Habitat Mitigation, Monitoring, and Adaptive Management Plan

American River Common Features General Reevaluation Report

December 2015

US Army Corps of Engineers®

Central Valley Flood Protection Board — Public Safety and Flood Management — State of California

SAFCA Sacramento Area Flood Control Agency

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Acronyms and Abbreviations

AAHU	Average Annual Habitat Unit
ARCF	American River Common Features
BA	biological assessment
BO	biological opinion
BPWG	Bank Protection Working Group
Corps	U.S. Army Corps of Engineers
County Parks	Sacramento County Department of Parks and Recreation
EIS/EIR	environmental impact statement/environmental impact report
ERDC	Engineer Research and Development Center
ETL	Engineering Technical Letter
GRR	general reevaluation report
GGS	giant garter snake
HEC-EFM	Hydrologic Engineering Center Ecosystem Function Model
HMMAMP	Habitat Mitigation, Monitoring, and Adaptive Management Plan
HSI	Habitat Suitability Index
HU	Habitat Units
IEP	Interagency Ecological Program
IWG	Interagency Working Group
IWM	instream woody material
NMFS	National Marine Fisheries Service
NEMDC	Natomas East Main Drainage Canal
PCE	primary constituent elements
PED	preconstruction engineering and design
RM	river mile
sDPS	southern distinct population segment
SRA	shaded riverine aquatic habitat
SMART	specific, measurable, attainable, realistic, and timely
SMWSE	summer mean water surface elevation
SWIF	System Wide Improvement Framework
TSP	tentatively selected plan
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VELB	valley elderberry longhorn beetle
WRDA	Water Resources Development Act
WMWSE	winter mean water surface elevation

1.0 INTRODUCTION

1.1 Purpose and Goals

Mitigation for habitat loss is a requirement to compensate for the loss of habitat due to a Federal action. Section 906(d) of the Water Resources Development Act of 1986 states that project alternatives must support recommendations with a specific plan to mitigate fish and wildlife losses. Additionally, the Endangered Species Act states that the purpose of compensatory mitigation is to offset environmental losses resulting from unavoidable impacts.

The primary purpose of vegetation and habitat monitoring is to determine the level of ecological function at each mitigation site as a part of an overall plan to create sites that offset the loss of habitat affected by construction of the proposed project. This Habitat Mitigation Monitoring and Adaptive Management Plan (HMMAMP) describes the types of habitats that will be impacted, the potential impacts caused by the project, and describes the types and amounts of mitigation that would be established in order to compensate for habitat losses. This plan also establishes a framework for the creation of mitigation sites and methods to evaluate the success of these sites in order to ensure that the goals and requirements of the project's required mitigation are accomplished.

The goal of the HMMAMP is to ensure that the conservation values of the mitigation sites are maintained in good condition in perpetuity. The plan's biological goals are to: (1) preserve the abundance and diversity of native species (particularly special status species) in the established habitats; (2) protect the habitat features from the effects of indiscriminate land use that may adversely impact mitigation habitats; and (3) restore any adverse condition within the mitigation habitat areas that may affect or potentially affect these areas. Monitoring would be conducted in a manner compatible with the type of mitigation site. Mitigation requirements are provided by the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) through biological opinions (BOs) received through the Endangered Species Act Section 7 consultation process.

The HMMAMP would be implemented by U.S. Army Corps of Engineers (Corps) staff through coordination with USFWS and NMFS. Monitoring would be conducted by qualified biologists from the Corps, USFWS, the Department of Water Resources (DWR), and the Sacramento Area Flood Control Agency (SAFCA) as necessary. Upon completion of the monitoring term as established by USFWS and NMFS, the land would be turned over to the non-Federal sponsor to be maintained in perpetuity.

1.2 Project Description

The Environmental Impact Statement/Environmental Impact Report (EIS/EIR) prepared for the American River Common Features General Reevaluation Report (ARCF GRR) describes the environmental resources in the project area; evaluates the direct, indirect, and cumulative environmental effects of the three alternative plans; and identifies avoidance, minimization, and mitigation measures. Most potential adverse effects would be either short term or would be avoided or reduced using best management practices.

The proposed project is located in and around the city of Sacramento, California. Sacramento is the state capital of California, located at the confluence of the Sacramento and American Rivers in the northern portion of California's Central Valley. The Sacramento Metropolitan area is the fourth largest in California, and includes seven counties and seven incorporated cities.

The purpose of the ARCF GRR is to evaluate alternatives to reduce the flood risk in the greater Sacramento area. The Sacramento Metropolitan area is one of the most at risk areas for flooding in the United States. There is a high probability that flows in either the American or Sacramento Rivers would stress the network of levees protecting the study area to the point that levees could fail. The consequences of such a levee failure would be catastrophic since the inundated area is highly urbanized and the flooding could be up to 20 feet deep.

The ARFC GRR study area includes: (1) approximately 12 miles of the north and south banks of the American River immediately upstream from the confluence with the Sacramento River; (2) the east bank of the Natomas East Main Drainage Canal (NEMDC), Arcade Creek, and the Magpie Creek Diversion Canal (collectively referred to as the East Side Tributaries); (3) the east bank of the Sacramento River downstream from the American River to Freeport, where the levee ties into Beach Lake Levee, the southern defense for Sacramento; and (4) the Sacramento Weir and Bypass, located along the north edge of the city of West Sacramento. A vegetation variance is being sought to allow for vegetation to remain on the lower portion of the waterside levee slope. A complete summary of the proposed measures is shown on Table 1.

Table 1. Proposed Measures for the ARCF Project.

Waterway/Location	Extent of Action	Proposed Measures
American River	North and south levees from the Sacramento River upstream for approximately 12 miles.	Construct bank protection or launchable rock trenches
Sacramento River	East levee from the American River to the North Beach Lake levee.	Install cutoff walls Construct bank protection Construct levee raise (Alternative 1 – 7 miles Alternative 2 – 1 mile) Construct geotextile reinforced soil embankment levee near the town of Freeport
NEMDC	East levee from Dry/Robla Creek to the American River.	Install cutoff walls Construct floodwalls
Arcade Creek	North and south levees from NEMDC to Marysville Boulevard.	Install cutoff walls Raise floodwalls Construct geotextile reinforced soil embankment levee in steep areas on the south levee
Magpie Creek Diversion Canal	Downstream of Raley Boulevard	Raise levees
Magpie Creek area	West side of Raley Boulevard	Construct new levee Install floodgates at two properties
Magpie Creek area	East of Raley Boulevard	Acquire property to create a flood detention basin Widen the Raley Boulevard/Magpie Creek bridge and raise the elevation of the roadway Remove the Don Julio Creek culvert
Magpie Creek area	Sacramento Northern Bike Trail	Install culvert beneath bike trail embankment Excavate new channel connecting culvert to Robla Creek Install stone erosion protection in new channel
Sacramento Weir and Bypass	North bypass levee to 1,500 feet north.	Widen the Sacramento Weir and Bypass by approximately 1,500 feet Construct a new section of weir and levee remove the existing Sacramento Bypass north levee

The Recommended Plan for the ARCF project is to Improve Levees and Widen the Sacramento Weir and Bypass. This alternative would include widening the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass and alleviate the need for most of the raises along the Sacramento River downstream of the bypass. This alternative would also include minimal levee raises along the Sacramento River. In order to reduce the extent of levee raises, the Sacramento Weir and Bypass would be widened to divert more flows into the Yolo Bypass. The levees along the American River, NEMDC, Arcade, and Magpie Creeks, would be improved to address identified seepage, stability, erosion, and height concerns. The levees along the Sacramento River would be improved to address identified seepage, stability, erosion, and a small amount of levee raising. Due to hydraulic, real estate, and environmental constraints within the study area, the majority of the levees would be fixed in place.

The Recommended Plan is the least environmentally damaging practicable alternative under the Clean Water Act and the environmentally preferable alternative under NEPA. This is mainly because it results in less riparian habitat removal along the Sacramento River.

1.3 Proposed Flood Risk Management Measures

1.3.1 Bank Protection

This measure consists of placing rock revetment on the river's bank, and in some locations on the levee slope, to prevent erosion (Figure 1). 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 loose materials would be removed. In most cases, large vegetation would be permitted to remain at these sites. Temporary access ramps would be constructed, if needed, using imported borrow material that would be trucked on site.

1.3.2 Launchable Rock Trench

This measure includes construction of a launchable rock filled trench, designed to deploy once erosion has removed the bank material beneath it (Figure 1). All launchable rock trenches would be constructed outside of the natural river channel. The vegetation would be removed from the footprint of the trench and the levee slope prior to excavation of the trench. The trench would be excavated at the toe of the existing levee. The bottom of the trench would be constructed close to the summer mean water surface elevation in order to reduce the rock launching distance and amount of rock required.

After excavation, the trench would be filled with revetment that would be imported from an offsite location. After rock placement the trench would be covered with a minimum of 3 feet of the stockpiled soil to allow for planting over the trench. Some vegetation could be permitted over the trench if planted outside the specified vegetation free zone required by the Engineering Technical Letter (ETL) 1110-2-583. This vegetation would likely be limited to native grasses, shrubs, and trees with shallow root systems to ensure that they do not limit the functionality of the trench during a flood event.

