# Biological Assessment

## American River Common Features
## General Reevaluation Report

## North Sacramento Streams Levee Improvement Project

**September 2015**

# Contents

Appendices ..... iv

Tables ..... iv

Figures ..... v

1.0 Introduction ..... 1

1.1 American River Common Features Study Area and Action Area ..... 3

1.2 Project Background and Authority ..... 5

1.2.1 Authority ..... 5

1.2.2 Background ..... 6

1.3 Future Consultation Approach ..... 8

2.0 Description of the Action and Project Evaluation Approach ..... 9

2.1 Introduction ..... 9

2.1.1 Alternative Formulation and Screening ..... 10

2.1.2 Measures Considered, But Eliminated From Future Consideration ..... 11

2.2 Alternative 2 – Improve Levees and Widen the Sacramento Weir and Bypass ..... 12

2.2.1 Vegetation and Encroachments ..... 14

2.2.2 Borrow Sites, Haul Routes, and Staging Areas ..... 20

2.2.3 American River ..... 27

2.2.4 Sacramento River ..... 31

2.2.5 East Side Tributaries ..... 36

2.2.6 Sacramento Weir and Bypass ..... 43

2.2.7 Additional North Sacramento Streams Project Components ..... 46

2.3 Operation and Maintenance ..... 49

2.4 Full Consultation Biological Assessment Approach ..... 50

2.5 Proposed Conservation and Mitigation Measures ..... 52

2.5.1 Compensation Timing ..... 52

2.5.2 Valley Elderberry Longhorn Beetle Conservation and Mitigation Measures ..... 52

2.5.3 Giant Garter Snake Conservation and Mitigation Measures ..... 53

2.5.4 Vernal Pool Crustacean Conservation and Mitigation Measures ..... 55

2.5.5 Western Yellow-Billed Cuckoo Conservation Measures ..... 56

2.5.6 Fisheries Conservation and Mitigation Measures ..... 57

2.5.7 Additional Minimization and Conservation Measures ..... 61

2.5.8 Summary of Environmental Commitments ..... 62

3.0 Federally Protected Species and Critical Habitat ..... 66

3.1 Plants ..... 66

3.2 Invertebrates ..... 66

3.2.1 Valley Elderberry Longhorn Beetle ..... 66

3.2.2 Vernal Pool Fairy Shrimp ..... 68

3.2.3 Vernal Pool Tadpole Shrimp ..... 70

3.3 Fish ..... 72

3.3.1 Sacramento River Winter-Run Chinook Salmon Evolutionarily Significant Unit ..... 72

3.3.2 Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit ..... 74

3.3.3 Central Valley Fall-/Late Fall–Run Chinook Salmon Evolutionarily Significant Unit ..... 76

3.3.4 Central Valley Steelhead Distinct Population Segment ..... 78

3.3.5 Delta Smelt ..... 80

3.3.6 Green Sturgeon Southern Distinct Population Segment ..... 82

3.4 Amphibians ..... 84

3.5 Reptiles ..... 84

3.5.1 Giant Garter Snake ..... 84

3.6 Birds ..... 85

3.6.1 Western Yellow-Billed Cuckoo ..... 85

4.0 Environmental Baseline ..... 88

4.1 Vegetation ..... 89

4.1.1 Historical Human Resource Use and Current Riparian Vegetation ..... 90

4.1.2 Site-Specific Analysis of Riparian Vegetation ..... 90

4.2 American River Hydraulic Baseline ..... 91

4.2.1 Folsom Dam Operations ..... 91

4.2.2 American River Erosion Susceptibility ..... 92

4.3 Affected Species in the Action Area ..... 95

4.3.1 Valley Elderberry Longhorn Beetle ..... 95

4.3.2 Chinook Salmon and Steelhead ..... 97

4.3.3 Green Sturgeon ..... 98

4.3.4 Delta Smelt ..... 98

4.3.5 Giant Garter Snake ... 99
4.3.6 Vernal Pool Fairy Shrimp ... 100
4.3.7 Vernal Pool Tadpole Shrimp ... 100
4.3.8 Western Yellow-Billed Cuckoo ... 101
5.0 Effects of the Proposed Action ... 102
5.1 Invertebrates ... 102
5.1.1 Valley Elderberry Longhorn Beetle ... 102
5.1.2 Vernal Pool Fairy Shrimp ... 107
5.1.3 Vernal Pool Tadpole Shrimp ... 108
5.2 Fish Species ... 108
5.2.1 Sacramento River Winter-Run Chinook Salmon ... 109
5.2.2 Central Valley Spring-Run Chinook Salmon ... 115
5.2.3 Central Valley Steelhead ... 116
5.2.4 Delta Smelt ... 118
5.2.5 Green Sturgeon ... 122
5.3 Giant Garter Snake ... 124
5.4 Western Yellow-Billed Cuckoo ... 126
5.5 Ongoing Project Actions ... 128
5.6 Effects on the Environmental Baseline ... 128
5.7 Effects on Essential Elements of Critical Habitat ... 128
5.8 Cumulative Effects ... 128
5.8.1 ESA Cumulative Effects Analysis ... 128
5.8.2 Federal Cumulative Effects Analysis ... 130
5.9 Conclusion and Effects Determination for Listed Species ... 135
5.9.1 Valley Elderberry Longhorn Beetle ... 135
5.9.2 Fish ... 135
5.9.3 Giant Garter Snake ... 137
5.9.4 Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp ... 137
5.9.5 Western Yellow-billed Cuckoo ... 138
5.10 Effects of the Proposed Action on Essential Fish Habitat ... 138
5.10.1 Effects of the Proposed Action on EFH ... 139
6.0 References ... 142

## Appendices

Appendix A. Species Lists.
Appendix B. American River Common Features GRR SAM Analysis.
Appendix C. Delta Smelt Shallow Water Habitat Analysis.
Appendix D. North Sacramento Streams Levee Improvements Project Preliminary Biological Evaluation.
Appendix E. Magpie Creek Flood Control Project Biological Opinion.
Appendix F. Habitat Maps of the American River Parkway.
Appendix G. Existing VELB Mitigation Sites within the American River Parkway.

## Tables

Table 1. Federally Protected Species and Critical Habitat Addressed in this Biological Assessment.
Table 2. Summary of ETL Compliance Method by Waterway.
Table 3. Proposed Measures for the American River Common Features Project.
Table 4. Alternative 2 - Proposed Remediation Measures by Waterway.
Table 5. Tentative Construction Schedule for Alternative 2.
Table 6. Comparison of 10, 100 and 200 year Frequency Flows under Various Conditions.
Table 7. Presence of Listed Species within the Study Area.
Table 8. Summary of Reach-Specific SRA Analysis.
Table 9. Comparison of Peak Discharges in the American River between Current and Future Events.
Table 10. American River Elderberry Shrub Effects and Proposed Compensation.
Table 11. Sacramento River Elderberry Shrub Effects and Proposed Compensation.
Table 12. O&M Elderberry Shrub Effects and Compensation.
Table 13. Assumed Life Stage Timing and Distribution of Special Status Fish Species.
Table 14. Impacts to Giant Garter Snake Habitat.

# Figures

Figure 1. American River Common Features Study Area.
Figure 2. Individual Reach Identification in the ARCF Study Area.
Figure 3. Potential Borrow Sites within 20-miles of the Study Area.
Figure 4. North Sacramento Streams Borrow Areas.
Figure 5. North Sacramento Streams Haul Routes.
Figure 6. North Sacramento Streams Staging Areas.
Figure 7. American River and East Side Tributaries Proposed Measures.
Figure 8. Planting Berms with Vegetation and Wetland Bench.
Figure 9. Erosion Protection – Launchable Rock Trench and Bank Protection Scenarios.
Figure 10. Sacramento River Proposed Measures.
Figure 11. Fix-In-Place with Cutoff Wall and Levee Raise.
Figure 12. Fix-In-Place with Cutoff Wall and No Levee Raise.
Figure 13. Planting Berm with Vegetation and Woody Material.
Figure 14. Conventional Open Trench Cutoff Wall or Floodwall Scenario.
Figure 15. North Sacramento Streams Levee Improvement Project Area Reaches.
Figure 16. Floodwall with Variable Raise and Bolster Typical.
Figure 17. Magpie Creek Proposed Measures.
Figure 18. North Sacramento Streams Potential Robla Creek Mitigation Sites.
Figure 19. Velocities in the Lower American River at 115,000 cfs.
Figure 20. Velocities in the Lower American River at 160,000 cfs.
Figure 21. American River Velocity Contours.
Figure 22. Bank Protection Site R4 in Planting Year 2001 on the American River.
Figure 23. Bank Protection Site 4R in 2005
Figure 24. Bank Protection Site 4R in 2010.

# American River Common Features Project
# North Sacramento Streams Levee Improvement Project
# **Biological Assessment**

## 1.0 Introduction

The U.S. Army Corps of Engineers (Corps) is requesting consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Federal Endangered Species Act (ESA) to evaluate, on a biological assessment (BA) level, potential effects associated with levee modifications proposed under the American River Common Features (ARCF) General Reevaluation Report (GRR) Project. In addition, the Sacramento Area Flood Control Agency (SAFCA) is proposing to implement some segments of the ARCF GRR in advance of the Federal project. This BA addresses the overarching ARCF GRR project, and SAFCA's North Sacramento Streams Levee Improvement Project (NSS), a subset of the ARCF GRR. The purpose of this BA is to meet Section 7 consultation requirements as well as requirements of the Magnuson-Stevens Fishery Conservation and Management Act of 1997 (NMFS 1997). This BA was prepared in accordance with the Corps' Engineering Regulation 1105-2-100 (Corps 2000a).

Section 7 of the ESA requires Federal agencies to conserve listed species and their critical habitat, and to consult with USFWS and NMFS (the Services) to ensure that actions they fund, authorize, or perform do not jeopardize the existence of any listed species or result in the destruction or adverse modification of their designated critical habitat. The actions covered in this BA are associated with future levee modifications proposed for the ARCF GRR Project (Figure 1).

The Magnuson-Stevens Fishery Conservation and Management Act of 1997 (MSA) governs the conservation and management of commercially harvested ocean fisheries. The purpose of the Act is to take immediate action to conserve, protect, and manage U.S. coastal fishery resources, anadromous species, and Essential Fish Habitat (EFH). EFH is the aquatic habitat (water and substrate) that is necessary for fish to spawn, breed, feed, or mature, and that allows production levels needed to: (1) support a long-term, sustainable commercial fishery, and (2) contribute to a healthy ecosystem (NMFS 1997). The ARCF study area is designated as EFH habitat for Pacific salmon under Section 305(b)(2) of the MSA. Species to be addressed in this BA include:

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

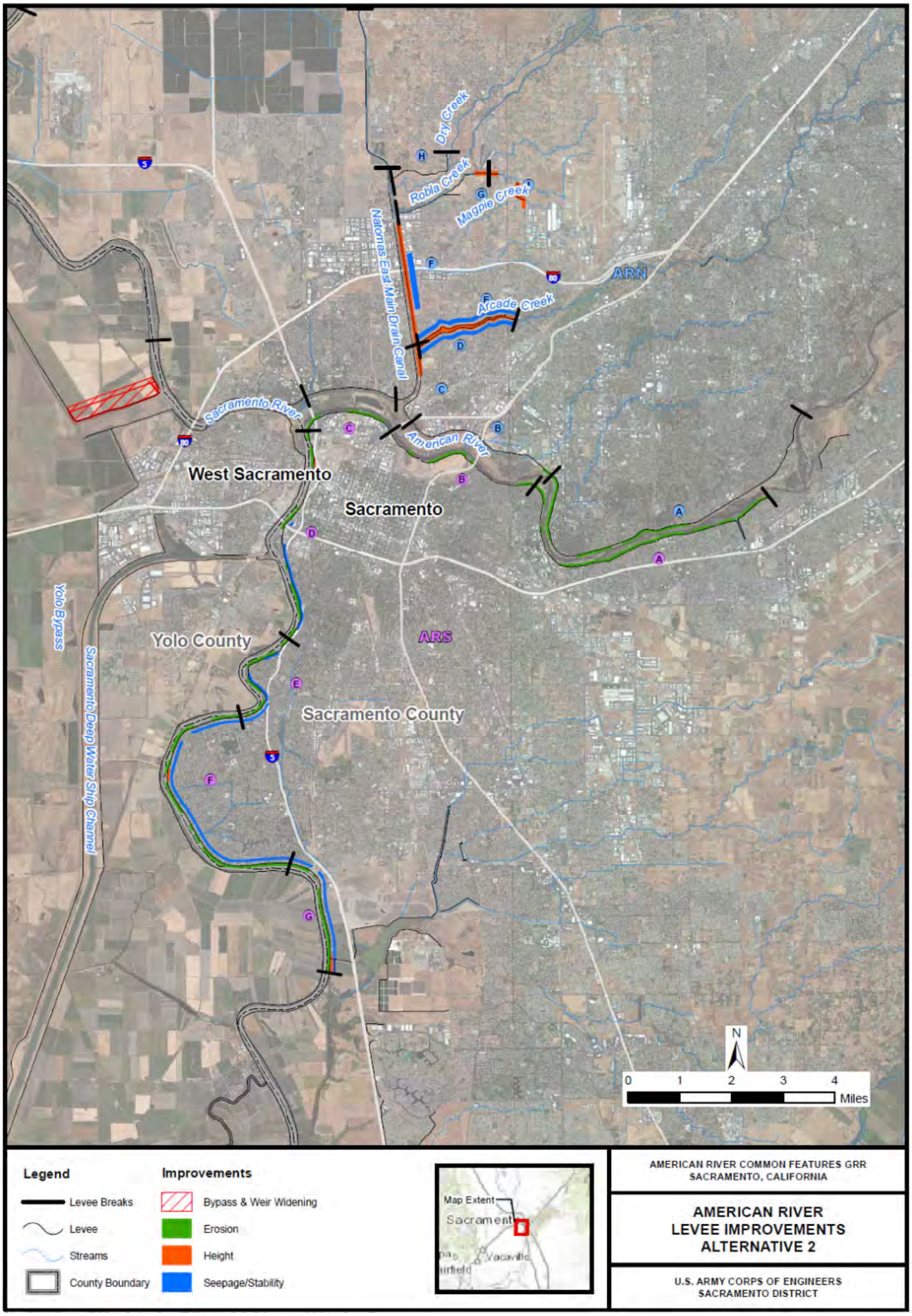


**Figure 1. American River Common Features Study Area.**

## 1.1 American River Common Features Study Area and Action Area

The study area is located within the Sacramento and American River Watersheds. The Sacramento River watershed covers approximately 26,000 square miles in central and northern California. Major tributaries of the Sacramento River include the Feather, Yuba, and American Rivers. The American River Watershed covers about 2,100 square miles northeast of the city of Sacramento and includes portions of Placer, El Dorado, Alpine, and Sacramento counties. The American River watershed includes Folsom Dam and Reservoir; inflowing rivers and streams, including the North, South, and Middle forks of the American River; and the lower American River downstream of Folsom Dam to its confluence with the Sacramento River in the city of Sacramento. The Sacramento and American Rivers, in the Sacramento area, form a flood plain covering roughly 110,000 acres at their confluence. The flood plain includes most of the developed portions of the city of Sacramento. Figure 1 shows the study area.

