Run Chinook Salmon</u>

Potential project effects that may affect, but are not likely to adversely affect from the actions are described below for each life stage and its habitat. Effects on designated critical habitat and EFH are addressed via description of habitat effects for each applicable species.

Construction-Related Effects

Adult Migration

Construction activities are not likely to affect winter-run adults because construction will avoid the primary migration period (December through July), will be restricted to the channel edge, and will include implementation of the avoidance and minimization measures described in Section 2.6.4 and 2.6.5.

Spawning

Winter-run Chinook salmon do not spawn in the study area. Therefore, no construction-related effects on winter-run Chinook salmon spawning or spawning habitat will occur.

Juvenile Rearing and Migration

Implementation of the bank erosion protection measures may result in adverse effects to juvenile and smolt winter-run Chinook salmon, their critical habitat, and EFH. Construction activities that increase noise, turbidity, and suspended sediment may disrupt feeding or temporarily displace fish from preferred habitat. Rearing or outmigrating salmon may not be able to readily move away from nearshore areas that are directly affected by construction activities such as placement of rock revetment; these effects could result in stress, injury, or mortality. Take of juvenile or smolt winter-run Chinook salmon could therefore occur via mortality or injury during construction activity, or by the impairment of essential behaviors such as feeding or escape from predators. Substantial increases in suspended sediment could temporarily bury substrates that support benthic macroinvertebrates, an important food source for juvenile salmonids. However, due to the limited duration and spatial extent of project actions, effects on salmonid feeding are expected to be minimal. In addition, spills or leakage of gasoline, lubricants, or other petroleum products from construction equipment or storage containers could result in physiological impairment or mortality to rearing or outmigrating salmon in the vicinity of the project sites. With implementation of best management practices, the impacts due to spills should be minimal.

Restricting in-water activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Sections 2.6.4 and 2.6.5 will minimize, but not avoid, potential construction-related effects on juveniles and smolts.

Long-Term Effects

The action area does not support spawning habitat for winter-run Chinook salmon and no long-term effects on spawning habitat will occur.

For juvenile winter-run Chinook salmon, the bank protection measures will generally provide long-term increases in bank shading at project sites. The plantings of native grasses and willows are designed to benefit juvenile Chinook salmon by increasing the availability (habitat area) and quality (shallow water and instream cover) of nearshore aquatic habitat and SRA relative to current conditions. Figures 19 through 21 show the long term scenario once bank protection measures are completed.

Figure 19. Site 4R on the American River after Bank Protection in 2001.

Figure 20. Site 4R in 2005.

Figure 21. Site 4R in 2010.

Central Valley Spring-Run Chinook Salmon

Potential project effects that may affect, but are not likely to adversely affect spring-run Chinook salmon are described below for each life stage and its habitat, including effects on designated critical habitat and EFH.

Construction-Related Effects

Adult Migration

Adult spring-run Chinook salmon migrate up the Sacramento River from March through September although most individuals have entered tributary streams by mid-June and will not be affected by construction activities. Therefore, potential for construction-related project effects will be similar to that described for winter-run Chinook salmon.

Spawning

Spring-run Chinook salmon do not spawn in the study area. Therefore, no direct effects on spring-run Chinook salmon spawning or spawning habitat will occur.

Juvenile Rearing and Migration

Similar to winter-run Chinook salmon, spring-run Chinook salmon typically spend up to 1 year rearing in fresh water before migrating to sea. Although the timing of outmigration differs somewhat between the two runs, largely due to the staggered outmigration timing of spring-run Chinook young-of-year and yearlings, rearing juvenile spring-run Chinook salmon are not expected to occur in the study area during construction periods.

Long-Term Effects

The action area does not support spawning habitat for spring-run Chinook salmon and no long-term effects on spawning habitat will occur.

For juvenile spring-run Chinook salmon, the bank protection measures will generally provide long-term increases in bank shading at project sites. The plantings of native grasses and willows are designed to benefit juvenile Chinook salmon by increasing the availability (habitat area) and quality (shallow water and instream cover) of nearshore aquatic habitat and SRA relative to current conditions.

Central Valley Fall-/Late Fall-Run Chinook Salmon

Potential project effects that may affect, but are not likely to adversely affect are described below for the relevant life stages and their habitat, including effects on EFH.

Construction-Related Effects

Adult Migration

Fall-/late fall-run Chinook salmon migrate into the Sacramento River and its tributaries from June through December; therefore, construction activities will coincide with most of the migration period. Construction activities that increase noise, turbidity, and suspended sediment may disrupt adult passage through the study area and may displace these fish as a result of effects on their preferred habitat. However, because construction activities will be restricted to the channel edge and will include implementing avoidance and minimization measures described in Sections 2.6.4 and 2.6.5, adverse effects on habitat will be minimized.

Spawning

Within the study area, there would be very little or no spawning habitat. Spawning occurs from September through December; therefore, construction activities may occur when individuals are spawning. Construction activities that increase noise, turbidity, and suspended sediment may affect spawning habitat. Substantial increases in suspended sediment could temporarily bury redds. Considering the limited duration and spatial extent of project actions, the small area of potential spawning habitat within the West Sacramento GRR study area, and incorporation of best management practices, impacts should be minimal.

Juvenile Rearing and Migration

Juvenile fall-run Chinook salmon emergence occurs from December through March, and juveniles migrate downstream to the ocean soon after emerging, rearing in fresh water for only a few months. Smolt outmigration typically occurs from March through July (Yoshiyama et al. 1998).

Juvenile late fall-run Chinook fry emergence occurs from April through June. Juveniles rear in their natal streams during the summer, and in some streams they remain throughout the year. Smolt outmigration can occur from November through May (Yoshiyama et al. 1998).

Long-Term Effects

Long-term changes on nearshore habitat are expected to have adverse effects on habitat that is important to all life stages of fall-/late fall-run Chinook salmon. The project could represent a long-term loss of a small amount of potential spawning habitat because repairs will require covering bottom substrates with revetment. However, the potential spawning area that might be affected is very small, if at all. In general, it is expected that channel areas immediately adjacent to erosion sites do not support spawning riffles.

Central Valley Steelhead

Potential project effects that may affect, but are not likely to adversely affect steelhead are described below for the relevant life stages and their habitat, including effects on designated critical habitat.

Construction-Related Effects

Adult Migration

In the Sacramento River, adult steelhead migrate upstream during most months of the year, beginning in July, peaking in September, and continuing through February or March. Adults use the river channel in the study area as a migration pathway to upstream spawning habitat, and may also use deep pools with instream cover as resting and holding habitat. The potential for construction-related effects on migrating adult steelhead would be similar to that described for adult winter-run Chinook salmon.

Spawning

Within the study area, there is minimal, if any, potential spawning habitat. Steelhead spawn in late winter and late spring outside of the August 1 through November 30 construction window; therefore, construction-related effects on steelhead spawning or their spawning habitat are not expected to occur.

Juvenile Rearing and Migration

Central Valley steelhead rear year-round in the cool upstream reaches of the mainstem Sacramento River and its major tributaries. Juveniles and smolts are most likely to be present in the study area during their downstream migration to the ocean, which may begin as early as December and peaks from January to May. The importance of main channel and floodplain habitats in the lower Sacramento River to rearing steelhead is becoming more understood. Steelhead smolts have been found in the Yolo Bypass during the period of winter and spring inundation (Sommer 2002). Sommer et al. (2001) found that Juvenile Chinook salmon that reared within a large, engineered floodplain of the Sacramento River (the Yolo Bypass) had higher rates of growth and survival than fish that reared in the main-stem river channel during their migration. Due to similarities with Chinook salmon in juvenile feeding strategies and habitats utilized, steelhead would also benefit from inundated floodplains of the Yolo Bypass. For purposes of this analysis, rearing juvenile steelhead are assumed to use nearshore and off-channel habitat in the study area. The potential for construction-related effects on steelhead juveniles and smolts and their habitat will therefore be similar to that described for winter-run Chinook salmon.

Long-Term Effects

The potential for long-term effects on adult migration habitat will be similar to that described for winter-run Chinook salmon. However, the potential spawning area is very small and it is expected that channel areas immediately adjacent to erosion sites do not support spawning riffles. The potential for long-term effects on steelhead juveniles and smolts and their critical habitat will be similar to that described for winter-run Chinook salmon.

Delta Smelt

Delta smelt in the Sacramento River have been documented upstream as far as the city of Sacramento (RM 60) (Moyle 2002), and may be present throughout their life cycle. Potential project effects that may affect, but are not likely to adversely affect are described below for relevant life stages and their habitats, including effects on designated critical habitat.

Construction-Related Effects

Adult Migration

Adult Delta smelt migrate upstream between December and January and spawn between January and July, with a peak in spawning activity between April and mid-May (Moyle 2002). Potential construction-related effects on adult Delta Smelt will be avoided or minimized by restricting in water construction activities on the Sacramento River to the August 1 through November 30 work window. If there is any change in effect due to construction constraints outside the work window, consultation will be initiated.

Spawning

Potential spawning habitat includes shallow channel edge waters in the Delta and Sacramento River. As a result, potential construction-related effects include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae, alteration of spawning and incubation habitat, and loss of shallow water habitat for spawning. Effects on delta smelt spawning and incubation will be minimized by restricting in-water construction activities on the Sacramento River, Yolo Bypass, and the DWSC to the August 1 through November 30 work window, thereby avoiding the seasons when spawning is most likely to occur. Considering the limited duration and spatial extent of project actions, the small area of potential spawning habitat within the West Sacramento GRR study area, and incorporation of BMPs, adverse impacts would be minimized.

Juvenile Rearing and Migration

Juvenile Delta smelt may be subject to disturbance or displacement caused by construction activities that increase noise, turbidity, and suspended sediment. Delta smelt may not be readily able to move away from channel or nearshore areas that are directly affected by construction activities (i.e., removal or placement of instream woody material, placement of rock revetment). Larvae may be disrupted during summer months as they migrate downstream to rear in the Delta. Incidental take of Delta smelt may occur from direct mortality or injury during a construction activity, or by the impairment of essential behavior patterns (i.e., feeding, escape from predators). In addition, physiological impairment could be caused by toxic substances (i.e., gasoline, lubricants, oil) entering the water. Construction-related effects on Delta smelt rearing and migration will be minimized by restricting in-water construction activities on the Sacramento River, Yolo Bypass, and the DWSC to the August 1 through November 30 work window, thereby avoiding the seasons when these life stages are most likely to occur.

Long-Term Effects

Non-native species may exploit the warmer water temperature in the shallow bench habitat created as an on-site mitigation feature and prey on Delta smelt eggs and larvae; however, it is expected that despite the risk of predation, construction of shallow benches will result in a net benefit to Delta smelt. Proposed planting of emergent vegetation will enhance habitat complexity by providing cover and incubation habitat, especially during high winter and spring flows.

Green Sturgeon

Potential project effects that may affect, but are not likely to adversely affect are described below for each life stage of green sturgeon and its habitat. An accurate assessment of potential project effects on green sturgeon and its habitat is difficult due to the limited information available on distribution, seasonal abundance, habitat preferences, and other life history requirements of this species.

Construction-Related Effects

Adult Migration

Adult green sturgeon are believed to move upstream through the West Sacramento GRR study area from February through late July (NMFS 2005c). Construction activities occurring outside of these time periods are not likely to affect migrating green sturgeon adults. Construction activities during July, however, may have adverse impacts on any adult green sturgeon that are still migrating upstream. Because construction activities will largely avoid the peak migration period, will be restricted to the channel edge, and will implement the avoidance and minimization measures described in Sections 2.6.4 and 2.6.5, adverse effects will be minimized.

Spawning

Spawning migrations of green sturgeon typically occur during the months of March through June (Thomas et al. 2013). The Sacramento River downstream of Knights Landing (RM 90) is not believed to have suitable spawning habitat for green sturgeon, primarily due to lack of suitable coarse bottom substrate such as large cobbles (Corps 2012). Therefore, the West Sacramento GRR project is not likely to affect spawning green sturgeon or their habitat.

Juvenile Rearing and Migration

Based on general knowledge of green sturgeon life history, larvae may occur in the Sacramento River and Delta shortly after spawning, from February through late July (peak spawning from April through June) (Emmett et al. 1991 as cited in Moyle 2002). Restricting in-water construction activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Sections 2.6.4 and 2.6.5 will minimize potential impacts of in-water construction activities on green sturgeon larvae. However, 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.

Long-Term Effects

Long-term changes in nearshore habitat are expected to have negligible effects on adult green sturgeon, because adult sturgeon use deep, mid-channel habitat during migration. If juvenile green sturgeon use nearshore areas of the Sacramento River, DWSC, and the Yolo Bypass Toe Drain as foraging habitat or refuge from predators, the general long-term effects of the project actions on nearshore habitat values will likely be similar to those described for salmonids and juvenile fish.

5.2.2 Southport EIP

Salmon, Steelhead, and Sturgeon

The following assessment addresses potential direct and indirect effects of the Proposed Action on endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened California Central Valley steelhead, threatened Southern DPS of North American green sturgeon, and their designated critical habitat. Potential project effects on listed species and critical habitat include both short-term and long-term effects. Short-term effects include temporary construction-related impacts on fish and aquatic habitat that may last from a few hours to days (e.g., suspended sediment and turbidity). Long-term effects typically last months or years, and are generally due to physical alteration of important habitat attributes of the channel, shoreline, and adjacent bank or floodplain. Short-term effects on listed fish species are evaluated qualitatively based on general knowledge of the impact mechanisms and species responses to construction actions. Long-term effects are measured in terms of the linear feet and area of riparian, SRA cover, and floodplain habitat affected by the Proposed Action and based on the responses of listed species to changes in habitat quantity and quality as measured by the SAM (Corps 2004).

Short-Term Effects

In-water construction activities, including the placement of rock slope protection, could result in localized, temporary disturbance of habitat that may alter natural behavior patterns of adult and juvenile fish and cause injury and death of individuals. These effects may include displacement, impaired feeding, and temporary disruption of migration and other essential behaviors. The extent of construction-related effects depends on the timing of these activities, the timing of fish presence in the Action Area, and the ability of the fish to successfully avoid the disturbance. In-water construction activities are scheduled for July 1 through October 31 and, therefore, should avoid the primary migration periods of adult and juvenile winter-run Chinook salmon and spring-run Chinook salmon (November through June). Steelhead adults occur in the Action Area primarily from September through March, while juveniles occur primarily from January through March. Adult green sturgeon are most likely to be present in the Action Area during the spring but may be present from March through September. Green sturgeon larvae and post-larvae may be present in the Action Area between June and October, and juveniles may be present year-round.

Potential Effects of Noise, Turbidity, and Suspended Sediment

Construction noise resulting from operation of the barge and placement of rock below the water surface would cause physical disturbance of the bed and water column of the river that could displace juvenile and adult fish into adjacent habitats and possibly cause direct physical injury or death from falling rock. The resulting noise, turbidity, and suspended sediment may disorient and result in temporary displacement of fish from preferred habitats or alter normal feeding, sheltering, and migration behavior.

The effects of increased turbidity and suspended sediment on salmonids have been well studied. Depending on the level of exposure, suspended sediment can cause lethal, sublethal, and behavioral effects in fish (Newcombe and Jensen 1996). For salmonids, elevated suspended sediment has been linked to a number of behavioral and physiological responses indicative of stress (gill flaring, coughing, avoidance, and increase in blood sugar levels) (Bisson and Bilby 1982; Sigler et al. 1984; Berg and Northcote 1985; Servizi and Martens 1992). Migrating adults have been reported to avoid high silt loads or cease migration when avoidance is not possible (Cordone and Kelley 1961, as cited by Bjornn and Reiser 1991). Bell (1986) cited a study in which adult salmon did not move in streams where the sediment concentration exceeded 4,000 mg/L (as a result of a landslide). Juveniles tend to avoid streams that are chronically turbid (Bisson and Bilby 1982; Lloyd et al. 1987) or move laterally or downstream to avoid turbidity plumes (Sigler et al. 1984; Lloyd et. al. 1987; Servizi and Martens 1992). Juvenile coho salmon have been reported to avoid turbidities exceeding 70 NTU (Bisson and Bilby 1982) and cease territorial behavior when exposed to a pulse of turbidity of 60 NTU (Berg 1982). Such behavior could result in displacement of juveniles from preferred habitat or protective cover, which may reduce growth and survival by affecting foraging success or increasing their susceptibility to predation.

Laboratory studies have demonstrated that chronic or prolonged exposure to high turbidity and suspended sediment levels can lead to reduced growth rates. For example, Sigler et al. (1984) found that juvenile coho salmon and steelhead trout exhibited reduced growth rates and higher emigration rates in turbid water (25–50 NTU) compared to clear water. Reduced growth rates generally have been attributed to an inability of fish to effectively feed in turbid water (Waters 1995). Green sturgeon may be affected in similar ways although NMFS (2008) stated that short-term increases in suspended sediments or turbidity were unlikely to affect the foraging success of green sturgeon because this species uses olfactory cues as opposed to vision to locate prey. Chronic exposure to high turbidity and suspended sediment also may affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995).

NMFS (2008) reviewed observations of turbidity plumes during similar construction activities in the Sacramento River and concluded that visible plumes are expected to be limited to only a portion of the channel width, extend no more than 1,000 feet downstream, and dissipate within hours of cessation of in-water activities. In addition, in-water construction activities would be limited to daylight hours only. Based on these observations, NMFS expects turbidity levels to exceed 25–75 NTUs and potentially result in disruption of normal feeding and sheltering behavior (NMFS 2008). However, excessive turbidity levels will be avoided with adherence to the RWQCB Basin Plan turbidity objectives. Consequently, the effects of exposure of individual fish to turbid water generated by construction activities would likely be limited to avoidance, brief disruptions of normal activities, and potentially higher risk of predation.

Based on the extent, frequency, and duration of proposed in-water construction activities, potential adverse effects include direct injury from falling rock, temporary disruption of normal behavior, and increased risk of predation. The timing of construction activities is expected to minimize exposure of the most vulnerable life stages of Chinook salmon and steelhead juveniles (i.e., fry). Green sturgeon adults, larvae, and juveniles are more likely to be exposed to short-term disturbances, but their presence along the shoreline is expected to be uncommon based on their benthic nature. With adherence to the proposed in-water construction window, Central Valley RWQCB turbidity objectives, and erosion and sediment control BMPs (SWPPP), potential adverse effects of noise, turbidity, and suspended sediment would be limited to temporary displacement and potential injury or death of small numbers of fish within the affected shoreline areas.

Fish Entrapment in Cofferdams

Cofferdams may be required to install temporary culverts needed to maintain connectivity between the river and restored floodplain prior to construction of the final levee breaches. The potential exists for entrapment and mortality of fish following closure and dewatering of the cofferdam. As discussed above, the timing of cofferdam installation and other in-water activities (July 1 through October 31) will avoid the primary period of occurrence of winter-run and spring-run Chinook salmon fry, which are considered the most vulnerable species and life stage that may occur in the action area. Other species and life stages that may be present at the time of in-water construction are unlikely to be injured or killed because of their larger size, greater mobility, or preference for deeper, offshore areas. The potential for entrapment of fish will be further reduced by limiting the extent of the cofferdam footprint to the shallow edge of the river. Therefore, potential entrapment of listed fish species is unlikely to occur.

Potential Discharge of Contaminants

Contaminants used at construction sites, including gasoline, diesel fuel, lubricants, and hydraulic fluid could enter the Sacramento River as result of spills or leakage from machinery or storage containers and injure or kill listed salmon, steelhead, and sturgeon. These substances can kill aquatic organisms through exposure to lethal concentrations or exposure to non-lethal levels that cause physiological stress and increased susceptibility to other sources of mortality such as predation. Petroleum products also tend to form oily films on the water surface that can reduce DO levels available to aquatic organisms. There is also a slight risk of the release of bentonite into the Sacramento River during jet grouting or deep soil mixing used to construct slurry cut off walls. Bentonite is a naturally occurring, inert, nontoxic material that meets National Sanitation Foundation/American National Standards Institute Drinking Water Additives Standards 60 and 61. Therefore, any inadvertent release of drilling fluid containing only water and bentonite would not have toxicity effects on ESA-listed fish. However, bentonite released into streams could result in turbidity, and cause many of the same behavioral, physiological, and physical effects described above for turbidity and suspended sediment.

Implementation of a spill prevention, control, and countermeasure plan and bentonite slurry spill contingency plan as part of the environmental commitments of the project is anticipated to minimize the potential for toxic or hazardous spills or discharges into the Sacramento River. Adherence to all preventative, contingency, and reporting measures in the approved plans would reduce the risk of injury or mortality of listed fish species to negligible levels.

Long-Term Effects

The Proposed Action is expected to result in long-term effects on riparian, SRA cover, and floodplain habitat, including modification of the designated critical habitat of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. Long-term effects on listed species and critical habitat may also occur as a result of local changes in hydraulic, geomorphic, and sediment transport conditions in the Sacramento River upstream and downstream of the project area. These modifications may affect behavior, growth, and survival of individuals and the primary constituent elements of critical habitat, including freshwater rearing sites, foraging areas, and migration corridors. The general effects of the Proposed Action on riparian, SRA cover, and floodplain habitat are described below, followed by a summary of long-term changes in habitat values and species responses based on the results of the SAM. This is followed by a general assessment of long-term effects on listed species and critical habitat related to potential fish stranding on the restored floodplain and predicted changes in local hydraulic, geomorphic, and sediment transport conditions in the main channel of the Sacramento River.

SRA Cover and Riparian Habitat

The loss of riparian vegetation and woody material and the replacement of natural substrate with rock revetment (riprap) generally reduces the quality of nearshore habitat for juvenile salmonids and other fishes by reducing habitat diversity and altering several important attributes of natural shorelines. These attributes, which characterize SRA cover, include natural substrates, riparian vegetation, woody material, and variable water depths and velocities, including shallow, low-velocity areas used by juveniles as refuge from fast currents and predators. Simple riprapped banks generally create more uniform physical and hydraulic conditions characterized by deeper, faster water, and lack of cover. These conditions reduce utilization by juvenile fishes and also inhibit the establishment of shoreline vegetation and retention of sediment, organic material, and large woody material, which provide important sources of cover and food for juvenile fishes and other aquatic organisms. In addition to cover and shelter for fish, riparian vegetation provides other important stream ecosystem functions, including channel and streambank stability; inputs of food (e.g., terrestrial insects), organic matter, and nutrients; and temperature-moderating shade (Murphy and Meehan 1991).

The Proposed Action would affect approximately 7,419 linear feet of the existing Sacramento River levee as a result of levee degradation and installation of rock slope and biotechnical bank protection at the proposed erosion repair and levee breach sites. The total area of bank within the construction limits between the submerged toe of the bank (-10 to -45 feet NAVD88) and the ordinary high water mark (OHWM) (+20 feet NAVD88) is approximately 8.49 acres. Where the remnant levee is breached, all existing SRA cover and riparian vegetation on the levee slope would be lost due to degradation of the levee and the addition of biotechnical and rock slope protection needed to create and protect the breaches. Within the erosion sites, the removal of SRA cover and riparian vegetation would be limited to the lower portion of the bank below elevation +12 feet NAVD 88.

Vegetation mapping of the project site in April–May 2011 indicates that the proposed erosion repairs, rock slope protection, and levee breaches for the Southport EIP would affect approximately 5.44 acres of cottonwood riparian woodland and 1.46 acres of riparian scrub. This includes the loss of approximately 2.01 acres of cottonwood riparian woodland and 0.51 acre of riparian scrub below the OHWM on the waterside slope of the existing levee. It is assumed that the portions of the existing levee outside the affected levee sites (totaling approximately 24,198 feet), including all existing SRA cover and riparian habitat, would remain intact and no longer be subject to levee maintenance activities. In addition, portions of the remnant levee that are currently devoid of vegetation or sparsely vegetated would be planted with woody riparian species to enhance SRA cover and riparian habitat values and meet any remaining onsite compensation requirements.

Onsite compensation and enhancement of SRA cover and riparian habitat will be achieved through the planting of native riparian species on the floodplain offset areas, levee breaches, remnant levees, and erosion repair sites. A detailed description of the SRA cover and riparian habitat compensation and enhancement objectives is being developed as part of the draft MMP for the Southport EIP (see Conservation Measure 6).

Erosion Repair Sites. Erosion repair and bank stabilization would be conducted in the second year of construction at three sites (C1, C2, and G3, comprising approximately 1,013 linear feet of bank) to treat several over-steepened or eroding levee areas in Segment C, D, and G (Appendix B, Figures 2 and 3a–3c). To minimize long-term impacts on SRA cover and riparian habitat, these sites have been designed to retain existing vegetation and woody material to the extent possible and promote onsite replacement of SRA cover and riparian vegetation. This would be accomplished by retaining existing woody vegetation (Sites C1 and C2) or planting woody vegetation (Site G3) above elevation 12 feet NAVD88, incorporating a 10:1 bench and soil fill within the average annual low and high water inundation zone of the river (between 7 to 12 feet NAVD88) to provide a surface for planting riparian vegetation, anchoring woody material, and creating shallow water habitat (Appendix B, Figures 3a–3c. The low benches will provide shallow water habitat for fish during typical winter and spring flows and woody instream and overhanging cover that will increase in extent over time as the planted vegetation becomes established. To address reductions in SRA cover values associated with the placement of rock and loss of shade along the summer/fall shoreline, onsite and imported IWM will be anchored between elevations 4 and 6 feet to achieve a minimum of 40% cover (approximately 400 linear feet) within the average summer/fall inundation zone. The proposed design is similar to other erosion control designs that have been employed on the lower Sacramento and American Rivers to minimize impacts on existing habitat values and restore some of the key attributes and functions of natural SRA cover and riparian habitat that would otherwise be lost as a result of standard revetment practices or continued erosion. In addition to increasing the amount of structural cover available to fish along the shoreline, the installation of IWM is also expected to promote sediment deposition on the rock bench as observed at locations where similar designs have been used to address the compensation needs of listed fish species (e.g., Sand Cove, RM 62.2).