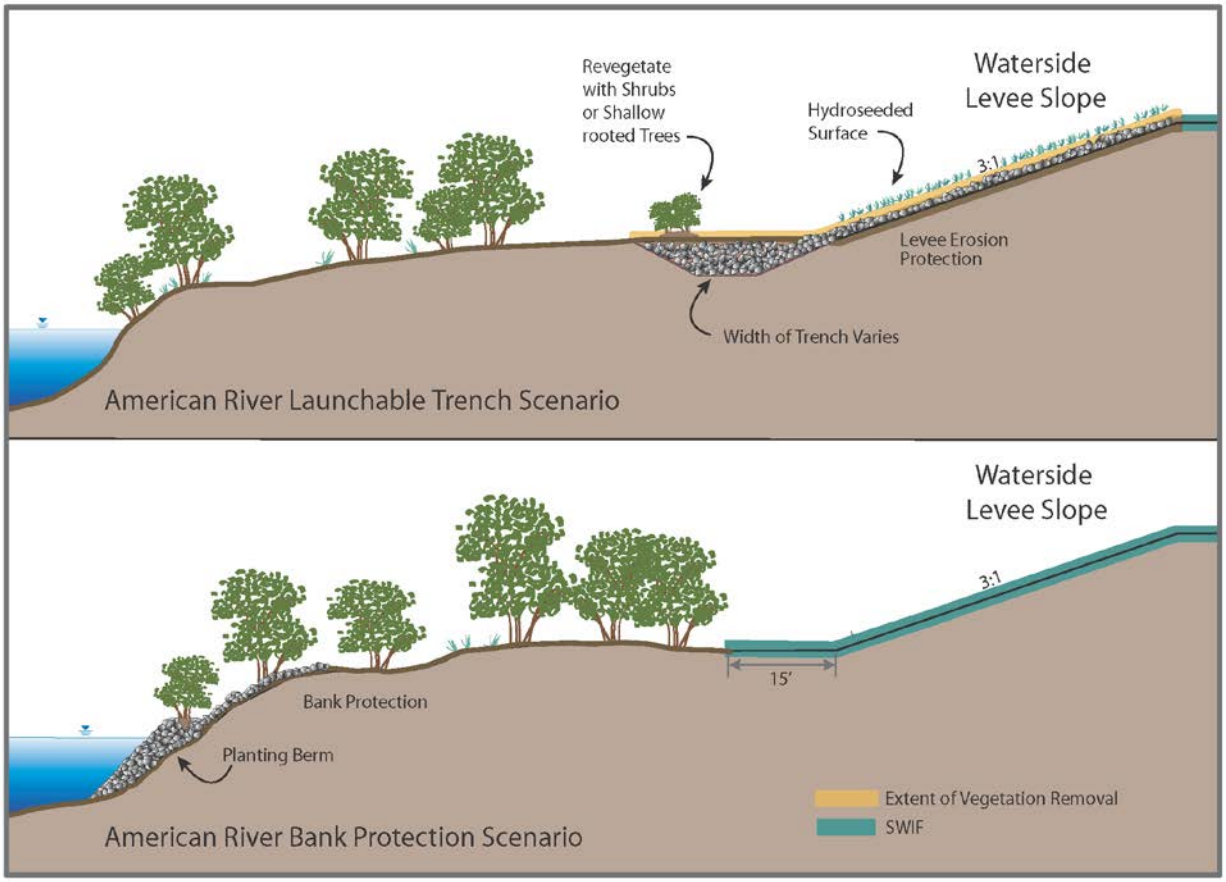

Figure 1. Bank Protection and Launchable Rock Trench Typical Design for American River.

1.3.3 Levee Geometry

Where the existing levee cross section does not meet the levee design requirements, slope flattening, crown widening, and/or a levee raise is required. This improvement measure addresses problems with slope stability, geometry, overtopping, and levee toe and crest access and maintenance. To begin levee embankment grading, the area would be cleared, grubbed, stripped, and, where necessary, portions of the existing embankment would be excavated to allow for bench cuts and keyways to tie in additional embankment fill. The existing levee centerline would be shifted landward

where necessary in order to meet Corps standard levee footprint requirements. The levee crown patrol road would be re-established and a new toe access corridor would be added 10 feet landward of the levee toe in areas where levee raises are required.

1.3.4 Cutoff Walls

To address seepage concerns, a cutoff wall would be constructed through the levee crown (Figure 2). A cutoff wall is a water resistant barrier that is constructed vertically into the levee and is designed to prevent through and underseepage in the levee. 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 80 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 up to 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.

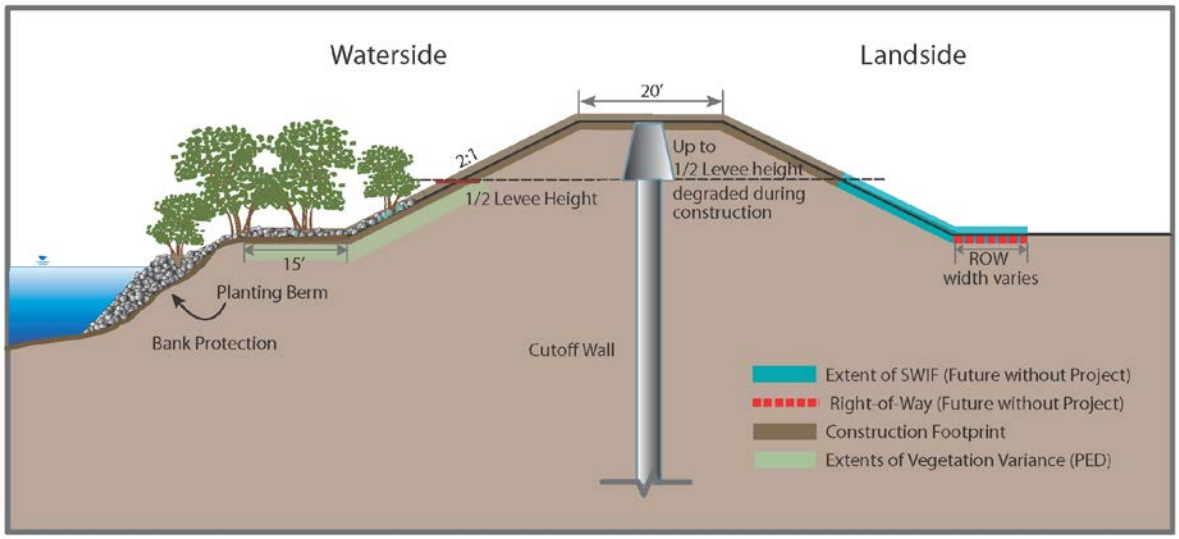

Figure 2. Fix-in-place with Cutoff Wall and No Levee Raise on the Sacramento River.

1.4 Types of Habitats Impacted

A variety of different habitat types occur within the study area including riparian habitat, shaded riverine aquatic habitat, oak woodland, ruderal herbaceous grasslands, and wetlands. These habitats are briefly described below.

1.4.1 Giant Garter Snake Upland Habitat

The giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, other waterways and agricultural wetlands such as irrigation and drainage canals and rice fields, and the adjacent uplands. Essential habitat components consist of: (1) adequate water during the snake's active period, (early spring through mid-fall) to provide a prey base and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat; (3) upland habitat for basking, cover, and retreat sites; and (4) higher elevation uplands for cover and refuge from flood waters.

Disturbed soil surfaces such as levee slopes should be hydroseeded to prevent erosion and restore upland habitat for giant garter snake. USFWS recommends a mix of at least 20 to 40 percent native grasses such as annual fescue (*Vulpia* spp.), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and needle grass (*Nassella* spp.); 2 to 10 percent native forbs; 5 percent rose clover (*Trifolium hirtum*); and 5 percent alfalfa (*Medicago sativa*). Approximately 40 to 68 percent of the mixture may be non-aggressive European annual grasses such as wild oats (*Avena sativa*), wheat (*Triticum* ssp.), and barley (*Hordeum vulgare*). The Corps will not include aggressive non-native grasses, such as perennial ryegrass (*Lolium perenne*), cheatgrass (*Bromus tectorum*), fescue (*Festuca* spp.), giant reed (*Arundo donax*), medusa-head (*Taeniatherum caput-medusae*), or Pampas grass (*Cortaderia selloana*) in the hydroseed mix.

1.4.2 Shaded Riverine Aquatic Habitat

Shaded Riverine Aquatic (SRA) habitat is defined as the near shore aquatic area occurring at the interface between a river and adjacent woody riparian habitat. The principal attributes of this valuable cover type include: (1) the adjacent bank being composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water; and (2) the water containing variable amounts of woody debris, such as leaves, logs, branches and roots, as well as variable depths, velocities, and currents. SRA occurs throughout the study area along the riverbanks and levees and is contained within the other identified habitat types in these areas.

1.4.3 Valley Foothill Riparian Habitat

Most valley foothill riparian habitat in the study area (hereafter referred to as “riparian habitat”) occurs along the American and Sacramento Rivers, but smaller riparian areas are found at all of the levees in the study area. The overstory of the riparian habitat consists of mature, well-established trees: Fremont cottonwood (*Populus fremontii)*, valley oak (*Quercus lobata*), black willow (*Salix gooddingii*), and box elder (*Acer negundo var. californicum*). During the surveys, Oregon ash (*Fraxinus latifolia*), western sycamore (*Platanus racemosa*), and white alder (*Alnus rhombifolia*) were also observed. The shrub layer consists of smaller trees and shrubs; representative species observed were poison oak

(*Toxicodendron diversilobum*), sandbar willow (*Salix exigua*), and California blackberry (*Rubus ursinus*). Elderberry shrubs (*Sambucus mexicana*), the host plant of the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), which is Federally listed as threatened, were observed in the riparian habitat along the American and Sacramento Rivers.