The city of Sacramento is the capitol of California, and thus is the government center for the state, which by itself has the 9th largest economy in the world. Many state offices located in downtown Sacramento, including the State Capitol building, are in areas that could be affected by flood events. Disruption of government services, and effects to emergency services and transportation corridors could have far ranging effects including life safety.

The ARCF 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), Dry, Robla, and Arcade Creeks and the Magpie Creek Diversion Channel (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 (Figure 1). This BA analyzes the effects of repairing the levees in the Sacramento area and widening the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass and alleviate the need to raise levees along the Sacramento River downstream of the bypass.

The action area for the ARCF GRR project includes the American River from below Folsom Dam to the confluence with the Sacramento River and the Sacramento River from the Sacramento Bypass down to below Freeport. In addition the action area includes the East Side Tributaries: the NEMDC, Dry, Robla, and Arcade Creeks, and the Magpie Creek Diversion Channel. The SAFCA NSS project includes approximately 5 miles of Arcade Creek and NEMDC, as well as an associated borrow site and staging areas. More information about these sites is included in the project description below.

The erosion repairs within the project area is likely to somewhat reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment perspective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather and especially the Yuba River systems. All of the available sediment in the American River watershed is being contained behind Folsom Dam. For velocity, the site specific designs will be constrained from allowing any velocity increases outside the erosion repair site. Sediment impacts due to the bypass widening are not known at this time, except to say that the study would constrain the design to minimize impacts to sediment transport. Further studies associated with the Bypass widening would be conducted during the preconstruction engineering and design phase of the project, and any impacts to listed species that are discovered during these studies would be coordinated with the resource agencies at that time. The action area for the project is directly related to the study area where construction activities would occur.

The project is designed to allow for the release of 160,000 cubic feet per second (cfs) from Folsom Dam. The levees along the American River are unable to withstand these maximum flows for extended periods of time without increased risk of erosion and potential failure. The exact location where erosion would occur and to what extent erosion would occur during any given event is unknown. Erosion within the American River Parkway is being addressed as part of the Folsom Dam Water Control Manual Update currently under evaluation and a biological assessment is being prepared to initiate Section 7 consultation with both USFWS and NMFS. Therefore, the affects of erosion due to changes in operations from Folsom Dam are not analyzed in this BA because construction of the American River and Sacramento Bypass measures for the ARCF GRR, which are dependant on releases from Folsom Dam, would not occur until after a Biological Opinion is received for the Water Control Manual Update. Sacramento River and East Side Tributaries measures would be necessary to improve the flood risk management system in the Sacramento area regardless of the change in operation at Folsom Dam and are not dependant on Folsom Dam operations for their implementation. As a result, construction in these areas could occur regardless of the Folsom Dam Water Control Manual Update schedule.

The American River Common Features General Reevaluation Report (ARCF GRR) is being completed in accordance with the principles that have been outlined in the Corps' SMART Planning Guide (May 2012). SMART Planning requires that all feasibility studies should be completed within a target of 18 months (to no more than three years at the greatest), at a cost of no more than $3 million, utilizing 3 levels of vertical team coordination, and of a "reasonable" report size. The SMART Planning methodology and framework were developed to facilitate more efficient, effective, and consistent delivery of Planning Decision Documents. As a result of this effort, team members and decision makers are required to accept a lower level of detail and higher level of uncertainty during the pre-authorization study phase. All designs associated with this project are therefore preliminary, with the largest footprint considered for analysis of maximum affects to listed species and designated critical habitat. As design refinements and more site specific data becomes available, where practicable, it is anticipated that there will be reductions in effects to listed species and designated critical habitat.

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

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

| Common Name | Scientific Name | Federal Status |
|---|---|---|
| **Threatened and Endangered Species** | | |
| Valley elderberry longhorn beetle | *Desmocerus californicus dimorphus* | T |
| Sacramento River winter-run Chinook salmon ESU | *Oncorhynchus tshawytscha* | E/MSA |
| Central Valley spring-run Chinook salmon ESU | *Oncorhynchus tshawytscha* | T/MSA |
| Central Valley steelhead DPS | *Oncorhynchus mykiss* | T |
| Delta smelt | *Hypomesus transpacificus* | T |
| Green sturgeon southern DPS | *Acipenser medirostris* | T |
| Giant garter snake | *Thamnophis gigas* | T |
| Vernal pool fairy shrimp | *Branchinecta lynchi* | T |
| Vernal pool tadpole shrimp | *Lepidurus packardi* | E |
| Western yellow-billed cuckoo | *Coccyzus americanus occidentalis* | T |
| **Critical Habitat** | | |
| Valley elderberry longhorn beetle | *Desmocerus californicus dimorphus* | |
| Sacramento River winter-run Chinook salmon ESU | *Oncorhynchus tshawytscha* | |
| Central Valley spring-run Chinook salmon ESU | *Oncorhynchus tshawytscha* | |
| Central Valley steelhead DPS | *Oncorhynchus mykiss* | |
| Delta smelt | *Hypomesus transpacificus* | |
| Green sturgeon southern DPS | *Acipenser medirostris* | |

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

## 1.2 Project Background and Authority

### 1.2.1 Authority

The ARCF project was authorized by Section 106(a)(1) of the Water Resources Development Act (WRDA) of 1996, (Public Law [PL] 104-303) (110 Stat. 3658, 3662-3663), as amended by Section 130 of the Energy and Water Development and Related Agencies Appropriations Act of 2008, (PL 110-161) (121 Stat. 1844, 1947). Additional authority was provided in Sections 366 and 566 of WRDA 1999, (PL 106-53), (113 Stat. 269, 319-20). Section 366 directed the Secretary to include specific levee improvement features in the overall project and Section 566(b) directed the Secretary to undertake additional study of American and Sacramento River levee modifications. Significant changes to the project cost were recommended in the Supplemental Information Report of March 2002. This report was submitted to the Assistant Secretary of the Army for Civil Works, but before it could be forwarded to Congress, Section 129 of the Energy and Water Development Appropriations Act of 2003, (PL 108-137), (117 Stat. 269, 1839) increased the authorized total cost of the project to $205,000,000. The current estimated cost of the authorized project is $274,100,000. In accordance with Section 902 of WRDA 1986 (Pub. L. 99-662, § 902, Nov. 17, 1986, 100 Stat. 4183), the allowable cost limit is $284,000,000.

To implement the NSS Levee Improvements Project, SAFCA would request permission from the Corps for:

- Alteration of Federal project levees, pursuant to Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408, referred to as "Section 408"); and
- Placement of fill in jurisdictional waters of the United States, pursuant to Section 404 of the Clean Water Act (33 USC 1344, referred to as "Section 404").

### 1.2.2 Background

After the flood of 1986, Congress directed the Corps to investigate the feasibility of reducing flood risk of the city of Sacramento. The Corps completed feasibility studies in 1991 and 1996, recommending a concrete gravity flood detention dam on the north fork of the American River at the Auburn site along with levee improvements downstream of Folsom Dam. Other plans evaluated in the report were Folsom Dam improvements and a stepped release plan for Folsom Dam releases. These additional plans also included levee improvements downstream of Folsom Dam. Congress recognized that levee improvements were "common" to all candidate plans in the report and that there was a Federal interest in participating in these "common features." Thus, the ARCF Project was authorized in WRDA 1996 and a decision on Auburn Dam was deferred to a later date. Major construction components for ARCF in the WRDA 1996 authorization include construction of seepage remediation along approximately 22 miles of American River levees and construction of levee strengthening and raising of 12 miles of Sacramento River levee in Natomas.

Following the flood of 1986, significant seepage was experienced on the Sacramento River from Verona (upstream end of Natomas) at River Mile (RM) 79 to Freeport at RM 45.5. In addition, both the north and south bank of the American River from RM 0 to approximately RM 11.4 experienced seepage. Seepage on the Sacramento River was so extensive that Congress, soon after the 1986 flood event, funded remediation in the Sacramento Urban Levee Improvement Project (Sac Urban). The Sac Urban Project constructed shallow seepage cutoff walls from Powerline Road in Natomas at approximately RM 64 down to Freeport.

Shortly thereafter, the Sacramento Valley experienced a flood event in 1997. Considerable seepage occurred on the Sacramento River as well as on the American River. Seepage on the American River was to be expected because remediation had yet to be constructed, but the occurrence of significant seepage on the Sacramento River in the reach remediated as part of the Sac Urban project was alarming and confirmed that deep underseepage was also of significant concern. As a result of this conclusion, seepage remediation on the American River (then in the late 1990s in the design phase) would need to be designed to remediate both through- and deep underseepage.

In 1999, Congress decided not to authorize Auburn Dam but instead to authorize improvements for Folsom Dam. By doing this, improvements to levees downstream of Folsom Dam could be fine tuned to work closely with the Folsom Dam improvements being discussed by Congress. Therefore, the ARCF project was modified by WRDA 1999 to include additional necessary features for the American River so that it could safely convey the proposed emergency release of 160,000 cfs from Folsom Dam. Major construction components for the ARCF project in the WRDA 1999 authorization include construction of seepage remediation and levee raises along four stretches of the American River, and construction of levee strengthening and raising of 5.5 miles of Natomas Cross Canal levee in Natomas. All American River features authorized in WRDA 1996 and 1999 have been constructed or are in design analysis for construction within a year or two.

Because of the considerable cost increase of seepage remediation on the American River, all funds appropriated by Congress throughout the late 1990s and the early part of the 2000s were used for construction activities on the American River instead of for design efforts in the Natomas Basin. Combining this with the recognition that all work in the Natomas Basin would also require significantly more effort than was anticipated at the time of authorization, it was decided in 2002 that a general reevaluation study would be required for at least the Natomas Basin portion of the ARCF project. This general reevaluation started in 2006.

At approximately the same time that the reevaluation study was beginning, the Folsom Dam Post Authorization Change report (PAC) was being completed by the Sacramento District. Results of this study showed that additional levee improvements were needed on the American River and on the Sacramento River below the American River in order to truly capture the benefits of the Folsom Dam projects. These levee improvements consisted primarily of addressing erosion concerns on the American River and seepage, stability, erosion, and height concerns on the Sacramento River below the American River. However, the full extent of the levee improvements necessary to address these concerns was not known. With the construction of the Sac Urban project, it was thought that the seepage and stability problems had been addressed. However, the 1997 flood event proved otherwise. Because of this, it was realized that additional reevaluation studies are also needed to include the additional two basins comprising the city of Sacramento, as well as the Natomas Basin.

The purpose of the ARCF project is to reduce the flood risk for the city of Sacramento. The following problems were identified within the Sacramento levee system:

- Seepage and Underseepage;
- Levee Erosion;
- Levee Stability;
- Levee Overtopping;
- Access for Maintenance and Flood Fighting;
- Vegetation and Encroachments;
- Releases from Folsom Dam;
- Floodplain Management; and
- Additional Upstream Storage from Existing Reservoirs.

### 1.3 Future Consultation Approach

In order to evaluate the maximum affects to listed species this BA looks at the largest foreseeable footprint. The Corps will consult on Alternative 2 (Proposed Alternative) which is the tentatively selected plan and the Locally Preferred Plan. Following project authorization as the Corps begins the design phase of the project, footprint refinements will likely reduce the effects to listed species. Coordination with the resource agencies will continue into the design phase to obtain input to avoid, minimize, or compensate for affects to listed species. The Corps would consult with the resource agencies of any project footprint changes, including potential reductions of impacts prior to the initiation of construction. This future coordination would attempt to reduce any mitigation required for the project and also would determine if additional consultation is needed for the project.

In addition, SAFCA, the project’s local sponsor, is proposing to implement some reaches of the ARCF GRR in advance of the Federal project. SAFCA would seek permission from the Corps pursuant to 33 USC §408 (Section 408) for alteration of the Federal levee system. Additionally, SAFCA would seek credit from the Corps under Section 221 of the Flood Control Act of 1970. This BA supports implementation of SAFCA’s NSS Levee Improvement Project.

# 2.0 Description of the Action and Project Evaluation Approach

## 2.1 Introduction

The ARCF GRR has identified a number of problems associated with the flood risk management system protecting the city of Sacramento and surrounding areas. There is a high probability that flows in the American and Sacramento Rivers will stress the network of levees protecting Sacramento to the point that levees could fail. The consequences of such a levee failure would be catastrophic, since the area inundated by flood waters is highly urbanized and the flooding could be up to 20 feet deep.

The majority of the Sacramento River levee within the study area requires seepage, slope stability, height, and erosion improvements in order to meet Corps criteria. Construction of the levee improvement measures will require complete vegetation removal within the construction footprint required to install the cutoff wall and raise the levee for approximately one mile. On the waterside, where construction does not remove vegetation, on the lower one-half of the slope to 15 feet waterward of the waterside levee toe, the vegetation will be left in place and a Vegetation Variance (VV) will be sought by the Sacramento District. To show that the safety, structural integrity, and functionality of the levee would be retained, an evaluation of underseepage and waterside embankment slope stability was completed given that a tree fell resulting in scouring of the root ball area.