Levee Breaches. Approximately 6,406 linear feet of the existing levee would be degraded to create the five levee breaches and associated shoulder rock (Figure 15), resulting in permanent losses of existing SRA cover and riparian vegetation on the affected banks. Based on the current design, individual breaches range in width (bank length) from approximately 645 to 1,345 feet, while the adjacent rock shoulders range from 90 to 228 feet long. Two of the breaches (N1 and S3) would be constructed in Year

3, and the remaining three breaches (N2, S1, and S2) would be constructed in Year 5. During Year 3 of construction, the existing levee within each of the proposed footprints of the deferred breaches (N2, S1, and S2) would be degraded (approximately 200 linear feet) to install one to two temporary culverts. The culverts will extend through the existing levee (bottom elevation of +7 feet) to maintain connectivity between the river and restored floodplain during the interim period.

A combination of rock slope protection and biotechnical methods would be used to control erosion and maximize the amount of vegetated surfaces within the levee breaches. The riverbank and apron zones will be planted with emergent marsh and woody riparian species (extending along the Sacramento River and laterally into the swales and restored floodplain) to restore SRA and riparian habitat to the extent possible. However, species selection within the riverbank and apron zones may be limited to those suitable for coppicing, which may be necessary to maintain uniform hydraulic conditions and minimize the risk of scour within the levee breaches (Figure 6). Existing rock slope protection within the riverbank zone between elevations +7 and +10 feet would be retained. In areas that lack revetment or where the revetment is found to be in poor condition (coverage), vegetated coir fabric will be installed between elevations +7 and +10 feet. No vegetation or other habitat features will be incorporated into the rock shoulders.

Floodplain Habitat

The levee setback component of the project would result in the restoration of approximately 120 acres of historical Sacramento River floodplain with a diverse mosaic of seasonal floodplain, wetland, riparian, and upland habitat. The goals of the offset area restoration design are to increase river-floodplain connectivity, restore ecologically functional floodplain habitat, and meet the flood risk–reduction objectives of the project.

Restoring floodplain habitat and connectivity of large rivers to their floodplains have been identified as important objectives of ecosystem restoration and species recovery efforts for listed and other special-status fish species in the Central Valley (NMFS 2009). Floodplains are recognized as major contributors to aquatic production and species diversity in large river systems where native fish species have evolved specific adaptations to exploit these variable but highly productive habitats (Welcomme 1979; Junk et al. 1989; Gutreuter et al. 1999). Historically, the Sacramento River Valley contained extensive areas of seasonal floodplains and wetlands that flooded nearly every winter and spring. These habitats supported significant production of native fish species and contributed substantially to overall biological productivity of the river and estuary (Ahearn et al. 2006). As demonstrated in the Yolo Bypass, floodplain habitat can greatly expand the quantity and quality of habitat available to juvenile salmon and other native fishes during seasonal inundation periods (Sommer et al. 2001, 2005). After young salmon have dispersed from spawning areas, the distribution and abundance of young salmon is determined largely by their preferences for shallow water and low water velocities, which in large rivers are found mostly along channel margins, floodplains, and other off-channel habitats (Beechie et al. 2005; Lestelle et al. 2005).

Floodplain restoration through the creation of setback levees is considered a key conservation action for addressing historical and ongoing impacts of levee construction and maintenance activities on listed fish species and their habitats, especially in the highly constrained portions of the lower Sacramento River. It is generally assumed that the number or biomass of fish that can be supported by aquatic ecosystems is directly proportional to the area of suitable habitat. In addition to increased living space, floodplains may further enhance the growth and survival of young fish by increasing the production and availability of food, increasing growth capacity (i.e., food conversion efficiency), reducing competition for food, and reducing potential encounters with predators. Floodplains also enhance the productivity of river-floodplain systems by increasing hydraulic residence time, water temperature, and inputs of organic matter, plankton, and macro-invertebrates from the floodplain into river channels (Ahearn et al. 2006).

The levee setback design was developed through a collaborative process among project engineers, biologists, and restoration ecologists to achieve the flood-risk reduction and habitat restoration objectives of the project. A principle step in this process has been the linkage of key hydrologic and hydraulic parameters (inundation timing, frequency, duration, depth, velocity) with habitat suitability criteria of the target species through the application of the the Corps' Ecosystem Functions Model and 2D hydrodynamic modeling (MIKE 21C) (cbec, inc. and ICF International 2013). Native Sacramento splittail and Chinook salmon (including winter-, spring-, and fall-run Chinook salmon) were selected as the target species for the offset area design. These species were selected because they are considered key indicator species of functional floodplain habitat in the Central Valley. A flood frequency analysis was performed using the long-term flow record from the Freeport gauge to evaluate the recurrence probability of flows and water surface elevations that correlate with the occurrence of suitable habitat for the target species. The ecological criteria for each of the target species and corresponding flows, recurrence intervals, and water surface elevations are summarized in Appendix B. In general, the offset areas have been designed to flood every 1–2 years for at least 2–3 weeks during December through May based on the minimum floodplain inundation requirements for successful spawning, incubation, and larval development of Sacramento splittail, and rearing and enhanced growth of juvenile Chinook salmon.

The levee offset areas were also designed to achieve the desired flooding regime (depth, duration, and extent of flooding), drainage patterns, and soil conditions to support riparian, wetland, and upland vegetation on the restored floodplain. Based on current design, much of the offset areas will be excavated down to an elevation of approximately 10 feet NAVD88 to achieve frequent inundation of the new floodplain and expand the amount of riparian habitat, SRA cover, and floodplain habitat available to fish over a broad range of flows. The floodplain design includes one or more interconnected swales or low-flow channels that would form the primary aquatic and riparian corridors connecting the river and floodplain (Appendix B, Figure 7). These channels are designed to maintain suitable soil moisture conditions for wetland and riparian vegetation, facilitate river-floodplain connectivity and drainage of the floodplain over a broad range of flows, and minimize the extent of suitable habitat (isolated ponds) for bass and other undesirable fish species that spawn and rear during the drier late spring and summer months. In addition, topographic heterogeneity has been incorporated into the project design grading plans to create a mosaic of wetland, riparian, and upland habitats supporting emergent wetland, willow-scrub, cottonwood forest, oak woodland plantings and native grasses. A draft MMP for the offset areas is being developed on behalf of WSAFCA and will be approved by NMFS, USFWS, and CDFW before implementation of the project. The MMP will include a detailed discussion of the design process; an updated review of the hydrologic, hydraulic, geomorphic, and ecological modeling results; representative plans and cross sections of the Proposed Action elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. Monitoring will be conducted over a period of 10 years. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria will be submitted to the resource agencies during the course of the monitoring period. Monitoring will be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

SAM Assessment. The SAM was developed by the Corps and Stillwater Sciences, in consultation with NMFS, USFWS, CDFW, and DWR, to address specific habitat assessment and regulatory needs for ongoing and future bank protection actions in the Sacramento River Bank Protection Project (SRBPP) Action Area. The SAM was designed to systematically evaluate the impacts and compensation requirements of bank protection and levee improvement projects on Chinook salmon, steelhead, green sturgeon, and delta smelt, and their critical habitat. The SAM has been used previously in both programmatic (Corps 2007a) and project-level (e.g., Jones & Stokes 2007) bank protection effect analyses.

The SAM quantifies habitat values in terms of a weighted species response index (WRI) that is calculated by combining habitat quality (i.e., fish response indices) with quantity (i.e., bank length or wetted area) for each season, target year, and relevant species/life stage. The fish response indices are derived from hypothesized relationships between key habitat attributes (described below) and the species and life stage responses. Species response indices vary from 0 to 1, with 0 representing unsuitable conditions and 1 representing optimal conditions for survival, growth, and/or reproduction. For a given site and scenario (i.e., with or without project), the SAM uses these relationships to determine the response of individual species and life stages to the measured or predicted values of each habitat attribute for each season and target year, and then multiplies these values together to generate an overall species response index. This index is then multiplied by the linear feet or area of shoreline to which it applies to generate a weighted species response index expressed in feet or square feet. The species response index provides a common metric that can be used to quantify habitat values over time, compare project conditions to existing conditions, and evaluate the effectiveness of on-site and off-site compensation actions. For example, the difference in WRIs between with- and without-project conditions in a given year provides a measure of the impacts (negative species response) or benefits (positive species response) of the project relative to baseline conditions. More detail on the SAM is provided by the Corps (2004, 2007a).

The SAM employs six habitat attributes to characterize nearshore, SRA cover, and floodplain habitats of listed fish species.

- *Bank slope*—This is the average bank slope along the average annual summer, fall, winter, and spring water surface elevation. This variable is used as an indicator of shallow-water habitat availability, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- *Floodplain availability*—This is the ratio of wetted area for the 2-year flood flow to the wetted area for the average annual winter-spring flow. This variable is used as an indicator of the amount seasonally flooded shallow-water habitat, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- *Bank substrate size*—This is median particle diameter of the bank (i.e., D_{50}) along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge and food availability for juveniles and adults.
- *Instream structure*—This is the percent of shoreline coverage of IWM along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover and resting habitat for juveniles and adults.
- *Aquatic and riparian vegetation*—This is the percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover.
- *Overhanging shade*—This is the percent of the shoreline coverage of shade along each average seasonal water surface elevation. This variable is used as an indicator of juvenile and adult predator refuge.

The SAM was used to quantify the responses of the target fish species and life stages to with-project conditions over a 50-year project period relative to the species and life stage responses under without-project (existing) conditions. The assessment followed the general steps outlined in the SAM User's Manual (Corps 2004). A detailed description of the data sources, methods, and assumptions used to characterize existing and with-project habitat conditions is presented in Appendix C.

The results of the SAM for each species, life stage, season of occurrence, and target year, as applied to the Southport EIP, are described below and presented graphically in Appendix D. The SAM results focus on the following life stages and primary seasons of occurrence based on the sensitivity of these life stages to project effects.

- Chinook salmon juvenile rearing and smolt migration in fall, winter, and spring (applies to winter-run and spring-run Chinook salmon).
- Steelhead juvenile rearing and smolt migration in fall, winter, and spring.
- Green sturgeon juvenile rearing (all seasons).

Appendix D also includes summary tables of the projected changes in habitat conditions between year 0 (existing conditions) and year 5 in terms of linear feet of specific habitat classes as defined by the SAM.

Chinook Salmon Juvenile Rearing. The SAM results indicate that the Proposed Action would result in slight initial habitat deficits (<5% reduction relative to baseline values) for juvenile winter-run and spring-run Chinook salmon rearing during the fall, followed by a gradual recovery in future years (Appendix D, Figure D-1). Nearly complete compensation of impacts resulting from the installation of rock and loss of existing IWM is achieved in Year 2 with the installation of IWM at the erosion repair sites. Subsequent growth of planted vegetation and associated increases in shade at the erosion control sites and on the remnant levee is expected to contribute to full recovery of fall habitat values in future years.

The Proposed Action would result in substantial long-term gains in winter and spring habitat values for juvenile winter-run and spring-run Chinook salmon (Appendix D, Figure D-1). Winter and spring WRIs for juvenile rearing are projected to increase rapidly in years 2–5 and continue to increase over the 50-year assessment period. Between years 5 and 50, WRI values are predicted to increase 35 to 65% over baseline values. These results reflect the positive responses of juvenile salmon to the large and immediate gains in habitat values resulting from increases in floodplain area, shallow water habitat, and natural substrate associated with the levee setback, increases in shallow water habitat on the constructed benches of the erosion repair sites, and gradual increases in shoreline cover resulting from the growth of planted vegetation on the levee breaches, erosion protection sites, and remnant levee.

Chinook Salmon Smolt Migration. The SAM results indicate that the responses of winter-run and spring-run Chinook salmon smolts to changes in SRA cover, riparian, and floodplain habitat associated with the Proposed Action would be similar to those predicted for juvenile rearing (Appendix D, Figure D-2). The slight initial deficit in fall WRIs is expected to recover completely by year 15. Like juvenile rearing, winter-spring WRIs for smolt migration are projected to increase rapidly in years 2–5 and continue to increase over the 50-year period. Between years 5 and 50, WRI values are predicted to increase 6 to 12% over baseline values.

Steelhead Juvenile Rearing. Similar to Chinook salmon, the SAM results indicate that the Proposed Action would result in slight initial habitat deficits (<5% reduction relative to baseline values) for steelhead rearing during the fall, followed by a gradual recovery in future years, and substantial habitat gains in winter-spring values (27 to 47% increase between years 5 and 50) beginning in the second year of construction and increasing throughout the 50-year assessment period (Appendix D, Figure D-3).

Steelhead Smolt Migration. The SAM results for steelhead smolt migration (Appendix D, Figure D-4) are similar to those for Chinook salmon smolt migration, as described above.

Green Sturgeon Juvenile Rearing. The SAM results indicate that the Proposed Action would result in small net gains in habitat values for juvenile green sturgeon in all seasons and project years (Appendix D, Figure D-5). Summer, fall, winter, and spring WRIs are predicted to exceed baseline values by 1 to 2% in years 5 through 50. These results reflect the positive responses of juvenile green sturgeon to increases in shallow water habitat and instream structure associated with the constructed bench and installed IWM at the erosion repair sites.

Fish Stranding

Following periods of floodplain inundation, receding floodwaters may collect in existing ponds, ditches, borrow areas, and other depressions on the restored floodplain, resulting in fish stranding and high mortality rates due to lethal water temperatures, low dissolved oxygen, predation, and desiccation. WSAFCA will minimize fish stranding by developing and implementing a drainage and grading plan that minimizes the extent of ponding and facilitates complete drainage of the active floodplain to the main river. The final offset area design will include substantial grading and re-contouring of the restored floodplain as necessary to facilitate complete drainage and unimpeded fish passage to the main river as floodwaters recede from the levee offset area. Features with substantial stranding risk will be filled and/or graded to minimize this risk. Bees Lakes would remain hydraulically isolated from the main river. As described above, the restoration and monitoring plan will evaluate the effectiveness of the grading and drainage features in preventing fish stranding and will include provisions for remediation should the design fail to meet established performance or success criteria.

Long-Term Hydraulic, Geomorphic, and Sediment Transport Conditions

The Proposed Action may adversely affect listed species and designated critical habitat as a result of local changes in hydraulic, geomorphic, and sediment transport conditions that may modify channel morphology, water depths and velocities, and suspended sediment and turbidity levels in the Sacramento River. As described in Appendix C-1 and C-2 of the Southport EIP Draft EIS/EIR (ICF International 2013), hydraulic modeling performed by MBK for Alternatives 2 and 5 (setback levee alternatives) indicate that the Proposed Action would not significantly affect water surface elevations or cause negative hydraulic effects in the Sacramento River under 100-year, 200-year, and 500-year flood events. In general, the risk of channel scour, bank erosion, and levee failure would be reduced relative to existing conditions because of proposed levee strengthening, increased bank stability, and reductions in shear stress associated with the widened floodplain. Although local shear stresses would be reduced, these reductions are not expected to significantly alter erosion, deposition, and sediment transport rates in the main channel of the Sacramento River. Therefore, the Proposed Action is not likely to adversely affect listed species or critical habitat through long-term effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River.

Operations and Maintenance

O&M activities that require in-water work are expected to occur between July 1 and October 31 for the life of the project to maintain flood control and habitat features in the Action Area. Anticipated O&M activities include vegetation maintenance up to four times a year (mowing or applying herbicide); control of burrowing rodent activity (baiting with pesticide); site-specific slope repair, as needed (resloping and compacting); patrol road reconditioning up to once a year (placing, spreading, grading, and compacting aggregate base or substrate); regular visual inspections of the levee; and relief well monitoring. In addition, periodic rock placement may be needed to prevent or repair localized scouring on the levee slopes and in the offset areas. Potential impacts from slope repairs would be similar to those described for construction activities but would be infrequent, localized, and shorter in duration. Consequently, the potential for adverse effects on listed fish species or critical habitat would be lower and further minimized by application of the BMPs and other minimization and avoidance measures that are proposed during construction.

Delta Smelt

The following assessment addresses potential direct and indirect effects of the proposed action on delta smelt and its designated critical habitat. Potential effects include both short-term and long-term effects. Short-term effects include temporary construction-related impacts on fish and aquatic habitat that may last from a few hours to days (e.g., suspended sediment and turbidity). Long-term effects typically last months or years, and are generally due to physical alteration of important habitat attributes of the channel, shoreline, and adjacent bank or floodplain, Short-term project effects on delta smelt are evaluated qualitatively based on general knowledge of the impact mechanisms and species responses to construction actions. Long-term project effects are measured in terms of the linear feet and area of riparian, SRA cover, and floodplain habitat affected by the proposed action, and the responses of listed species to changes in habitat quantity and quality as measured by the SAM (Corps 2004).

Direct Effects

Short-Term Effects of Noise, Turbidity, and Suspended Sediment

In-water construction activities, including operation of the barge and placement of rock below the water surface, would cause physical disturbance of the bed and water column of the Sacramento River. The resulting noise, turbidity, and suspended sediment may result in temporary avoidance or displacement of delta smelt from preferred habitat, disruption of migration and spawning activities, disturbance or mortality of eggs and newly hatched larvae, and alteration of spawning and incubation habitat. Eggs and newly hatched larvae are most vulnerable to these effects because of their inability to move away from areas that are directly affected by in-water construction activities. Potential effects include injury or mortality from falling rock and burial of eggs or larvae by suspended sediment.

The extent of construction-related effects depends on the timing of these activities, the timing of fish presence in the Action Area, and their ability to successfully avoid the disturbance. In-water construction activities are scheduled for July 1 through October 31, and therefore should avoid the primary migration, spawning, and larval dispersal periods of delta smelt. Adult delta smelt migrate upstream between December and January and spawn between late February and June, with peak spawning activity between mid-April and May (Bennett 2005). Because larvae move downstream shortly after hatching, restriction of in-water activities to the July 1–October 31 window should avoid adverse construction-related effects on incubation and early larval stages originating in the Action Area. However, the potential exists for delta smelt larvae or juveniles to be present in the Action Area in the early summer as they disperse downstream from potential spawning areas upstream of the Action Area. Based on the potential upstream extent of spawning in the Sacramento River, small numbers of larvae or juveniles could be adversely affected by in-water construction activities that occur in the Sacramento River after July 1. Potential turbidity and sedimentation effects on these life stages will be minimized by adhering to the proposed in-water construction window, RWQCB turbidity objectives, and erosion and sediment control BMPs (SWPPP).

Potential Discharge of Contaminants

Contaminants used at construction sites, including gasoline, diesel fuel, lubricants, and hydraulic fluid, could enter the Sacramento River as result of spills or leakage from machinery or storage containers and injure or kill delta smelt and other listed fish species. These substances can kill aquatic organisms through exposure to lethal concentrations or exposure to non-lethal levels that cause physiological stress and increased susceptibility to other sources of mortality such as predation. Petroleum products also tend to form oily films on the water surface that can reduce dissolved oxygen levels available to aquatic organisms. There is also a slight risk of the release of bentonite into the Sacramento River during jet grouting or deep soil mixing used to construct slurry cut off walls. Bentonite is a naturally occurring, inert, nontoxic material that meets National Sanitation Foundation/American National Standards Institute Drinking Water Additives Standards 60 and 61. Therefore, any inadvertent release of drilling fluid containing only water and bentonite would not have toxicity effects on ESA-listed fish. However, bentonite released into streams could result in turbidity and cause many of the same behavioral, physiological, and physical effects described above for turbidity and suspended sediment.

Implementation of a spill prevention, control, and countermeasure plan and bentonite slurry spill contingency plan as part of the environmental commitments of the project is anticipated to minimize the potential for toxic or hazardous spills or discharges into the Sacramento River. Adherence to all preventative, contingency, and reporting measures in the approved plans would reduce the risk of injury or mortality of listed fish species to negligible levels.

Fish Entrapment in Cofferdams

Cofferdams may be required to install temporary culverts needed to maintain connectivity between the river and restored floodplain prior to construction of the final levee breaches. The potential exists for entrapment and mortality of delta smelt adults, eggs, and larvae following closure and dewatering of the cofferdam. As discussed above, the timing of cofferdam installation and other in-water activities (July 1 through October 31) would avoid the primary delta smelt spawning, incubation, and larval dispersal period in the Action Area. However, because spawning may extend into July, small numbers of adult, eggs, or larvae may be present. The potential for entrapment of delta smelt would be minimized by constructing the cofferdam during summer low water conditions and limiting the extent of the cofferdam footprint to the shallow edge of the river.

Long-Term Effects on Critical Habitat

The project is expected to result in long-term modification of SRA cover, riparian, and floodplain habitat, including modification of the designated critical habitat of delta smelt. Long-term effects on delta smelt and critical habitat may also occur as a result of local changes in hydraulic, geomorphic, and sediment transport conditions in the Sacramento River upstream and downstream of the project area. These modifications may affect behavior, growth, and survival of individuals and the primary constituent elements of critical habitat. General effects of the project on riparian, SRA cover, and floodplain habitat are described below, followed by a summary of long-term changes in habitat values and species responses based on the results of the SAM. This is followed by a general assessment of long-term effects on delta smelt and critical habitat related to potential fish stranding on the restored floodplain and predicted changes in local hydraulic, geomorphic, and sediment transport conditions in the main channel of the Sacramento River.

SRA Cover and Riparian Habitat. The loss of riparian vegetation and the replacement of natural substrate with riprap generally reduces the quality of nearshore habitat for fish by reducing habitat diversity and altering several important attributes of natural shorelines. These attributes, which characterize SRA cover, include natural substrates, riparian vegetation, woody material, and variable water depths and velocities, including shallow, low-velocity areas used by native fishes for spawning, foraging, and refuge from fast currents, deep water, and predators. Simple riprapped banks generally create more uniform physical and hydraulic conditions characterized by deeper, faster water, and lack of cover. These conditions reduce utilization by native fishes and also inhibit the establishment of shoreline vegetation and retention of sediment, organic material, and large woody material, which provide important sources of cover and food for juvenile fish and other aquatic organisms. In addition to cover and shelter for fish, riparian vegetation provides other important stream ecosystem functions, including channel and streambank stability; inputs of food (e.g., terrestrial insects), organic matter, and nutrients; and temperature-moderating shade (Murphy and Meehan 1991).

The Proposed Action would affect approximately 7,419 linear feet of the existing Sacramento River levee as a result of levee degradation and installation of rock slope and biotechnical bank protection at the proposed erosion repair and levee breach sites (Appendix B, Figures 3a–c , 5a–c, and 6). The total area of bank within the construction limits between the submerged toe of the bank (-10 to -45 feet NAVD88) and the OHWM (+20 feet NAVD88) is approximately 8.49 acres. Where the remnant levee is breached, all existing SRA cover and riparian vegetation on the levee slope would be lost due to degradation of the levee and the addition of biotechnical and rock slope protection needed to create and protect the breaches (Appendix B, Figures 5a–5c and 6). Within the erosion sites, the removal of SRA cover and riparian vegetation would be limited to the lower portion of the bank below elevation +12 feet NAVD 88 (Appendix B, Figures 3a–3c).

Vegetation mapping of the project site in April–May 2011 indicates that the proposed erosion repairs, rock slope protection, and levee breaches for the Southport EIP would affect approximately 5.44 acres of cottonwood riparian woodland and 1.46 acres of riparian scrub. This includes the loss of approximately 2.01 acres of cottonwood riparian woodland and 0.51 acre of riparian scrub below the OHWM on the waterside slope of the existing levee. It is assumed that the portions of the existing levee outside the affected levee sites (totaling approximately 24,198 feet), including all existing SRA cover and riparian habitat, would remain intact and no longer be subject to levee maintenance activities. In addition, portions of the remnant levee that are currently devoid of vegetation or sparsely vegetated would be planted with woody riparian species to enhance SRA cover and riparian habitat values and meet any remaining onsite compensation requirements.

Onsite compensation and enhancement of SRA cover and riparian habitat would be achieved through the planting of native riparian species on the floodplain setback area, levee breaches, remnant levees, and erosion repair sites. A detailed description of the SRA cover and riparian habitat compensation and enhancement objectives is being developed as part of the MMP for the Southport EIP (see Conservation Measure 6 on page 2-30).