1.4.4 Valley Elderberry Longhorn Beetle Habitat

The valley elderberry longhorn beetle (beetle) is completely dependent on its host plant, elderberry (*Sambucus* spp.), which is a common component of the remaining riparian forests and adjacent upland habitats of California's Central Valley. These forests consist of several canopy layers with a dense undergrowth (Katibah, 1983). Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), willows (Salix spp.), and valley oak (*Quercus lobata*) are common upper canopy species. The shrub layer consists of smaller trees and shrubs; representative species observed were poison oak (*Toxicodendron diversilobum*), sandbar willow (*Salix exigua*), and California blackberry (*Rubus ursinus*). Studies have found that the beetle is more abundant in dense native plant communities with a mature overstory and a mixed understory.

1.4.5 Oak Woodland

Valley oak woodland is dominated with valley oak, interior live oak, box elder, white alder, Oregon ash, and black walnut. Shrubs in this habitat type include California grape (*Vitis californica*), California blackberry (*Rubus ursinus*), and blue elderberry (*Sambucus cerulea*). Oak woodlands are typically found on higher or upland portions of the study area than the riparian habitat discussed above.

1.4.6 Green Sturgeon Benthic Habitat

Little is known about juvenile green sturgeon freshwater rearing. Green sturgeon are presumed to be generalist, opportunistic benthic feeders. Benthic substrate needs to include abundant prey items within estuarine habitats and soft bottom substrates for juvenile, subadult, and adult life stages. Prey species for juvenile, subadult, and adult green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fishes, including crangonid shrimp, burrowing thalassinidean shrimp (particularly the burrowing ghost shrimp), amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies. These prey species are critical for the rearing, foraging, growth, and development of juvenile, subadult, and adult green sturgeon within the bays and estuaries. The benthic substrate should include sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of elevated levels of contaminants (e.g., selenium, PAHs, and pesticides) that can cause adverse effects on all life stages of green sturgeon.

1.5 Environmental Baseline

The ARCF action area includes the mainstem Sacramento River from Freeport (river mile [RM] 46) in the Delta upstream to the American River confluence (RM 60). The region also includes the lower American River from the confluence with the Sacramento River upstream to RM 11, NEMDC, Arcade Creek, Dry/Robla Creeks and Magpie Creek.

Downstream from the American River confluence, the Sacramento River is moderately sinuous (average sinuosity of 1.3), with the channel confined on both sides by man-made levees enhanced by decades of man-made additions. The channel in this reach is of uniform width, is not able to migrate, and is typically narrower and deeper relative to the upstream reach due to scour caused by the concentration of shear forces acting against the channel bed (Brice 1977). Channel migration is similarly limited along the lower American River because of man-made levees and regulated flows from Folsom Dam.

The natural banks and adjacent floodplains of both rivers are composed of silt- to gravel-sized particles with poor to high permeability. Historically, the flow regimes caused the deposition of a gradient of coarser to finer material, and longitudinal fining directed downstream (sand to bay muds). The deposition of these alluvial soils historically accumulated to form extensive natural levees and splays along the rivers, 5 to 20 feet above the floodplain for as far as 10 miles from the channel (Thompson 1961). The present day channels consist of fine-grained cohesive banks that erode due to natural processes as well as high flow events (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.

NEMDC is an approximately 13.3-mile, human-made, partially leveed drainage channel that provides drainage from Sankey Road and connects streams of the American Basin (Dry, Robla, and Arcade Creeks) to the American River. South of the confluence with Arcade Creek, the east and west levees of NEMDC are dominated by wild oats grasslands while the channel is characterized by Fremont cottonwood forest, with smaller amounts of valley oak woodland, smart-weed cocklebur patches, and perennial rye grass fields.

The approximately 16.2-mile-long channel of Arcade Creek extends east-to-west from Orangevale to the American River, via NEMDC. The north and south levees are dominated by wild oats grasslands. Valley oak woodland is the main riparian vegetation type along Arcade Creek, but Fremont cottonwood forest occurs in small patches along the easternmost reach of Arcade Creek near NEMDC. Hardstem bulrush marsh is found within Arcade Creek near Norwood Avenue while water primrose wetlands are predominant within the channel of Arcade Creek from approximately the confluence with NEMDC to Norwood Avenue. East of Norwood Avenue, the creek channel becomes narrower, and

dominated by a shaded canopy of valley oak woodland.

The environmental baseline in the ARCF GRR action area includes the sites completed under the Water Resources Development Act (WRDA) 1996 and WRDA 1999 authorizations. The WRDA 1996 construction included installing slurry walls in the American River levees to address seepage and slope stability concerns. The WRDA 1999 construction included shape and slope improvements to specific reaches of the American River levee system and some segments of the Sacramento River levees.

1.6 Potential Project Impacts

A vegetation variance is being sought by the Sacramento District to comply with ETL 1110-2-583 on the waterside of the levee. The vegetation variance request requires the Corps to show that the safety, structural integrity, and functionality of the levee would be retained if the vegetation were to remain in place. This would allow most of the trees on the lower one half of the waterside slope to remain in place, reducing the impacts to vegetation and wildlife. In addition, a System Wide Improvement Framework (SWIF) agreement with the non-Federal sponsor would allow vegetation and encroachment compliance on the landside of the levee to be deferred and addressed by the local maintaining agency at a later time. This would be a beneficial effect to vegetation and wildlife, as standard long-term Operations and Maintenance (O&M) of the levee system in the study area would otherwise require the immediate removal of all vegetation. Vegetation impacts throughout the project area would occur in the proposed construction footprint.

Infestation of invasive weeds has an influence on hydraulic roughness during high-flow events, decreases the capacity of the floodway, and adversely affects bank erosion and sedimentation processes. The Corps would remove the noxious weeds from the various plant communities prior to construction. For each of the action alternatives, direct effects to stands of grassland habitat with invasive plants would result from clearing and grubbing and rock placement activities once levee improvements and construction begin. The total number of acres of grassland affected would be refined during the design phase.

The estimated impacts for the habitats discussed above and special-status species impacts as established in the BOs are shown below on Table 2.

Table 2. Impacts for ARCF GRR Recommended Plan.

	GGS Upland ***	GGS Aquatic ***	Riparian/ Western Yellow-billed Cuckoo **	SRA Habitat ***	Elderberry Shrubs **	Vernal Pools **	Delta Smelt Spawning **	Shallow Water **	Oak Woodland *	Wetlands
American River North										
Reach A (American River)			22 acres	19,000 LF	284 stems					
Reach B (American River)			0.5 acre		183 stems					0.05 acre
Reach C (American River & NEMDC)									1 acre	
Reach D (Arcade Creek)			6 acres							
Reach E (Arcade Creek)			4.5 acres							
Reach F (NEMDC)									1 acre	
Reach G (Dry/ Robla Creek)	*No Measures Proposed*									
Reach H (Dry/ Robla Creek)	*No Measures Proposed*									
Reach I (Magpie Creek)						0.25 acre				
American River South										
Reach A (American River)			37 acres	6,850 LF	1,437 stems					0.35 acre
Reach B (American River)			2 acres	875 LF	1,144 stems					

	GGS Upland ***	GGS Aquatic ***	Riparian/ Western Yellow-billed Cuckoo **	SRA Habitat ***	Elderberry Shrubs **	Vernal Pools **	Delta Smelt Spawning **	Shallow Water **	Oak Woodland *	Wetlands
Reach C (American River)				3,800 LF	81 stems					
Reach D (Sacramento River)			10.6 acres	9,200 LF	163 stems		10 acres	5 acre		
Reach E (Sacramento River)			6.2 acres	8,850 LF			6 acres	4 acre		
Reach F (Sacramento River)			41.6 acres	21,100 LF			12 acres	4 acre		
Reach G (Sacramento River)			12.2 acres	11,150 LF			4 acres	1 acre		
Sacramento Weir and Bypass	30 acres	15 acres	8 acres	1,500 LF						See GGS Aquatic
TOTAL (Alt 2)	**30 acres**	**15 acres**	**150.6 acres**	**82,325 LF**	**3,292 stems**	**0.25 acre**	**32 acres**	**14 acre**	**2 acre**	**0.40 acre**

*State Listed **Federal Listed ***State and Federal Listed

1.7 Habitat Evaluation

For the purposes of evaluating the impacts of the ARCF GRR on fish and wildlife resources in the project area, with a reliance on existing information in the spirit of SMART Planning, the Habitat Evaluation Procedures (HEP) for the *American River Watershed Investigation, Common Features Modifications, Mayhew Drain Site Project* were relied upon as a reference baseline. The HEP for the Mayhew Drain Site Project was conducted in 2005 to quantify anticipated impacts to fish and wildlife and their habitats, and to determine mitigation needs for the project. This HEP was selected for the ARCF GRR because the Mayhew Drain Site is located within the overall study area for the ARCF GRR, and the habitat type and value at the Mayhew site is consistent with the habitat that occurs throughout the ARCF GRR project area.

The HEP provided information for two general types of wildlife habitat comparisons: 1) the relative value of different areas at the same point in time; and 2) the relative value of the same areas at future points in time. By combining the two types of comparisons, the impacts of proposed project on wildlife habitat were quantified and compensation needs (in terms of acreage) for the project were determined. The assumption that habitat for selected wildlife species or communities can be numerically described by a model produces a Habitat Suitability Index (HSI). The HSI, a value from 0.0 to 1.0, provides a measure of habitat quality for a sample area in terms of suitability for the particular species or community being evaluated.

For the Mayhew Drain project, the Northern oriole Riparian woodland model was used because it best suited the habitat type in the project area. The quantity part of the formula is any measure of area which is appropriately sized for the study. The product of these two measures is comparable to "habitat value" which equals habitat quantity multiplied by habitat quality. This formula is expressed as a Habitat Unit (HU).

Habitat Type x Habitat Area = Habitat Value

The Average Annual Habitat Units (AAHUs) over the life of the project can then used to determine mitigation needs. The model, variables measured and data collection methods used for the Mayhew Drain Project are shown below in Table 3. For the ARCF GRR, data was estimated visually and using google earth.