An analyses section/index point was chosen for the VV analyses which was considered to be representative of the most critical channel and levee geometry and the without project analyses showed the section does not meet underseepage and slope stability criteria. The cross-section geometry of the index point incorporated tree fall and scour by using a maximum depth of scour for cottonwoods as approximately 11.0 feet; the associated soil removed was projected at a 2:1 slope from the base of the scour toward both the landside, and waterside slopes. The base scour width was equal to the maximum potential diameter at breast height (dbh) of cottonwoods (12.0 feet) projected horizontally at a depth of 11.0 feet below the existing ground profile. The results show that the tree fall and scour did not significantly affect levee performance and that the levee meets Corps seepage and slope stability criteria considering the seepage and stability improvement measures are in place ("with project" conditions). Therefore, it is a reasonable conclusion that a VV to allow vegetation to remain would not jeopardize the safety, structural integrity, and functionality of the Sacramento River levee. The Sacramento Weir and Bypass levees would be constructed in compliance with the Corps ETL as these would be new levees. No vegetation removal would be required within the existing or expanded Sacramento Bypass. Table 2 below summarizes the project reaches and whether or not a variance would be requested outside of the construction footprint.

**Table 2. Summary of ETL Compliance Method by Waterway.**

| | **Vegetation Variance** | **SWIF** |
|---|---|---|
| Sacramento River (lower ½ of levee slope which is outside construction footprint) | | |
| Waterside | X | |
| Landside | | X |
| American River | | |
| Trench Landside[1] | | X |
| Bank Protection | | X |
| North Area Tributaries[2] | | |
| NEMDC | X | X |
| Dry/Robla Creeks | X | X |
| Arcade Creek | X | X |
| Magpie Creek[3] | X | X |

1 The waterside footprint for the trench construction would require removal of vegetation and therefore compliance with the ETL.
2 A variance is included for these tributaries waterside slopes outside of the construction footprint, and a SWIF would be prepared by the non-Federal partners for the landside slopes and access.
3 The new levee constructed along Raley Boulevard would be constructed in compliance with the ETL.

### 2.1.1 Alternative Formulation and Screening

A wide variety of management measures were developed to address the planning objectives. These measures were evaluated and then screened using the Corps planning process. Formulation strategies were then developed to address various combinations of the planning objectives and planning constraints. Based upon these strategies, various combinations of the measures were assembled to form an array of preliminary plans. The preliminary plans were then evaluated, screened and reformulated, resulting in a final array of alternatives.

The formulation strategies used to address the objectives and constraints included:

- Measures to reduce flood stages;
- Measures to address seepage and underseepage;
- Measures to address stability;
- Measures to achieve the urban levee level of protection;
- Measures to address erosion;
- Measures to address maintenance and emergency response access; and
- Non-structural measures.

Approximately 35 different measures were developed to address these formulation strategies. The measures then went through a preliminary screening process prior to combining them into alternatives. This screening was done by evaluating the measures against the four planning criteria established in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies: completeness, efficiency, effectiveness, and acceptability. In addition, the local sponsor identified a planning criterion of ability to implement the project.

### 2.1.2 Measures Considered, But Eliminated From Future Consideration

Some measures originally identified that could contribute to addressing Sacramento's flood problems and needs were reviewed and dropped from further consideration. These measures included:

- Upstream storage on the American River (Auburn Dam);
- Transitory storage in upstream basins;
- Yolo Bypass improvements;
- Reoperation of upstream reservoirs: and
- Construction of a diversion structure just upstream of the existing I Street Bridge on the Sacramento River.

The Corps has a long history of studying upstream storage on the American River. Auburn Dam was proposed for authorization by the Corps in both 1991 and 1996, with no authorization granted by Congress. Since that time, Congress has consistently directed the Corps to focus on downstream elements rather than upstream storage under the scope of this study, as levee improvements are considered to be the first increment necessary to improve the overall system. As a result, this alternative was eliminated from consideration under this study. However, upstream storage may be considered to be a viable measure to further reduce the level of risk to the flood risk management system under future studies.

The I Street Bridge diversion structure was proposed to limit flood flows through the city of Sacramento and push excess flows into the Yolo Bypass in order to limit the need for levee repairs downstream of the structure. This measure was not carried forward for a variety of reasons. The estimated implementation time would leave the urban Sacramento River at risk for an unacceptably long period of time. Operation of the structure would inundate the Yolo Bypass more frequently than current operations, causing an unknown disruption to the Yolo County agricultural economy. In addition, the construction of a permanent structure in the Sacramento River channel is inconsistent with the goals and objectives of the Central Valley Flood Protection Plan, a key planning effort by the State of California; moving forward with a measure that is inconsistent with this plan could risk the partnership between the Corps and the State for the ARCF GRR.

The remaining three measures listed above include upstream transitory storage, Yolo Bypass improvements, and reoperation of upstream reservoirs. These three measures were all eliminated from further consideration because none would reduce flood stages to a low enough level to eliminate the need for downstream levee repairs. As a result, the downstream levee repairs remain the common element between these measures and remain the primary focus of Alternative 2, the tentatively selected plan, detailed in Section 2.2 below.

In addition, some non-structural measures were considered, and eliminated, including flood proofing individual structures, relocating residents out of the flood plain, and raising structures to above the floodplain. All of these non-structural measures were eliminated because the sheer number of residents in the floodplains, particularly in the American River South study area in the Pocket and Meadowview neighborhoods, made this alternative cost-prohibitive when compared to the proposed alternatives.

## 2.2 Alternative 2 – Improve Levees and Widen the Sacramento Weir and Bypass

Alternative 2, the tentatively selected plan, involves the construction of fix-in-place levee remediation measures to address seepage, stability, erosion, and height concerns identified for the American River levees, NEMDC, Arcade, Dry/Robla, and Magpie Creeks. The levees along the Sacramento River would be improved to address identified seepage, stability, erosion, and a minimal amount of height concerns. Most height concerns along the Sacramento River would be addressed by a widening of the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass. A summary of the measures proposed under this study are included in Table 3.

**Table 3. Proposed Measures for the American River Common Features Project.**

| Waterway/Location | Extent of Action | Proposed Measure |
|---|---|---|
| American River | North and south levees from the confluence with the Sacramento River upstream for approximately 12 miles. | • Construct bank protection or launchable rock trenches |
| Sacramento River | East levee from the American River to Morrison Creek. | • Install cutoff walls<br>• Construct bank protection<br>• Construct levee raise |
| NEMDC | East levee from Dry/Robla Creek to the American River | • Install cutoff walls<br>• Construct floodwalls |
| Arcade Creek | North and south levees from NEMDC to Marysville Boulevard | • Install cutoff walls<br>• Raise floodwalls |
| Dry/Robla Creek | | • Raise floodwalls |
| Magpie Creek Diversion Canal | Upstream of Raley Boulevard | • Construct floodwalls |
| Magpie Creek area | South of Raley Boulevard | • Construct new levee |
| Magpie Creek area | East of Raley Boulevard | • Acquire property to create a flood detention basin<br>• Widen the Raley Boulevard/Magpie Creek bridge and raise the elevation of the roadway<br>• Remove the Don Julio Creek culvert |
| Sacramento Weir and Bypass | North bypass levee to 1,500 feet north. | • Widen the Sacramento Weir and Bypass by approximately 1,500 feet<br>• Construct a new section of weir and levee<br>• Remove the existing Sacramento Bypass north levee |

All proposed measures are detailed in Sections 2.2.1 through 2.2.4 below. Due to the urban nature and proximity of existing development within the American River North and South basins, Alternative 2 proposes fix in place remediation. The purpose of this alternative would be to improve the flood damage reduction system to safely convey flows to a level that maximizes net benefits. Table 4 summarizes the levee problems discussed above and the proposed measure for each waterway.

**Table 4. Alternative 2 - Proposed Remediation Measures by Waterway.**

| Waterway | Seepage Measures | Stability Measures | Erosion Protection Measures | Overtopping Measures |
|---|---|---|---|---|
| **American River**[1] | --- | --- | Bank Protection, Launchable Rock Trench | --- |
| **Sacramento River** | Cutoff Wall | Cutoff Wall | Bank Protection | Sacramento Bypass and Weir Widening, Levee Raise |
| **NEMDC** | Cutoff Wall | Cutoff Wall | --- | Floodwall |
| **Arcade Creek** | Cutoff Wall | Cutoff Wall | --- | Floodwall |
| **Dry/Robla Creeks** | --- | --- | --- | Floodwall |
| **Magpie Creek**[2] | --- | --- | --- | Floodwall, Levee Raise |

1 American River seepage, stability, and overtopping measures were addressed in the American River Common Features, WRDA 1996 and 1999 construction projects.
2 In addition to the Floodwall, Magpie Creek will include construction of a new levee along Raley Boulevard south of the creek, and construction of a detention basin on both sides of Raley Boulevard. In addition, some improvements would need to occur on Raley Boulevard, including widening of the Magpie Creek Bridge, raising the elevation of the roadway, and removing the Don Julio Creek culvert.

### 2.2.1 Vegetation and Encroachments

In addition to the proposed levee improvements measures shown in Table 3, the following measures and policies would be addressed during construction:

- Utility encroachments will be brought into compliance with Corps policy as a part of project construction activities. Utilities that penetrate the levee would be removed during excavation of the levee and replaced with one of two fixes as construction commences. These two fixes include: (1) a surface line over the levee prism, or (2) a through-levee line equipped with positive closure devices.
- Private encroachments such as fences and stairs in the levee shall be removed by the non-federal sponsor prior to construction.

The Corps' Engineering Technical Letter (ETL) 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, calls for the removal of wild growth, trees, and other vegetation, which might impair levee integrity or flood-fighting access in order to reduce the risk of flood damage. The vegetation requirements include a 15 foot waterside, landside, and vertical vegetation-free zone. In certain instances, to further enhance environmental values or to meet state or Federal laws and/or regulations, a variance can be requested from the standard vegetation guidelines set forth in this ETL.

The ARCF GRR has identified significant and extensive seepage, stability, overtopping, and erosion problems with the levees that increase the risk of flooding for the Sacramento area. Due to the potential for catastrophic consequences associated with a levee failure in this urban area, all identified problems, including vegetation and encroachments, require correction in order to reduce the flood risk to an acceptable level. However, risk reduction measures must be implemented in a "worst first" manner in order to immediately maximize the amount of risk reduction for each increment of investment. The engineering analysis conducted to date generally indicates that seepage and erosion concerns pose a significantly higher risk of levee failure than those associated with vegetation and encroachments. However, specific instances of vegetation and encroachment problems have been identified as high risk and require resolution concurrent with other high risk issues.

In the case of construction associated with the recommended plan, vegetation and encroachment removal is secondary to the primary flood risk management measures (i.e. seepage cutoff barrier, levee raise, slope flattening). In an effort to modernize the levee system to meet current engineering standards, vegetation and encroachment issues (including landside levee access) in the study area will be resolved through a combination of construction actions associated with implementation of the recommended plan and formal agreements. The formal agreements involve the integrated use of a SWIF agreement with the local maintaining agency (LMA) and a variance from vegetation standards in ETL 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures.

**System Wide Improvement Framework**

The SWIF is an agreement between the Corps and the non-Federal sponsor that allows the LMA to defer compliance with ETL 1110-2-583. Under the SWIF agreement, the LMA would address landside vegetation and encroachment issues (including landside levee access) through the implementation of their standard operation and maintenance (O&M) actions over time. Therefore, vegetation not impacted by project construction would be addressed by the LMA in accordance with the State's Levee Vegetation Management Strategy in the Central Valley Flood Protection Plan (CVFPP) over the next 20 to 40 years. The SWIF will be planned and implemented by the non-Federal sponsor and includes the following criteria:

- An engineering inspection and evaluation shall be conducted to identify trees and other woody vegetation (alive or dead) on the levee and within 15 feet of the levee toe that pose an unacceptable threat to the integrity of the levee. Identified trees shall be removed and associated root balls and roots shall be appropriately remediated. Based on the engineering inspection and evaluation, trees and other woody vegetation that do not pose an unacceptable threat need not be removed.

- In cases of levee repair or improvement projects, vegetation within the project footprint shall be removed as part of construction activities.
- Trees and other woody vegetation that are not removed must be monitored as part of routine levee maintenance to identify changed conditions that cause any of these remaining trees and other woody vegetation to pose an unacceptable threat to levee integrity. Otherwise, such trees and woody vegetation are to be maintained according to the levee vegetation management criteria included in the CVFPP which establish a vegetation management zone (including the landside levee slope, crown and upper 1/3 of the waterside slope) in which trees are trimmed up to 5 feet above the ground (12-foot clearance above the crown road) and thinned for visibility and access while brush, trees and other woody vegetation less than four inches in diameter at breast height, weeds or other such vegetation over 12 inches high are to be removed in an authorized manner.

**Vegetation Variance**

A vegetation variance would be sought during the preconstruction engineering and design phase before construction to allow vegetation to remain on the lower 2/3 of the waterside slope and out 15 feet from the waterside toe. If granted, the variance would allow for vegetation to remain in these areas. To show that the safety, structural integrity, and functionality of the levee would be retained with a variance, an evaluation of underseepage and waterside embankment slope stability was completed by Corps geotechnical engineers.

This evaluation was completed for the section/index point at levee mile (LM) 5.92 on the Sacramento River. This index point was chosen for the variance analyses because it was considered to be representative of the most critical channel and levee geometry, underseepage and slope stability conditions, and vegetation conditions. The cross-section geometry of the index point incorporated tree fall and scour by using maximum potential diameter at breast height (dbh) of cottonwoods (12.0 feet) projected horizontally at a depth of 11.0 feet below the existing ground profile. The results show that the tree fall and scour did not significantly affect levee performance and that the levee meets Corps seepage and slope stability criteria considering the seepage and stability improvement measures are in place (“with project” conditions). Therefore, it is a reasonable conclusion that by allowing vegetation to remain as stated above, the safety, structural integrity, and functionality of the Sacramento River levee would be retained.

The vegetation variance request would be developed during the design phase to allow for vegetation to remain on the lower portion of the waterside levee slope (Figures 8 and 9). Vegetation on the upper waterside levee slope would be removed as part of project construction. If a variance is not approved, the recommendations for this portion of the project will be reformulated and further environmental compliance efforts would be required.