Erosion Repair Sites. Erosion repair and bank stabilization would be conducted in the second year of construction at three sites (C1, C2, and G3, comprising approximately 1,013 linear feet of bank) to treat several over-steepened or eroding levee areas in Segment C, D, and G (Appendix B, Figures 2 and 3a-3c). To minimize long-term impacts on SRA cover and riparian habitat, these sites have been designed to retain existing vegetation and woody material to the extent possible and promote onsite replacement of SRA cover and riparian vegetation. This would be accomplished by incorporating a 10:1 bench and soil fill within the average annual low and high water inundation zone of the river (between +7 to +12 feet NAVD88) to provide a surface for planting riparian vegetation, anchoring woody material, and creating shallow water habitat (Appendix B, Figures 3a-3c). The low benches would provide shallow water habitat for fish during typical winter and spring flows and woody instream and overhanging cover that would increase in extent over time as the planted vegetation becomes established. To address reductions in SRA cover values associated with the placement of rock and loss of shade along the summer-fall shoreline, onsite and imported IWM would be anchored between elevations 4 and 6 feet to achieve a minimum of 40% cover (approximately 400 linear feet) within the average summer-fall inundation zone. The proposed design is similar to other erosion control designs that have been employed on the lower Sacramento and American Rivers to minimize impacts on existing habitat values and restore some of the key attributes and functions of natural SRA cover and riparian habitat that would otherwise be lost as a result of standard revetment practices or continued erosion. In addition to increasing the amount of structural cover available to fish along the shoreline, the installation of IWM is also expected to promote sediment deposition on the rock bench as observed at locations where similar designs have been used to address the compensation needs of listed fish species (e.g., Sand Cove, RM 62.2).

Levee Breaches. Approximately 6,406 linear feet of the existing levee would be degraded to create the five levee breaches (Appendix B, Figure 2), resulting in permanent losses of existing SRA cover and riparian vegetation within the proposed beach locations. Based on the current design, individual breaches range in width (bank length) from approximately 645 to 1,345 feet. Two of the breaches (N1 and S3) would be constructed in Year 3, and the remaining three breaches (N2, S1, and S2) would be constructed in Year 5. During Year 3 of construction, the existing levee within each of the proposed footprints of the deferred breaches (N2, S1, and S2) would be degraded (approximately 200 linear feet) to install one to two temporary culverts. The culverts would extend through the existing levee (bottom elevation of +7 feet) to maintain connectivity between the river and restored floodplain during the interim period.

A combination of rock slope protection and biotechnical methods would be used to control erosion and maximize the amount of vegetated surfaces within the levee breaches. The riverbank and apron zones would be planted with emergent marsh and woody riparian species (extending along the Sacramento River and laterally into the swales and restored floodplain) to restore SRA and riparian habitat to the extent possible. However, species selection within the riverbank and apron zones may be limited to those suitable for coppicing which may be necessary to maintain uniform hydraulic conditions and minimize the risk of scour within the levee breaches (Appendix B, Figure 8). Existing rock slope protection within the riverbank zone between elevations +7 and +10 feet would be retained. In areas that lack revetment or where the revetment is found to provide insufficient protection, vegetated coir fabric would be installed between elevations +7 and +10 feet. The existing levee bordering the levee breaches (shoulders) would be armored with standard rock revetment to serve as scour protection. Individual segments of shoulder rock would range in length from 90 to 228 feet long and total 1,780 linear feet. No vegetation or other habitat features would be incorporated into the rock shoulders.

Remnant Levee. Portions of the existing levee outside the erosion repair sites and levee breaches (totaling approximately 24,198 feet), including existing SRA cover and riparian habitat, would remain intact and no longer be subject to levee maintenance activities. However, portions of the remnant levee that are currently devoid of vegetation or sparsely vegetated would be planted with woody riparian to enhance SRA cover and riparian habitat values and meet any remaining onsite compensation requirements.

Floodplain Habitat. The levee setback component of the project would result in the restoration of approximately 120 acres of historical Sacramento River floodplain supporting seasonal floodplain, wetland, riparian, and upland habitat. The goals of the offset area restoration design are to increase river-floodplain connectivity, restore ecologically functional floodplain habitat, and meet the flood risk reduction objectives of the project.

Restoring floodplain habitat and connectivity of large rivers to their floodplains have been identified as important objectives of ecosystem restoration and species recovery efforts for listed and other special-status fish species in the Central Valley (NMFS 2009). Floodplains are recognized as major contributors to aquatic production and species diversity in large river systems where native fish species have evolved specific adaptations to exploit these variable but highly productive habitats (Welcomme 1979, Junk et al. 1989, Gutreuter et al. 1999). Historically, the Sacramento River Valley contained extensive areas of seasonal floodplains and wetlands that flooded nearly every winter and spring. These habitats supported significant production of native fish species and contributed substantially to overall biological productivity of the river and estuary (Ahearn et al. 2006). As demonstrated in the Yolo Bypass, floodplain habitat can greatly expand the quantity and quality of habitat available to juvenile salmon and other native fishes during seasonal inundation periods (Sommer et al. 2001, 2005). After young salmon have dispersed from spawning areas, the distribution and abundance of young salmon is determined largely by their preferences for shallow water and low water velocities, which in large rivers are found mostly along channel margins, floodplains, and other off-channel habitats (Beechie et al. 2005, Lestelle et al. 2005).

Floodplain restoration through the creation of setback levees is considered a key conservation action for addressing historical and ongoing impacts of levee construction and maintenance activities on listed fish species and their habitat, especially in the highly constrained portions of the lower Sacramento River. It is generally assumed that the number or biomass of fish that can be supported by aquatic ecosystems is directly proportional to the area of suitable habitat. In addition to increased living space, floodplains may further enhance the growth and survival of young fish by increasing the production and availability of food, increasing growth capacity (i.e., food conversion efficiency), reducing competition for food, and reducing potential encounters with predators. Floodplains also enhance the productivity of river-floodplain systems by increasing hydraulic residence time, water temperature, and inputs of organic matter, plankton, and macro-invertebrates from the floodplain into river channels (Ahearn et al. 2006).

The levee setback design was developed through a collaborative process among project engineers, biologists, and restoration ecologists to achieve the flood-risk reduction and habitat restoration objectives of the project. A principle step in this process has been the linkage of key hydrologic and hydraulic parameters (inundation timing, frequency, duration, depth, velocity) with habitat suitability criteria of the target species through the application of the Corps' Ecosystem Functions Model and 2D hydrodynamic modeling (MIKE 21C) (cbec, inc. and ICF International 2013).

Native Sacramento splittail and Chinook salmon (including winter-, spring-, and fall-run Chinook salmon) were selected as the target species for the offset area design. These species were selected because they are considered key indicator species of functional floodplain habitat in the Central Valley. A flood frequency analysis was performed using the long-term flow record from the Freeport gauge to evaluate the recurrence probability of flows and water surface elevations that correlate with the occurrence of suitable habitat for the target species. The ecological criteria for each of the target species and corresponding flows, recurrence intervals, and water surface elevations are summarized in Appendix D. In general, the offset areas have been designed to flood every 1-2 years for at least 2-3 weeks during December through May based on the minimum floodplain inundation requirements for successful spawning, incubation, and larval development of Sacramento splittail, and rearing and enhanced growth of juvenile Chinook salmon.

The offset areas were also designed to achieve the desired flooding regime (depth, duration, and extent of flooding), drainage patterns, and soil conditions to support riparian, wetland, and upland vegetation on the restored floodplain. Based on current design, much of the offset areas would be excavated down to an elevation of approximately 10 feet NAVD88 to achieve frequent inundation of the new floodplain and expand the amount of riparian habitat, SRA cover, and floodplain habitat available to fish over a broad range of flows. The floodplain design includes one or more interconnected swales or low-flow channels that would form the primary aquatic and riparian corridors connecting the river and floodplain (Appendix B, Figure 9). These channels are designed to maintain suitable soil moisture conditions for wetland and riparian vegetation, facilitate river-floodplain connectivity and drainage of the floodplain over a broad range of flows, and minimize fish stranding and the extent of suitable habitat (isolated ponds) for bass and other undesirable fish species during the drier late spring and summer months. In addition, topographic heterogeneity has been incorporated into the project design grading plans to create a mosaic of wetland, riparian, and upland habitats supporting emergent wetland, willow-scrub, cottonwood forest, oak woodland plantings and native grasses.

An MMP for the offset areas is being developed on behalf of WSAFCA and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the project. The MMP will include representative plans and cross sections of the Proposed Action elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

SAM Assessment. The SAM was developed by the Corps and Stillwater Sciences, in consultation with NMFS, USFWS, CDFW, and CDWR, to address specific habitat assessment and regulatory needs for ongoing and future bank protection actions in the Sacramento River Bank Protection Project (SRBPP) Action Area. The SAM was designed to systematically evaluate the impacts and compensation requirements of bank protection and levee improvement projects on Chinook salmon, steelhead, green sturgeon, and delta smelt, and their critical habitat. The SAM has been used previously in both programmatic (Corps 2007a) and project-level (e.g., Jones & Stokes 2007) bank protection effect analyses.

The SAM quantifies habitat values in terms of a WRI that is calculated by combining habitat quality (i.e., fish response indices) with quantity (i.e., bank length or wetted area) for each season, target year, and relevant species/life stage. The fish response indices are derived from hypothesized relationships between key habitat attributes (described below) and the species and life stage responses. Species response indices vary from 0 to 1, with 0 representing unsuitable conditions and 1 representing optimal conditions for survival, growth, and/or reproduction. For a given site and scenario (i.e., with or without project), the SAM uses these relationships to determine the response of individual species and life stages to the measured or predicted values of each habitat attribute for each season and target year, and then multiplies these values together to generate an overall species response index. This index is then multiplied by the linear feet or area of shoreline to which it applies to generate a weighted species response index, expressed as feet or square feet. The species response index provides a common metric that can be used to quantify habitat values over time, compare project conditions to existing conditions, and evaluate the effectiveness of on-site and off-site compensation actions. For example, the difference in WRIs between with- and without-project conditions in a given year provides a measure of the impacts (negative species response) or benefits (positive species response) of the project relative to baseline conditions. More detail on the SAM is provided by the Corps (2004 and 2007a).

The SAM employs six habitat attributes to characterize nearshore, SRA cover, and floodplain habitats of listed fish species:

- Bank slope – This is the average bank slope along the average annual summer, fall, winter, and spring water surface elevation. This variable is used as an indicator of shallow-water habitat availability, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- Floodplain availability – This is the ratio of wetted area for the 2-year flood flow to the wetted area for the average annual winter-spring flow. This variable is used as an indicator of the amount seasonally flooded shallow-water habitat, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- Bank substrate size – This is median particle diameter of the bank (i.e., D_{50}) along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge and food availability for juveniles and adults.
- Instream structure – This is the percent of shoreline coverage of IWM along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover and resting habitat for juveniles and adults.

- Aquatic and riparian vegetation – This is the percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover.
- Overhanging shade – This is the percent of the shoreline coverage of shade along each average seasonal water surface elevation. This variable is used as an indicator of juvenile and adult predator refuge.

The SAM was used to quantify the responses of delta smelt to with-project conditions over a 50-year project period relative to the species and life stage responses under without-project (existing) conditions. The assessment followed the general steps outlined in the SAM User's Manual (Corps 2004). A detailed description of the data sources, methods, and assumptions used to characterize existing and with-project habitat conditions is presented in Appendix E.

The results of the SAM, as applied to the Southport EIP, for the spawning/incubation and larval/juvenile rearing life stages of delta smelt are described below and presented graphically in Appendix F. The SAM focuses on these life stages because of their potential presence in the action area and sensitivity to project effects.

Delta Smelt Spawning and Incubation. The Proposed Action would result in long-term gains in winter and spring habitat values (i.e., positive species responses) for delta smelt during the primary winter and spring spawning and incubation period (February–May). Winter and spring WRIs are projected to increase rapidly in years 2–5 and continue to increase over the 50-year with-project period. Between years 5 and 50, WRI values are predicted to increase by 1,509 to 2,336 linear feet, representing an 8% to 12% increase over baseline (existing) habitat values. These results reflect the positive responses of delta smelt to the large and rapid gains in habitat values resulting from increases in floodplain area and shallow water habitat associated with the levee setback and constructed benches, and gradual increases in shoreline cover (aquatic and riparian vegetation) resulting from the growth of planted vegetation on the levee breaches, erosion protection sites, and remnant levee.

Delta Smelt Larval and Juvenile Rearing. The SAM results indicate that the responses of larval and juvenile delta smelt to changes in SRA cover, riparian, and floodplain habitat associated with the proposed action would be similar to those predicted for spawning and incubation (Appendix F, Figure F-2). Between years 5 and 50, winter and spring WRIs are projected to increase by 1,388 to 2,049 linear feet, representing a 9% to 13% increase over baseline (existing) habitat values in response to increases in floodplain area and shallow water habitat under with-project conditions. Virtually no change in WRIs under average summer flow conditions is predicted to occur under with-project conditions (Appendix F, Figure F-2). Based on the SAM response relationships, these results reflect the insensitivity of larval and juvenile delta smelt to changes in average substrate size and IWM levels along the average summer-flow shoreline under with-project conditions (see Appendix E, Table E-4).

Fish Stranding

Following periods of floodplain inundation, receding floodwaters may collect in existing ponds, ditches, borrow areas, and other depressions on the restored floodplain, resulting in fish stranding and high mortality rates due to lethal water temperatures, low dissolved oxygen, predation, and desiccation. WSAFCA will minimize fish stranding by developing and implementing a drainage and grading plan that minimizes the extent of ponding and facilitates complete drainage of the active floodplain to the main river. The final levee offset area design will include substantial grading and re-contouring of the restored floodplain as necessary to facilitate complete drainage and unimpeded fish passage to the main river as floodwaters recede from the levee offset area. Features with substantial stranding risk will be filled and/or graded to minimize this risk. Bees Lakes would remain hydraulically isolated from the main river. As described above, the mitigation and monitoring plan will evaluate the effectiveness of the grading and drainage features in preventing fish stranding and will include provisions for remediation should the design fail to meet established performance or success criteria.

Long-Term Hydraulic, Geomorphic, and Sediment Transport Conditions

The Proposed Action may adversely affect delta smelt and designated critical habitat as a result of local changes in hydraulic, geomorphic, and sediment transport conditions that may modify channel morphology, water depths and velocities, and suspended sediment and turbidity levels in the Sacramento River. As described in Appendix C-1 and C-2 of the Southport EIP Draft EIS/EIR (ICF International 2013), hydraulic modeling performed by MBK for Alternatives 2 and 5 (setback levee alternatives) indicate that the Proposed Action would not significantly affect water surface elevations or cause negative hydraulic effects in the Sacramento River under 100-year, 200-year, and 500-year flood events. In general, the risk of channel scour, bank erosion, and levee failure would be reduced relative to existing conditions because of proposed levee strengthening, increased bank stability, and reductions in shear stress associated with the widened floodplain. Although local shear stresses would be reduced, these reductions are not expected to significantly alter erosion, deposition, and sediment transport rates in the main channel of the Sacramento River. Therefore, the Proposed Action is not likely to adversely affect delta smelt or critical habitat through long-term effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River.

Indirect Effects

Operations and Maintenance

O&M activities are not part of the Federal action. Because O&M activities are conducted by DWR and local flood protection districts, the effects of these activities are not part of the Proposed Action. However, they are discussed in this BA because they are interrelated and interdependent to the Proposed Action.

O&M activities that require in-water work are expected to occur between July 1 and October 31 for the life of the project to maintain flood control and habitat features in the action area, Anticipated O&M actions include vegetation maintenance up to four times a year (mowing or applying herbicide), control of burrowing rodent activity (baiting with pesticide), site-specific slope repair, as needed (resloping and compacting), patrol road reconditioning up to once a year (placing, spreading, grading, and compacting aggregate base or substrate), regular visual inspections of the levee, and relief well monitoring. In addition, periodic rock placement may be needed to prevent or repair localized scouring on the levee slopes and in the offset areas. Potential impacts from slope repairs would be similar to those described for construction activities but would be infrequent, localized, and shorter in duration. Consequently, the potential for adverse effects on listed fish species or critical habitat would be lower and further minimized by application of the BMPs and other minimization and avoidance measures that are proposed during construction.

5.3 Giant Garter Snake

5.3.1 West Sacramento GRR

Potential effects to the giant garter snake and its habitat could occur during repairs to the Yolo Bypass levee, DWSC east and west levees, and the South Cross levee.

Based on the USFWS's 1997 Programmatic Formal Consultation for giant garter snake, fixing the levee in place would likely result in Level 2 impacts, which are defined as those that result in minimal environmental effects, such as repair, rehabilitation, or replacement of previously authorized structures, and would not result in permanent habitat loss and would result in temporary habitat disturbance that does exceed 20 acres (USFWS 1997).

The study area contains numerous aquatic or irrigation features that are or have the potential to be waters of the United States, including wetlands. These habitat features include, but are not limited to, emergent wetlands (approximately 86 acres), irrigated rice and grain crops (approximately 20 acres), open water (approximately 413 acres), and seasonal wetlands (0.3 acre). This includes open waters that are protected under Federal law from removal, filling, hydrological interruption, or other construction activities.

Direct effects including construction activities associated with this alternative would result in the loss of waters of the United States, including wetlands, as well as upland habitat and disruption of wildlife movement corridor. Except for the proposed levee work on the water side of the Sacramento River levees where high flows exclude this snake, this effect would be considered significant because fixing the levee in place would remove nearshore wetlands and upland habitat that provide suitable habitat ranging between marginal to optimal with low to moderate to high food, cover, and water values for the giant garter snake depending on the quantity and quality of the habitat. It also disturbs the aquatic environment as rock revetment is placed in the water.

In the short term, there are adverse effects due to temporary habitat disturbance to waterways providing habitat for the snake from construction activities to fix the levee in place. In the long term, it is estimated that a total of 53.5 acres of seasonal and permanent wetland habitat that provides foraging, breeding, and rearing habitat for the giant garter snake and up to 30.9 acres of non-native grassland (associated with the oak woodland habitat lost) habitat would be significantly affected by the construction activities to fix the levees in place.

Table 20. Effects on Giant Garter Snake Habitat in the West Sacramento Project Area.

Habitat	Permanent
Aquatic Habitat	53.5
Upland Habitat	30.9

During post construction levee maintenance activities and maintenance of mitigation plantings, there are potential significant indirect effects to the giant garter snake. If driving on dirt roads in close proximity to the existing wetlands or other water body types and newly created mitigation plantings is necessary, it could disturb the giant garter snake due to vibration, noise, and dust covering the aquatic environment and wetlands. However, these effects are considered short term and it is not significant because the use of vehicles is reduced to one or two vehicles/trucks needed or there is a restricted limited use of heavy equipment needed later for levee repair.

Potential adverse indirect effects to the giant garter snake could occur as a result of the following post construction activities:

- O&M activities, including removal of weeds, tree and shrub trimming up to four times per year, and reconditioning of levee slopes and road with a bull dozer, as needed;
- Permanent altering of light and noise levels;
- Temporary alteration of flows if dewatering a portion of the water body and riparian floodplain/zone for levee repairs or installation of closure structures in the DWSC is necessary;
- Damage caused through toxicity associated with herbicides, insecticides, and rodenticides;
- Introduction of pet and human disturbance (including trash dumping);
- Increases or changes in habitat to attract non- native competitors or predators; and
- Introduction of invasive nonnative plant species onto disturbed and nearby degraded areas.

All project areas would be surveyed prior to final designs to determine the extent to which the species may be impacted. To minimize potential impacts to the species, work will occur between May 1 and October 1 when snakes are active and can move out of the construction area.

5.3.2 Southport EIP

As discussed in Chapter 3, suitable aquatic habitat for giant garter snake in the Action Area consists of irrigation and drainage ditches and emergent wetland, as shown in Appendix B, Figure 7. Figure 7 shows Bees Lakes as Adjacent Aquatic Habitat; although Bees Lakes is outside of the Action Area, it creates suitable upland habitat for giant garter snake within the Action Area. Most of the active fields in the Action Area are fallowed or planted in wheat, which does not require irrigation; therefore these ditches were not considered suitable for giant garter snake because they are dry during the snake's active season.

Suitable upland habitat consists of fallow agricultural fields and nonnative grassland in the Action Area. For the effects discussion below, impacts on suitable upland areas were calculated if they occur within 200 feet of suitable aquatic habitat.

<u>**Direct Effects**</u>

Construction of the Proposed Action would result in the temporary disturbance of 155 acres and the permanent loss 2.24 acres of suitable upland habitat in the Action Area (Table 21). Temporary loss of up to 155 acres of suitable upland habitat in the Action Area would occur in fallow agricultural fields and grasslands in the borrow areas. The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials. Temporarily affected upland habitat would be restored to preproject conditions within a maximum of two seasons (a season is defined as the calendar year between May 1 and October 1 [U.S. Fish and Wildlife Service 1997]), as described in Conservation Measure 16.

The permanent loss of 2.24 acres of suitable upland habitat would result from work in fallow agricultural fields and nonnative grasslands. Compensation would be required for permanent impacts on giant garter snake as described in Conservation Measure 18.

Table 21. Effects on Giant Garter Snake Habitat in the Southport EIP Action Area.

Habitat	Temporary	Permanent
Aquatic Habitat	0	0
Upland Habitat[1]	155[2]	2.24

[1] Upland habitat consists of fallow agricultural fields and nonnative grasslands from borrow sites within 200 feet of aquatic habitat.
[2] The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials.

While there would be no temporary or permanent effects of suitable aquatic habitat for giant garter snake in the Action Area, disturbance or degradation of aquatic habitat could occur if soil or other materials are sidecast or fall into the habitat. Fuel or oil leaks or spills adjacent to aquatic habitat could also cause degradation of habitat. These potential effects would be avoided by installing sediment and construction barrier fencing (Conservation Measure 12), locating staging areas away from aquatic habitat (Conservation Measure 13), implementing sediment and contaminant BMPs as required by the NPDES permit (SWPPP) (Conservation Measure 2), and preparing a frac-out plan and SPCCP (Conservation Measures 3 and 4).

Construction activities in suitable habitat could result in the injury, mortality, or disturbance of giant garter snakes. Giant garter snakes could be injured or crushed by construction equipment working in suitable aquatic and upland habitat or if soil or other materials are side-cast or fall into suitable aquatic habitat. Snakes could also be killed by construction vehicles traveling though the Action Area. Fuel or oil spills from construction equipment into aquatic habitat could also cause illness or mortality of giant garter snakes. Trenches left open overnight could trap snakes moving through the construction area during the early morning hours. Noise and vibrations from construction equipment, and presence of human activity during construction activities may also disturb giant garter snakes within the Action Area. Most construction activities will be limited to the snake's active period (May 1–October 1) when the potential for direct mortality is reduced because snakes can actively move and avoid danger. However, if work requires construction during the snakes dormant period (October 2-April 30) giant garter snakes, if present in the upland agricultural and grassland adjacent to the work area, could be injured or killed. Conservation Measure 16 would be implemented to reduce the potential for mortality during this time period.

Potential effects on giant garter snake would be minimized or avoided by conducting biological resources awareness training, conducting work during the active period (May 1–October 1) (Conservation Measure 1), installing exclusion fencing around suitable habitat (Conservation Measure 12), conducting preconstruction surveys and monitoring (Conservation Measure 14), and providing escape routes or covering open trenches (Conservation Measure 15). If work continued past October 1, additional preconstruction surveys and monitoring would be required (Conservation Measure 14).

Indirect Effects

Construction of the Proposed Action is not expected to have any indirect effects on giant garter snake. Several indirect effects on giant garter snake and its habitat were considered but were determined to have no potential to occur as a result of the Proposed Action. Specifically, the following determinations were made.

There would be no increase of trash, hazardous waste, or off-road vehicle use due to increased human presence. The Proposed Action would not result in development or increased access to giant garter snake habitat.

The Proposed Action would not result in indirect effects on habitat suitability through changes in the length of inundation or other habitat modifications that would make the habitat less suitable for giant garter snake.

Effects from Operation and Maintenance

Post-construction setback levees, adjacent levees, strengthening in place (slope flattening), seepage berms, slurry cutoff walls, riprap bank stabilization, and relief wells would be subject to typical O&M. O&M activities in the project area are conducted per the approved Corps O&M manual applicable to this reach. Such activities include hand and mechanical (mower) removal of weeds, spraying of weeds with approved pesticides, minimal tree or shrub trimming all up to four times a year, monthly control of burrowing rodent activity by baiting with pesticide, and reconditioning of levee slope and road with a bull dozer as needed.

Effects on giant garter snake and its habitat were considered but were determined to have no potential to occur as a result of the Proposed Action. Specifically, the following determinations were made.

- There would be no increased use of herbicides and/or pesticides from pre-project conditions as a result of the Proposed Action. Vegetation control would remain the same as existing conditions—typically twice per year. Herbicide and bait station use would also be at the same frequency as existing conditions.
- The Proposed Action would not result in an increase in potential mortality of giant garter snake due to an increase in vehicles traveling to the project components to conduct maintenance activities. Inspections are infrequent (flood control facilities four times per year; relief wells once per year, plus inspections after high water events), and travel would be along the existing levee road and paved roads to the levee. Patrol road recondition activities would typically be performed once per year and would include placing, spreading, grading, and compacting aggregate base or substrate. Erosion control and slope repair activities would include resloping and compacting; fill and repair of damage from rodent burrows would be treated similarly.