Table 3. HSI model, Variables, and Data Collection Methods.

HSI Model and Cover-Type	HSI Model Variables	Data Collection Method
Northern oriole Riparian Woodland	V1 – Average height of deciduous tree canopy	Visual estimation
	V2- Percent deciduous tree crown cover	Densiometer along belt transects
	V3 – Stand width	Estimated using aerial photos

Since it is not possible to empirically determine habitat quality and quantity for future years, future HSI values were projected. This was accomplished by increasing or decreasing specific baseline variables and/or HSI values for each evaluation element for the Northern oriole based on best professional knowledge of performance at other mitigation sites, literature on plant growth, and conditions at reference sites. To predict changes in the HSI for each future scenario, it was necessary to make assumptions regarding baseline and future values within project impact and compensation areas. The assumptions made for the ARCF GRR with project can be seen in Table 4 and without project can be seen in Table 5 below.

Table 4. HSI Variables for the ARCF GRR Based on Habitat Values.

HEP - FUTURE WITH-PROJECT							
Time	**Variables**			**Suitability Index**			**Output**
	V1	**V2**	**V3**	**SI-V1**	**SI-V2**	**SI-V3**	**HSI**
TY1	20	25%	2	0.60	1.00	1.00	0.84
TY2	10	25%	2	0.30	1.00	1.00	0.67
TY25	20	75%	2	0.60	0.75	1.00	0.77
TY50	35	75%	2	1.00	0.75	1.00	0.91
HSI = (V1*V2*V3)^1/3						Average	0.80

Table 5. HSI Variables for the ARCF Without Project Based on Habitat Values.

HEP - FUTURE WITHOUT-PROJECT							
Time	**Variables**			**Suitability Index**			**Output**
	V1	**V2**	**V3**	**SI-V1**	**SI-V2**	**SI-V3**	**HSI**
TY1	35	75%	2	1.00	0.75	1.00	0.91
TY2	35	75%	2	1.00	0.75	1.00	0.91
TY25	35	75%	2	1.00	0.75	1.00	0.91
TY50	35	75%	2	1.00	0.75	1.00	0.91
HSI = (V1*V2*V3)^1/3						Average	0.91

The HSI value of 0.80 in Table 4 results from a temporal loss of habitat value and function from the removal of existing mature riparian habitat. This is due to the lower values given to mitigation plantings during the establishment period. The ARCF GRR proposes to implement riparian habitat mitigation at a 2:1 ratio. A 2:1 mitigation ratio is a reasonable requirement for implementation of mitigation for this habitat type, because the proposed project will decrease the connectivity of existing habitat along the Sacramento River system. Additionally, temporal loss of onsite habitat results in a reduction in value and function of the new vegetation within the mitigation areas as it grows to maturity. This also accounts for the loss of other services that riparian vegetation provides, including:

- An essential food source for fish and wildlife, including ESA species;

- Aquatic resting and refugia for resident and migratory fish species;
- Large woody debris recruitment;
- Nesting and rearing habitat for terrestrial wildlife species;
- Nutrients for the ecological system;
- Shade for the river which maintains water temperatures and dissolved oxygen concentrations; and,
- Increased habitat value for VELB.

The above-listed functions and services associated with a newly created acre of habitat are usually expected to be less than those associated with natural habitat. As a result the 2:1 mitigation ratio is appropriate to compensate for the loss of mature riparian habitats.

To determine whether the proposed mitigation amounts were cost effective, a Cost Effective /Incremental Cost Analysis (CE/ICA) was conducted. The CE/ICA report is included with this document as Appendix A. The Mayhew HEP and the Northern oriole HSI model variables were referenced to establish habitat values for the CE/ICA. The cost for mitigation was estimated for five scenarios for the purposes of the CE/ICA for both alternatives. These scenarios included: (1) maximized on- and off-site habitat creation; (2) maximizing the use of credits at a local mitigation bank; (3) a combination of on-site, off-site, and a mitigation bank at a 2:1 ratio; (4) a combination of on-site, off-site, and a mitigation bank at a 1:1 ratio; and (5) a combination of on-site, off-site, and a mitigation bank at a 3:1 ratio. Per the discussion above and the results shown in Table 4, the loss in ecological value associated with on-/off-site mitigation was reduced to an overall 0.8 habitat value. The Recommended Plan is the Alternative 2 Combination Plan with a 2:1 ratio, because it is the smallest mitigation proposal that accomplishes the terms and conditions of the Biological Opinions, and the CE/ICA determined that it was a cost effective plan.

1.8 Proposed Mitigation Measures

The preparation of mitigation plans, including objectives, plan design, determination of success criteria, and monitoring needs would be coordinated with Federal and State resource agencies to the greatest extent practicable. Mitigation objectives are specific actions to be taken to avoid and minimize adverse effects, such as Best Management Practices, compliance with Federal and State regulatory laws, and environmental commitments. Mitigation objectives include the identification of specific amounts of mitigation required to compensate for remaining unavoidable losses.

Items below present a summary of environmental commitments that the Corps would implement as part of the ARCF project to mitigate by avoiding and minimizing impacts and to meet the requirements, terms and conditions specified in the BOs.

- A vegetation variance is being sought by the Sacramento District to comply with ETL 1110-2-583 in order to exempting the Sacramento River and East Side Tributaries from vegetation removal in the lower third of the waterside of the levee prior to final construction and design phase. The ARCF GRR will be complying with the ETL on landside of the levee under a SWIF. 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. As a result, vegetation removed under the ARCF GRR would be limited to the footprint necessary in order to construct the proposed measures. Disturbance or removal of trees or larger woody vegetation would be replaced with native riparian species, outside of the vegetation free zone, as established in the ETL.
- The Corps would use a rock soil mixture to facilitate re-vegetation of the proposed project area. 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 to allow native riparian vegetation to be planted to ensure that SRA habitat lost is replaced or enhanced. Alternatively, a rock lined soil trench approach could be taken.
- Vegetation removal, particularly tree removal, would be conducted between September 16 and January 31, to the extent feasible, to minimize potential loss of active bird nests and bat maternity roosts.
- Construction would be scheduled when listed terrestrial and aquatic species would be least likely to occur in the project area, approximately May or June through October, depending on the species present on a site-specific basis. If construction needs to extend into the timeframe that species are present, the Corps would coordinate with the resource agencies.

In addition to the mitigation measures described above, the Corps would implement compensatory mitigation, as described below.

The mitigation acreages for ARCF GRR were calculated using a combination of site surveys and aerial photography from Google Earth to determine where the project footprint impacted different habitat types. The habitat types included: riparian, SRA, giant garter snake (GGS), valley elderberry longhorn beetle (VELB), vernal pools, and Delta smelt shallow water. The acreages of each impacted habitat type were then broken up by reach.

Table 7 describes the types and amounts of habitat that would be potentially impacted by the project, the duration of the impacts, the amount of mitigation in total acreage per the USFWS and NMFS BOs and the recommendations of the USFWS Coordination Act Report, and projected costs as estimated according to existing mitigation prices.

Costs are displayed showing the difference between the estimate for on site mitigation or mitigation at a bank. Currently, permanent impacts to GGS uplands and aquatic habitat, vernal pools, Delta smelt spawning and shallow water habitat, and wetlands are proposed to occur at a mitigation bank. Riparian, SRA, elderberry, oak woodland, and green sturgeon are proposed to occur on site.

Table 7. Environmental Effects and Proposed Mitigation for the Recommended Plan.

Habitat Type	Potential Impacts	Duration of Impact	Mitigation (Acres/Linear Feet)	Cost at Mitigation Bank	Cost On- or Off-Site within Study Area
GGS Uplands	30 acres 75 acres	Permanent Temporary	90 acres 75 acres	$4,500,000	N/A*
GGS Aquatic	15 acres	Permanent	45 acres	$2,250,000	
Riparian	150.6 acres	Permanent	301.2 acres		$16,566,000
Shaded Riverine Aquatic Habitat	82,325 lf	Permanent	82,325 lf		$19,020,000**
Elderberry Shrubs	3,292 stems	Permanent	1,715.6 credits 70.89 acres		$6,026,000
Vernal Pools	0.25 acre	Permanent	0.5 acre	$138,000	---
Green Sturgeon	20 acres	Permanent	Restore acres, monitoring, and fish passage features		$16,259,000
Delta Smelt Spawning Habitat	34 acres	Permanent	34 acres	$4,160,000	
Shallow Water Habitat (Delta Smelt)	14 acres	Permanent	42 acres	$5,460,000	
Oak Woodland	2 acres	Permanent	4 acres		$200,000
Wetlands	0.4 acres	Permanent	0.8 acres	$130,000	---
Sub-Total				**$16,775,000**	**$58,341,000**

* 75 acres of temporary effects to GGS habitat from the relocation of the Sacramento Bypass toe drain would consist of standard site restoration erosion control features such as hydroseeding. This is contained within construction costs and is not considered a mitigation cost. It is presented in this plan due to monitoring requirements, as described in Section 2.1 below.
** SRA habitat mitigation is provided in the project's cost estimate as a separate construction cost rather than a mitigation cost, since it is a feature of the bank protection designs and would be included as a part of the construction contract. The cost is displayed under the Fish and Wildlife Facilities account as "Construction" costs and is estimated to be approximately $231 per linear foot.