Construction of Alternative 2 is proposed to take approximately 13 years. The construction reaches have been prioritized based on a variety of factors, including the condition of the levee, the potential damages that would occur due to levee failure, and construction feasibility considerations, such as the availability of equipment at any given time. The tentative schedule of construction is shown in Table 5. The project reaches are shown in Figure 2 below.

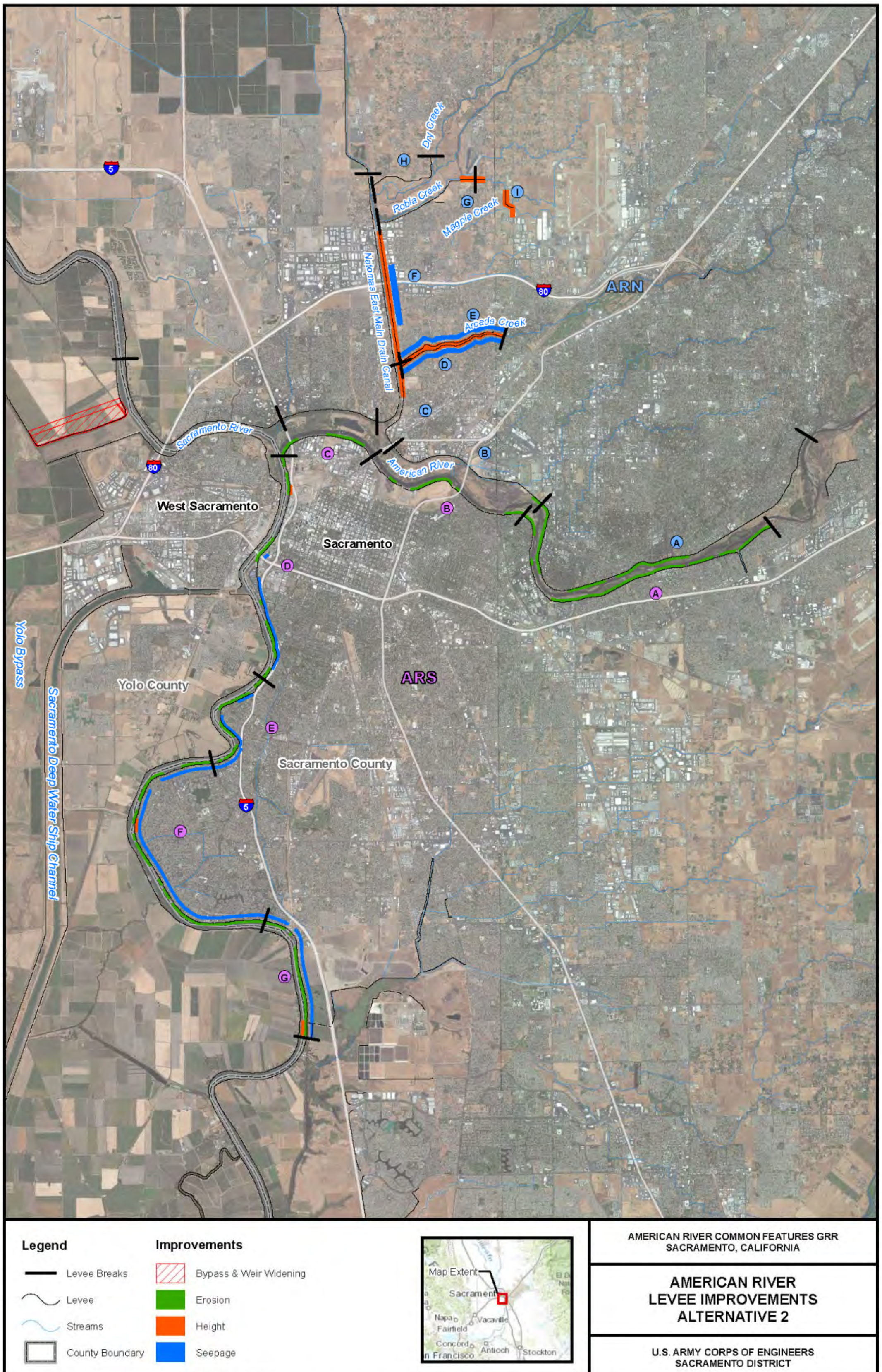


**Figure 2. Individual Reach Identification in the ARCF Study Area.**

**Table 5. Tentative Construction Schedule for Alternative 2.**

| PRIORITY | WATERWAY | REACH[1] | YEAR OF PROJECT CONSTRUCTION | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1 | Sacramento River | ARS F | | | | | | | | | | | | | |
| 2 | Sacramento River | ARS E | | | | | | | | | | | | | |
| 3 | American River | ARS A | | | | | | | | | | | | | |
| 4 | Sacramento River | ARS G | | | | | | | | | | | | | |
| 5 | Sacramento River | ARS D | | | | | | | | | | | | | |
| 6 | American River | ARS B | | | | | | | | | | | | | |
| 7 | American River | ARN A | | | | | | | | | | | | | |
| 8 | American River | ARS C | | | | | | | | | | | | | |
| 9 | American River | ARN B | | | | | | | | | | | | | |
| 10 | Sacramento Weir & Bypass | -- | | | | | | | | | | | | | |
| 11 | Arcade Creek | ARN D | | | | | | | | | | | | | |
| 12 | NEMDC | ARN F | | | | | | | | | | | | | |
| 13 | Arcade Creek | ARN E | | | | | | | | | | | | | |
| 14 | NEMDC | ARN C | | | | | | | | | | | | | |
| 15 | Dry/Robla Creek | ARN G | | | | | | | | | | | | | |
| 16 | Magpie Creek | ARN I | | | | | | | | | | | | | |

[1] Individual reach ID's can be seen in Figure 2.

### 2.2.2 Borrow Sites, Haul Routes, and Staging Areas

**Borrow Sites**

It is estimated that a maximum of 1 million cubic yards (cy) of borrow material could be needed to construct the project. Because this project is in the preliminary stages of design, detailed studies of the borrow needs have not been completed. Actual volumes exported from any single borrow site would be adjusted to match demands for fill. Borrow sites would be selected that do not cause an impact to endangered species or their habitat and therefore, consultation for borrow sites is not required.

To identify potential locations for borrow material, soil maps and land use maps were obtained for a 20-mile radius surrounding the project area. These potential borrow locations are shown on Figure 3. Borrow sites would be lands that are the least environmentally damaging and would be obtained from willing sellers. The criteria used to determine potential locations were based on current land use patterns and soil types from the Natural Resources Conservation Service (NRCS). The data from land use maps and NRCS has not been field verified, therefore, to ensure that sufficient borrow material would be available for construction the Corps looked at all locations within the 20 miles radius for 20 times the needed material. This would allow for sites that do not meet specifications or are not available for extraction of material.

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

Clean rock would be commercially acquired in order to construct the American and Sacramento River bank protection sites. For the Sacramento River, it is assumed that the rock would be acquired from a commercial source in the Bay Area and barged up the Sacramento River to the construction sites. Rock for the American River sites would be acquired from a commercial source within a 50-mile radius and would be hauled in trucks to the construction sites.

Haul routes would be determined during the design phase and would be dependant on what borrow sites and staging areas are selected for project construction. To the maximum extent feasible, haul routes would be selected based on existing commercial haul routes and levee roads and would avoid impacts to Federally listed species.

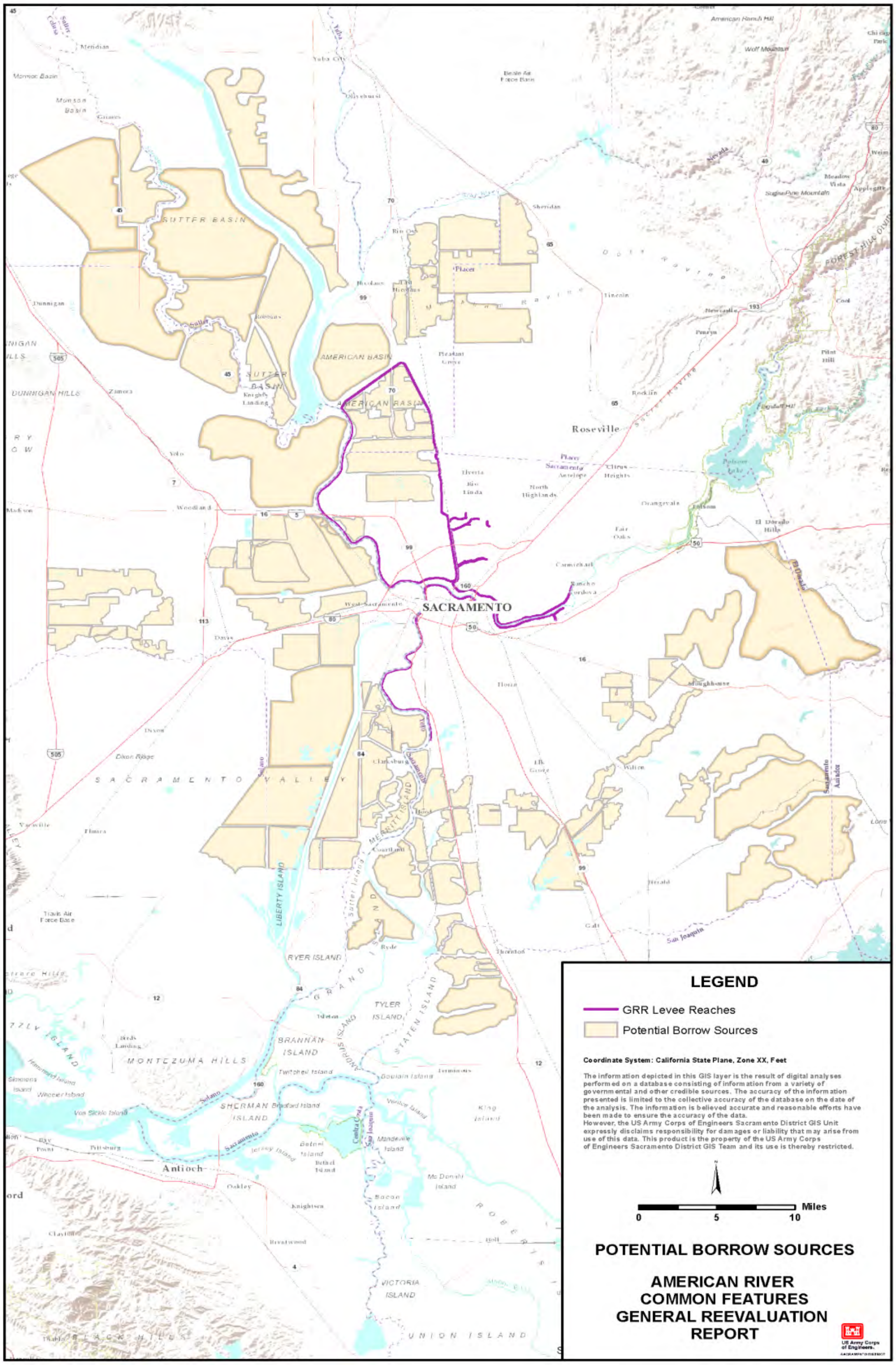


**Figure 3. Potential Borrow Sites within 20-miles of Study Area**.

SAFCA has selected a borrow site to provide suitable material for the NSS Levee Improvements based on proximity to the project area. The preferred borrow source, Borrow Site 2/Site 2K is shown in Figure 4. Approximately 27,000 cy of material will be excavated from the 5.5-acre borrow site in order to construct the levee improvements. Borrow Site 2 would be returned to pre-project conditions following construction activities.

SAFCA's goal in selecting haul routes is to use existing levee crowns for hauling wherever possible (Figure 5). However, there are locations where hauling on paved public roads is the best available option because the levee crown is already paved for public use or because there is inadequate room on the waterside of the levee to develop a temporary toe road without affecting standing water or low flow channels. Final haul routes would be selected based on constraints, the construction schedule, and in coordination with the City.

Borrow Site 2 is in close proximity to the NEMDC levee and East Levee Road located on the levee crown. From these two sites, haul trucks would use East Levee Road from the borrow site down to a point just north of the existing Del Paso/Main Avenue Bridge over NEMDC. At this point, haul trucks would divert off the road, down the levee slope, and pass under the bridge on an existing road. Just downstream of the Del Paso/Main Avenue Bridge, a short span temporary bridge would cross a narrow section of the low flow NEMDC channel. A temporary culvert crossing of the low flow channel is also possible. From the temporary bridge (or culvert) crossing, the haul trucks would proceed up a new sloping ramp constructed on the waterside of the NEMDC east levee to the levee crown. Trucks would then continue down the levee crown to the Arcade Creek north levee. At the Arcade Creek north levee, trucks would cross the existing Union Pacific Railroad (UPRR) tracks at the existing at-grade crossing and proceed along the north levee crown to the improvement sites.

To access the Arcade Creek south levee and the work proposed on the NEMDC east levee, haul trucks would continue south following an access ramp down the levee slope to Arcade Creek. At the creek, a short temporary bridge would be constructed to cross the low flow channel. A temporary culvert crossing of the low flow channel is also possible. From the temporary bridge (or culvert) crossing, the haul trucks would proceed up a new sloping ramp constructed on the waterside of the NEMDC east levee to the levee crown in the vicinity of the existing railroad at-grade crossing near the existing City of Sacramento Pump Station. Trucks would then proceed up the Arcade Creek south levee crown, or south to the improvement sites on the NEMDC east levee south of Arcade Creek.


**Figure 4. North Sacramento Streams Borrow Site 2/Site 2K.**


**Figure 5. North Sacramento Streams Haul Routes.**

Along the proposed haul routes, there are many opportunities to make use of existing undeveloped toe roads or develop new toe roads without affecting channel areas to facilitate truck passage and to avoid active work sites. Several temporary bridge crossings of the low-flow channel may also be needed to connect the north and south side levee waterside toe roads on Arcade Creek to facilitate movement of material and equipment around active work areas. Railroad car undercarriages on temporary abutment supports would be one option for temporary bridge crossings. Spans of up to 85 feet are possible. Locations for toe roads, ramps on levee slopes, and temporary bridge crossings would be finalized as part of final project design. Gravel on levee crowns along haul routes would be maintained as needed during periods of hauling, including watering for dust control and periodic grading to control rutting.