5.4 Ongoing Project Actions

As described in Section 2.0, in-water construction work will be completed during established work windows for salmonids and Delta smelt. Maintenance activities may occur year-round in the dry areas. Such activities include hand and mechanical (mower) removal of weeds, spraying of weeds with approved pesticides, minimal tree or shrub trimming all up to four times a year, monthly control of burrowing rodent activity by baiting with pesticide, and reconditioning of levee slope and road with a bull dozer as needed.

5.5 Effects on the Environmental Baseline

Effects of the proposed action include reductions in nearshore aquatic and riparian habitat that is used by aquatic and terrestrial species. Placement of revetment on earthen banks alters natural fluvial processes that sustain high-value nearshore and floodplain habitats in alluvial river systems. Effects are expected to be similar to effects described in Sections 5.1 through 5.3. Cumulative effects from these two projects, combined with the American River Common Features project and the SRBPP, on the environmental baseline are discussed in Section 5.7.2 below.

5.6 Effects on Essential Elements of Critical Habitat

The project actions may affect designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Delta smelt and green sturgeon. Potential impacts of the project actions on critical habitat for listed species are discussed separately for each species in Section 5.2.

5.7 Cumulative Effects

5.7.1 ESA Cumulative Effects Analysis

The ESA requires NMFS and USFWS to evaluate the cumulative effects of the proposed actions on listed species and designated critical habitat, and to consider cumulative effects in formulating Biological Opinions (USFWS and NMFS 2002a). The ESA defines cumulative effects as "those effects of future State or private actions, not involving Federal activities that are reasonably certain to occur within the action area" of the proposed action subject to consultation (USFWS and NMFS 2002b). 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 Federal ESA. Federal actions, including hatcheries, fisheries, and land management activities are, therefore, not included. For the purposes of this BA, the area of cumulative effects analysis is defined as the Sacramento River watershed.

A number of other commercial and private activities, including hatchery operations, timber harvest, recreation, as well as urban and rural development, could potentially affect listed species in the Sacramento River basin. Levee maintenance activities by state agencies and local reclamation districts are likely to continue, although any effects on listed species will be addressed through Section 10 of the ESA. Ongoing non-federal activities that affect listed salmonids, Green Sturgeon, Delta Smelt, valley elderberry longhorn beetle, giant garter snake 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 ETL could result in increased effects on listed species. The extent and pace of those activities are not yet known.

Cumulative effects may also include non-federal rock revetment projects. Some non-federal rock revetment projects carried out by State or local agencies (e.g., reclamation districts) that do not fill wetlands or occur below the ordinary high water line will not need Section 404 (Clean Water Act) permits from the Corps and resulting Section 7 (ESA) consultation, but any effects on listed species should be addressed through Section 10 of the ESA. These types of actions are possible at many locations throughout the West Sacramento GRR study area, but are not included as part of the current project.

Potential cumulative effects on fish may include any continuing or future non-federal diversions of water that may entrain adult or larval fish or that may incrementally decrease outflows, thus changing the position of habitat for these species. Water diversions through intakes serving numerous small, private agricultural lands and duck clubs in the Delta, upstream of the Delta, and in Suisun Bay contribute to these cumulative effects. These diversions also include municipal and industrial uses and power production. Several new diversions are in various stages of action. The introduction of exotic species may also occur under numerous circumstances. Exotic species can displace native species that provide food for larval fish.

Potential cumulative effects on all species addressed in this BA could include: wave action in the water channel caused by boats that may degrade riparian and wetland habitat and erode banks; dumping of domestic and industrial garbage; land uses that result in increased discharges of pesticides, herbicides, oil, and other contaminants; and conversion of riparian areas for urban development. In addition, routine vegetation clearing and mowing associated with agricultural practices may affect or remove habitat for the valley elderberry longhorn beetle and giant garter snake.

5.7.2 Federal Cumulative Effects Analysis

While cumulative effects analyses in ESA consultations are specifically to address non-federal actions as explained above, the following cumulative analysis of Federal actions is being provided to inform the agencies of federal actions affecting listed species in the general local area. The Corps has initiated consultation with USFWS and NMFS on four different Federal actions which could create a cumulative effect on listed species in the Sacramento area. These four projects include the West Sacramento Project, the Southport EIP, the American River Common Features Project, and the Sacramento River Bank Protection Project (SRBPP).

The purpose of the American River Common Features Project is to determine whether there is a Federal interest in modifying the authorized project for flood risk reduction in the Greater Sacramento Area at the confluence of the Sacramento and American Rivers. The proposed alternatives for this project include improving levees along the American River, NEMDC, Arcade, Dry/Robla, and Magpie

Creeks to address identified seepage, stability, erosion, and height concerns. The levees along the Sacramento River would be improved to address identified seepage, stability, and erosion concerns. Approximately one mile of levee raising would still be required on the Sacramento River. Due to environmental, real estate, and hydraulic constraints within the study area, the majority of the levees would be fixed in place. In addition, the project proposes to widen the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass.

The SRBPP was authorized to protect the existing levees and flood control facilities of the SRFCP. The SRBPP is a long-range program of bank protection authorized by the Flood Control Act of 1960. The SRBPP directs the Corps to provide bank protection along the Sacramento River and its tributaries, including that portion of the lower American River bordered by Federal flood control project levees. Beginning in 1996, erosion control projects at five sites covering almost two miles of the south and north banks of the lower American River have been implemented. Additional sites at RM 149 and 56.7 on the Sacramento River totaling one-half mile have been constructed since 2001. During 2005 through 2007, 29 critical sites totaling approximately 16,000 linear feet were constructed under the Declaration of Flood Emergency by Governor Schwarzenegger. This is an ongoing project, and additional sites requiring maintenance will continue to be identified indefinitely until the remaining authority of approximately 24,000 linear feet is exhausted over the next 3 years. WRDA 2007 authorized an additional 80,000 linear feet of bank. For implementation of the 80,000 additional linear feet of bank protection, the Corps has submitted a biological assessment and initiated formal consultation with NMFS and USFWS.

Potential cumulative impacts from the combination of these projects to each of the listed species included in this consultation are below. During preconstruction engineering and design, the Corps designs will avoid impacts to special status species, where possible, or otherwise minimize effects to each of these species.

Valley Elderberry Longhorn Beetle

Concurrent construction of multiple projects over the next 10 to 15 years within the Sacramento Metropolitan area would likely cause mortality to beetles due to construction operations. Construction activities for the multiple projects would occur each year during the flight season of beetles. Since construction activities would be adjacent to known VELB locations it is likely that some mortality may occur. The exact number injured or killed is unknown but would likely be minimal due to the exceptional flight ability of the beetle to avoid construction vehicles. No designated critical habitat would be affected with the construction of any of the projects.

Shrubs within the each project footprint would be transplanted to areas in close proximately to the current locations. Additionally, compensation would be located within the vicinity of impacted shrubs. Transplanting of shrubs and planting of seedlings and natives within the project vicinity would provide connectivity for the beetle. Connectivity is a primary cause of the beetle decline and an important element in the recovery and sustainability for the beetle. The transplanting of shrubs and compensation within the same area as the potential impacts would result in effects to the beetle but not result in jeopardy to the Valley Elderberry Longhorn Beetle.

Salmon, Steelhead, and Sturgeon

The proposed projects could adversely modify critical habitat or contribute to the loss or degradation of sensitive habitats for listed species such as the Sacramento River winter-run Chinook salmon, Central Valley steelhead, Central Valley spring-run Chinook salmon, and green sturgeon in the greater project vicinity. However, with site specific erosion repair designs, retention of SRA through vegetation variances, and the installation of riparian plantings and instream large woody material, the proposed projects are expected to increase habitat values over time by increasing the amount of riparian habitat, SRA cover, and floodplain habitat available to listed fish over a broad range of flows.

The erosion repair activities of these combined projects would likely reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment perspective, the bank material we are protecting 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. All of the available sediment in the American River watershed is being contained behind Folsom Dam. The site specific designs will be constrained from allowing any velocity increases outside the erosion repair site (Schlunegger 2014).

Site specific designs such as setback levees, IWM, and shallow bank slopes within the SRBPP, Common Features, West Sacramento, and Southport EIP projects would be incorporated to address erosion repair while including features for increasing habitat for listed fish. The levee setback component of the Southport EIP and West Sacramento projects would result in the restoration of historical Sacramento River floodplain in the project areas, with a diverse mosaic of seasonal floodplain, wetland, riparian, and upland habitat. The goals of the offset area restoration designs are to increase river-floodplain connectivity, restore ecologically functional floodplain habitat, and meet the flood risk–reduction objectives of the projects. Based on the SAM, establishing connectivity of the floodplain to the river will result in large and rapid gains in habitat quantity and quality that will fully compensate for initial habitat deficits on the existing levee and result in significant long-term species benefits (improved growth and survival) relative to existing conditions. Although not addressed by the SAM, these benefits will be enhanced over time by revegetation of the floodplain and development of a diverse mosaic of wetland, riparian and upland plant communities that will further improve the habitat and ecosystem functions of the restored floodplain. In addition to increasing the amount of structural cover available to fish along the shoreline, the installation of IWM is also expected to promote sediment deposition on the rock bench as observed at locations where similar designs have been used to address the compensation needs of listed fish species. Project actions are unlikely to result in long-term habitat losses to Sacramento River winter-run Chinook salmon, Central Valley steelhead, Central Valley spring-run Chinook salmon, and green sturgeon.

The American River Common Features and West Sacramento Projects would have initial cover losses due to project actions but will be partially offset by installing riparian plantings and native grasses along the lower slopes. These features will increase the availability of high quality shallow water habitat for juvenile Chinook salmon and steelhead, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Because of the vegetation variance that the Corps will be seeking, tree removal would be limited to no more than the upper one-half of the waterside of the levees therefore leaving the lower one-half or more of the trees in place on the Sacramento River within the study area. SRA would not be compromised, thus maximizing existing SRA values in the study area. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species.

Delta Smelt

The proposed projects, with the implementation of site specific designs, would provide long-term net benefits to delta smelt as explained above in for the other fish species. However, there are four specific significant threats to the delta smelt that have been identified by the USFWS: direct entrainments by State and Federal water export facilities, summer and fall increases in salinity, summer and fall increases in water clarity, or effects from introduced species.

Implementation of the various projects would not affect direct entrainments by State and Federal water export facilities. The only potential affect could be with the American River Common Features Project and the release of more water down the Sacramento Bypass into the Yolo Bypass during high water events. The excess water that would normally be moving downriver through the Sacramento area would enter the system farther down in the Delta area. Since adult delta smelt are moving up the system to spawn at this time this would not affect entrainment in the water export facilities. Summer and fall increases in salinity is driven more by low flow drought years and water releases in the Sacramento tributaries then site specific designs for erosion protection in the project areas. Summer and fall increases in water clarity are associated with, among other factors, invasive non-native clam species and non-native plant species, which are generally located down in the Delta below the project areas, that are filtering out vital chlorophyll and plankton that would normally increase turbidity which helps the delta smelt avoid predators. However, as mentioned above the erosion repair activities of these combined projects would likely reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, as explained above, from a system sediment perspective, the bank material we are protecting 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.

Giant Garter Snake

The giant garter snake could be affected by multiple projects being constructed within the Sacramento Metropolitan area over the next 10 to 15 years. Primarily habitat loss would occur on the West Sacramento side of the Sacramento River adjacent to the Sacramento Bypass and the West

Sacramento and Southport construction areas. Short term impacts would occur for a single construction season along haul routes and within borrow sites. To minimize potential impacts to snakes work within giant garter snake habitat would be conducted between May 1 and October 1 when snakes are active and can move out of the construction area. Snake mortality could occur during construction along haul routes, however, the snakes are mobile and would likely move out of the way from construction equipment. There would be a permanent loss of rice fields with the expansion of the Sacramento Bypass which would be compensated for by the American River Common Features Project.

5.8 Conclusion and Effects Determination for Listed Species

5.8.1 Conclusions and Determinations for the West Sacramento Project

Valley Elderberry Longhorn Beetle

In cases where work occurs within 20 feet of elderberry plants, the contractor will be instructed to avoid impacts to shrubs as much as possible. Any impacts to plants will be mitigated according to the guidelines outlined in Section 2.8.2. In consideration of this information, the project actions are unlikely to result in long-term habitat losses to valley elderberry longhorn beetle, as long as the applicable mitigation and compensation measures are implemented. However, project actions may adversely affect valley elderberry longhorn beetles due to potential take during construction.

Fish Species

Project effects on listed fish species include alteration of the designated critical habitat of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Delta smelt, and green sturgeon. Project effects may include localized incidental take due to disturbance, displacement, or impairment of feeding or other essential behaviors of adult and juvenile salmon, steelhead, and green sturgeon during construction and O&M activities. Injury or mortality of juvenile salmonids, green sturgeon, and Delta smelt could occur if individuals are unable to readily move away from channel or nearshore areas directly affected by construction activities. Accidental discharge of toxic substances during construction could cause physiological impairment or mortality of listed fish and other aquatic species at or immediately downstream of project sites. Other potential stressors include noise, suspended sediment, turbidity, and sediment deposition generated during in-water construction activities. These effects could also occur in areas downstream of project sites, because noise and sediment may be propagated downstream. Restricting in-water activities to the August 1 through November 30 work window, and implementing BMPs, will minimize the potential for adverse effects.

Long-term project effects on the habitat of listed fish species include alteration of river hydraulics, removal of instream and overhead cover, and alteration of substrate conditions along the seasonal low- and high-flow shorelines of the Sacramento River erosion sites. Implementation of the project will result in temporary losses of instream structure and riparian vegetation along the summer-fall and winter-spring shorelines and will also limit long-term fluvial functioning necessary for the development and renewal of SRA habitat in the future.

Initial cover losses due to project actions discussed above will be partially offset by installing riparian plantings and native grasses along the lower slopes. The remaining losses will be compensated for by purchasing mitigation credits from local mitigation banks. These features will increase the availability of high quality shallow water habitat for juvenile Chinook salmon and steelhead, spawning and incubating Delta smelt, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Because we will not be removing any trees on the lower one-third of the waterside of the levees in the Sacramento River area, SRA will not be compromised thus maximizing existing SRA values in the study area. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species.

In consideration of the above information, the project actions are not likely to result in long-term habitat losses to Sacramento River winter-run Chinook salmon, Central Valley steelhead, Central Valley spring-run Chinook salmon, Delta smelt, and green sturgeon as long as the applicable mitigation and compensation measures are implemented. This conclusion is based on the Corps' commitment to: (1) minimize temporary habitat losses through the incorporation of on-site mitigation features (e.g., vegetated riparian and wetland benches, riparian plantings, and no planned tree removal) in the project area measures; and (2) implementation of off-site habitat compensation measures (e.g., riparian planting, rock removal) prior to or concurrent with project construction. However, project actions may adversely affect these focus species due to: (1) incidental take during construction and O&M activities; (2) fragmentation of existing natural bank habitats due to the placement of revetment; and (3) the potential loss of long-term fluvial functioning necessary for the development and renewal of shaded riverine aquatic habitat.

Giant Garter Snake

To minimize the potential for adverse effects, giant garter snake habitat will be designated as an environmentally sensitive area delineated with signs or fencing, and if possible, avoided by all construction personnel. Additional measures and habitat compensation as outlined in Section 2.8.3 will also be implemented.

In consideration of the above information, the project actions are unlikely to result in long-term habitat losses to the giant garter snake, with implementation of the applicable mitigation and compensation measures. However, even with on-site mitigation and off-site compensation, the project actions may adversely affect giant garter snakes due to: (1) take during construction and O&M activities; and (2) habitat fragmentation.

5.8.2 Determinations, Summary, and Conclusions for the Southport EIP

Valley Elderberry Longhorn Beetle

Because of the potential direct effects discussed in detail above, including the removal of 18 elderberry shrubs and the potential for injury or mortality of VELB during removal and transplantation, the Proposed Action is likely to adversely affect VELB. However, the project will result in substantial long-term benefits to VELB as approximately 120 acres of floodplain habitat will be restored or enhanced as part of project implementation.

Salmonids

Summary and Conclusions

The Southport EIP is expected to result in adverse short-term, construction- and O&M-related effects on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, southern DPS North American green sturgeon, and their designated critical habitat. Potential effects may include physical injury or death and temporary modification of feeding, migration, or other essential activities. During in-water construction activities, injury or mortality of juvenile salmonids and green sturgeon could occur because of their proximity to in-water work areas (nearshore areas), limited ability to avoid direct contact with construction equipment and materials, and sensitivity to noise, turbidity, and suspended sediment. Barge operation and placement of rock (riprap) and temporary cofferdams in the river will cause underwater noise and physical disturbance of the bed and water column of the river that could cause physical injury, death, entrapment, and displacement of individuals from preferred habitat. Temporary increases in suspended sediment and turbidity are expected to reach levels known to cause avoidance behavior in juvenile salmonids, potentially causing displacement of juveniles from cover and increased exposure to predators. Accidental discharge of toxic substances during construction could cause physiological impairment or mortality of individuals at or immediately downstream of construction sites.

Potential short-term effects on listed fish species may include injury or mortality of fish from rock placement; entrapment of fish within temporary cofferdams or turbidity barriers; temporary disruption of feeding, migration, and sheltering behavior, and displacement of fish from preferred habitat in response to noise, turbidity, and suspended sediment; and associated increases in predation risk. The timing of in-water construction activities is expected to minimize exposure of the most sensitive Chinook salmon and steelhead life stages (i.e., fry) which occur in the Action Area primarily in winter and spring following the onset of high flows (November through May). Adults and most juvenile winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon that may be present during the proposed construction window (July 1 through October 31) utilize deeper water and are expected to detect and move away from affected nearshore areas. Most construction activities potentially affecting these species will occur in Year 2 of the proposed construction period, thus avoiding or minimizing the potential for adverse effects on multiple year classes. Based on these considerations and the implementation of proposed conservation measures and BMPs, adverse effects resulting from construction and O&M activities will be limited to temporary harassment and potential injury or death of small numbers of juvenile winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon during in-water activities.

Long-term project effects on listed fish species include modification of the designated critical habitat of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. Habitat modification may affect behavior, growth, and survival, and the primary constituent elements of critical habitat, including freshwater rearing sites, foraging areas, and migration corridors. These modifications include substantial long-term increases in the quantity and quality of riparian, SRA cover, and floodplain habitat available to fish on the restored floodplain. Major objectives of the levee offset areas include restoring ecologically functional floodplain habitat based on the hydrological, hydraulic, and geomorphic characteristics and habitat functions of natural floodplains. Based on the SAM, establishing connectivity of the floodplain to the river will result in large and rapid gains in habitat quantity and quality that will fully compensate for initial habitat deficits on the existing levee and result in significant long-term species benefits (improved growth and survival) relative to existing conditions. Although not addressed by the SAM, these benefits will be enhanced over time by revegetation of the floodplain and development of a diverse mosaic of wetland, riparian, and upland plant communities that will further improve the habitat and ecosystem functions of the restored floodplain.

Initial habitat deficits associated with the loss of natural substrate and removal of existing riparian vegetation and IWM on the existing levee slope will be addressed onsite through the integration of engineered benches, IWM, biotechnical materials, and revegetation of the erosion repair sites, levee breaches, and remnant levee. Based on the SAM, initial deficits in winter-spring habitat values will be fully offset in the first year of levee breach construction and repairs (Year 2) by increases in floodplain area and shallow water habitat on the restored floodplain and constructed benches, followed by long-term increases in habitat values associated with the growth of planted vegetation on the levee breaches, erosion protection sites, and remnant levee. The installation of IWM along the summer-fall shorelines of the erosion repair sites is sufficient to compensate or nearly compensate for initial deficits in fall habitat values although complete recovery may take 15 years or more depending on the success of shoreline plantings in creating shade and IWM along the summer-fall shoreline in future years. However, these deficits are not expected to significantly affect species survival and growth because of their small magnitude and the substantial increases in winter-spring habitat values discussed above. Additionally, planting the remnant levee is expected to effectively restore and potentially enhancing summer-fall habitat values along the existing levee slope.

An MMP for the offset areas is being developed on behalf of WSAFCA and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the project. The MMP will include representative plans and cross sections of the Proposed Action elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. The existing O&M requirements and practices will also be incorporated into the plan. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

In summary, the Proposed Action will result in adverse, short-term construction- and O&M-related effects on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, southern DPS North American green sturgeon, and the freshwater and migration primary constituent elements of critical habitat. These effects will be minimized by the proposed frequency, timing, and duration of in-water activities, and successful implementation of the proposed conservation measures and other BMPs described in the project description. Based on the SAM, the Proposed Action is expected to largely compensate for initial impacts on SRA cover and riparian habitat values on the existing waterside levee of the Sacramento River through the integration of engineered benches, IWM, biotechnical materials, and revegetation of the erosion repair sites, levee breaches, and remnant levee. The proposed levee offset and floodplain restoration plan is expected to substantially improve habitat values for listed fish species in the Action Area by restoring ecologically functional floodplain habitat based on the hydrological, hydraulic, and geomorphic characteristics and habitat functions of natural floodplains. With successful implementation of the MMP, the reconnection and restoration of floodplain habitat will result in significant long-term improvement in rearing and migration primary constituent elements and species responses (improved growth and survival), contributing to overall increases in the conservation value of critical habitat in the Action Area.

Effects Determination

The Proposed Action is likely to adversely affect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, and southern DPS North American green sturgeon and their designated critical habitat. Adverse effects would result from construction, operations, and maintenance activities, and initial losses of SRA cover and riparian habitat associated with erosion repairs, rock slope protection, and levee breach creation on the existing Sacramento River levee. Overall, the Proposed Action, including successful implementation of the MMP, will result in substantial long-term benefits to listed fish species and overall increases in the conservation value of critical habitat in the Action Area through restoration and enhancement of historic Sacramento River floodplain in the levee offset areas.

Delta Smelt

The proposed action is likely to adversely affect delta smelt and its designated critical habitat. Adverse effects would result from construction, operations, and maintenance activities, and initial losses of SRA cover and riparian habitat associated with erosion repairs, rock slope protection, and levee breach creation on the existing Sacramento River levee. Overall, the proposed action, including successful implementation of the MMP, would result in substantial long-term benefits to delta smelt and overall increases in the conservation value of critical habitat in the action area through restoration and enhancement of historic Sacramento River floodplain in the offset areas.

Giant Garter Snake

Because of the potential direct effects discussed in detail above, including the permanent loss of 2.24 acres of upland habitat and the potential for injury or mortality during construction, the Proposed Action is likely to adversely affect giant garter snake.

5.9 Effects on Essential Fish Habitat

5.9.1 West Sacramento Project

Important components of EFH for Chinook salmon spawning, rearing, and migration include:

- Substrate composition;
- Water quality;
- Water quantity, depth, and velocity;
- Channel gradient and stability;
- Food;
- Cover and habitat complexity;
- Space;
- Access and passage; and
- Habitat connectivity.

The project's study area includes habitats that have been designated as EFH for Chinook salmon, a major contributor to Pacific Coast salmon fisheries. The Pacific Coast salmon fishery EFH extends along the Pacific Coast from Washington to Point Conception in California. Freshwater EFH includes all habitat currently and historically accessible to salmon and is based on descriptions of habitat used by Coho and Chinook salmon. The EFH excludes areas above naturally occurring barriers such as waterfalls, which have been present for several hundred years, and impassible dams identified on large rivers (NMFS 1997).

Project effects on EFH are incorporated into the analyses for the salmonid species (Section 5.2). A separate analysis to address potential effects on EFH was therefore unnecessary. As discussed in those analyses, effects of the proposed action on EFH are likely to occur.

Effects on rearing and migration habitat are likely to occur for all Chinook salmon species. The proposed action could also reduce the value of nearshore habitats due to temporary removal of instream structure and riparian vegetation during construction. Project area designs will, in many cases, result in decreased bank substrate size and increased shallow water habitat, instream structure, and shade. These habitat features will help compensate for initial habitat losses in the long-term.

The combination of project features intended to avoid, minimize, or compensate for effects on fish species, including off-site habitat compensation required for impacts on listed species, are reasonable and prudent measures for EFH conservation.

5.9.2 Southport EIP

The MSA, as amended (U.S.C. 180 et seq.), requires that EFH be identified and described in Federal fishery management plans. Federal action agencies must consult with NMFS on any activity that they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. NMFS defines these terms as follows.

- "Waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate.
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- "Necessary" means habitat required to support a sustainable fishery and a healthy ecosystem.
- "Spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle.

Freshwater EFH for salmon consists of four major components: spawning and incubation habitat, juvenile rearing habitat, juvenile migration corridors, and adult migration corridors and adult holding habitat. Important attributes of EFH for spawning, rearing, and migration include suitable substrate composition; water quality (e.g., dissolved oxygen, nutrients, temperature); water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity (e.g., large woody material, pools, channel complexity, aquatic vegetation); space; access and passage; and floodplain and habitat connectivity (Pacific Fishery Management Council 2003).

The Action Area of the Southport EIP is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon FMPs. EFH in the Action Area consists of adult migration habitat and juvenile rearing and migration habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley fall-/late fall-run Chinook salmon, all of which are managed under the Pacific Coast Salmon FMP. Descriptions of these species are described in Chapter 3.