1.9 Location of Mitigation and Compensation Sites

WRDA 2007 Section 2036(c) directs the Corps to, where appropriate, first consider the use of an approved mitigation bank to compensate for wetland impacts. Credits for additional habitat types, including riparian zones, is also permitted, if credits are available and the use of them is deemed appropriate. As discussed above, the Corps proposes to purchase credits at a mitigation bank for permanent impacts to GGS uplands and aquatic habitat, vernal pools, Delta smelt spawning and shallow water habitat, and wetlands. As a result, these habitat types are not discussed further in this document, because the mitigation bank would be responsible for all site establishment, monitoring, adaptive management measures, and for achieving mitigation success.

The onsite mitigation proposed for the ARCF GRR consists of riparian, SRA, oak woodland, elderberry habitats, all of which are components of the riparian habitat corridor along the Sacramento River. Section 4.a.3 of WRDA 2007 Section 2036(c) implementation guidance states that credits for riparian habitat may be purchased at a mitigation bank, but are not required to be as a first order preference. All of these habitats contribute to the riparian corridor of the Sacramento and American Rivers. As described in Section 1.7 above, the removal of 268 acres of riparian, SRA, oak woodland, and elderberry habitat under the ARCF GRR could adversely affect ESA species within the project area if the function and services provided by riparian habitat is relocated away from the Sacramento River and American River riparian corridors. Additionally, credits are not available for the quantity of riparian habitat being removed for the ARCF project and mitigation requirements would likely increase if the projects proposed all mitigation offsite. As a result, it is appropriate to select on- and off-site mitigation within the study area for these habitat types rather than purchasing credits at a mitigation bank.

Upon completion of construction, sites with preexisting habitat would be restored to pre-construction conditions, where feasible. Sites compatible with on-site mitigation such as the 75 acres of upland GGS habitat and 82,325 linear feet of SRA habitat would be restored in place. Riparian habitat, elderberry compensation, and oak woodland habitat would be mitigated on-and off-site within the project area to the greatest extent practicable. The specific locations for offsite mitigation along the American River would be coordinated with the Sacramento County Department of Parks and Recreation (County Parks) during the design phase of the project.

On-site mitigative features are proposed as part of the bank protection construction to mitigate for impacts to SRA habitat. These features would be designed on a site-specific basis during the design phase and would include a planting berm as shown on Figure 1 above. Riparian vegetation installed on the planting berm would include large woody species such as Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), and valley oak (*Quercus lobata*), white alder (*Alnus rhombifolia*), and box elder (*Acer negundo var. californicum*); shrub-scrub species such as elderberry (*Sambucus* spp.), redbud (*Cercis canadensis*), and coyote brush (*Baccharis pilularis*); and understory species such as California rose (*Rosa californica*), California blackberry (*Rubus ursinus*), and wild grape (*Vitus californica*); and native grasses such as annual fescue (*Vulpia* spp.), California brome (*Bromus*

carinatus), blue wildrye (*Elymus glaucus*), and needle grass (*Nassella* spp.).

The Corps is committed to implementing project conservation and mitigation as detailed in the BOs, however site selection and real estate coordination has not occurred at this time for onsite and offsite mitigation and would be determined during the design phase of the project. This HMMAMP will accompany the final EIS/EIR, and will be updated throughout the design phase as detailed design efforts allow for finalizing the mitigation plans. The HMMAMP will be coordinated with the Services during the design phase and updated as needed. The Corps would go through the following process in order to determine sites for implementing compensation for impacts to riparian habitat, including VELB compensation sites:

- The Corps would assess opportunities to purchase credits at a mitigation bank as a first option.
- The Corps would assess opportunities for on-site compensation to replace the habitat function and services that would be impacted within the study area. This assessment would include considering site-specific conditions, including whether the site is protected from future erosion by bank protection, or remains at risk of berm and vegetation loss due to the launchable rock trench.
- If on-site compensation is not possible, the Corps would evaluate opportunities to expand existing Corps mitigation sites within the American River Parkway, such as the River Bend Park mitigation site.
- If the Corps requires additional lands for compensation, other opportunities within the American River Parkway would be assessed in coordination with County Parks, USFWS, NMFS, and the American River Flood Control District.

Although much of the mitigation would occur on-site, for riparian, SRA, elderberries, oak woodland, and green sturgeon benthic habitat, some mitigation would be compensated for through the purchase of credits from approved mitigation or conservation banks. Mitigation bank credits are available within the project watershed for riparian habitat, elderberry shrubs, and oak woodland on the Sacramento River.

1.10 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 targeted species from designated compensation sites. For example, compensation time would be the time required for on-site plantings to provide significant amounts of shade or structural complexity from instream woody material recruitment to provide habitat for fish species. 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 United States Code [USC] § 2283). Additionally, ER 1105-2-100, Appendix C states that authorized ecological resource mitigation activities and features should occur before construction of the project, concurrent with the acquisition of lands, or concurrent with the physical construction of the project.

2.0 Mitigation and Management Strategy

The purpose of this HMMAMP is to present conceptual mitigation proposals, establish performance standards, and outline adaptive management tasks and costs. Conceptual mitigation proposals are based on the habitat impacts described above. Performance standards are established below for each habitat type, and monitoring would be conducted with the intent of meeting those standards. Over the 3 to 5 year site establishment period, improvements in field and analytic techniques may lead to changes in the monitoring methodology. While this vegetation and habitat monitoring methodology protocol builds on past years' experiences, it is likely that other opportunities for improvement will be identified in the future that should be incorporated into the protocol. In the future, there may be a determination that specific performance standards have been met and that associated monitoring tasks could cease. Similarly, it could be determined that a monitoring task was not returning useful information, and therefore not worth the expense of continuation.

Monitoring must be closely integrated with adaptive management. The application of adaptive management principles to mitigation projects by modifying mitigation objectives during the monitoring period is a reasonable and foreseeable alternative. Unrealistic expectations or inaccurate assumptions can lead to the establishment of inappropriate project objectives. It is possible that a decision to modify success criteria might be reached based on results after several years of monitoring. In addition to modifying project objectives, there is a potential for changes to or adaptation of management actions based on monitoring results. The purpose of adaptive management is to enable strategic changes to improve the mitigation sites to functioning habitat.

Vegetation and habitat variable monitoring and data collection would occur annually by a qualified biologist, botanist, or habitat restoration specialist using the protocol described below and shown in Table 8 to determine the success of riparian revegetation plantings and overall habitat development.

The project's compensation objective is to directly mitigate for the loss of habitat value that results from construction impacts. This plan focuses on establishing successful and diverse habitats that provide an ecological value consistent with mature existing habitat conditions in the study area. The specific habitats focused on within the sections below are the habitats that would be created by the Corps on-site or off-site, including GGS upland habitat, habitat for VELB, and habitat for green sturgeon. In addition, mitigation sites would be created which present a combination of riparian, oak woodland, and SRA habitats, which are highly related and provide value to a number of listed species, including VELB, Western yellow-billed cuckoo, and fish species.

Table 8. Summary of On-site Habitat Types and Monitoring Recommendations.

Habitat	Monitoring Variable	Method to be Used	Spacing/number of Samples	Data to be Collected	Success Criteria
GGS Upland	Total Herbaceous Species Cover	Visual estimates of cover within 1 square meter (m^2) sampling quadrats	One quadrat randomly located in each planting zone	Herbaceous species composition, total cover, and observation of GGS	Meeting 75% native species present and 95% overall cover onsite within 1 year
Riparian Habitat	Vegetation Species Cover (Ground and Canopy)	Line-intercept estimates of ground and overhead canopy cover with visual estimates of vigor	Monitoring transects; number of transects and spacing dependent on site length	Woody species composition, growth, and natural recruitment	75% vegetative cover after 5 years
SRA Habitat	Shaded Riverine Aquatic (SRA) Cover	Line-intercept estimates of canopy cover overhanging the river	Transect parallel to the shoreline along summer mean water surface elevation (SMWSE); length of transect dependent on site length	Woody species composition and percentage of canopy cover overhanging river (shade)	75% vegetative cover after 5 years
Elderberry	Elderberry and Native Vegetation Health and Vigor (VELB habitat)	Visual assessment of vegetation health and vigor; census of VELB and exit holes	Total census of elderberry shrubs and native vegetation, census of VELB and exit holes	Total survival of elderberry and native vegetation, census of VELB and exit holes	Survivability of 60% shrubs*; 75% vegetative cover after 5 years
Oak Woodland Habitat	Woody Species Overhead Canopy Cover	Line-intercept estimates of overhead canopy cover and visual estimates of vigor	Monitoring transects; number of transects and spacing dependent on site length	Woody species composition, growth, and natural recruitment	75% vegetative cover after 5 years
Green Sturgeon Benthic Habitat	In-water slope and substrate	Substrate sampling and visual assessment of slope/substrate conditions.	Monitoring the width and depth of the river at regular intervals throughout the project area.	Substrate content, percentage of fines, slope defining measurements.	Slope (H:V) of 2:1 with substrate at average of 0-10 inches.

*60% survivability is the established survival criteria for elderberry shrubs in the USFWS Conservation Guidelines for the Valley Elderberry Longhorn Beetle (1999).

2.1 GGS Uplands Mitigation

2.1.1 Objectives and Implementation Strategy

The primary objective of upland habitat mitigation is to restore upland refugia habitat for the giant garter snake (*Thamnophis gigas*) (GGS) in a manner consistent with adjacent equitable habitat. Upland refugia habitat is generally considered native grasslands with space appropriate for basking,

cover, and retreat sites for GGS. Upland refugia is also considered higher elevation areas for cover and refuge from flood waters. Upland refugia restoration would take place on grasslands adjacent to GGS wetland habitat as well as levee slopes for higher elevation refuge. These conservation and restoration measures are taken from the Guidelines for Restoration and/or Replacement of Giant Garter Snake Habitat (USFWS, 1997).