Storm Water Pollution Prevention Plan (SWPPP) requirements would apply to haul routes during construction. Following construction, temporary ramps would be removed, temporary bridges and abutments would be removed, and all disturbed areas would be revegetated.

**Staging Areas**

While staging areas have not been identified at this point in the planning phase, sites will be selected that do not require the removal of large vegetation or habitat that is valuable for endangered species. Staging areas would be selected that do not cause an impact to federally listed species or their habitat and therefore, this BA does not address staging areas and consultation for staging areas is not anticipated. Prior to construction, any staging areas would be cleared, grubbed, and stripped.

For SAFCA's NSS project, four potential staging areas have been identified for potential use to support construction (Figure 6). Several of these areas have been used previously to support levee improvements along Arcade Creek. The areas would require little preparation other than surface stripping, and temporary connection roads and ramps to the levee crown. The primary use for the staging areas would be for temporary trailers, parking, and material staging and for stockpiling and blending of excavated soils with imported borrow to make the excavated soils suitable for use in levee reconstruction. This would involve stockpiles of material to be processed, a processing area where excavated soils and imported soils would be spread out and processed to mix and moisture condition the material, and stockpiles of processed material. Importing, processing, and exporting material for levee reconstruction would all be continuous activities once the work flow is established during the start of the construction season. Other disturbed areas would be also be stabilized. Staging areas would be returned to pre-project conditions following construction activities unless the owner agrees to some grade raising to help dispose of excess construction soils.


**Figure 6. North Sacramento Streams Staging Areas.**

The following sections contain more detailed information on the specific measures proposed under this alternative for the American River North and South study areas.

### 2.2.3 American River

Levees along the American River under Alternative 2 require improvements to address erosion. The proposed measures for these levees consist of waterside armoring to prevent erosion to the river bank and levee, which could potentially undermine the levee foundation. There are two measures proposed for the American River levees: (1) a maximum of 31,000 linear feet (LF) of bank protection, and (2) a maximum of 65 acres/45,000 LF of launchable rock trench. Both of these measures are described in detail in the subsections below. These numbers are maximized because there is some overlap identified to account for the uncertainty of site-specific conditions. For example, for some reaches both bank protection and launchable rock trench impacts were estimated even though both measures would not be constructed in the same reach. Figure 7 shows the erosion protection locations on the American River.

**Bank Protection**

The Corps conducts ongoing erosion repairs to sites on the Sacramento River levees under the Sacramento River Bank Protection Project (SRBPP). As part of the SRBPP NMFS Biological Opinions, the Corps is required to conduct post-construction monitoring in order to evaluate the relative success of on-site habitat features that are incorporated into the repairs. Under the SRBPP, bank protection designs have been constantly evolving, as the results of the monitoring help inform engineers to adapt the designs to optimize for site-specific conditions in meeting the objective of the habitat features. The Corps will use the best available information and SRBPP design templates as a basis for designing site-specific bank protection repairs for this project. As a result, the bank protection measure described below is a basic example of a typically designed bank protection site.

This measure consists of placing rock revetment on the river's bank to prevent erosion. This measure entails installing revetment along the stream bank based on site-specific analysis (Figure 7). 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 of loose material and understory growth prior to construction. 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.

The placement of rock onto the bank will occur from a land based staging area using long reach excavators and loader. The loader brings the rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the water side of the levee.

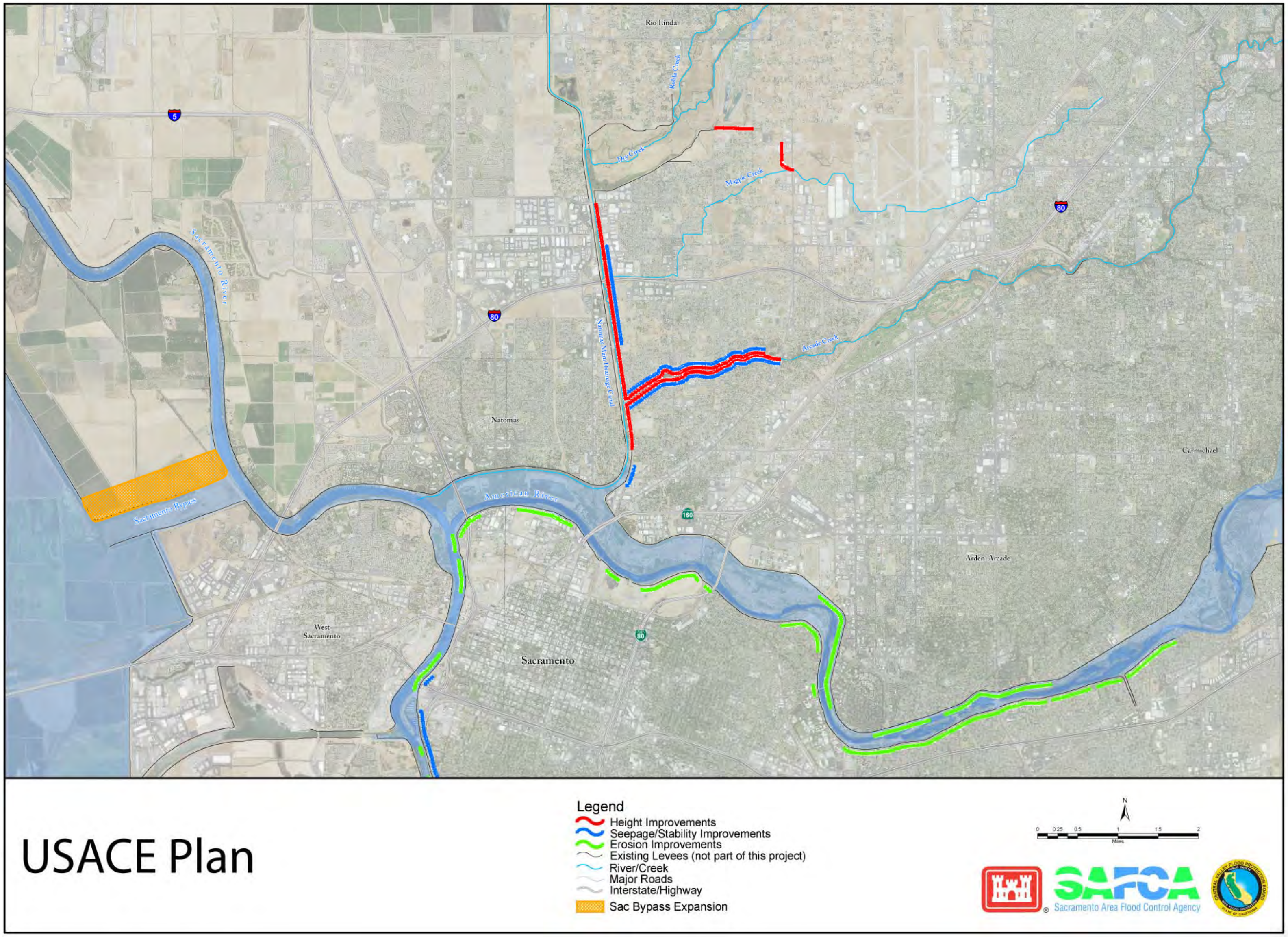


**Figure 7. American River and East Side Tributaries Proposed Measures.**

The revetment would be placed on the existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After revetment placement has been completed, a planting berm would be constructed in the rock to allow for revegetation of the site. The planting berm varies in width from 5 to 15 feet (Figure 8). In all cases the planting will occur outside the vegetation free zone as required by the ETL.

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.).

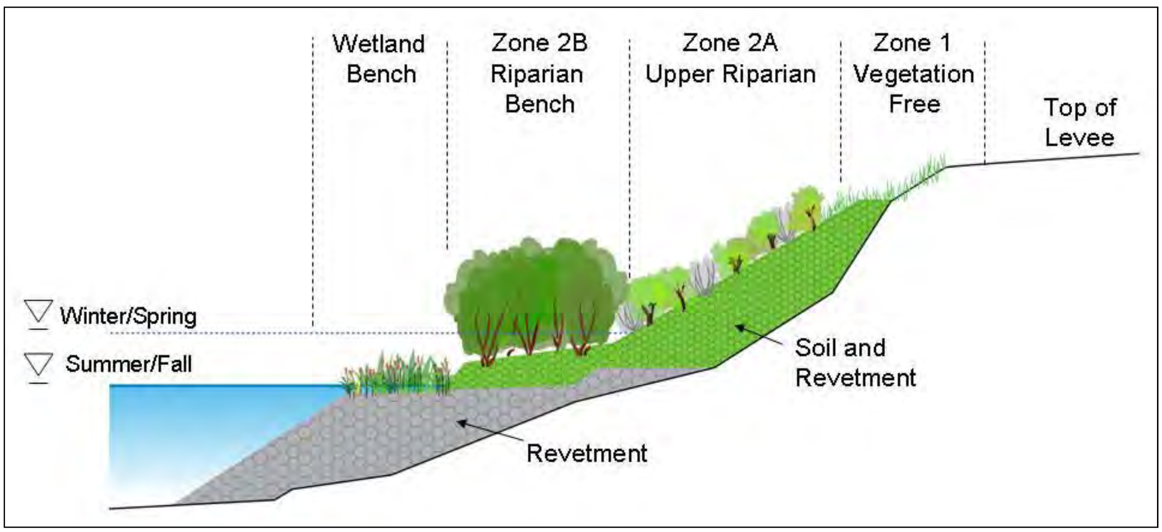


**Figure 8. Planting Berms with Vegetation and Wetland Bench.**

**<u>Launchable Rock Trench</u>**

This measure includes construction of a launchable rock filled trench, designed to deploy once erosion has removed the bank material beneath it (Figure 9). 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 configuration would include a 2:1 landslide slope and 1:1 waterside slope and would be excavated at the toe of the existing levee. All soil removed during trench excavation would be stockpiled for potential reuse. 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 for a planting berm. Rock placed on the levee slope would be covered with 2 feet of stockpiled soil. All disturbed areas would be reseeded with native grasses and small shrubs where appropriate. Trees and shrubs could be permitted on the berm if planted outside the specified vegetation free zone as required by the ETL. This alternative would not increase flows in the American River that would cause additional erosion along the banks. If flow changes occur that could cause loss of floodplain between the levee and the existing natural channel (the Parkway land) it will be addressed under the Folsom Reoperation Biological Assessment and EIS/EIR if applicable.

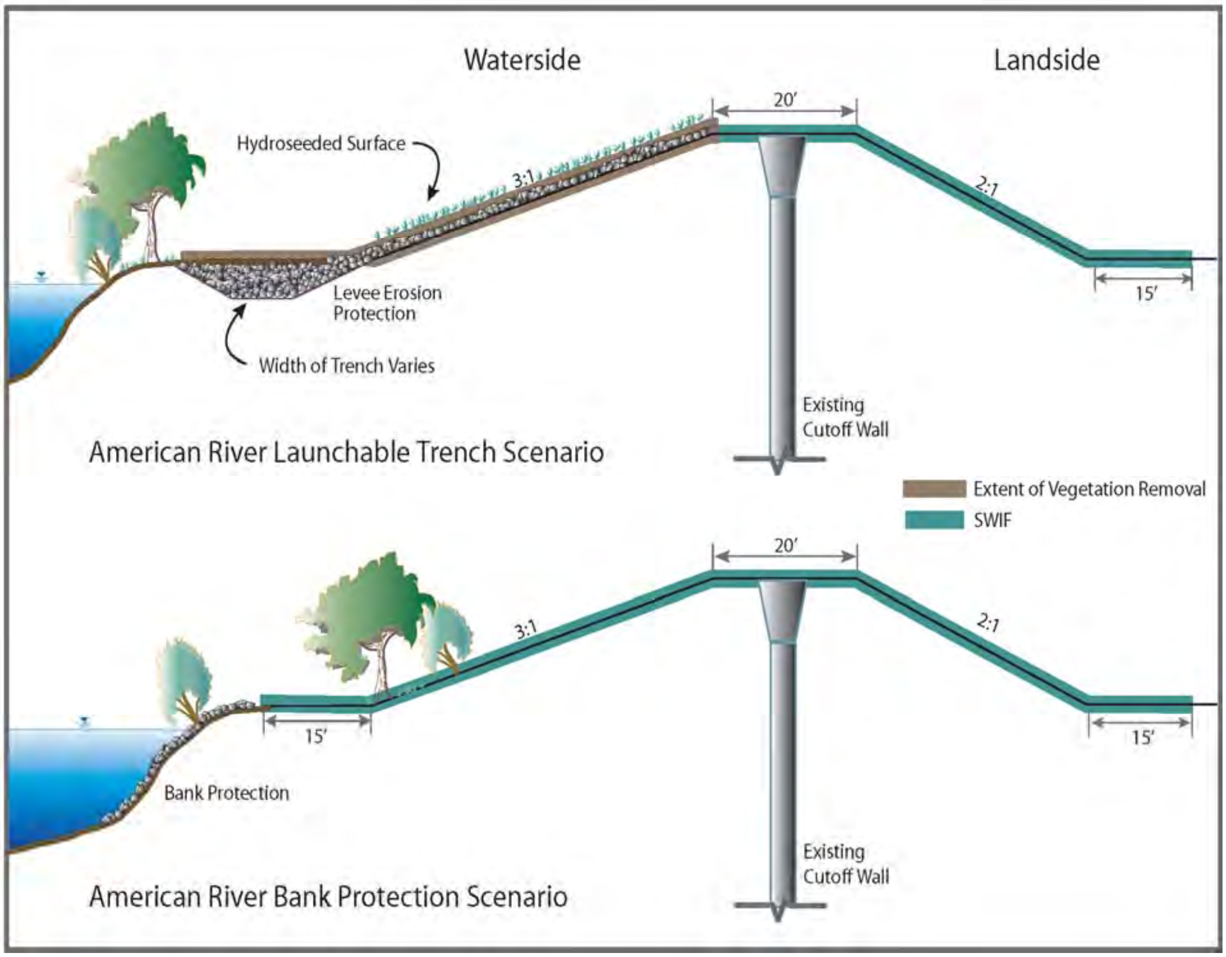


**Figure 9. Erosion Protection – Launchable Rock Trench and Bank Protection Scenarios.**

### 2.2.4 Sacramento River

Levees along the Sacramento River require improvements to address seepage, stability, and erosion. Approximately 50,300 LF of bank protection and cutoff wall or slope stability work is proposed for the Sacramento River. In addition, these levees require a total of one mile of intermittent height improvements in order to convey additional flows that exceed current design levels. Figure 10 shows the proposed measures for the Sacramento River.