Effects of the Proposed Action on EFH

The effects of the Proposed Action on Pacific Coast salmon EFH would be similar to the effects of the Proposed Action on the designated critical habitat of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead, as discussed in the preceding BA. A summary of these effects and conclusions are presented below and applied to EFH.

The proposed action would result in short-term and long-term effects on Pacific coast salmon EFH. Short-term effects include construction-related increases in turbidity and suspended sediment in the Sacramento River. As discussed in the preceding BA, these effects would be temporary and localized and would be further minimized by the restriction of in-water construction activities to the low-flow period (July 1 and October 31) and compliance with Central Valley RWQCB turbidity objectives and other proposed erosion and sediment control BMPs (see Conservation Measures). The risk of spills or discharges of contaminants in the Sacramento River would be effectively minimized by implementation of a spill prevention and control plan.

Long-term effects on Pacific coast salmon EFH include modification of SRA cover, riparian, and floodplain habitat. Adverse effects resulting from the removal of riparian vegetation and installation of riprap on the waterside slope of the Sacramento River levee would be addressed through onsite integration of engineered benches, IWM, biotechnical materials, and re-vegetation at the erosion repair sites, levee breaches, and remnant levee. Based on the SAM, initial deficits in winter-spring habitat values would be fully offset in the first year of levee breach construction (year 3) by increases in floodplain area and shallow water habitat on the restored floodplain, followed by long-term increases in habitat values associated with the growth of planted vegetation on the erosion repair sites, levee breaches, and remnant levee. The installation of IWM along the summer-fall shorelines of the erosion repair sites is sufficient to compensate or nearly compensate for initial deficits in fall habitat values although complete recovery may take 15 years or more depending on the success of plantings in creating shade and IWM along the summer-fall shoreline. Planting the remnant levee is expected to effectively restore and potentially enhance summer-fall habitat values along the existing levee slope. Overall, the proposed action, including successful implementation of the MMP, would compensate for adverse effects on EFH and result in substantial long-term increases in the quantity and quality of EFH for Chinook salmon through the restoration and enhancement of historic Sacramento River floodplain in the levee setback area.

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Appendix A
Regionally Occurring Species

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

January 16, 2014

Document Number: 140116111503

Sara Martin
ICF International
630 K Street
Suite 400
Sacramento, CA 95814

Subject: Species List for Southport Early Implementation Project

Dear: Ms. Martin

We are sending this official species list in response to your January 16, 2014 request for information about endangered and threatened species. The list covers the California counties and/or U.S. Geological Survey 7½ minute quad or quads you requested.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

Please read Important Information About Your Species List (below). It explains how we made the list and describes your responsibilities under the Endangered Species Act.

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be April 16, 2014.

Please contact us if your project may affect endangered or threatened species or if you have any questions about the attached list or your responsibilities under the Endangered Species Act. A list of Endangered Species Program contacts can be found here.

Endangered Species Division

TAKE PRIDE® IN AMERICA

U.S. Fish & Wildlife Service

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Counties and/or U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 140116111503

Database Last Updated: September 18, 2011

No quad species lists requested.

County Lists

Yolo County

Listed Species

Invertebrates

Branchinecta conservatio
Conservancy fairy shrimp (E)

Branchinecta lynchi
vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)

Elaphrus viridis
delta green ground beetle (T)

Lepidurus packardi
Critical habitat, vernal pool tadpole shrimp (X)
vernal pool tadpole shrimp (E)

Syncaris pacifica
California freshwater shrimp (E)

Fish

Acipenser medirostris
green sturgeon (T) (NMFS)

Hypomesus transpacificus
Critical habitat, delta smelt (X)
delta smelt (T)

Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)

Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
California tiger salamander, central population (T)
Critical habitat, CA tiger salamander, central population (X)

Rana draytonii
California red-legged frog (T)

Reptiles

Thamnophis gigas
giant garter snake (T)

Birds

Charadrius alexandrinus nivosus
western snowy plover (T)

Strix occidentalis caurina
northern spotted owl (T)

Vireo bellii pusillus
Least Bell's vireo (E)

Plants

Cordylanthus palmatus
palmate-bracted bird's-beak (E)

Neostapfia colusana
Colusa grass (T)
Critical habitat, Colusa grass (X)

Sidalcea keckii
Keck's checker-mallow (=checkerbloom) (E)

Tuctoria mucronata
Critical habitat, Solano grass (=Crampton's tuctoria) (X)
Solano grass (=Crampton's tuctoria) (E)

Proposed Species

Amphibians

Anaxyrus canorus
Yosemite toad (PX)

Candidate Species

Birds

Coccyzus americanus occidentalis

Western yellow-billed cuckoo (C)

Key:

(E) *Endangered* - Listed as being in danger of extinction.
(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
Critical Habitat - Area essential to the conservation of a species.
(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
(C) *Candidate* - Candidate to become a proposed species.
(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.
(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, **or may be affected by** projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list. See our Protocol and Recovery Permits pages.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our Map Room page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. More info

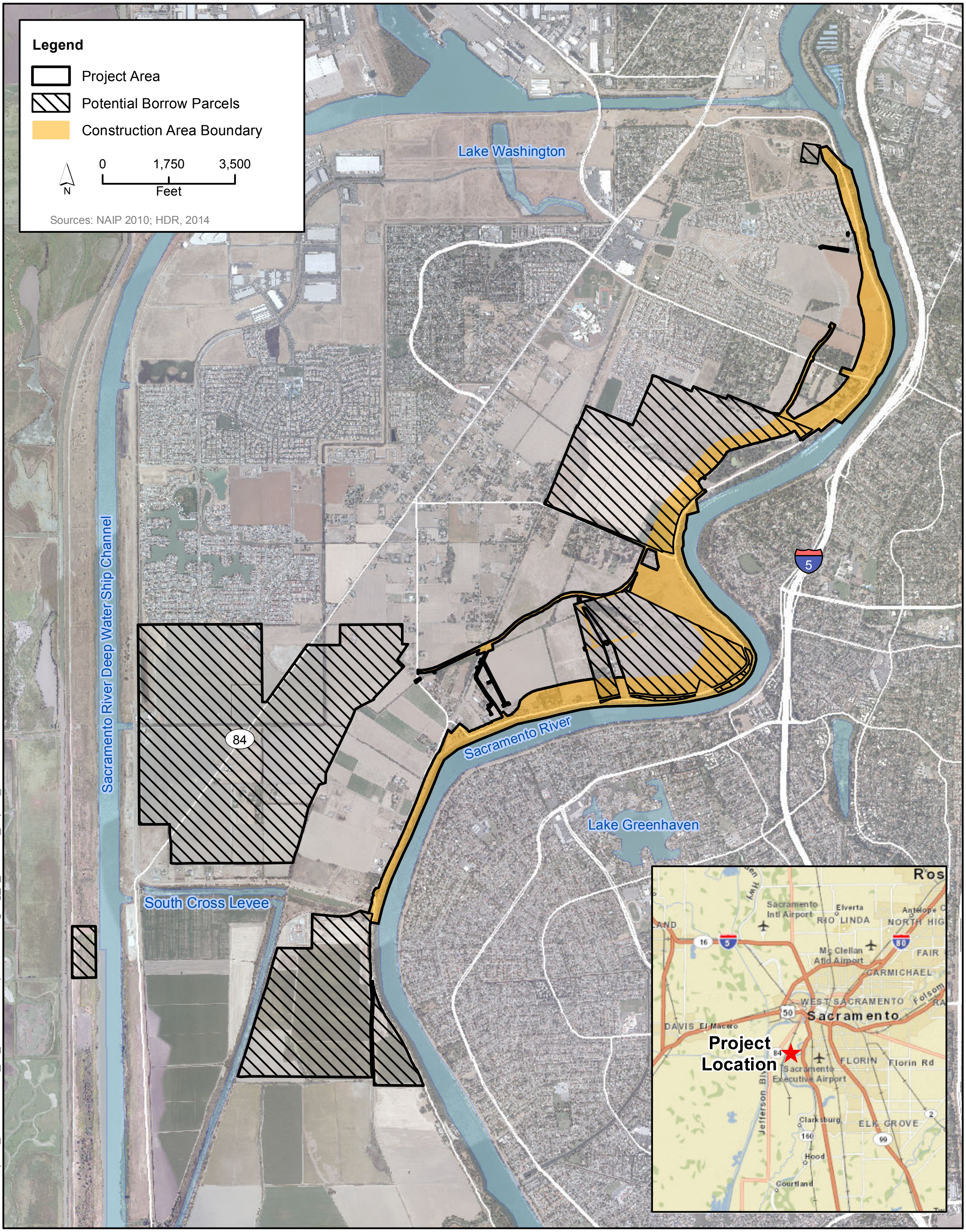
Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6520.

Updates

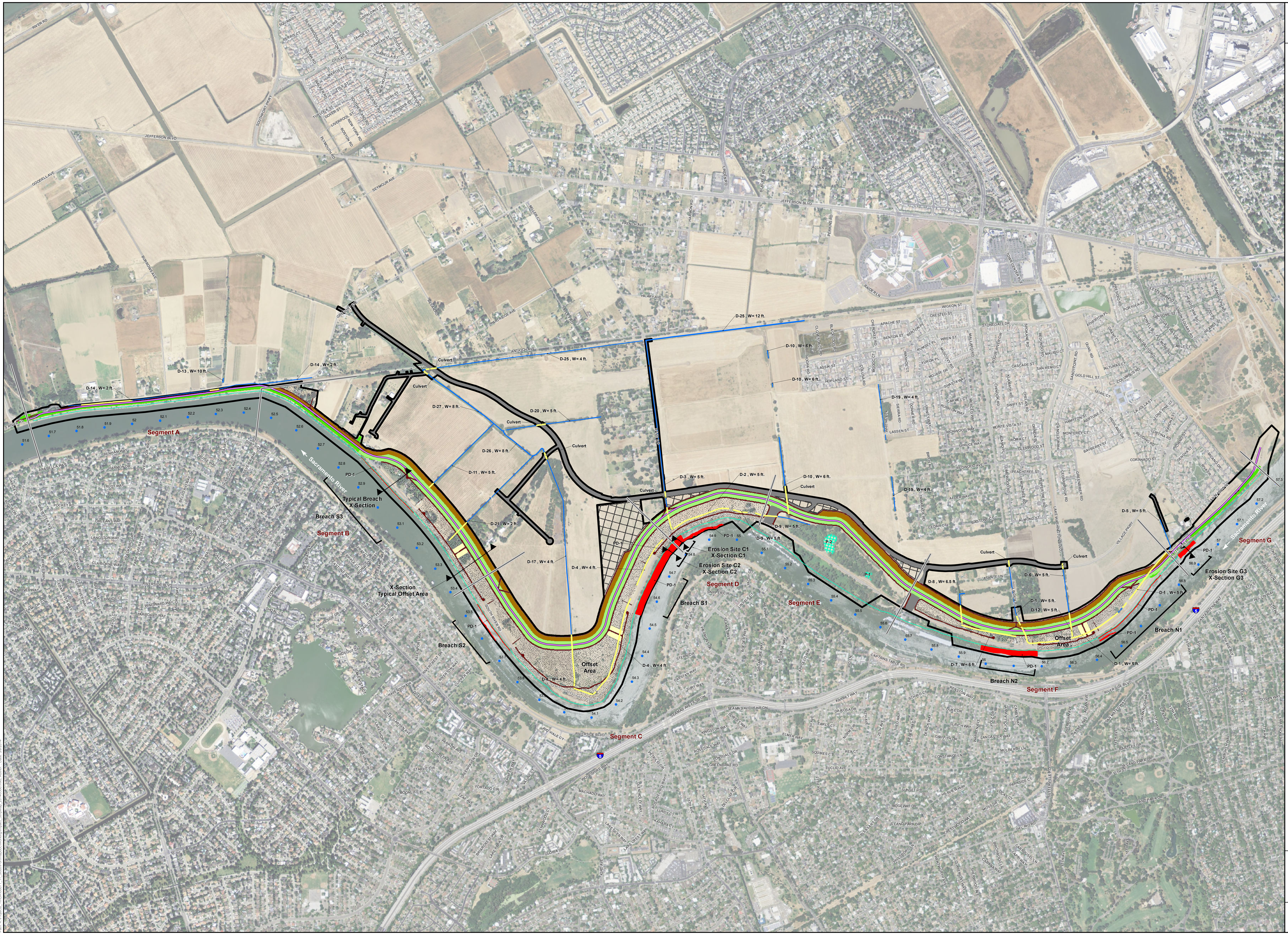
Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be April 16, 2014.

Appendix B
Design Drawings of the Bank Stabilization, Levee Repair, and Levee Breach Designs



Path: K:\Projects_1\HDR\00071_11_SouthPort\mapdoc\Working\Fig_1_Location_Impact_20131210.mxd AA 5/8/2014

Figure 1
Project Location



Southport Sacramento River
Early Implementation Project
May 6, 2014
SPK-2012-00462

Legend

- Construction Area Boundary
- Ditch Fill (1.548 acres)
- Rock Fill (10.306 acres)
- Ordinary High Water Mark (OHWM)
- Segment Boundary
- Sacramento River Mile
- Pond
- Ditch

Project Elements

- Cutoff Wall
- Cellular Berms
- Offset Area Grading
- Proposed Roads
- O&M Corridor
- Seepage Berm
- Setback Levee
- Levee Degrade
- Staging Area

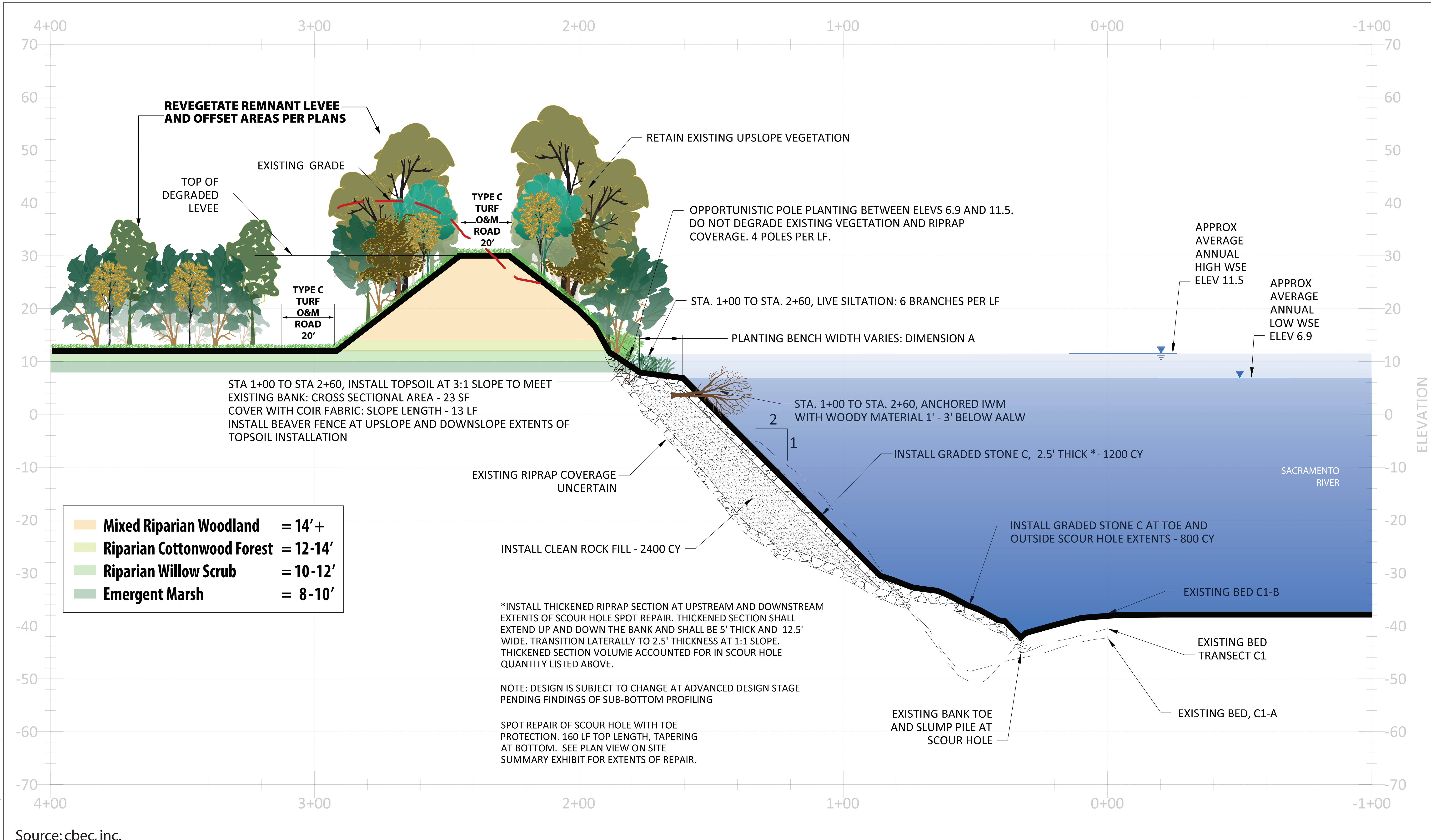
W = Average Width at Ordinary High Water Mark

0 400 800 1,600
Feet
1 inch = 800 feet

Notes:
Source: Project Elements, HDR, April 2014
Base Map Source: ICF, 2014
Imagery Source: NAIP 2010
USGS Topo Quad: Sacramento West
PLSS: Wetlands Land Grant

Prepared By: ICF, International 916.737.3000
Drawn By: Edward Douglas, March 28, 2013
Revised May 6, 2014

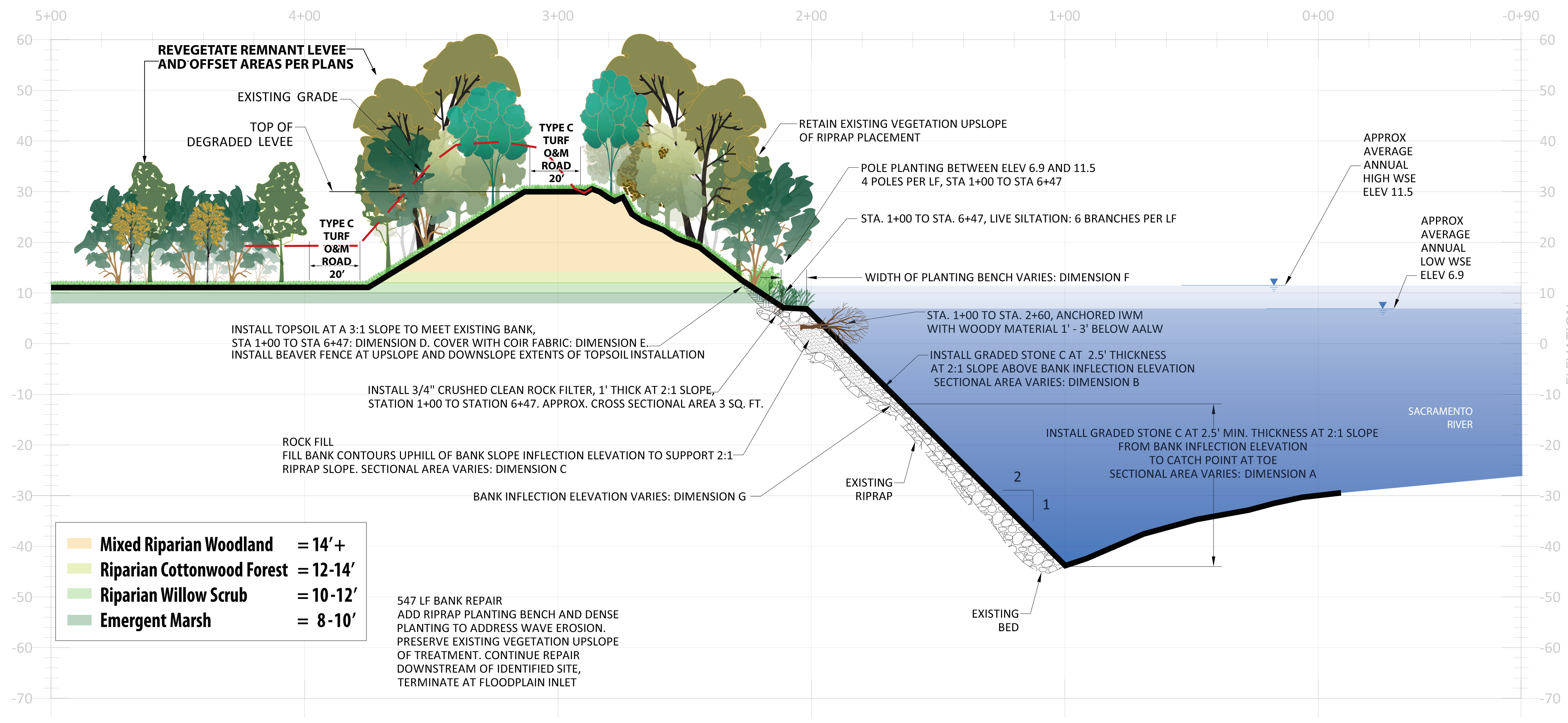
Figure 2
Project Plan View Showing Impacts to Potential Waters of the United States, Including Wetlands



Source: cbec, inc.

00071.11 Southport/Cross Sections (05-08-2014) SS

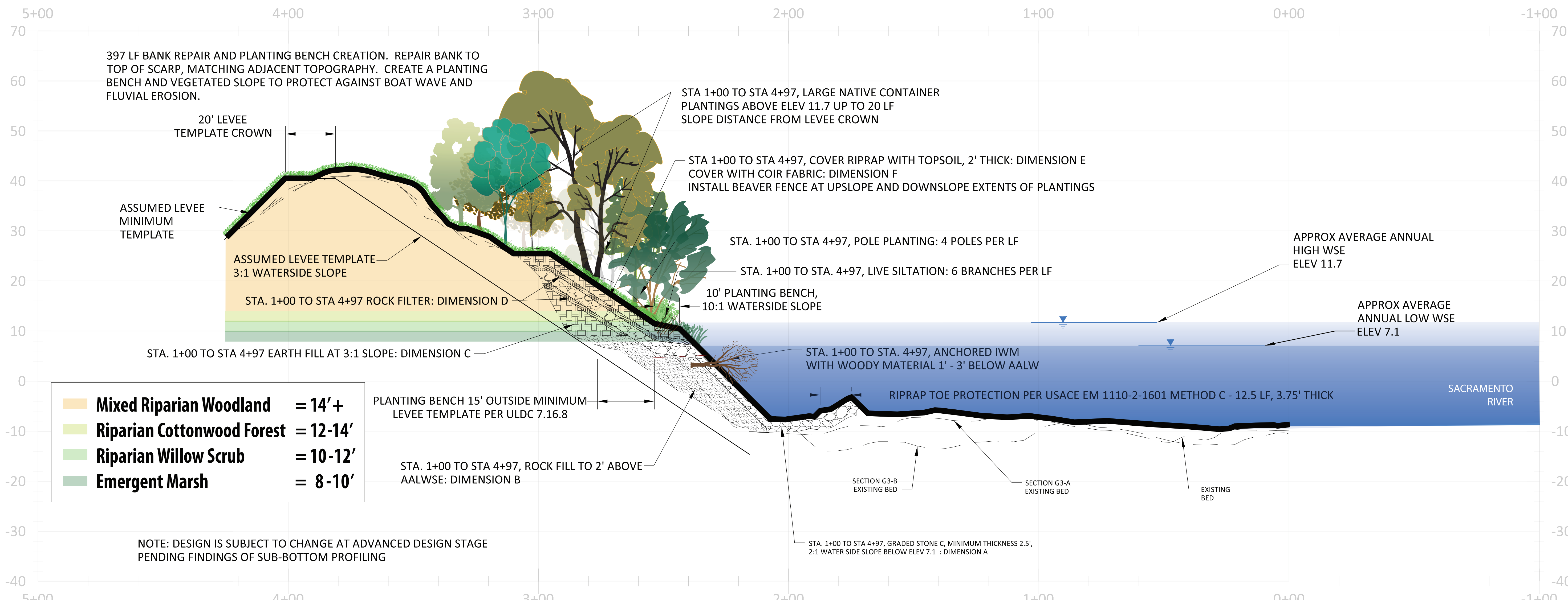
Figure 3a
Typical Section of Bank Armoring, Fill, and Restoration Plantings
Erosion Site C1, Remnant Levee, and O&M Roads
Existing Levee Station 166+00



00071.11 Southport/Cross Sections (05-08-2014) SS

Source: cbec, inc.