Restoring GGS habitat includes minimizing the potential impacts of project activities to the existing habitat. Use of silt fencing and protective mats to prevent runoff and reduce the possibility of individual GGS from entering the project area is recommended. Designation of environmentally sensitive areas and providing worker awareness training is also recommended. Construction activities should be 200 feet from GGS aquatic habitat, and should occur between May 1 and October 1. Project areas should be surveyed for GGS 24 hours prior to ground disturbing activities, and surveys should be repeated if a lapse in construction activity of two weeks or greater has occurred. If aquatic habitat must be removed as part of the construction activities, any dewatering would occur after April 15 and dewatered habitat would be left dry for at least 15 consecutive days.

Upon the completion of construction, the area would be regraded to the preexisting contour. Upland refugia would be hydroseeded with native grasses. USFWS recommends a mix of native grass seeds such as annual fescue (*Vulpia* spp.), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and needle grass (*Nassella* spp.). Additional native plant seeds consistent with adjacent habitat may be used at the discretion of USFWS. Permanent irrigation would not need to be established for this habitat type, however the site would require periodic watering in drought conditions.

2.1.2 Success Criteria

Monitoring of GGS upland habitat would focus on: (1) the percentage cover of native species, and (2) the percentage of overall vegetative cover. The restored habitat would be considered successful if 75 percent of the vegetation on site consists of native species. Additionally, the overall vegetative cover on site must be 95 percent.

2.1.3 Mitigation Monitoring Strategy

Restored habitat should be monitored for one year following implementation. Surveys would involve a general overview of the condition of the site, an estimate of ground cover, and a passive (observation only) GGS survey to determine potential habitat use. A ground cover survey would occur to determine the ground cover percent of native and non-native species. Ground cover surveys, if determined by the Corps to be needed to evaluate the success of the mitigation area, would involve the use of a one square meter quadrat placed haphazardly in the restored areas. Once placed, all herbaceous vegetation within the quadrat would be recorded to species level. The percent of cover by native and non-native species would be determined in addition to the percent of total cover.

Monitoring reports documenting the restoration effort would be submitted to USFWS upon completion of the restoration implementation and one year from restoration implementation. Monitoring reports would include photos, the timing of the completion of the restoration, what materials were used in the restoration, plantings (if specified), and justification of any substitutions to USFWS recommended guidelines. Monitoring reports would also include recommendations for additional remedial actions, if necessary.

2.1.4 Adaptive Management Strategy

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

Adaptive Management Triggers

- Desired Outcome: Increase percent cover of GGS upland habitat.

  Trigger: 95% cover is not achieved within one year.

- Desired Outcome: Decrease percent of non-native invasive species that outcompete natives.

  Trigger: Non-native percent cover of more than 25% within one year.

Adaptive Management Measures

If the triggers established above occur, the following measures would be implemented for GGS upland habitat in order to adaptively manage the site for success.

- If the performance criteria are not met within one year, additional monitoring would be implemented in order to ensure that the site is successful.
- If non-native species are outcompeting the native species, measures would be implemented to manage presence of invasive species, including mowing and selective removal of non-native species at optimal times for native growth.
- If non-native species are outcompeting the native species and targets for overall cover are not being met, then revegetation of native species would occur.
- Supplemental watering if targets for overall cover are not being met.

2.2 Riparian, Oak Woodland, and Shaded Riverine Aquatic Habitat

2.2.1 Objectives and Implementation Strategy

The primary objective of riparian habitat mitigation is to compensate for impacted habitat types and community types, and reduce erosion rates within the alluvial floodplain. Native plant communities and streambank vegetation would be represented in species density appropriate to the surrounding area. As native vegetation matures, it helps to stabilize stream banks and shorelines; provides food, shelter, shade, and access to adjacent habitats; nursery habitat; pathways for movement by resident and nonresident aquatic, semi-aquatic, and terrestrial organisms; and improves and protects water quality by reducing the amount of sediment and other pollutants such as pesticides, organic materials, and nutrients in surface runoff. The long term goal of riparian mitigation is to provide habitat similar to the habitat that was impacted by project construction. These improvements would enhance nesting opportunities for native bird species, and provides opportunities to satisfy VELB compensation. Oak woodland and SRA habitat are considered components of riparian habitat with specific functions within the ecosystem.

Riparian vegetation would include large woody species such as Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), valley oak (*Quercus lobata*), white alder (*Alnus rhombifolia*), and box elder (*Acer negundo var. californicum*); shrub-scrub species such as elderberry (*Sambucus spp.*), redbud (*Cercis Canadensis*), and coyote brush (*Baccharis pilularis*); and understory species such as California rose (*Rosa californica*), California blackberry (*Rubus ursinus*), and wild grape (*Vitus californica*); and native grasses such as annual fescue (*Vulpia* spp.), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and needle grass (*Nassella* spp.). Native trees and shrubs provide a buffer to adjacent urban and industrial land uses, and provide habitat structure for wildlife. Leaf litter and large organic debris would create a variety of microhabitats, increasing species diversity and potentially creating a prey base for larger predators.

SRA habitat consists of riparian trees and shrubs growing on the bank and over-hanging the channel that provide instream shade for the water column adjacent to the bank and deposit insects, organic matter, and nutrients into the river. Shade from the vegetation helps to cool water temperatures in the river. SRA is especially important to juvenile salmonids as they migrate down the river to the sea. Terrestrial insects that live on riparian vegetation fall into the river and provide an important food source for fish. Proposed SRA mitigation would occur on the planting berms designed into the bank protection sites along the American and Sacramento Rivers, as shown in Figures 1 and 2 above. Riparian trees and shrubs would be installed in the planting berms, and existing large trees would be protected in place on the lower waterside slope of the levee. Implementation of this SRA habitat mitigation, including protecting large trees in place, is part of the recommended plan and is reliant on the approval of a vegetation variance, which will be sought during the design phase of the project.

The primary objective of oak woodland mitigation, which would occur in the upland zone of the riparian habitat, is the establishment of mature valley oaks and savannah. Planting would generally occur during the late fall when the plants are dormant and soils are moist. Establishment of woody vegetation would likely require multiple techniques including transplants, cuttings, acorn plantings, and seedlings.

Riparian and oak woodland mitigation sites would likely require fencing to protect establishing habitats from recreation, wildlife, and other potential damages. Sites would have irrigation during the establishment period, and would be watered as needed until the vegetation is established and self-sustaining. Mowing would occur periodically to ensure that weed species do not shade out new plantings.

SRA habitat would be established in planting berms along the river. These sites could require beaver fencing. Sites would have temporary irrigation during the summer, and would be watered as needed until the vegetation is established and self-sustaining. A weed eater would be used to ensure that weed species do not shade out new plantings.

2.2.2 Success Criteria

Monitoring of riparian, oak woodland, and SRA habitats would focus on: (1) the percent cover of native plant species; (2) presence of at least five native species contributing to structural diversity; (3) percentage of canopy cover over water; and (4) decrease percent cover of non-native invasive species that out-compete natives. Additionally, an inventory of wildlife species would be recorded during annual monitoring. Table 9 establishes the percentages required to meet these performance standards. If the habitat is meeting these performance standards, conditions should be consistent enough to estimate community composition and general success of planting efforts. Table XX establishes the percentages required to meet these performance standards.

Table 9. Riparian, Oak Woodland, and SRA Habitat Performance Standards.

Performance Standard	Quantitative Measure
Percent cover of native plant species	75%
Structural diversity	At least five native species contributing to 75% canopy and 50% shrub cover
Percent of canopy cover over water per LF	75%
Percent cover of non-native species	Less than 15%

2.2.3 Mitigation Monitoring Strategy

The following monitoring procedures will provide the information necessary to evaluate the success of riparian, oak woodland, and SRA habitat mitigation. Vegetation sampling will occur annually for the duration of the monitoring period. Sampling will occur during spring months, at the peak of growing season, and will consist of permanent field monitoring plots along one or more transects either perpendicular to the river or parallel to the floodplain slope. Plots will be located randomly within each site, and the distance between plots and along transects will be site specific. Woody species with overhead canopy cover that falls along the vegetation monitoring transect, including those that were planted, have recruited naturally to the site, or were existing at the site prior to planting efforts would be recorded. Monitoring will measure percent cover of native and non-native plant species, structural diversity, and percent cover over water. Photograph stations are also important for documenting vegetation conditions. All plots and photograph stations will be documented via Global Positioning System (GPS) coordinates to maintain consistency throughout the monitoring period.

Additionally, field personnel would visually estimate the height (+/- 2 feet) of each tree and shrub that provides overhead canopy cover. Exact heights are not necessary, since there is no tree height criterion included in this protocol. Rather, approximate tree heights would be visually assessed to monitor tree growth over time. Data collected would include species name, location (feet) along the vegetation monitoring transect (upper extent of canopy and lower extent of canopy), whether the tree or shrub is planted (P), recruited (R), or existing (E), height (feet), and vigor as determined using the metric outlined in Table 10, below.

Table 10. Estimation of General Health and Vigor for Plant Species.

Visual Estimate of Foliage	Vigor Category	Value
81 percent (or greater) of foliage appears to be healthy	Excellent	4
51 to 80 percent of foliage appears to be healthy	Good	3
25 to 50 percent of foliage appears to be healthy	Fair	2
Less than 25 percent of foliage appears to be healthy	Poor	1
Dead	Dead	0

General observations, such as fitness and health of plantings, native plant species recruitment, and signs of drought stress would be noted during the surveys. Additionally, potential soil erosion, flood damage, vandalism and intrusion, trampling, and pest problems would be qualitatively identified. A visual check of irrigation infrastructure and fencing would also be conducted. A general inventory of all wildlife species observed and detected using the mitigation site would be documented. Nesting sites and other signs of wildlife use of the newly created habitat would be recorded.