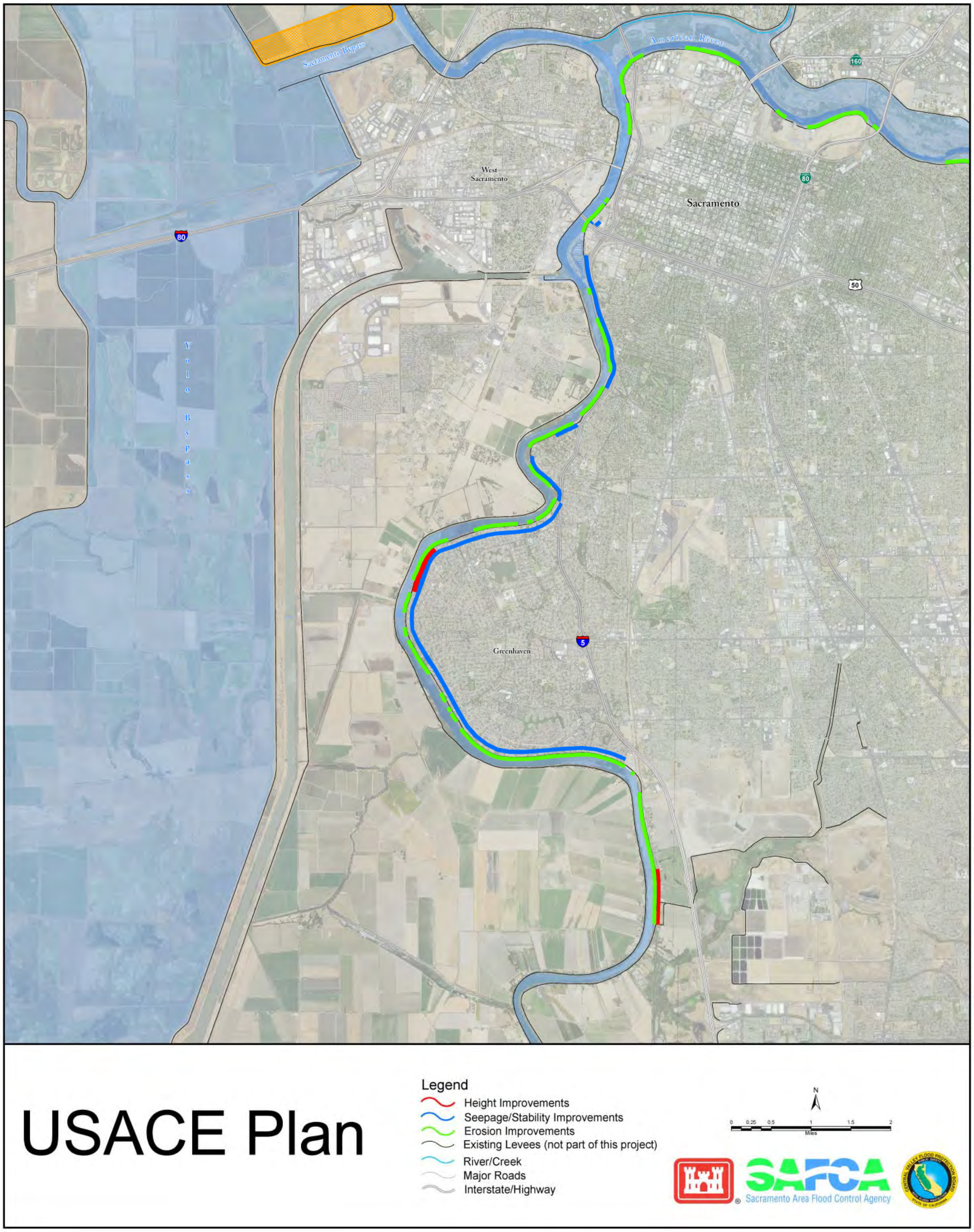


**Figure 10. Sacramento River Proposed Measures.**

Where the existing levee does not meet the levee design requirements, as discussed in Section 2.2 above, slope flattening, crown widening, and/or a minimal amount of levee raise is required. This improvement measure addresses problems with slope stability, geometry, height and levee crest access and maintenance. To begin levee embankment grading, loose material and vegetation understory 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. Excavated and borrow material (from nearby borrow sites) would be stockpiled at staging areas. Haul trucks and front end loaders would bring borrow materials to the site, which would then be spread evenly and compacted according to levee design plans.

The levee would be raised approximately 1 to 3 feet which would result in the levee footprint extending out a maximum of 5 feet on the landside from the existing levee. The levee crown patrol road would be re-established at the completion of construction. A typical design for these levees is shown in Figure 11 below.

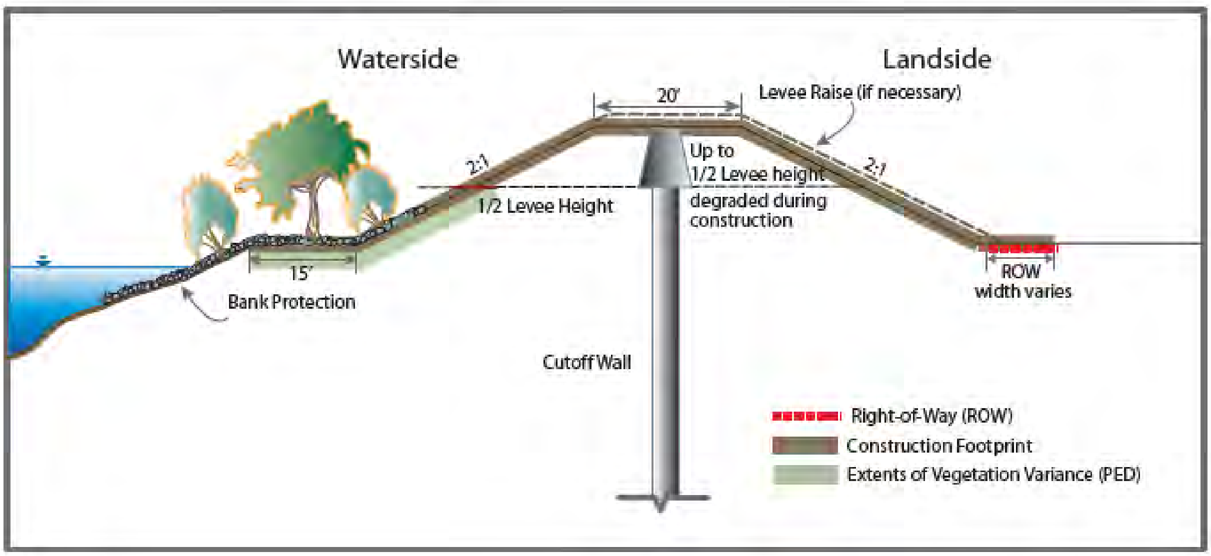


**Figure 11. Fix-In-Place with Cutoff Wall and Levee Raise.**

**<u>Cutoff Walls</u>**

To address seepage concerns, a cutoff wall will be constructed through the levee crown (Figure 9). The cutoff wall would be installed by one of two methods: (1) conventional open trench cutoff walls, or (2) deep soil mixing (DSM) cutoff walls. The method of cutoff wall selected for each reach would depend on the depth of the cutoff wall needed to address the seepage. The open trench method can be used to install a cutoff wall to a depth of approximately 85 feet. For cutoff walls of greater depth the DSM method would be utilized.

Prior to construction of either method of cutoff wall, the construction site and any staging areas would be cleared, grubbed, and stripped. The levee crown would be degraded 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. This method of slurry wall installation will also reduce the risk of slurry mixture following seepage paths and leaking into the river or into landside properties.

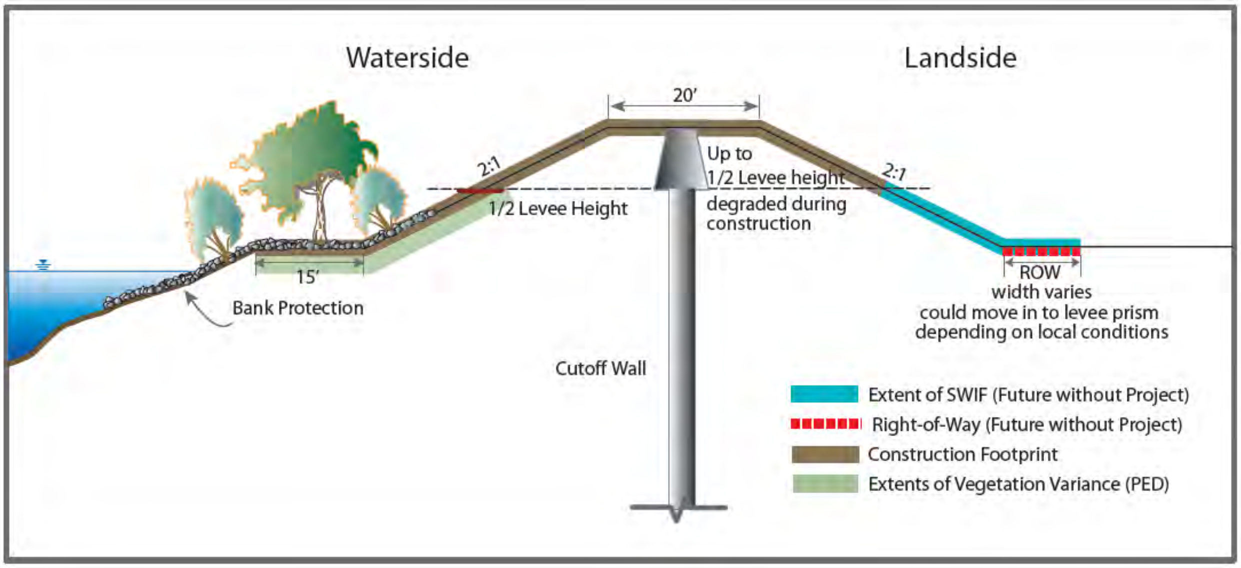


**Figure 12. Fix-In-Place with Cutoff Wall and No Levee Raise.**

**Open Trench Cutoff Wall**

Under the open trench method, a trench approximately 3 feet wide would be excavated at the top of levee centerline and into the subsurface materials up to 85 feet deep with a long boom excavator. As the trench is excavated, it is filled with low density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench is mixed nearby with hydrated bentonite, and in some applications cement. The soil bentonite mixture is backfilled into the trench, displacing the temporary slurry. Once the slurry has hardened, it would be capped and the levee embankment would be reconstructed with impervious or semi-impervious soil.

**DSM Cutoff Wall**

The DSM method involves a crane supported set of two to four mixing augers used to drill through the levee crown and subsurface to a maximum depth of approximately 140 feet. As the augers are inserted and withdrawn, a cement bentonite grout would be injected through the augers and mixed with the native soils. An overlapping series of mixed columns would be drilled to create a continuous seepage cutoff barrier. A degrade of up to one half the levee height would be required for construction of the DSM wall. For both methods, once the slurry has hardened it would be capped and the levee embankment would be reconstructed with impervious or semi-impervious soil.

**Bank Protection**

Bank protection on the Sacramento River would be addressed via either the launchable rock trench method described for the American River in Section 2.2.1 above, or by standard bank protection with planting berm (Figure 9). The standard bank protection measure for the Sacramento River consists of placing rock protection on the bank to prevent erosion. This measure entails filling the eroded portion of the bank, where necessary, and installing revetment along the waterside levee slope and streambank from streambed to a height determined by site-specific analysis. Large trees on the lower 1/2 slope will be protected in place to retain SRA habitat. The sites would be prepared by removing vegetation along the levee slopes at either end of the site for construction of a temporary access ramp, if needed. The ramp would then be constructed using imported borrow material that would be trucked on site.

The placement of rock onto the levee slope would occur from atop the levee and/or from the water side by means of barges. Rock required within the channel, both below and slightly above the water line at the time of placement, would be placed by an excavator located on a barge. Construction would require two barges: one barge would carry the excavator, while the other barge would hold the stockpile of rock to be placed on the channel slopes. Rock required on the upper portions of the slopes would be placed by an excavator located on top of the levee. Rock placement from atop the levee would require one excavator and one loader for each potential placement site. The loader brings the rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the water side of the levee.

The revetment would be placed via the methods discussed above on existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After revetment placement has been completed, a small planting berm would be constructed in the rock to allow for revegetation of the site (Figure 13).

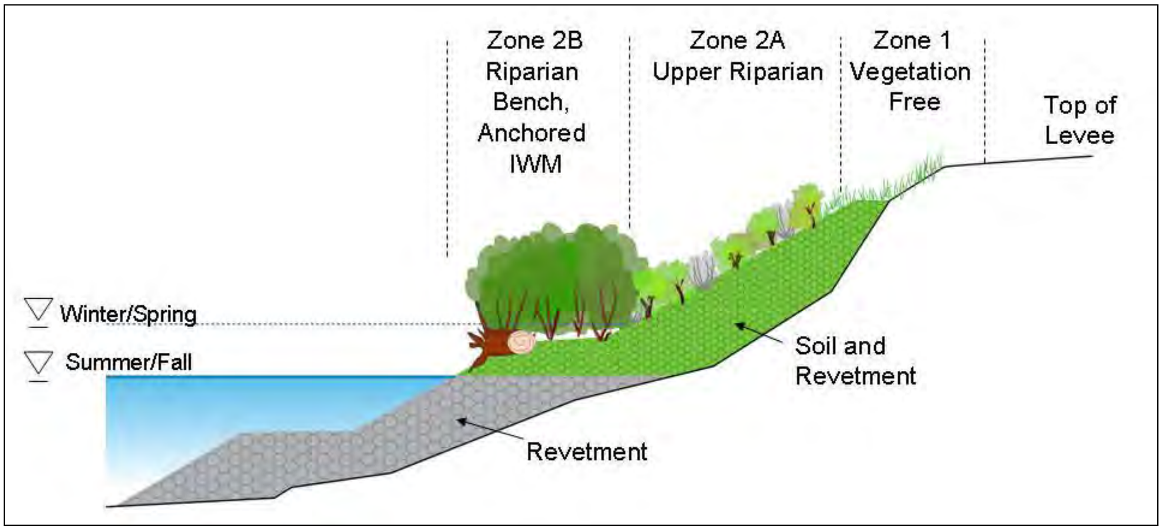


**Figure 13. Planting Berm with Vegetation and Woody Material.**

### 2.2.5 East Side Tributaries

The East Site Tributaries include measures proposed for the Natomas East Main Drain Canal (NEMDC), Arcade Creek, Dry/Robla Creek, and Magpie Creek. Arcade Creek and portions of NEMDC are included in the North Sacramento Stream Project, SAFCA's early implementation action on the ARCF GRR. The proposed measures for the East Side Tributaries under the ARCF GRR are shown on Figure 7 above.