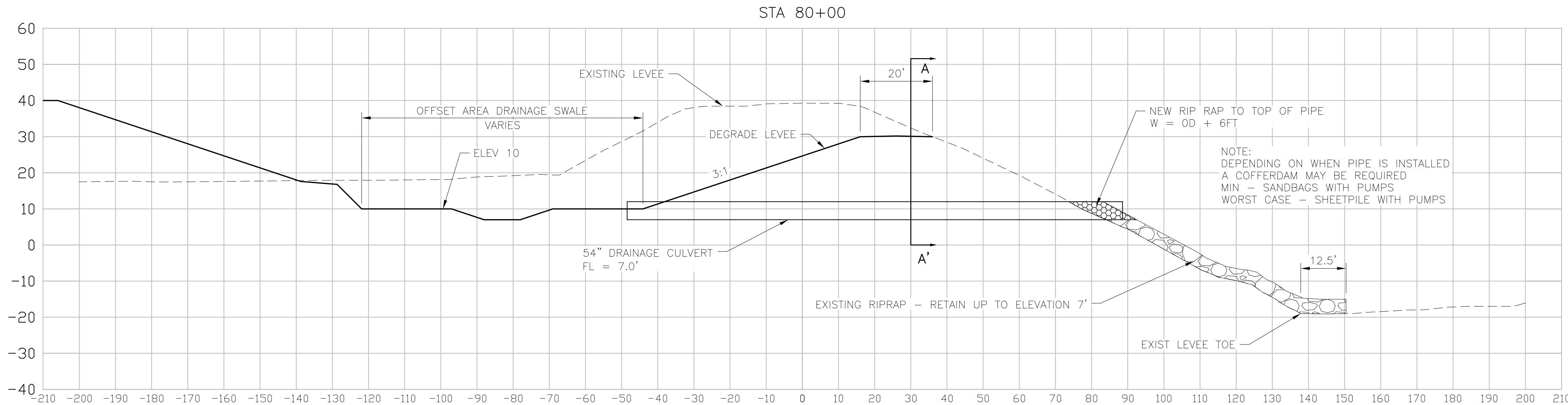
Figure 3b
Typical Section of Bank Armoring, Fill, and Restoration Plantings
Erosion Site C2, Remnant Levee, and O&M Roads
Existing Levee Station 160+00



Source: cbec, inc.

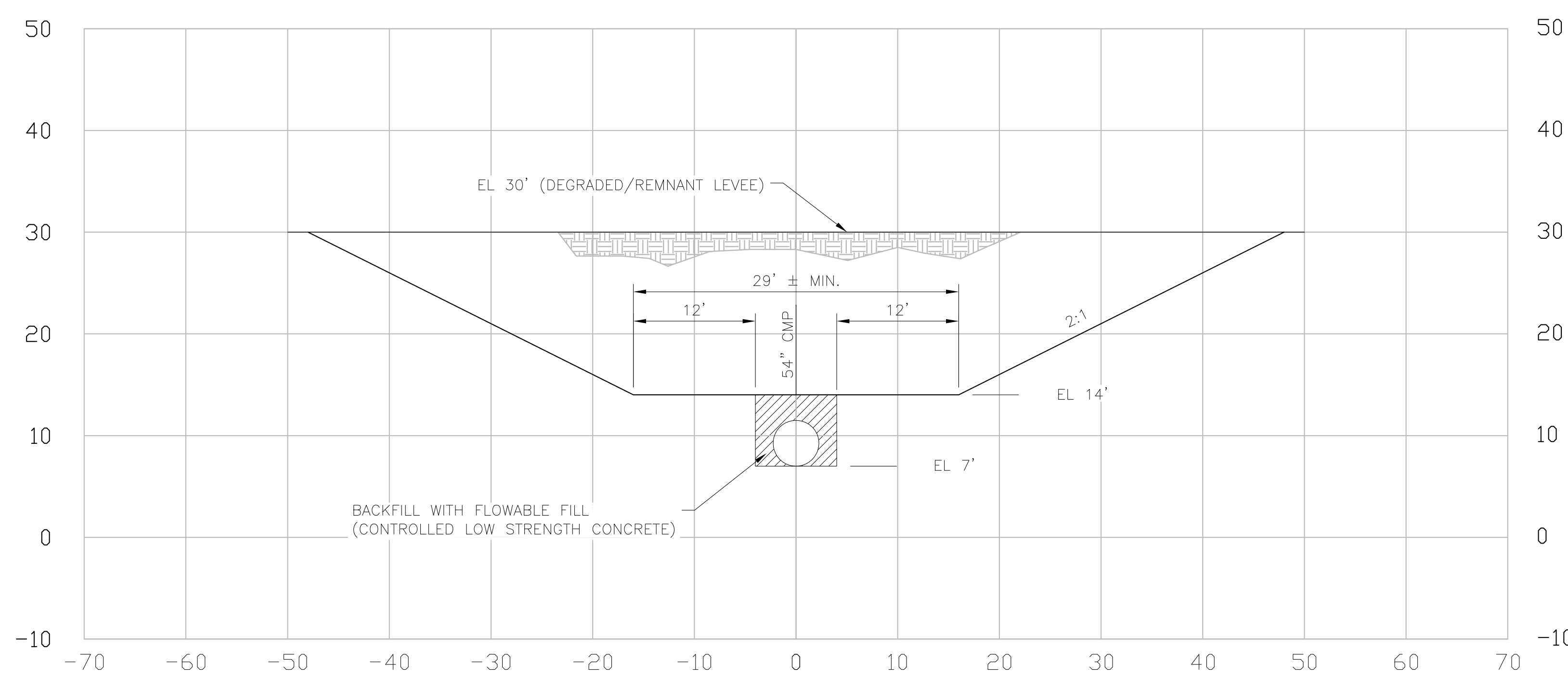
00071.11 Southport/Cross Sections (05-08-2014) SS

Figure 3c
Typical Section of Bank Armoring, Fill, and Restoration Plantings
Erosion Site G3
Existing Levee Station 275+00



TYPICAL SECTION

SCALE: 1" = 20'



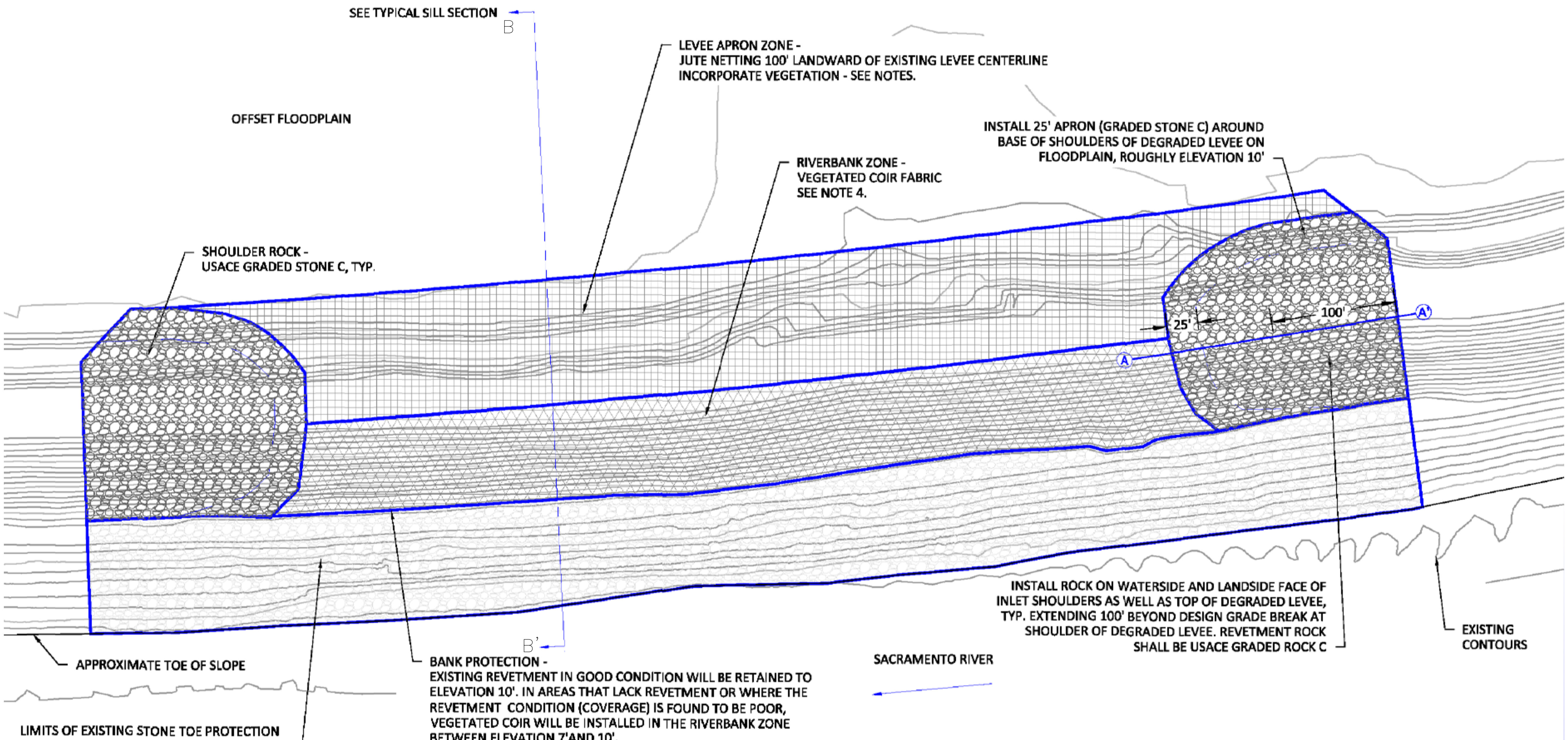
TYPICAL TRENCH SECTION A–A'

SCALE: 1" = 10'

Source: HDR (2014)

00071.11 Southport/PD for Permits (05-08-2014) SS

Figure 4
Typical Culvert Section
Breaches N2, S1, S2



NOTES:

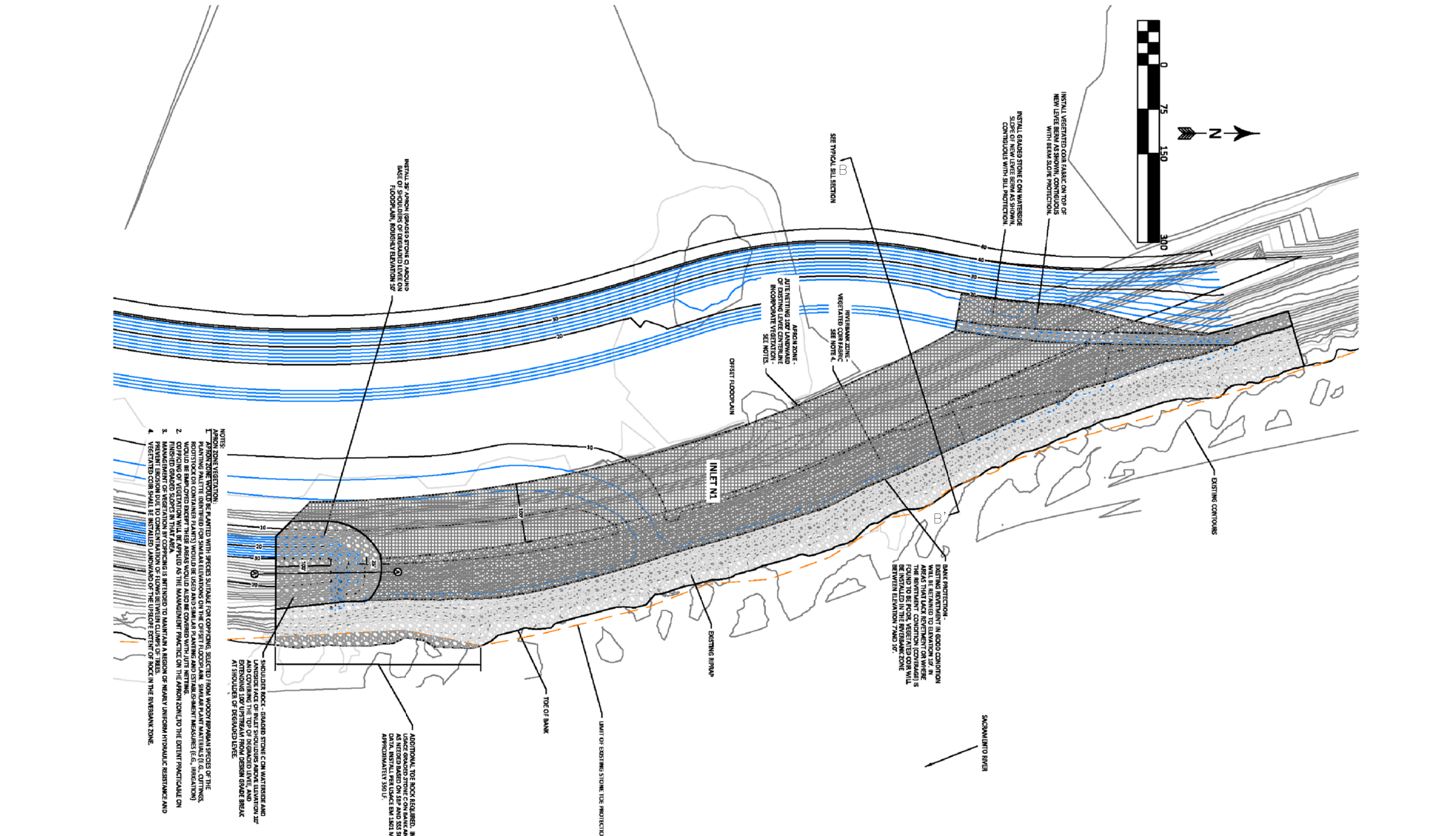
APRON ZONE VEGETATION:

1. APRON ZONE WOULD BE PLANTED WITH SPECIES SUITABLE FOR COPPICING, SELECTED FROM WOODY RIPARIAN SPECIES OF THE PLANTING PALETTE IDENTIFIED FOR SIMILAR ELEVATIONS ON THE OFFSET FLOODPLAIN. SIMILAR PLANT MATERIALS (E.G., CUTTINGS, ROOTSTOCK OR CONTAINER PLANTS) WOULD BE USED AND SIMILAR PLANTING AND ESTABLISHMENT MEASURES (E.G., IRRIGATION) WOULD BE EMPLOYED EXCEPT THESE AREAS WOULD ALSO BE COVERED WITH JUTE NETTING.
2. COPPICING OF VEGETATION WILL BE APPLIED AS THE MANAGEMENT PRACTICE ON THE APRON ZONE, TO THE EXTENT PRACTICABLE ON FINISHED GRADED SLOPES IN THAT AREA.
3. MANAGEMENT OF VEGETATION BY COPPICING IS INTENDED TO MAINTAIN A REGION OF NEARLY UNIFORM HYDRAULIC RESISTANCE AND PREVENT EROSION DUE TO CONCENTRATION OF FLOWS BETWEEN CLUMPS OF TREES.
4. VEGETATED COIR SHALL BE INSTALLED LANDWARD OF THE UPSLOPE EXTENT OF ROCK IN THE RIVERBANK ZONE.

Source: HDR (2014)

00071.11 Southport/PD for Permits (05-08-2014) SS

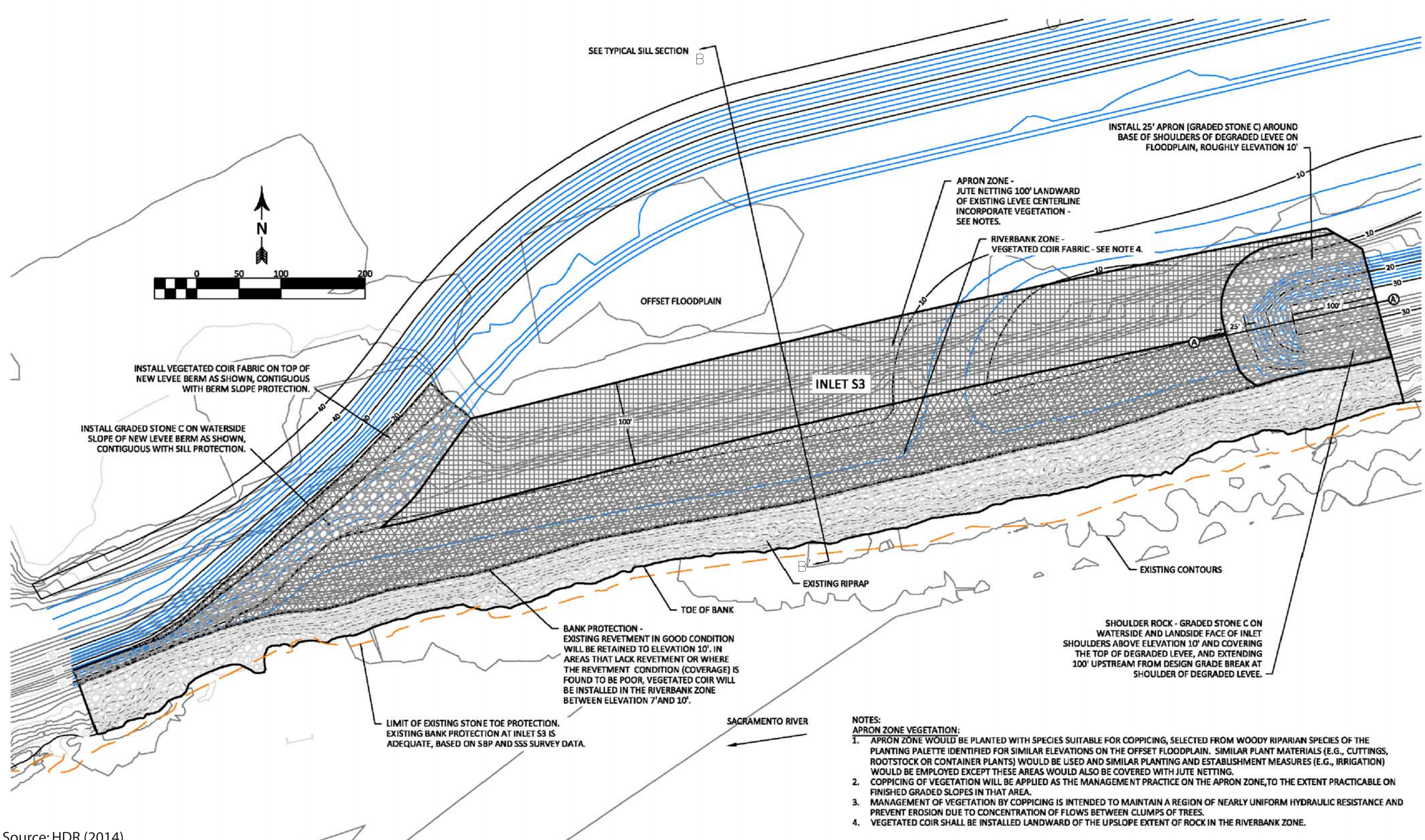
Figure 5a
Breach S1, S2, N2
Typical Plan View



Source: HDR (2014)

00071.11 Southport/PD for Permits (05-08-2014) SS

Figure 5b
Breach N1 Plan View



NOTES:
APRON ZONE VEGETATION:

1. APRON ZONE WOULD BE PLANTED WITH SPECIES SUITABLE FOR COPPICING, SELECTED FROM WOODY RIPARIAN SPECIES OF THE PLANTING PALETTE IDENTIFIED FOR SIMILAR ELEVATIONS ON THE OFFSET FLOODPLAIN. SIMILAR PLANT MATERIALS (E.G., CUTTINGS, ROOTSTOCK OR CONTAINER PLANTS) WOULD BE USED AND SIMILAR PLANTING AND ESTABLISHMENT MEASURES (E.G., IRRIGATION) WOULD BE EMPLOYED EXCEPT THESE AREAS WOULD ALSO BE COVERED WITH JUTE NETTING.
2. COPPICING OF VEGETATION WILL BE APPLIED AS THE MANAGEMENT PRACTICE ON THE APRON ZONE,TO THE EXTENT PRACTICABLE ON FINISHED GRADED SLOPES IN THAT AREA.
3. MANAGEMENT OF VEGETATION BY COPPICING IS INTENDED TO MAINTAIN A REGION OF NEARLY UNIFORM HYDRAULIC RESISTANCE AND PREVENT EROSION DUE TO CONCENTRATION OF FLOWS BETWEEN CLUMPS OF TREES.
4. VEGETATED COIR SHALL BE INSTALLED LANDWARD OF THE UPSLOPE EXTENT OF ROCK IN THE RIVERBANK ZONE.

Source: HDR (2014)

00071.11 Southport/PD for Permits (05-08-2014) SS

Figure 5c
Breach S3 Plan View

K:\Projects_1\HDR\00071_11_SouthPort\mapdoc\BA_Figures\Fig_3_Elderberry_ShrubLoc.mxd AA 5/9/2014

Figure 6
Elderberry Shrub Locations in the Action Area

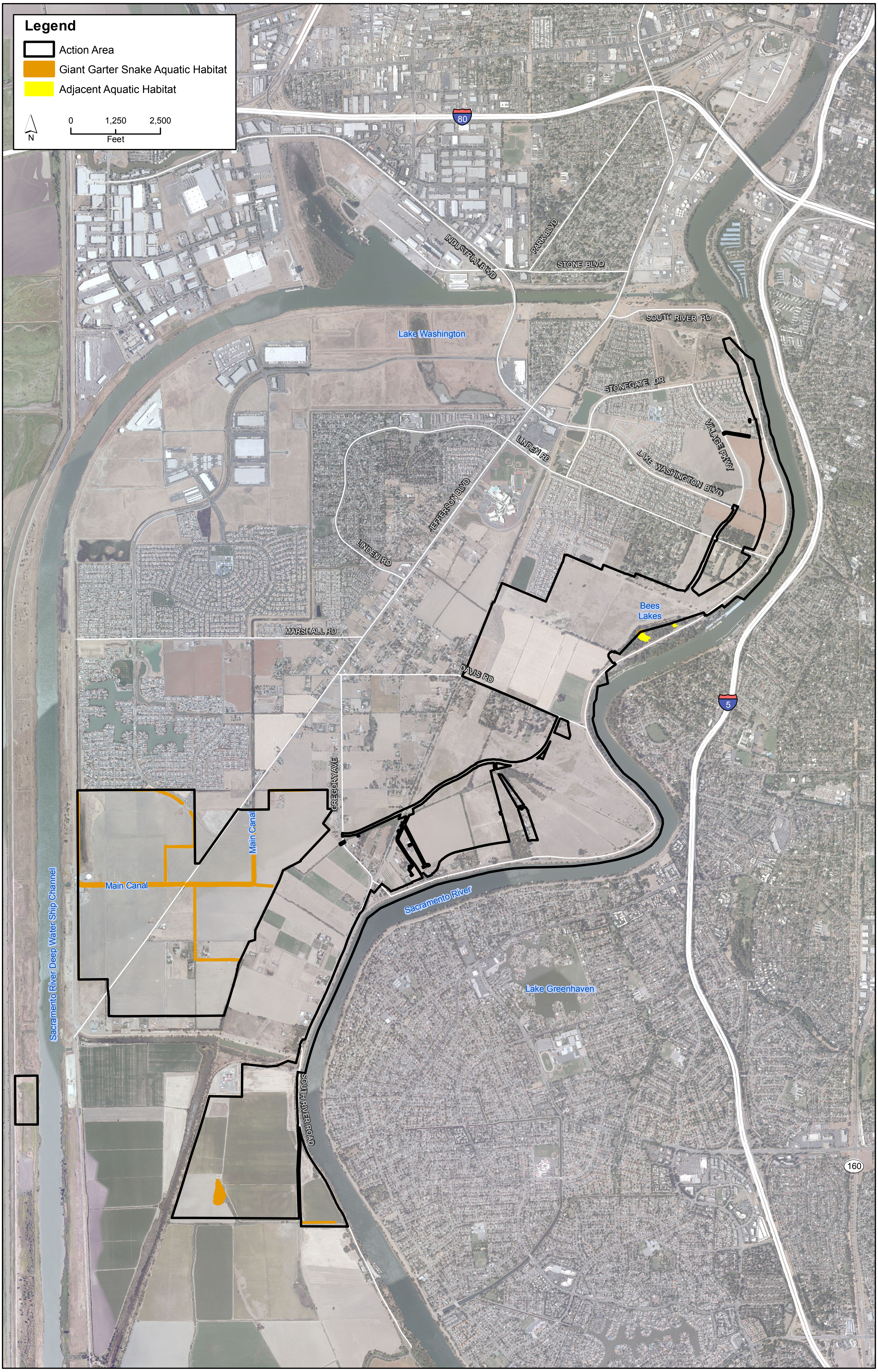


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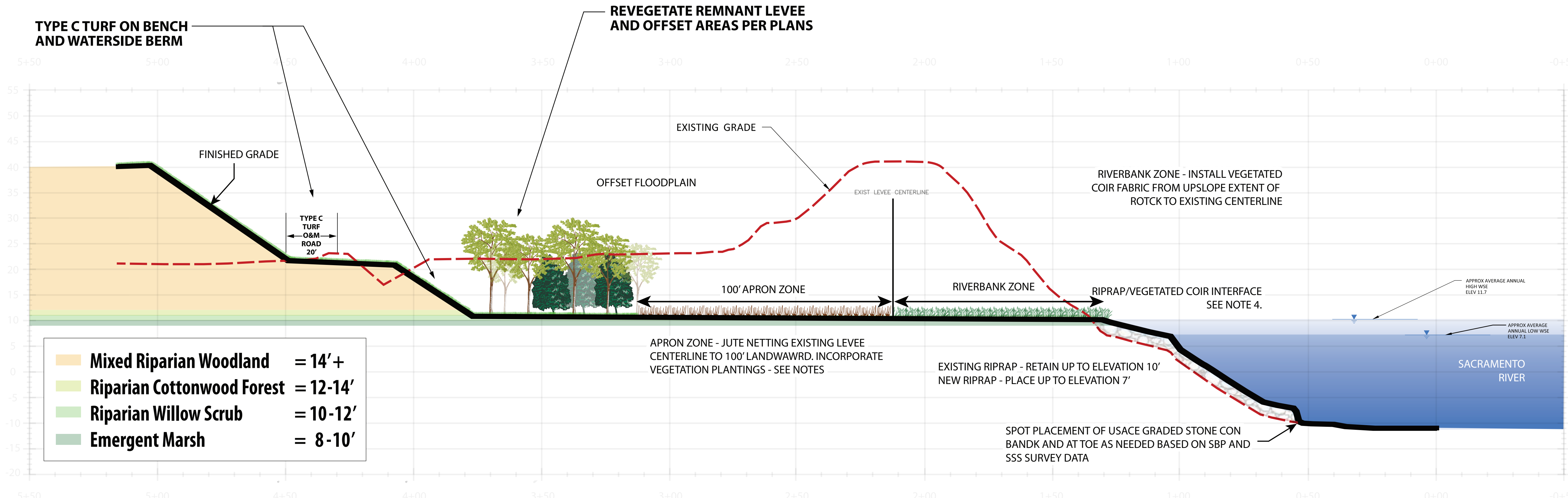
Figure 7
Suitable Giant Garter Snake Aquatic Habitat in the Action Area