Monitoring reports documenting the restoration effort would be prepared following the first monitoring period and would continue annually until the site has met the success criteria. Monitoring reports would include photos, the timing of the completion of the restoration, what materials were used in the restoration, and plantings (if specified). Monitoring reports would also include recommendations for additional adaptive management measures, if necessary. Following this initial establishment period, any subsequent monitoring activities would be the responsibility of the local maintaining agency, and would focus primarily on general and biological inspections for the purposes of fire management and habitat evaluation.

2.2.4 Adaptive Management Strategy

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

Adaptive Management Triggers

- Desired Outcome: Increase percent cover of native riparian habitat.

  Triggers: If 50% cover of native riparian habitat is not achieved within 3 years, or 75% cover of native riparian habitat is not achieved within 5 years.

- Desired Outcome: Maintain appropriate structural diversity of native riparian habitats.

  Trigger: Suitable structural diversity is not achieved, if canopy cover and/or shrub cover does not achieve 50% within 5 years.

- Desired Outcome: Increase percent vegetative cover over water per linear foot to support native fish.

  Trigger: If percent cover over water is not 30% within 3 years, and 50% within 5 years.

- Desired Outcome: Decrease percent cover of non-native invasive species that outcompete natives.

  Trigger: If non-native percent cover is greater than 15% during the monitoring period.

Adaptive Management Measures

If the triggers established above occur, the following measures would be implemented for riparian, oak woodland, and SRA habitat in order to adaptively manage the site for success.

- Replanting may be needed if triggers for vegetative cover, vegetative cover over water, and/or structural diversity are being met. Monitoring results should be used to assess the underlying cause of inadequate cover, which may require that additional adaptive management actions be implemented to support successful replanting. Adaptive management actions could include targeted revegetation, such as replanting varieties of species that are exhibiting the greatest growth and survival, or planting at elevations that are exhibiting the greatest growth and survival.
- Nonnative species management may be needed if monitoring results show that the triggers for nonnative species present are met, or if nonnative species are impacting the survival of native species. Adaptive management measures may include adjustments to nonnative control methods, such as plant removal, grading of site to remove nonnative roots, or mowing and selective removal of non-native species at optimal times for native growth.
- Irrigation and/or supplemental water may be needed if vegetation is not meeting success criteria, or if species are exhibiting signs of water stress. Assessment of monitoring results may show that drought conditions are causing poor establishment or die off of planted vegetation. Adaptive management actions would include supplemental water to support achievement of percent cover criteria and structural diversity.
- Plant protection may be needed if triggers for vegetative cover and/or structural diversity are being met. If monitoring results show that plantings are failing due to predation or trampling from human use, then adaptive management actions would include plant cages or protective fencing that could be installed to protect plantings.

2.3 Elderberry Shrubs

2.3.1 Objectives and Implementation Strategy

The primary objective of elderberry shrub mitigation is to compensate for the adverse effects of the project on habitat important to the Federally listed valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB). Where possible, conservation areas would connect with adjacent habitat in order to prevent isolation of beetle populations. Removal, transplanting, and establishment of elderberry shrubs would be coordinated with USFWS and would follow the USFWS Conservation Guidelines for the valley elderberry longhorn beetle (USFWS, 1999).

Elderberry shrubs with one or more stems measuring one inch or greater in diameter at ground level must be transplanted if they cannot be avoided by the proposed project. Elderberry shrubs should be transplanted when they are dormant, typically from November to the first two weeks in February. Transplanting during the non-growing season would reduce shock to the plant and increase transplantation success. Most transplants require watering through the first summer.

Elderberry stems measuring greater than one inch in diameter are considered habitat for the VELB and trimming or removal of stems would require coordination and mitigation. Each elderberry stem that is adversely affected must be replaced in the conservation area with elderberry seedlings or cuttings as specified by USFWS. Seedlings and cuttings should be obtained from local sources. If the project site is in the vicinity of the conservation area, cuttings may be obtained from elderberry shrubs to be transplanted

Mitigation site planting areas must be at least 1,800 square feet for each elderberry transplant. As many as five additional elderberry plantings (cuttings or seedlings) and up to five associated native species plantings may also be planted within the 1,800 square foot area with the transplant. Studies have found that the VELB is more abundant in dense native plant communities with a mature overstory and a mixed understory. Therefore, a mix of native riparian species such as Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), valley oak (*Quercus lobata*), box elder (*Acer negundo*), white alder (*Alnus rhombifolia*), and California button willow (*Cephalanthus occidentalis californica*) would be planted along with the elderberry shrubs. Stock of saplings, cuttings, and seedlings would be obtained from local sources. Planting or seeding the area with native herbaceous species is also encouraged. Weeds and other non-native plants would be removed by mechanical means at least once a year or at the discretion of USFWS.

No pesticides, herbicides, fertilizers, or other chemical agents would be used in or within 100 feet of the conservation area. Fencing would be placed around the conservation area during the establishment period of the elderberry shrubs. Signs would be posted on the fence stating the status of the VELB and the purpose of the habitat. The conservation area would be protected in perpetuity as habitat for the VELB. Conservation areas may be transferred to resource agencies or appropriate private organizations for long term management. Biologists and law enforcement personnel from the California Department of Fish and Wildlife and USFWS must be given complete access to the project site to monitor transplanting activities. Personnel from these agencies must also be given complete access to the conservation area to monitor the beetle and its habitat in perpetuity.

2.3.2 Success Criteria

After the first year, it is anticipated that the sites would be evaluated to determine the level of project success and apply adaptive management, if necessary. If the habitat meets the below performance standards for three consecutive years, depending on physical site characteristics, conditions should be consistent enough to estimate community composition and general success of planting efforts. Three consecutive years of success should indicate that the project sites are self-sustaining and should not require supplemental irrigation or intensive weed control. Following this initial establishment period, any subsequent monitoring activities would be the responsibility of the local maintaining agency, and would focus primarily on general and biological inspections for the purposes of fire management and habitat evaluation.

Monitoring of elderberry habitats would focus on a minimum survival rate of at least 60 percent of the elderberry shrubs. Within one year of discovery that survival has dropped below 60 percent, additional plantings would be installed to bring survival above this level. Monitoring of associated riparian habitat would focus on: (1) the percent cover of native plant species; (2) presence of at least five native species contributing to structural diversity; and (3) decrease percent cover of non-native invasive species that out-compete natives. Additionally, an inventory of wildlife species would be recorded during annual monitoring. Table 11 establishes the percentages required to meet these performance standards. If the habitat is meeting these performance standards, conditions should be consistent enough to estimate community composition and general success of planting efforts.

Table 11. Elderberry and Associated Riparian Habitat Performance Standards.

Performance Standard	Quantitative Measure
Percent survivability of elderberry shrubs	60%
Percent cover of native riparian species	75%
Structural diversity	At least 5 native species contributing to 75% canopy and 50% shrub cover
Percent cover of non-native species	Less than 15%

2.3.3 Mitigation and Monitoring Strategy

Monitoring would be conducted annually per the USFWS Conservation Guidelines for the valley elderberry longhorn beetle (USFWS, 1999). Two surveys would be conducted by qualified biologists between February 14 and June 30 of each year until the mitigation has met the success criteria. Surveys would include:

1. An evaluation of the elderberry plants and associated native plants on the site, including the number of plants, their size and condition.
2. Presence of the adult beetles, including the number of beetles observed, their condition, behavior, and their precise locations.
3. Presence of beetle exit holes in elderberry stems, noting their locations and estimated ages.
4. An evaluation of the adequacy of the fencing, signs, and weed control efforts in the avoidance and conservation areas.
5. A general assessment of the habitat, including any real or potential threats to the beetle and its host plants, such as erosion, fire, excessive grazing, off-road vehicle use, vandalism, excessive weed growth, etc.

A written report presenting and analyzing the data from the project monitoring would be prepared following the surveys, and would be submitted by December 31 of the same year to USFWS. The report would address the status and progress of the transplanted and planted elderberry shrubs, associated native plants and trees, and any failings of the conservation plan and the steps taken to correct them. Any observations of beetles or fresh exit holes must be noted. Copies of original field notes, raw data, and photographs of the conservation area would be included with the report. A vicinity map of the site and maps showing where the individual adult beetles and exit holes were observed would also be included. The survival rate, condition, and size of the elderberry and associated native plants would be analyzed in the report. Real and likely future threats would be addressed along with suggested remedies and preventative measures (such as limiting public access, more frequent removal of invasive non-native vegetation, etc.).

2.3.4 Adaptive Management Strategy

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

Adaptive Management Triggers

- Desired Outcome: Increase percent survivability of elderberry shrubs.

  Triggers: If 60% survivability is not achieved during the monitoring period.

- Desired Outcome: Increase percent cover of native riparian habitat.

  Triggers: If 50% cover of native riparian habitat is not achieved within 3 years, or 75% cover of native riparian habitat is not achieved within 5 years.

- Desired Outcome: Maintain appropriate structural diversity of native riparian habitats.

  Trigger: Suitable structural diversity is not achieved, if canopy cover and/or shrub cover does not achieve 50% within 5 years.

- Desired Outcome: Decrease percent cover of non-native invasive species that outcompete natives including elderberry shrubs.

  Trigger: If non-native percent cover is greater than 15% during the monitoring period.

Adaptive Management Measures

If the triggers established above occur, the following measures would be implemented for VELB habitat in order to adaptively manage the site for success.