**Natomas East Main Drain Canal (NEMDC)**

The east levee of the NEMDC requires 6,000 LF of improvements to address seepage and stability at locations where historic creeks had intersected the current levee alignment. A conventional open trench centerline cutoff wall would be constructed at these locations to address the seepage and stability problems (Figure 14). The open trench cutoff walls would be constructed as described for the Sacramento River levee in Section 2.2.2 above.

In addition, SAFCA is proposing to address seepage and stability in advance of the Federal project on a 1,700 foot reach of the NEMDC from Station 3028+00 to Station 3051+00, just south of the Arcade Creek south levee. For this reach, SAFCA proposes to construct a cement bentonite (CB) slurry cutoff wall at the waterside toe of the levee. This measure is described in greater detail in the Arcade Creek discussion below.

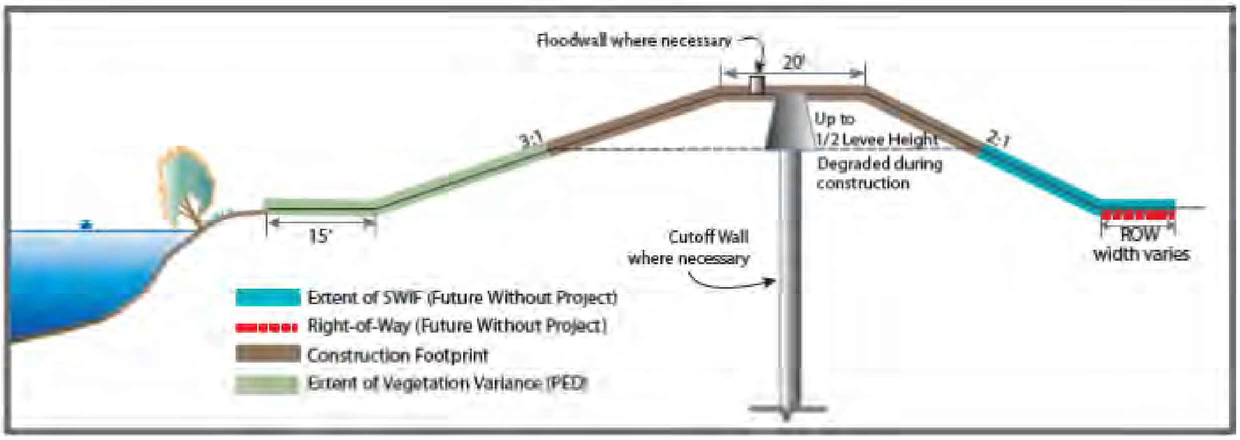


**Figure 14. Conventional Open Trench Cutoff Wall or Floodwall Scenario.**

**<u>Arcade Creek</u>**

The Arcade Creek levees require improvements to address seepage, slope stability, and overtopping when the event exceeds the current design. A centerline cutoff wall would be constructed to address seepage along 22,000 feet of the levee (Figure 12). There is a ditch adjacent to the north levee at the landside toe which provides a shortened seepage path, and could affect the stability of the levee. The ditch would be replaced with a conduit or box culvert and then backfilled. This would lengthen the seepage path and improve the stability of the levee (Figure 12). The majority of the Arcade Creek levees have existing floodwalls which vary in height from 1 to 4 feet, however there remains a height issue in this reach. A 1 to 4-foot floodwall raise would allow the levees to pass flood events greater than the current design level. The new floodwall or added height would result in a total floodwall height of approximately 4 to 6 feet. The floodwall would be placed at the waterside hinge point of the levee and would be designed to disturb a minimal amount of waterside slope and levee crown for construction (Figure 14). The waterside slope would be re-established to its existing slope and the levee crown would grade away from the wall and be surfaced with aggregate base.

SAFCA's NSS project is primarily focused on addressing seepage and slope stability concerns on Arcade Creek. Figure 15 below shows Arcade Creek in detail, broken down into Arcade Creek North (ACN) and Arcade Creek South (ACS) reaches. The NSS project includes centerline cutoff walls for most of the Arcade Creek levees (ACS A, ACS B, and ACN B). For the ACS C and ACN C reaches, stretching generally from Rio Linda Boulevard to Marysville Boulevard, SAFCA proposes to construct a CB slurry cutoff wall at the waterside toe of the levee, rather than a centerline cutoff wall. In addition, on the ACN C reach, SAFCA proposes to reconstruct the waterside slope from Station 5075+00 to Station 5100+00, and from Station 5100+00 to Marysville Boulevard, SAFCA proposes to construct a sheet pile cutoff wall at the centerline of the levee, rather than the waterside toe cutoff wall. For the ACN A reach, SAFCA proposes to install pressure relief wells along the landside toe of the levee. The waterside toe slurry cutoff walls and sheet pile walls are described in greater detail below.

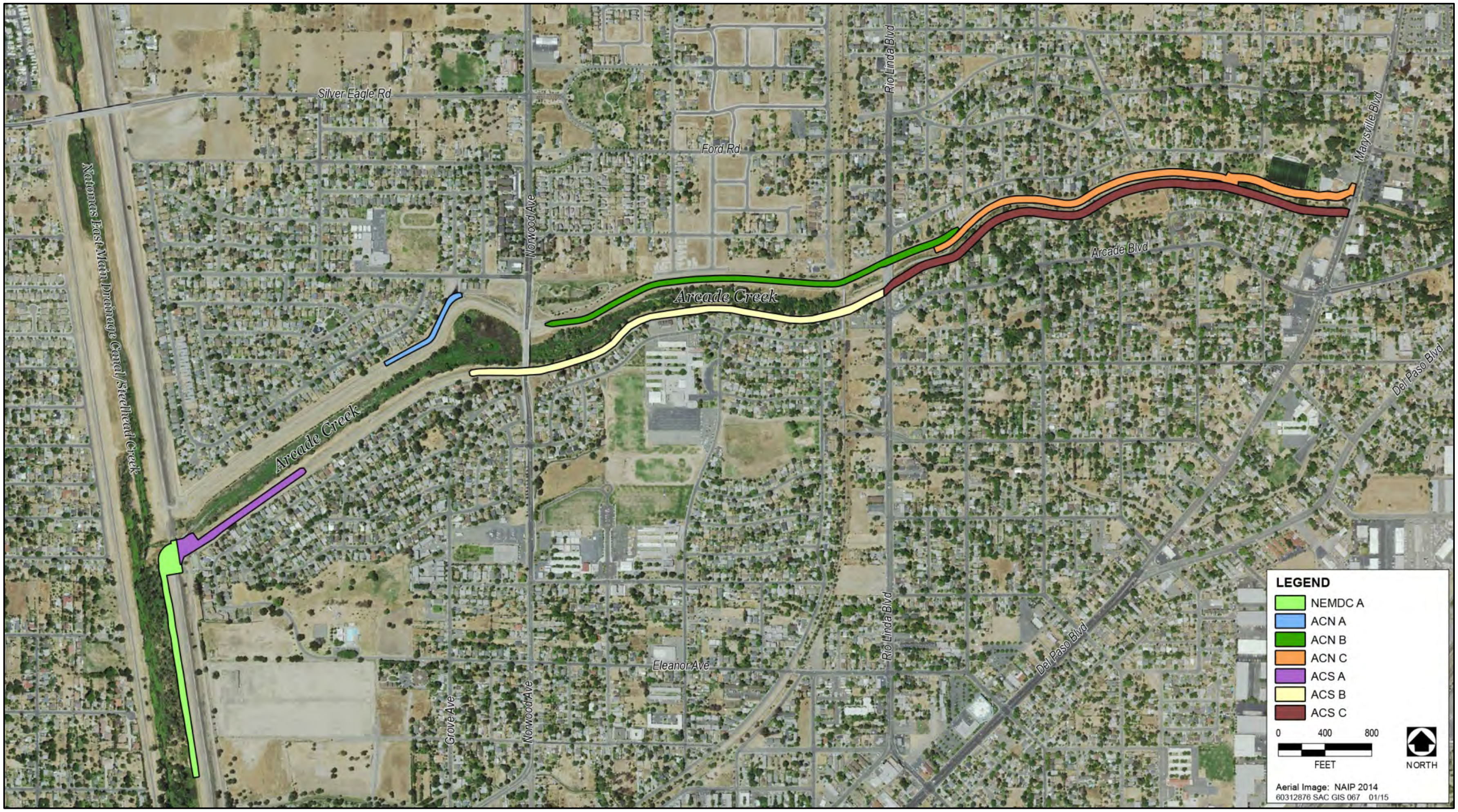


**Figure 15. North Sacramento Streams Levee Improvement Project Area Reaches.**

**Toe Slurry Cutoff Wall Construction**

Construction of the toe CB slurry cutoff walls to depths ranging from 15 to 30 feet along the existing waterside levee toe would be accomplished primarily with small- to medium-size excavators depending on required wall depth. This equipment and the associated sequence of excavation and placement of the centerline CB material into the trench, would require constructing a work bench along the toe. The bench elevation would be selected based on existing topography, required working room for cutoff wall installation, optimizing earthwork, and minimizing the need for bench elevation changes along the levee that could complicate slurry wall construction.

Excavations for the bench would extend deep enough below existing grade to remove organic material and soft, unsuitable foundation soils. Some dewatering and groundwater control is anticipated in connection with this excavation. Bench excavation would also extend into the existing waterside slope of the levee as needed to ensure that new selected bench fill material is integrated effectively with existing low permeability blanket material on the levee slope. This provides an integral seepage barrier with the cutoff wall over the full height of the levee. To the fullest extent possible, all excavated non-organic soil suitable for reuse would be processed and used for reconstruction to minimize off-hauling materials.

Some portions of ACN C reach, as described above, would require a more substantial excavation and reconstruction of the waterside slope to provide a low permeable seepage levee slope barrier, which may not currently exist. Here again, the bench fill material would be integrated with the slope reconstruction fill to provide an integral seepage barrier with the cutoff wall over the full height of the levee slope.

After the foundation has been excavated and accepted, properly moisture conditioned embankment materials would be placed in accordance with accepted levee construction standards and compacted to create the bench working surface for slurry wall construction. Each lift would be moisture-conditioned and compacted to the specified density using suitable tamping foot compactors.
After backfilling to the working surface for cutoff wall construction, the CB wall would be installed. For CB centerline wall construction, it is assumed that 50 percent of the material from the trench can be salvaged and processed with other excavated soil or borrow material for reuse in levee reconstruction. The remaining material from the trench excavation is assumed unsuitable for reuse and would be disposed of as described previously.

After installation of the cutoff wall, properly moisture-conditioned embankment materials would be placed to complete the bench construction to a minimum height of approximately 3 feet over the top of the cutoff wall and complete reconstruction of cuts on the waterside slope. Embankment material would be blended and processed material suitable for reuse. Each lift would be moisture-conditioned and compacted to the specified density using suitable tamping foot compactors.
After the bench is completed, the top and waterside slope would be covered with rip rap to control erosion over the completed cutoff wall. Above the bench, all disturbed construction areas would be revegetated. Gravel surfacing on the levee crown would be supplemented or replaced within the levee repair limits wherever damaged by haul vehicles and other construction-related traffic.

**Sheet Pile Cutoff Walls**

Sheet pile cutoff walls are installed with a crane and hydraulic ram that hammers or pushes the sheet pile into the ground to the desired depth. In levee reach ACN C near Marysville Boulevard where the wall would be located along the approximate existing levee crown centerline, the asphalt concrete surfacing would be removed prior to sheet pile placement. No levee degradation is needed except to develop an access platform for the crane of sufficient width. A 3-foot-wide by 3-foot-deep trench would be excavated along the sheet pile alignment. The sheet piling would be driven in the trench. The trench would then be backfilled with suitable levee fill materials placed on both sides and over the top of the completed wall. After backfilling the trench the existing asphalt-concrete pavement would be reconstructed.

**Dry and Robla Creeks**

The Dry and Robla Creeks levees require improvements to address overtopping for when flood events exceed the design level. Height improvements would be made with a new floodwall constructed to a height of 4 to 6 feet along 2,500 LF of the south levee. The floodwall would be placed at the waterside hinge point of the levee and would be designed to disturb a minimal amount of waterside slope and levee crown for construction (Figure 16). Construction of the floodwall would be consistent with the description for NEMDC, above. The waterside slope would be re-established to its existing slope and the levee crown would grade away from the wall and be surfaced with aggregate base.