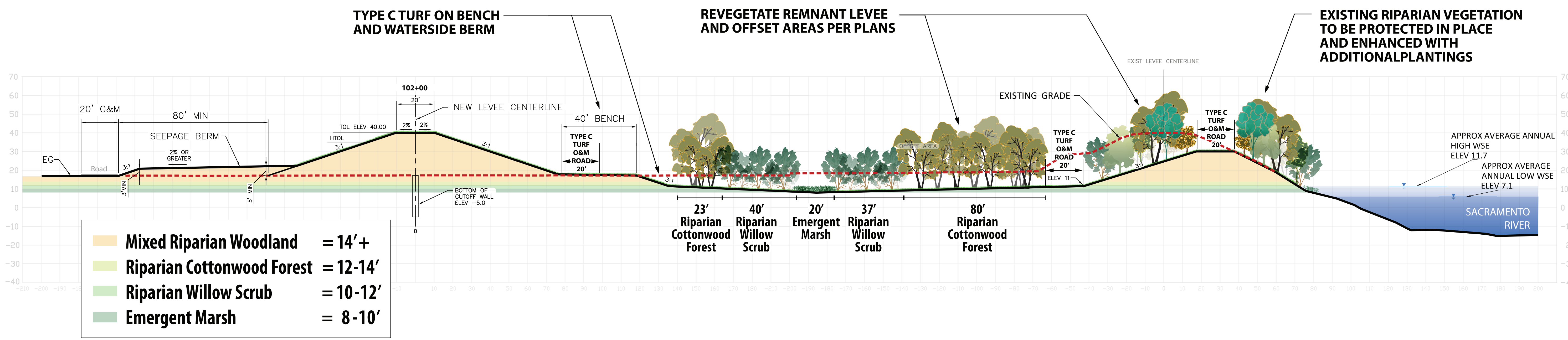
NOTES:

APRON ZONE VEGETATION:

1. APRON ZONE WOULD BE PLANTED WITH SPECIES SUITABLE FOR COPPICING, SELECTED FROM WOODY RIPARIAN SPECIES OF THE PLANTING PALETTE IDENTIFIED FOR SIMILAR ELEVATIONS ON THE OFFSET FLOODPLAIN. SIMILAR PLANT MATERIALS (E.G., CUTTINGS, ROOTSTOCK OR CONTAINER PLANTS) WOULD BE USED AND SIMILAR PLANTING AND ESTABLISHMENT MEASURES (E.G., IRRIGATION) WOULD BE EMPLOYED EXCEPT THESE AREAS WOULD ALSO BE COVERED WITH JUTE NETTING.
2. COPPICING OF VEGETATION WILL BE APPLIED AS THE MANAGEMENT PRACTICE ON THE APRON ZONE,TO THE EXTENT PRACTICABLE ON FINISHED GRADED SLOPES IN THAT AREA.
3. MANAGEMENT OF VEGETATION BY COPPICING IS INTENDED TO MAINTAIN A REGION OF NEARLY UNIFORM HYDRAULIC RESISTANCE AND PREVENT EROSION DUE TO CONCENTRATION OF FLOWS BETWEEN CLUMPS OF TREES.
4. EXISTING REVETMENT IN GOOD CONDITION WILL BE RETAINED TO ELEVATION 10'. IN AREAS THAT LACK REVETMENT OR WHERE THE REVETMENT CONDITION (COVERAGE) IS FOUND TO BE IN POOR CONDITION, VEGETATED COIR FABRIC WILL BE INSTALLED IN THE RIVERBANK ZONE BETWEEN ELEVATION 7'AND 10'.

00071.11 Southport/Cross Sections (05-08-2014) SS

Figure 8
Typical Sill, Inlet/Outlet Apron and Levee Breach Typical Section



ICF INTERNATIONAL

Figure 9
Typical Section of Proposed Levee, Offset Area, and Remnant Levee
Proposed Levee Station 102+00

Appendix C
Elderberry Stem Count Data for Action Area

Appendix C
Elderberry Stem Count Data for Action Area

C.1 Status in the Action Area

There are two California Natural Diversity Database (CNDDB) (2014) records of VELB occurrence in the action area (Figure 6 in the BA). One hundred and six elderberry shrubs were identified during the spring 2011–2013 surveys in the action area (Table C-1). Not all of these shrubs would be affected by the Proposed Action. See Section 3.2 Species Accounts in the biological assessment for the number of shrubs and stems directly and indirectly affected by the Proposed Action.

Table C-1. Summary of Stem Counts for All Elderberry Shrubs in the Action Area

Shrub	Presence of Exit Holes?	Riparian Habitat?	Number of Stems (by Diameter) 1–3 Inches	3–5 Inches	>5 Inches	Comments
1	N	N	3	4	2	
2	Y	Y	0	1	1	
3	Y	Y	13	5	5	
4	N	Y	19	2	2	
5	N	Y	18	0	1	
6	N	Y	60	5	9	
7	N	Y	33	10	18	
8	N	Y	8	5	2	
9	N	Y	30	2	8	
10	Y	Y	8	4	2	
11	–	Y	–	–	–	Covered in grapevines
12	–	Y	–	–	–	Covered in grapevines
13	–	Y	–	–	–	Covered with poison oak
14	–	Y	–	–	–	Covered with poison oak
15	–	Y	–	–	–	Covered with poison oak
16	Y	Y	1	1	2	No impact
17	Y	Y	1	0	1	No impact
18	Y	Y	3	0	2	No impact
19	Y	Y	17	2	3	No impact
20	Y	Y	11	1	1	No impact
21	Y	Y	8	2	2	No impact
22	–	Y	–	–	–	No impact. Covered in grapevines
23	N	Y	3	3	1	No impact
24	N	Y	18	7	7	
25	N	N	19	6	1	
26	N	N	18	2	0	
27	N	Y	9	0	2	Covered in blackberry brambles; best estimate of stems

Shrub	Presence of Exit Holes?	Riparian Habitat?	Number of Stems (by Diameter) 1–3 Inches	3–5 Inches	>5 Inches	Comments
28	N	Y	2	0	0	
29	–	–	–	–	–	
30	Y	Y	0	0	1	
31	–	N	–	–	–	No Access
32	N	N	3	1	1	
33	–	N	–	–	–	No Access
34	Y	N	12	6	10	
35	N	N	9	1	8	
36	N	Y	0	0	1	
37	–	Y	–	–	–	Covered in blackberry and poison oak
38	–	Y	–	–	–	Covered in blackberry and poison oak
39a	N	N	3	0	0	
39b	–	N	–	–	–	Covered in blackberry and poison oak
40	–	–	–	–	–	
41a	–	N	–	–	–	Covered in blackberry
41b	–	N	–	–	–	Covered in blackberry
41c	Y	N	5	7	2	
42	–	–	–	–	–	
43	–	–	–	–	–	
44a	–	–	–	–	–	
44b	–	–	–	–	–	
44c	–	–	–	–	–	
44d	–	–	–	–	–	
45	Y	N	1	0	9	
46	–	–	–	–	–	
47	Y	Y	42	8	2	
48	–	–	–	–	–	
49	N	N	0	0	1	
50	Y	N	16	7	7	
51	Y	N	14	4	7	
52	Y	Y	6	1	1	
53	Y	N	29	17	3	
54	N	Y	17	1	0	
55	–	–	–	–	–	
56	–	–	–	–	–	
57	–	–	–	–	–	
58	–	–	–	–	–	
59	–	–	–	–	–	
60	–	–	–	–	–	
61	–	–	–	–	–	
62	–	–	–	–	–	
63	–	–	–	–	–	

Shrub	Presence of Exit Holes?	Riparian Habitat?	Number of Stems (by Diameter) 1–3 Inches	3–5 Inches	>5 Inches	Comments
64	N	Y	31	12	0	Best estimate of stem count; shrub surrounded by willow/ blackberry/ fennel
65	N	Y	2	2	4	Thick grapevine surrounding shrub, best estimate of stem count.
66	N	Y	38	12	7	
67	N	Y	10	12	4	
68	Y	Y	16	4	2	
69	–	Y	–	–	–	Impenetrable blackberry around most of the shrub
70	N	Y	6	3	2	
71	–	Y	–	v	–	Impenetrable blackberry around most of the shrub
72	Y	Y	5	2	5	
73	N	Y	3	0	2	
74	Y	Y	24	7	7	
75	N	Y	47	5	1	
76	Y	Y	12	3	2	
77	Y	Y	11	3	0	
78	Y	Y	13	3	9	
79	Y	Y	9	4	5	
80	–	Y	–	–	–	Impenetrable blackberry
81	–	Y	–	–	–	Impenetrable blackberry
82	–	Y	–	–	–	Impenetrable blackberry
83	–	Y	–	–	–	
84	–	Y	–	–	–	Impenetrable blackberry
85	–	Y	–	–	–	Impenetrable blackberry
86	–	Y	–	–	–	Impenetrable blackberry
87	–	Y	–	–	–	
88	–	Y	–	–	–	Impenetrable blackberry around the shrub
89	–	Y	–	–	–	Impenetrable blackberry around the shrub
90	–	Y	–	–	–	Impenetrable blackberry and poison oak around the shrub
91	–	Y	–	–	–	Impenetrable blackberry and poison oak around the shrub
92	N	Y	10	15	8	
93	–	Y	–	–	–	Impenetrable blackberry
94	–	Y	–	–	–	Impenetrable blackberry
95	–	Y	–	–	–	Impenetrable blackberry
96	–	Y	–	–	–	Covered in grapes and poison oak
97	Y	Y	3	0	1	
98	N	Y	4	0	0	
99	N	N	1	0	0	
100	Y	Y	8	2	0	

Appendix D

Fish Habitat and Eco-Hydrologic Design Criteria for the Levee Setback

Table D-1. Native Fish Habitat Evaluation/Design Criteria for Southport EIP

Species	Season	Duration	Depth	Temp	Vegetation	Velocity	Dissolved Oxygen	Diet	Drainage Connectivity	Interannual Frequency	Flow (cfs)
Sacramento Splittail[1]	Mar-Apr	>3 weeks[2]	1-2 m[3]	<20oC[4]	Herbaceous annual vegetation[5]	Low but not stagnant[6]	>1 mg/L[7]	Macro-invertebrates, zooplankton	Complete to river to avoid stranding	1 out of 3 years[8]	33,500
Sacramento Splittail	Criteria as above									2 out of 3 years[8]	18,100
Juvenile Chinook Salmon[9]	Dec-May	>2 weeks[10]	1-2 m[11]	<20oC[12]	Variable[13]	<30 cm/sec[14]	>3 mg/L[15]	Macro-invertebrates, zooplankton	Complete to river to avoid stranding	1 out of 3 years[16]	70,100
Juvenile Chinook Salmon	Criteria as above									2 out of 3 years[16]	32,100

Notes:

1 Unless noted otherwise, the evaluation/design criteria for Sacramento splittail are based on Moyle et al. (2004).

2 Floodplain benefits for splittail increase with increasing duration of floodplain inundation; the minimum duration for completion of spawning, incubation, and larval development is approximately 3 weeks but the strongest year classes occur in years of continuous floodplain inundation during March and April.

3 Applies to adult Sacramento splittail pre-spawning and spawning life stages; larvae and juveniles may occur at shallower depths.

4 General upper limit of water temperatures associated with extended residence and spawning on floodplains.

5 Spawning Sacramento splittail have been observed in open floodplain areas with dense annual vegetation (e.g., cockleburs) but it is generally thought that a mosaic of riparian, wetland, and terrestrial habitats, including relatively large open areas dominated by annual vegetation, optimize benefits for native fish species and other floodplain-dependent species (Crain et al. 2004).

6 Sacramento splittail prefer slow moving sections of rivers and sloughs but flowing water is important for maintaining suitable temperatures and water clarity on floodplains.

7 Sacramento splittail can tolerate dissolved oxygen levels less than 1 mg/L but higher levels are preferred.

8 Sacramento splittail populations are expected to benefit from increasing frequency of appropriate habitat conditions on floodplains.

9 Unless noted otherwise, the evaluation/design criteria for Chinook salmon are based on Moyle (2002).

10 Floodplain benefits for juvenile Chinook salmon increase with increasing duration of floodplain inundation in winter and spring (Sommer et al. 2001); inundation periods of two weeks considered a minimum duration for juveniles to establish residency and experience enhanced growth on floodplain.

11 Corresponds to upper range of water depths utilized by juvenile Chinook salmon in Yolo Bypass during floodplain inundation (Sommer et al. 2005); juveniles likely occur at shallower depths based on general habitat preferences of juvenile Chinook salmon (e.g., Everest and Chapman 1972).

12 General upper limit of water temperatures associated with enhanced growth of juveniles in Yolo Bypass (Sommer et al. 2005).

13 Preferences for specific vegetation types have not been clearly defined but it is generally thought that a mosaic of riparian, wetland, and terrestrial habitats, including relatively large open areas dominated by annual vegetation, optimize benefits for native fish species and other floodplain-dependent species (Crain et al. 2004).

14 Juvenile Chinook salmon prefer low velocity areas but highest densities on floodplains are often associated with velocity gradients or non-uniform hydraulic conditions created by topographic variability and vegetation breaks on floodplain (Sommer et al. 2005); velocity preferences of juvenile Chinook salmon are size-dependent and generally range from near zero to 30 cm/sec (Bjornn and Reiser 1991).

15 Chinook salmon juveniles can tolerate dissolved oxygen levels as low as 3–4 mg/L but higher levels are preferred.

16 Chinook salmon populations are expected to benefit from increasing frequency of appropriate habitat conditions on floodplains.

Table D-2. Summary of Eco-hydrologic Criteria and Flows for Southport EIP

Species	Season	Duration	Interannual Frequency	Flow (cfs)	Approximate Recurrence Interval (years)	Approximate Water Surface Elevation (NAVD 88 – ft) within Offset
Sacramento Splittail[1]	Mar-Apr	>3 weeks	1 out of 3 years[2]	33,500	1.05	10.5
Sacramento Splittail[1]	criteria as above		2 out of 3 years[2]	18,100	0.6	7
Juvenile Chinook Salmon[3]	Dec-May	>2 weeks[4]	1 out of 3 years[5]	70,100	1.9	20
Juvenile Chinook Salmon	criteria as above		2 out of 3 years[5]	32,100	1.05	10.4

Notes:

1 Unless noted otherwise, the evaluation/design criteria for Sacramento splittail are based on Moyle et al. (2004).

2 Sacramento splittail populations are expected to benefit from increasing frequency of appropriate habitat conditions on floodplains.

3 Unless noted otherwise, the evaluation/design criteria for Chinook salmon are based on Moyle (2002).

4 Floodplain benefits for juvenile Chinook salmon increase with increasing duration of floodplain inundation in winter and spring (Sommer et al. 2001); inundation periods of two weeks are considered a minimum duration for juveniles to establish residency and experience enhanced growth on floodplain.

5 Chinook salmon populations are expected to benefit from increasing frequency of appropriate habitat conditions on floodplains.

Appendix E

Standard Assessment Methodology (SAM) Methods and Assumptions

Appendix E
Standard Assessment Methodology

Long-term effects of the Southport EIP on critical habitat and species responses to these effects were measured using the Standard Assessment Methodology (SAM) (U.S. Army Corps of Engineers 2004). The SAM computations were performed using the SAM Electronic Calculation Template (ECT) Version 3.0 beta edition (June 2009) developed for the U.S. Army Corps of Engineers (USACE) and the Central Valley Flood Protection Board by Stillwater Sciences (U.S. Army Corps of Engineers 2004). The SAM was used to quantify the responses of the target fish species and life stages to with-project conditions over a 50-year project period relative to the species and life stage responses under existing conditions. The following describes the data sources, methods, and assumptions used to characterize existing and with-project habitat conditions. The results of the SAM for each species, life stage, season of occurrence, and target year, as applied to the Southport EIP, are presented graphically in Appendix F.

E.1 Characterization of Existing Conditions

The following data sources were used to characterize SAM habitat conditions (as defined by bank slope, floodplain availability, substrate size, instream structure, aquatic vegetation, and overhanging shade) within the Southport project area under existing or pre-project conditions:

- USACE's Sacramento River revetment database – This database was used to stratify the project reach into subsegments that encompass relatively uniform bank conditions based on their general physical characteristics (USACE 2007). This database was used to characterize existing habitat conditions within individual subsegments where more recent data were unavailable.
- West Sacramento/Southport EIP Revetment Condition Assessment – This report presents the results of a recent assessment of existing revetment conditions within the project reach, including extent of riprap cover, particle size distribution, bank profile, presence of vegetation, and photographs of representative sites (cbec 2012).
- Southport Sacramento River EIP 65% Design Submittal Design Documentation Report –This report includes topographic profiles and photographs of the existing erosion sites that were used to characterize bank slope, substrate, and cover characteristics of specific subsegments within the Southport project area (HDR 2013).
- Tree locations and canopy diameters delineated during tree surveys conducted in 2012-2013.
- Aerial images of the Southport EIP project reach (Google™ Earth, August 13, 2013 imagery) provided updated images of bank conditions that were used to address gaps or uncertainties related to existing cover characteristics within individual subsegements.

GIS was used to overlay the project features on an aerial image of the project reach to create a base map for the SAM assessment. For the purposes of the SAM, the project reach was subdivided into 42 segments based on the boundaries of the proposed project features (e.g., levee breaches) and subsegments representing relatively uniform bank conditions as defined by the USACE's revetment database. This segmentation was used to characterize existing and with-project habitat values within each segment and weight these values according to the percent contribution of each segment to the total reach length.

The SAM employs six habitat attributes to characterize nearshore, SRA cover, and floodplain habitat of listed fish species:

- ***Bank slope*** – Average bank slope along the average annual summer, fall, winter, and spring water surface elevation.
- ***Floodplain availability*** – Ratio of wetted area for the 2-year flood flow to the wetted area for the average annual winter-spring flow.
- ***Bank substrate size*** – Median particle diameter of the bank (i.e., D_{50}) along each average seasonal water surface elevation.
- ***Instream structure*** – Percent of shoreline coverage of IWM along each average seasonal water surface elevation.
- ***Aquatic and riparian vegetation*** – Percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation.
- ***Overhanging shade*** – Percent of the shoreline coverage of shade along each average seasonal water surface elevation.

The following describes how input values for each of these attributes were derived for existing conditions in the SAM assessment.

Bank Slope

Existing bank slopes (rise-over-run ratio) were obtained from levee profiles drawn from topographic data collected at 18 riprap evaluation transects (Segments A, B, F, and G) and 13 erosion study transects (Segments C, D, E, and F) on the waterside slope of the Southport levee. Transect locations were imported into the GIS base map to determine the applicability of individual or multiple transects to specific subsegments. Additional levee profiles were obtained as needed from a CAD-based topographic surface of the existing project levee. Within each subsegment, the average slopes of the levee within the 3-foot depth zone below the average annual low and high water surface elevations (WSEs) were used to characterize the availability of shallow water habitat under average summer-fall and winter-spring inundation conditions.

Floodplain Availability

The SAM attribute of floodplain inundation ratio, which represents floodplain availability, was assumed to have a value of 1, reflecting the absence of significant floodplain habitat above the winter-spring shoreline under existing conditions.

Bank Substrate Size

The median substrate size (D_{50}) along the summer-fall and winter-spring shorelines of the project reach was determined using a combination of particle size data collected at revetment transects (cbec 2012), photographs taken at revetment and erosion site transects (cbec 2012, HDR 2013), aerial photography (Google Inc. 2010), and the revetment data (USACE 2007). Based on previous SAM assessments (e.g., USACE 2007a), all natural or unrevetted banks were considered to have a D_{50} of 0.25 inches. For revetted sites, it was evident that the USACE database consistently overestimated the median particle sizes at individual revetment sites based on comparison of these values with the values generated from Wolman pebble counts at representative transects. Because of the higher level of accuracy associated with pebble counts, median particle sizes from pebble count data were used to characterize substrate conditions at existing revetment sites. Where data were lacking, the average D_{50} of 6 inches from the pebble count data was applied to existing revetment sites.

Instream Structure

The extent of IWM along the average summer-fall and winter-spring shorelines of the Southport project reach could not be reliably quantified except at several subsegments where aerial and ground-based photography provided reasonable coverage. Therefore, the USACE's revetment database was used as the primary source for these values. The revetment database uses four classes of instream structure, based on ranges of percent shoreline having IWM. Table E-1 indicates how these revetment database attribute values were converted to a single value for input to SAM. These values were assumed to be appropriate for both the summer-fall and winter-spring seasons.

Table E-1. Conversion of Revetment Database Instream Woody Material Classes to SAM Attribute Value for Instream Structure.

Revetment Database IWM Class	SAM Input Value
None	0%
1-10%	5%
11-50%	30%
>50%	75%

Aquatic Vegetation

None of the recent survey data or photographs allowed an accurate determination of the extent of aquatic or riparian vegetation along the average summer-fall and winter-spring shorelines of the Southport project reach. Following the approach used by USACE (2007a), the revetment database attribute for Emergent Vegetation was used for fall and summer aquatic vegetation characterization, and the Ground Cover attribute was used for the spring and winter characterization. Within the Southport project reach, this approach generally gave a vegetation value of zero for fall and summer WSELs, which is appropriate given the scarcity of emergent aquatic vegetation. Table E-2 indicates how these revetment database attribute values were converted to a single value for input to SAM.

Table E-2. Conversion of Revetment Database Emergent Vegetation and Ground Cover Classes to SAM Attribute Values for Vegetation.

	Revetment Database Class	SAM Input Value
Fall and Summer:	False	0%
	PEM 1-5%	3%
Emergent Vegetation Attribute	PEM 6-25%	15%
	PEM 26-75%	50%
	PEM >75%	85%
Spring and Winter:	<25%	13%
	26-50%	38%
Ground Cover Attribute	51-75%	63%
	>75%	88%

E.1.1.1 Overhanging Shade

The extent of overhanging shade along the summer-fall and winter-spring shorelines of the project reach was determined using a combination of tree survey data and aerial photography of the project reach taken in October 2010 (Google Inc. 2010). Polygons denoting the canopy coverage of each surveyed tree were imported into the GIS base map. The percent of the average summer-fall shoreline covered by shade was estimated within each segment based on the intersection of canopy cover with the apparent shoreline in the photograph (average Sacramento River flow at Freeport in October 2010 was approximately 12,000 cfs which is typical of fall flows in the Action Area). The percent of the average winter-spring shoreline covered by shade was estimated by shifting the shoreline position approximately 15 feet landward (based on an average slope of 3:1 for the project reach) and examining each sub-segment for any significant changes in the extent of overhanging canopy cover.

E.1.1.2 Summary of Existing Conditions

Existing conditions were calculated as the weighted average of the habitat attribute values across all subsegments (Table E-3). These averages served as the input values describing existing conditions for the SAM assessment. Consistent with previous applications of the SAM, existing conditions are assumed to remain unchanged during the 50-year project period.

Table E-3. Southport Sacramento River EIP – SAM Input Values (Existing Conditions)

	Seasonal Values			
	Fall	Winter	Spring	Summer
Shoreline Length (feet)	30,604	30,604	30,604	30,604
Bank Slope (dW:dH)	2.9:1	2.8:1	2.8:1	2.9:1
Floodplain Inundation Ratio (AQ2:AQavg)	1.0:1	1.0:1	1.0:1	1.0:1
Bank Substrate Size (D50 in inches)	5.1	5.0	5.0	5.1
Instream Structure (% shoreline)	4.9	7.1	7.1	4.9
Vegetation (% shoreline)	0.0	70.3	70.3	0.0
Shade (% shoreline)	7.4	17.4	17.4	7.4

E.1.2 Characterization of With-Project Conditions

With-project conditions were characterized using the 90% design plans and specifications, including representative cross-sections of the proposed erosion repair sites, levee breaches, and levee setback areas, and assumptions related to the density and growth of planted vegetation within these project features. With-project conditions on the waterside levee slope were characterized by four major bank treatment types: erosion repair site, levee breach (including shoulder rock), and planted remnant levee. Existing conditions were assumed to persist throughout the 50-year project period for segments where no treatment was proposed. However, winter-spring floodplain inundation ratios for these segments were modified depending on the presence of a setback levee and the ratio of the distance of the new levee from the centerline of the river to the distance of the existing levee from the centerline of the river. Assumptions regarding the extent of shoreline cover (aquatic vegetation and overhanging shade) provided by planted vegetation are based on planting densities and canopy growth rates of trees and shrubs for similar bank protection designs.