- Replanting may be needed if triggers for vegetative cover and/or survivability are being met. Monitoring results should be used to assess the underlying cause of inadequate cover or survival, which may require that additional adaptive management actions be implemented to support successful replanting. Adaptive management actions could include targeted revegetation, such as replanting at elevations that are exhibiting the greatest growth and survival.
- Nonnative species management may be needed if monitoring results show that the triggers for nonnative species present are met, or if nonnative species are impacting the survival of native species including elderberry shrubs. Adaptive management measures may include adjustments to nonnative control methods, such as plant removal, grading of site to remove nonnative roots, or mowing and selective removal of non-native species at optimal times for native growth.
- Irrigation and/or supplemental water may be needed if vegetation is not meeting success criteria, or if species are exhibiting signs of water stress. Assessment of monitoring results may show that drought conditions are causing poor establishment or die off of planted vegetation. Adaptive management actions would include supplemental water to support achievement of percent cover criteria and structural diversity.
- Plant protection may be needed if triggers for vegetative cover and/or survivability are being met. If monitoring results show that plantings are failing due to predation or trampling from human use, then adaptive management actions would include plant cages or protective fencing that could be installed to protect plantings.

2.4 Green Sturgeon

2.4.1 Objectives and Implementation Strategy

The ARCF GRR project will restore existing or create new habitat to compensate for the quality and quantity of green sturgeon habitat (including soft bottom benthic substrate) permanently impacted by project construction. If possible, this would occur at a mitigation bank, however currently no mitigation banks in the Sacramento area provide credits for green sturgeon habitat.

If onsite mitigation is not possible, and there are no mitigation banks available, then compensation for green sturgeon habitat would occur within the north Delta in as close of a proximity to the study area as possible. The non-Federal sponsor supports green sturgeon mitigation, has the capability to implement the mitigation, and would participate in implementation of this mitigation in coordination with the Corps. Based on current best available science, there are limited opportunities for habitat creation within the study area. Created or restored habitat would be designed in coordination with NMFS and would be based on the primary constituent elements (PCEs) of critical habitat such as food availability, water flow, water quality, migration corridors, and sediment quality. Successful establishment of onsite mitigation or creation of offsite habitat will be determined through the success criteria in Section 2.6.3 below.

2.4.2 Success Criteria

The overall performance standard for green sturgeon habitat is based on the establishment of slope and substrate, with a focus on a suitable range of conditions for rearing juvenile green sturgeon developed from SAM. Slope and substrate are critical components of habitat for rearing juvenile green sturgeon. Slope is used as an indicator of shallow water refuge for juveniles as well as food and resting areas. Substrate size is used as an indicator of juvenile refuge from predators, suitable predator habitat, and food availability for juvenile and adult life stages of focus fish. Table 12 below establishes the suitable range of substrate and slope that must be met for each year of monitoring. Slope and substrate would be monitored yearly along with other potential variables discussed below. The monitoring will continue until all performance standards have been achieved for three consecutive years.

Table 12. Green Sturgeon Habitat Performance Standards.

	Acceptable Range
Slope (H:V)	>2:1
Substrate (average size, inches)	0 – 10

Note: Based on outputs from the SAM model. The Corps, in coordination with NMFS, determined that these outputs from the SAM model are the most likely outputs that would remain relevant to sturgeon with improved baseline condition data.

As stated previously, there is insufficient knowledge of the species' relationship to many habitat attributes; however, there may be opportunities to incorporate additional habitat attributes into the evaluation process. Experts at the Corps Engineering Research and Design Center would be engaged in order to develop a post-construction sampling and monitoring plan that would be refined during PED based on any improvements in the understanding of the species at that time. Potential habitat attributes that could be incorporated into success criteria following preconstruction monitoring and the development of the EFM model include:

- Food Resources – Benthic invertebrates and fishes (various species of shrimp, amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies) can be measured in terms of biomass loss, gain, or recovery rate. The impact on the benthic environment can be quantified within the footprint and adjacent to the footprint. Grab samples would be collected at various points of the river. These samples would be analyzed in order to determine the bed material and any change in presence of benthic food sources (clams, invertebrates, etc.) that resulted from construction.
- Water Flow – Although levee improvement projects are unlikely to impact water flow, there may be some localized increase in flow over revetment that could affect the swimming or foraging habits of green sturgeon. These changes can be assessed through a physical or hydraulic model. This monitoring should be paired with a fish tracking study to assess the species presence/ association with habitat/project features in the project area.
- Water Depth – A diversity of water depth is necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages of green sturgeon and salmonids. Water depth impacted by levee construction or bank armoring can be measured impact through a direct physical quantification of changes to shallow and deep water habitat.
- Water Quality –Although levee improvement projects are unlikely to impact long term water quality, sediment quality, or migratory corridors, baseline conditions of these resources could be determined in order to develop a greater understanding of how these resources could impact normal behavior, growth, and viability of all life stages of green sturgeon and other fish species. Water Quality monitoring would involve testing water temperature, salinity, oxygen content, and other chemical characteristics within the project reach.

2.4.3 Mitigation Monitoring Strategy

The mitigation monitoring strategy will focus on the successful establishment of critical habitat elements, including slope and substrate. Post-construction monitoring would continue until the mitigation site has met the success criteria for three consecutive years. Slope would be monitored on an annual basis using range finding technologies. Slope will be sampled in varying distances perpendicular to the shoreline to assess slope ratio and depth. Substrate can vary seasonally and therefore will be monitored bi-annually before and after high flows. Substrate would be evaluated

through direct physical samples. Substrate will be sampled in varying distances perpendicular to the shoreline to assess the content of benthic material.

A post-construction monitoring report would be produced annually following monitoring. The report would summarize and analyze all monitoring activities with overall evaluation of the performance of the success criteria. Additional results, analysis, proposed adaptive management measures, and associated costs would be incorporated into the monitoring report.

2.4.4 Adaptive Management Strategy

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

Adaptive Management Triggers

- Desired Outcome: Maintain slope gradient of greater than 2H:1V.

  Triggers: If slope is less than 2H:1V during the monitoring period.

- Desired Outcome: Maintain acceptable range of substrate conditions to provide benthic habitat.

  Triggers: If average substrate sizes are composed of cobbles larger than 10 inches during the monitoring period.

Adaptive Management Measures

If the triggers established above occur, the following measures would be implemented for green sturgeon benthic habitat in order to adaptively manage the site for success.

- Slope regrading may be needed if monitoring results show that the trigger for slope angle is met. Adaptive management measures may include grading to recontour slope angle to 2H:1V or greater.
- Sediment management measures may be needed if the trigger for substrate is met. If monitoring results show that average substrate composition is larger than 10 inches, then the following measures may be implemented. Measures may include gravel augmentation, sediment catching measures, and/or introduction of fines.

3.0 Adaptive Management Costs

This section outlines the feasibility level adaptive management costs for the American River Common Features (ARCF) General Reevaluation Report (GRR) study. The adaptive management plan for this project reflects a level of detail consistent with the project Feasibility Study. The primary intent is to develop adaptive management costs appropriate for and specific to the project's adaptive management measures and monitoring strategies, as described in Section 2.0 of this document. The specified management actions allow estimation of the adaptive management program costs for the project.

The cost for implementation of this plan are provided at October 2015 price levels and prior to contingency. The cost for implementing the monitoring plan proposed above is approximately $5.05 million and is shown on Table 13 below.

Table 13. Monitoring Costs for the ARCF GRR.

Monitoring	Assumed Tasks for Monitoring	Frequency	Cost Assumptions	Total Cost for 5 Years
Vegetation Monitoring	Assume monitoring of mitigation sites, including transects for percent cover of natives and non-natives, structural diversity, and canopy cover over water using transect/plot monitoring. Assume vegetation mapping, inventories of general wildlife, and observations of damage to habitat would be recorded. Assume monitoring of all parameters would be done concurrently during each monitoring event.	Annually for 5 Years	Monitoring: Cost estimate based on standard establishment contract, including monitoring cost and annual report from contractor. Assume $50,000 per year for 4 biologists to survey mitigation sites	$1,296,000
Green Sturgeon Habitat Monitoring	Assume monitoring of slope and in-channel habitat elements including substrates (i.e., composition and percentage of fines)	Annually for 5 Years	Monitoring: Assume monitoring of 8 reaches for 5 years	$3,750,000
			TOTAL MONITORING	**$5,050,000**

The cost for the adaptive management plan is approximately $5.15 million and is shown on Table 14 below.

Table 14. Adaptive Management Costs for the ARCF GRR.

Adaptive Management Measures	Assumed Tasks for Adaptive Management	Cost Assumptions	Total Cost for 5 Years
Irrigation/Supplemental Water	Apply supplemental irrigation to water stressed plants	Assuming $900 per acre per year for 5 years	$900,000
Re-planting	Assume that assume 25% of vegetation may require replanting over 5 years.	Cost of vegetation was estimated at $5,000 per planted acre	$2,220,000
Plant Protection & Fencing	Assume 10,000 plant cages and 10,000 feet of fencing may be needed.	Assume $10/plant cage; $3/linear foot for fencing; plus $50,000 installation. Costs referenced from existing restoration contracts.	$280,000
Slope Regrading and Sediment Management	Recontouring or existing slopes and gravel augmentation	Assume regarding and gravel augmentation at 25% of mitigation site at $35 per CY	$1,560,000
Annual Report	Produce annual report	Assume $37,500 per report, annually for 5 years	$190,000
		TOTAL ADAPTIVE MANAGEMENT	**$5,150,000**
		TOTAL MONITORING AND ADAPTIVE MANAGEMENT	**$10,200,000**

The combined monitoring and adaptive management costs at October 2015 price levels, as included in the certified total project cost summary under the 06 “fish and wildlife facilities” account, total $10.2 million for the Recommended Plan.

4.0 References

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