Through iteration of the SAM, it was found that 1,000-1,500 linear feet of revegetated remnant levee (depending on existing SRA cover values) would be required to achieve full onsite compensation of SRA cover impacts along the summer-fall shoreline. To illustrate the effect of this compensation action, the results in Appendix F include the effects of planting approximately 1,100 feet of the remnant levee in Segments F and G of the project levee (immediately upstream and downstream of the erosion repair site G3).

Years 1 through 50 represent the number of years following construction. The proposed timing of construction of each project component was incorporated into the SAM assessment to reflect the temporal changes in habitat conditions during the four-year construction period.

The following describes how input values for each of the SAM habitat attributes were derived for with-project conditions.

E.1.2.1 Bank Slope

For the erosion repair sites, a bank slope of 10:1 was assumed in winter and spring and 2:1 in summer and fall based on the design slopes and elevation of the constructed bench relative to the average seasonal water surface elevations (Appendix B, Figures 3a through 3c). These changes would take effect in year 2 of the construction period based on the proposed construction schedule. For the levee breaches, a bank slope of 10:1 was assumed in winter and spring based on the design slope and elevation of the breaches relative to the average winter-spring water surface elevation (Appendix B, Figure 8). This change would take effect in year three of the construction period for levee breaches N1 and S3 and year five of the construction period for levee breaches N2, S1, and S2. No change in levee slope was assumed for the toe of the levee breaches (below the summer-fall shoreline) or for the toe and upper slopes of the levee breach shoulders (above and below the summer-fall shoreline); if needed, rock placed on these zones would match the contours of the existing levee slope. No changes in levee profile or slope were assumed for the planted remnant levee.

E.1.2.2 Floodplain Availability

The distance from the centerline of the Sacramento River to the centerline of the existing levee and the distance from the centerline of the river to the centerline of the proposed setback levee (perpendicular and through the center of each subsegment) were measured in GIS to calculate the floodplain inundation ratio for each sub-segment. Sub-segments without landward setback levees were assumed to retain a floodplain inundation ratio of 1:1. All summer-fall floodplain inundation ratios were assumed to be 1:1. Based on the proposed construction schedule, it was assumed that the setback levee and associated increases in floodplain width would not be effective until the initial breaching of the existing levee at sites N1 and S3 in year 3 of construction.

E.1.2.3 Bank Substrate Size

For all bank treatments involving the placement of rock, it was assumed that the median size of rock would be 10 inches in diameter based on previous SAM assessments (e.g., Jones & Stokes 2006). Although natural processes are expected to result in the deposition of fine sediment on the rock bench, 10-inch diameter rock was assumed to be the dominant substrate type along the winter-spring shoreline throughout the 50-year evaluation period because of uncertainties related to the timing and extent of sediment deposition. Where soil and/or coir fabric would be placed on top of the constructed bench, levee slope, or levee beach to create a planting surface, the median substrate size was assumed to be 0.25 inches. Based on the proposed construction schedule, changes in bank substrate size would take effect in year 2 at the erosion repair sites (G3, C1, and C2) and in year 3 at the initial levee breach sites (N1 and S3). With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites (N2, S1, and S2). These effects include the replacement of existing substrate with 10-inch diameter rock along approximately 600 feet (200 feet per breach) of the existing levee in year 3. These culverts and associated rock revetment would be removed in year 5 to create the remaining levee breaches.

E.1.2.4 Instream Structure

Although an effort would be made to preserve existing IWM within the proposed levee breaches and erosion repair sites, it was assumed that all existing IWM would be eliminated from the summer-fall and winter-spring shorelines during construction. However, all erosion repair site designs include the installation of onsite and imported IWM that would be anchored on the waterside face of the constructed bench to enhance nearshore habitat values within the average summer-fall inundation zone (below 7-foot elevation) (Appendix B, Figures 3a through 3c). It was assumed that IWM would cover approximately 40% of the shoreline of each erosion repair site and would persist throughout the 50-year assessment period. With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites (N2, S1, and S2). These effects include the removal of existing vegetation along approximately 600 feet (200 feet per breach) of the existing levee in year 3.

E.1.2.5 Aquatic Vegetation

At the erosion repair sites, all existing riparian and aquatic vegetation below elevation 12 feet would be removed in year 2, resulting in the loss of instream cover primarily within the winter-spring inundation zone. In the same year, woody riparian vegetation would be planted on the constructed bench and adjacent slope, resulting in 20% cover along the winter-spring shoreline. At all sites, it was assumed that planted vegetation would provide 20% shoreline cover through year 5, 50% by year 15, and 75% by year 25. An average of 75% shoreline cover is assumed to be maintained through year 50.

At the levee breach sites, degradation of the levee would result in the removal of all existing levee vegetation. This would occur in year 3 at the initial levee breach sites (N1 and S3) and year 5 at the remaining levee breach sites (N2, S1, and S2). In these years, woody riparian vegetation would be planted within the levee breach, resulting in 20% cover within the winter-spring inundation zone. Within the levee breaches, it was assumed that planted vegetation would provide 20% cover through year 5, 50% by year 15, and 75% by year 25. An average of 75% shoreline cover is assumed to be maintained through year 50. It was assumed that the levee breach shoulders would be maintained free of vegetation throughout the 50-year assessment period.

With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites (N2, S1, and S2). These effects include the removal of existing vegetation along approximately 600 feet (200 feet per breach) of the existing levee in year 3.

The same assumptions regarding the extent of cover provided by planted vegetation at the erosion repair sites would be applied to the remnant levee planting sites.

E.1.2.6 Overhanging Shade

At the erosion repair sites, the removal of all existing vegetation below elevation 12 feet would eliminate all canopy (shade) cover along the average summer-fall shoreline, while retention of upslope vegetation would preserve the shade along the average winter-spring shoreline. With the construction of the bench and planting of riparian vegetation on the bench and adjacent slope in year 2, it was assumed that planted vegetation would contribute 10% canopy cover through year 5, 25% canopy cover by year 15, and a maximum of 50% cover by year 25 over the average winter-spring shoreline. Based on projected canopy growth rates and the average width of the benches, these plantings are expected to provide 10% canopy cover by year 15 and a maximum of 20% by year 25 over the average summer-fall shoreline.

Degradation of the levee to create the levee breaches would result in the removal of all existing vegetation and canopy cover in year 3 at the initial levee breach sites (N1 and S3) and year 5 at the remaining levee breach sites (N2, S1, and S2). Similar to the erosion repair sites, woody riparian vegetation planted within the levee breach in these years is expected to result in 10% canopy cover within the winter-spring inundation zone. However, because of periodic coppicing of vegetation on the levee breach to minimize scour damage, it is assumed that canopy cover would be limited to a maximum of 25% (10% cover through year 5 and 25% between years 15 and 50).

Because of unrestricted growing conditions and the proximity of vegetation to the average winter-spring and summer-fall shorelines on remnant levees, it was assumed that planted vegetation on remnant levees would achieve greater canopy coverage and natural IWM recruitment than that projected for the erosion repair sites. Accordingly, it was assumed that planted vegetation on remnant levees would provide 1) 10% canopy cover through year 5, 30% by year 15, and a maximum of 60% by year 25 over the average winter-spring shoreline, 2) 15% canopy cover by year 15 and a maximum of 40% by year 25 over the average summer-fall shoreline; 3) 10% instream structure (IWM) between years 15 and 50 within the average winter-spring inundation zone; and 4) 5% instream structure between years 15 and 50 within the average summer-fall inundation zone. These values are comparable to those observed in areas of high riparian tree density on the existing project levee.

With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites (N2, S1, and S2). These effects include the removal of existing vegetation and overhead canopy along approximately 600 feet (200 feet per breach) of the existing levee in year 3.

E.1.2.7 Summary of With-Project Conditions

With-project conditions were calculated as the weighted average of the habitat attribute values across all subsegments (Table E-4). These averages served as the input values describing with-project conditions for the SAM assessment.

[Table is on next page]

Table E-4. Southport Sacramento River EIP – SAM Input Values (With-Project Conditions)

	Seasonal Values			
	Fall	Winter	Spring	Summer
Shoreline Length (feet)	30,604	30,604	30,604	30,604
Bank Slope (dW:dH)				
Year 0	2.9:1	2.8:1	2.8:1	2.9:1
Year 1	2.9:1	2.8:1	2.8:1	2.9:1
Year 2	2.9:1	3.4:1	3.4:1	2.9:1
Year 3	2.9:1	3.4:1	3.4:1	2.9:1
Year 4	2.9:1	4.2:1	4.2:1	2.9:1
Year 5	2.9:1	4.2:1	4.2:1	2.9:1
Year 50	2.9:1	4.2:1	4.2:1	2.9:1
Floodplain Inundation Ratio (Q2:Qavg)				
Year 0	1.0:1	1.0:1	1.0:1	1.0:1
Year 1	1.0:1	1.0:1	1.0:1	1.0:1
Year 2	1.0:1	1.8:1	1.8:1	1.0:1
Year 3	1.0:1	1.8:1	1.8:1	1.0:1
Year 4	1.0:1	1.8:1	1.8:1	1.0:1
Year 5	1.0:1	1.8:1	1.8:1	1.0:1
Year 50	1.0:1	1.8:1	1.8:1	1.0:1
Bank Substrate Size (D50 in inches)				
Year 0	5.1	5.0	5.0	5.1
Year 1	5.1	5.0	5.0	5.1
Year 2	5.7	4.8	4.8	5.7
Year 3	5.7	4.8	4.8	5.7
Year 4	5.8	4.3	4.3	5.8
Year 5	5.8	4.3	4.3	5.8
Year 50	5.8	4.3	4.3	5.8
Instream Structure (% shoreline)				
Year 0	4.9	7.1	7.1	4.9
Year 1	4.9	7.1	7.1	4.9
Year 2	5.9	6.6	6.6	5.9
Year 3	5.9	6.6	6.6	5.9
Year 4	5.7	6.4	6.4	5.7
Year 5	5.7	6.4	6.4	5.7
Year 15	5.9	6.8	6.8	5.9
Year 50	5.9	6.8	6.8	5.9
Aquatic Vegetation (% shoreline)				
Year 0	0.0	70.3	70.3	0.0
Year 1	0.0	70.3	70.3	0.0
Year 2	0.0	63.8	63.8	0.0
Year 3	0.0	63.8	63.8	0.0
Year 4	0.0	60.5	60.5	0.0
Year 5	0.0	60.5	60.5	0.0
Year 15	0.0	72.6	72.6	0.0
Year 50	0.0	72.6	72.6	0.0
Shade (% shoreline)				
Year 0	7.4	17.4	17.4	7.4
Year 1	7.4	17.4	17.4	7.4
Year 2	6.4	16.8	16.8	6.4
Year 3	6.4	16.8	16.8	6.4
Year 4	5.7	16.7	16.7	5.7
Year 5	5.7	16.7	16.7	5.7
Year 15	7.5	22.2	22.2	7.5
Year 50	7.5	22.2	22.2	7.5

E.1.3 References Cited

E.1.3.1 Printed References

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E.1.3.2 Electronic Data

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Appendix F
SAM Results

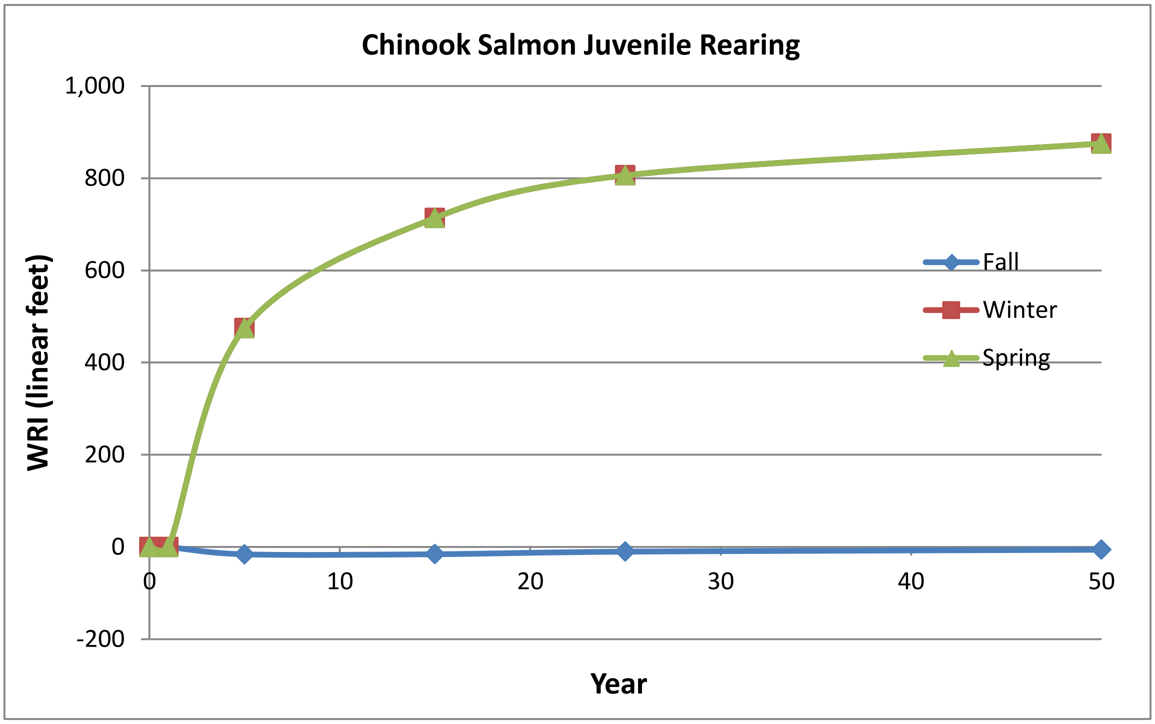

Figure F-1. Chinook Salmon Juvenile Rearing Weighted Response Indices for Southport Early Implementation Project

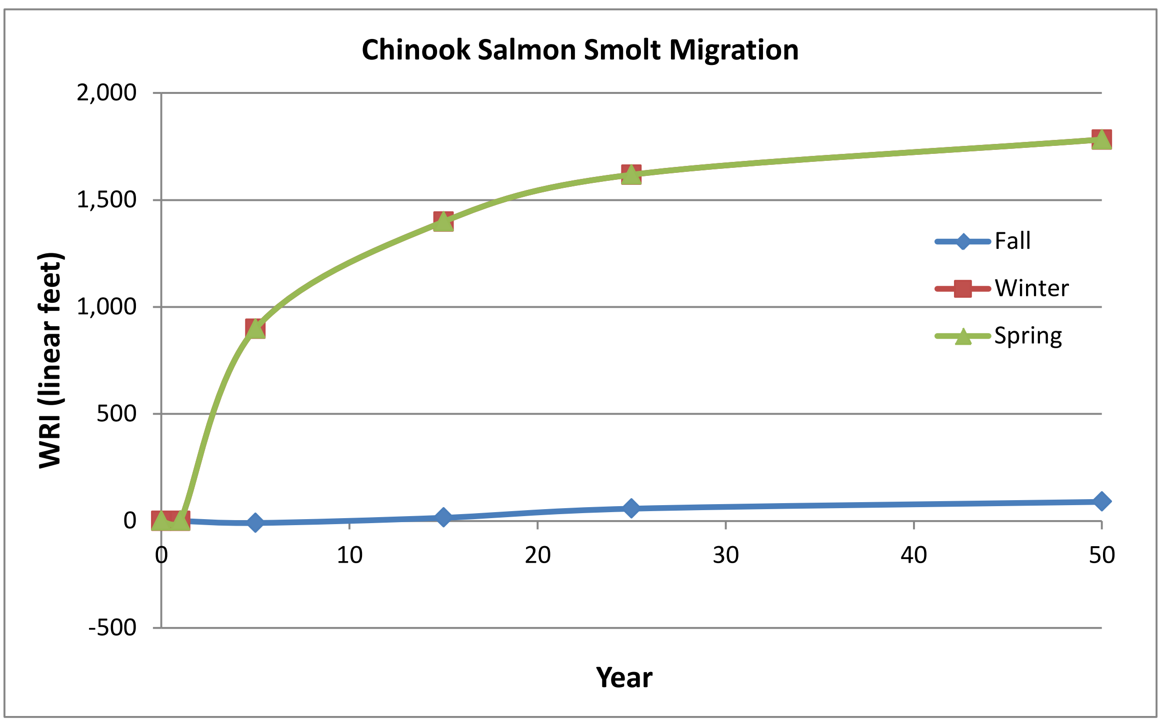

Figure F-2. Chinook Salmon Smolt Migration Weighted Response Indices for Southport Early Implementation Project

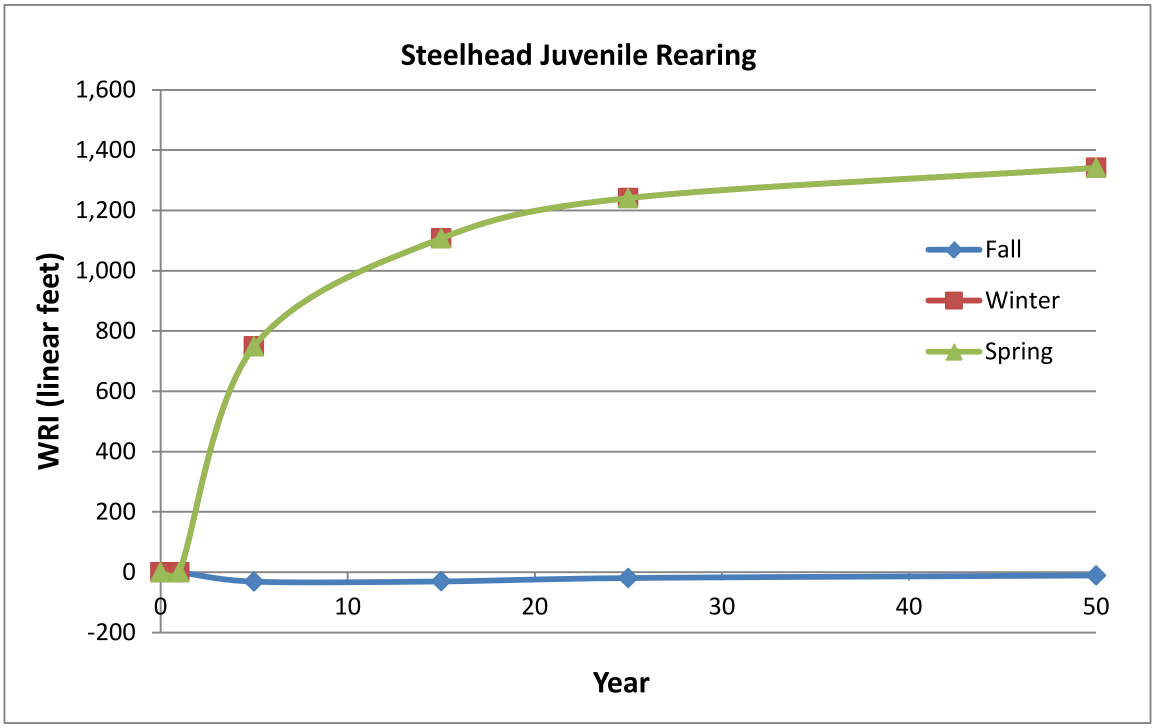

Figure F-3. Steelhead Juvenile Rearing Weighted Response Indices for Southport Early Implementation Project

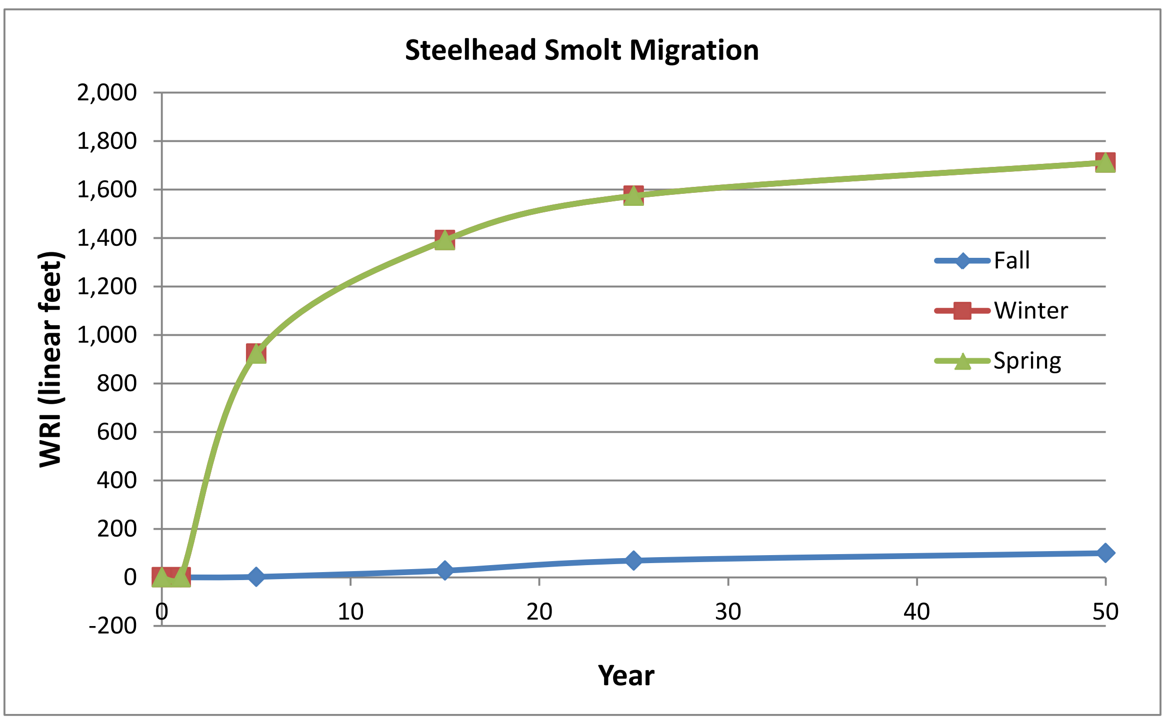

Figure F-4. Steelhead Smolt Migration Weighted Response Indices for Southport Early Implementation Project

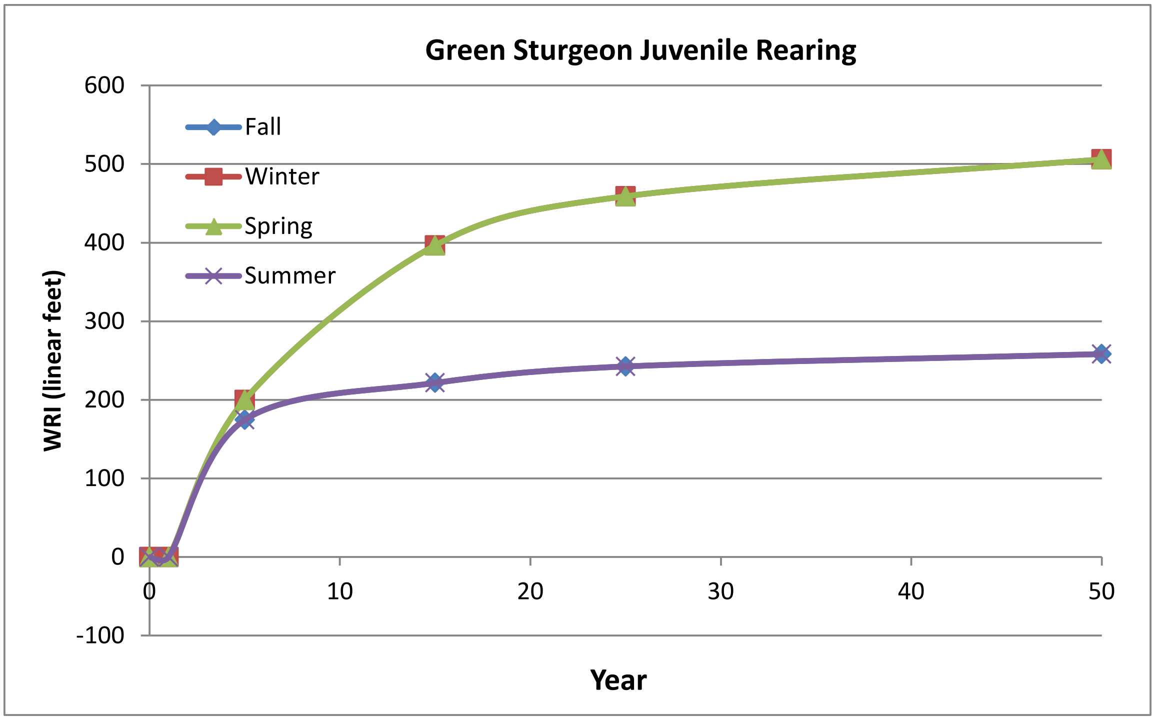

Figure F-5. Green Sturgeon Juvenile Rearing Weighted Response Indices
for Southport Early Implementation Project