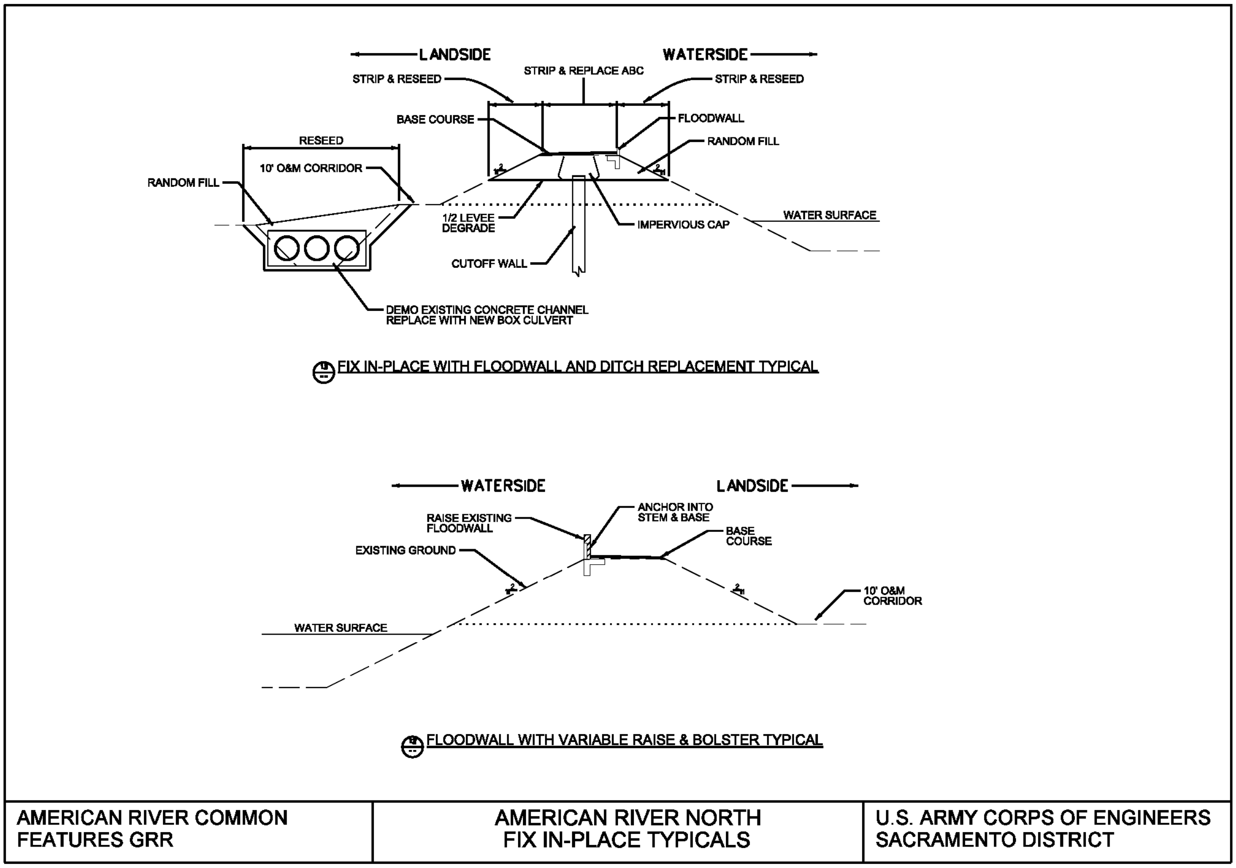


**Figure 16. Floodwall with Variable Raise and Bolster Typical.**

**<u>Magpie Creek Diversion Canal</u>**

A number of features are proposed for the Magpie Creek Diversion Canal. The existing project levee on the diversion canal would be raised by approximately 3 to 4 feet for a distance of approximately 2,100 feet. Construction of the raise would be similar to the levee raise described for the Sacramento River above. Additionally, a new, approximately 1,000-foot-long levee would be constructed adjacent to Raley Boulevard, south of the Magpie Creek bridge. The footprint of the existing and new levee is shown on Figure 17.

In addition to the above levee improvements, an approximately 79-acre flood detention basin would be created for the overflow of flood waters in the Magpie Creek area. The flood detention basin would mostly be created through the acquisition of property in the floodplain that is currently flooded during high water events. The flood detention basin would be located on both sides of Raley Boulevard near Magpie Creek. The frequency of flooding of this property would not change with implementation of the proposed measures, however, there would be a increase in surface elevation on the property during these events and the property may remain flooded for longer durations.

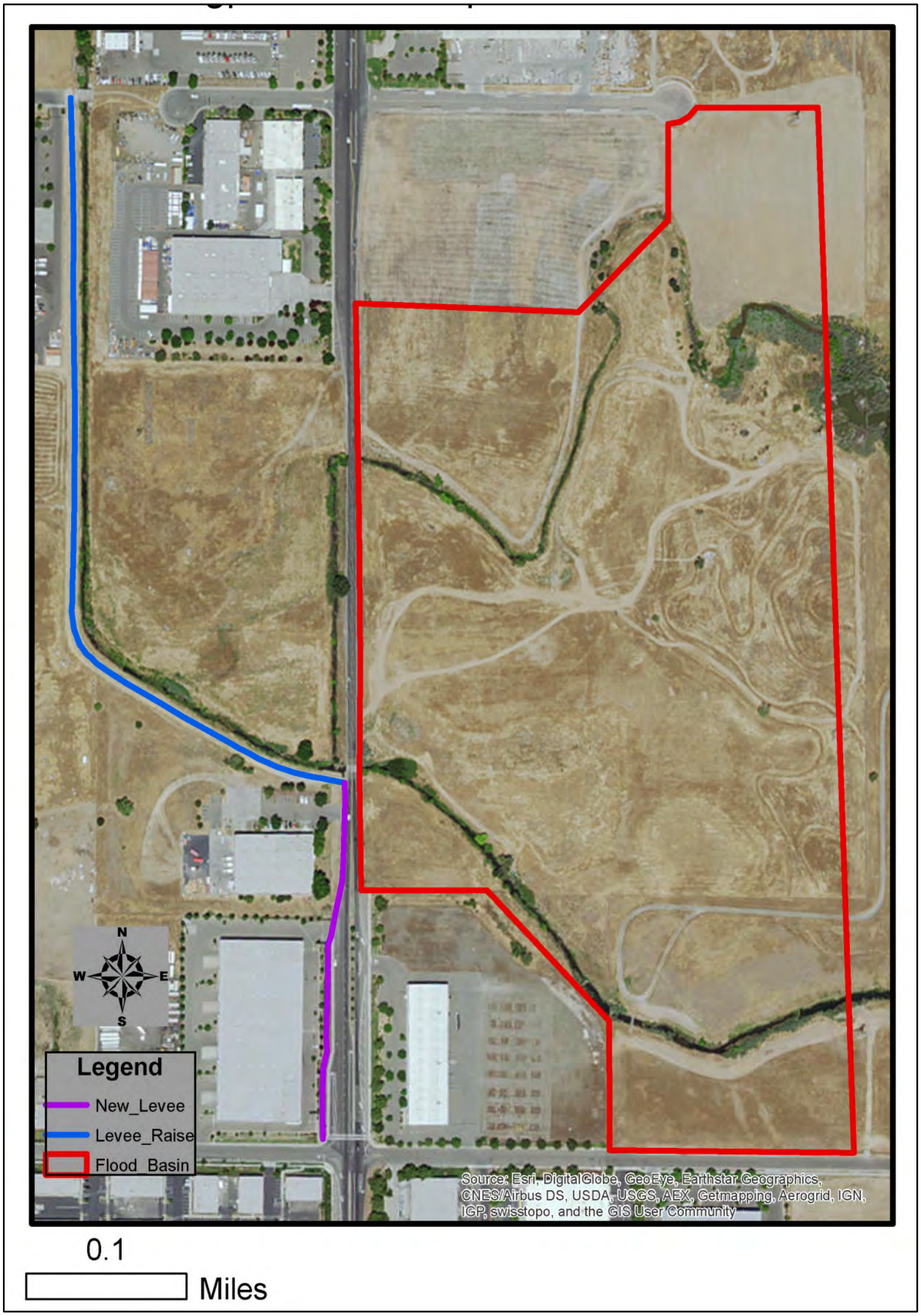


**Figure 17. Magpie Creek Proposed Measures.**

The features and design proposed for Magpie Creek were originally associated with a separate project, the Magpie Creek Flood Control Project, which was planned and designed by the Corps and SAFCA in 2004. In September 2004, USFWS issued a Biological Opinion to the Corps on the Magpie Creek Flood Control Project (Appendix E). Since the design has not changed at this time from the 2004 project, the 2004 Biological Opinion is considered to be valid and addresses the potential impacts associated with this portion of the ARCF GRR. These effects are summarized throughout this BA, as appropriate.

### 2.2.6 Sacramento Weir and Bypass

The Sacramento Weir was completed in 1916. It is the only weir that is manually operated – all others overflow by gravity on their own. It is located along the right bank of the Sacramento River approximately 4 miles upstream of the Tower Bridge, and about 2 miles upstream from the confluence with the American River. Its primary purpose is to protect the city of Sacramento from excessive flood stages in the Sacramento River channel downstream of the American River. The weir limits flood stages (water surface elevations) in the Sacramento River to project design levels through the Sacramento/West Sacramento area. Downstream of the Sacramento Weir, the design flood capacity of the American River is 5,000 cfs higher than that of the Sacramento River. Flows from the American River channel during a major flood event often exceed the capacity of the Sacramento River downstream of the confluence. When this occurs, floodwaters flow upstream from the mouth of the American River to the Sacramento Weir.

The project design capacity of the weir is 112,000 cfs. It is currently 1,920 feet long and consists of 48 gates to divert floodwaters to the west through the mile-long Sacramento Bypass to the Yolo Bypass. Each gate has 38 vertical wooden plank "needles" (4 inches thick by 1 foot wide by 6 feet long). It is cumbersome and expensive to operate, and questions have long been asked about whether this 1916 design is appropriate for today’s water management needs (DWR 2010).

Though the weir crest elevation is 24.75 feet, the weir gates are not opened until the river reaches 27.5 feet at the I Street gage with a forecast to continue rising. This gage is about 1,000 feet upstream from the I Street Bridge and about 3,500 feet upstream from the mouth of the American River. The number of gates to be opened is determined by the National Weather Service /Department of Water Resources (DWR) river forecasting team to meet either of two criteria: (1) to prevent the stage at the I Street gage from exceeding 29 feet, or (2) to hold the stage at the downstream end of the weir to 27.5 feet (DWR 2010). The weir gates are then closed as rapidly as practicable once the stage at the weir drops below 25 feet. This provides "flushing" flows to re-suspend sediment deposited in the Sacramento River between the Sacramento Weir and the American River during the low flow periods when the weir is open during the peak of the flood event (DWR 2010).

Under Alternative 2, the Sacramento Weir and Bypass would be expanded to roughly twice their current width to accommodate increased bypass flows. The existing north levee of the Sacramento Bypass would be degraded and a new levee would be constructed approximately 1,500 feet to the north. The existing Sacramento Weir would be expanded to match the wider bypass. At this time, it is not known whether the new segment of weir would be constructed consistent with the 1916 design described above, or whether it would be designed to be a gravity-type weir. The new north levee of the bypass would be designed to be consistent with the existing Sacramento Bypass north levee, however, it would also include a 300-foot-wide seepage berm on the landside with a system of relief wells. A hazardous, toxic, and radiological waste (HTRW) site near the existing north levee would be remediated by the non-Federal sponsor prior to construction.

To avoid potential effects to the Yolo Bypass, the new segment of the Sacramento Weir would be operated only during high water situations, when flows from Folsom Dam exceed 115,000 cfs. Operation of the existing Sacramento Weir and Bypass would remain the same, as described above. While not specifically modeled, there are not expected to be any water quality impacts. The approximate change in water diversions, which are shown in Table 6 below, would vary based on the size of the flood event. The frequency of water diversion is expected to be the same, which is to use the current Sacramento Weir operation based on a stream gage at the I Street Bridge (Schlunegger 2014). Under these operation assumptions, Alternative 2 would result in a diversion of flows from the Sacramento River to the Yolo Bypass that would slightly raise water surface elevations in the Yolo Bypass when flows in the American River exceed 115,000 cfs.

With the Folsom Dam improvements in place, releases from Folsom Dam would be above 115,000 cfs for flood events greater than 1/100 ACE event. Therefore, for events up to and including the 1/100 ACE event, only the existing weir will be operated per the criteria previously established. For events greater than the 1/100 ACE event when the release from Folsom Dam will go above 115,000 cfs, the new weir will be opened. With the increased flood storage space and anticipatory releases at Folsom Dam, this translates into a reduction of flows into the Yolo Bypass with Alternative 2 in place compared to the existing conditions. See Table 6 for a comparison of the flows at various locations for the Existing Condition, the Future Without Project Condition (Folsom Dam improvements), and Future With Project Condition (Alternative 2) in place. For the 1/100 ACE event and greater, the benefits of the Folsom Dam improvements would be realized in the form of reduced flows compared to the existing condition.

**Table 6. Comparison of 10, 100 and 200 year Frequency Flows under Various Conditions.**

| 10 year event | Existing Condition | Future Without Project Condition with JFP | Future With Project Condition (Alternative 2) |
|---|---|---|---|
| American River | 43,000cfs | 72,000cfs | 72,000cfs |
| Sacramento Bypass | 50,000cfs | 66,000cfs | 66,000cfs |
| Yolo Bypass below Sac Bypass | 270,000cfs | 296,000cfs | 296,000cfs |
| **100 year event** | **Existing** | **Future Without Project and Alt. 1** | **Alt. 2 (TSP)** |
| American River | 145,000cfs | 115,000cfs | 115,000cfs |
| Sacramento Bypass | 131,000cfs | 115,000cfs | 115,000cfs |
| Yolo Bypass below Sac Bypass | 555,000cfs | 535,000cfs | 535,000cfs |
| **200 year event** | **Existing** | **Future Without Project and Alt. 1** | **Alt. 2 (TSP)** |
| American River | 320,000cfs | 160,000cfs | 160,000cfs |
| Sacramento Bypass | 183,000cfs | 149,000cfs | 164,000cfs |
| Yolo Bypass below Sac Bypass | 656,000cfs | 631,000cfs | 643,000cfs |

The widening of the Sacramento Weir and Bypass diverts flood flows from the Sacramento and American River into the Yolo Bypass. At a 10-year level event, the Yolo Bypass is already flooded with water from levee toe to levee toe. By the time flows in the American River exceed 115,000 cfs, water would be approximately 5 to 6 feet below the top of the Yolo Bypass levees. As a result, to avoid impacts to the Yolo Bypass, the widened portion of the weir will only be operated when flood releases from Folsom Dam are above the existing objective release of 115,000 cfs which would occur during flood events greater than 1/100 ACE event. Therefore, for events up to the 1/100 ACE event, there would be no change in flow conditions in the Sacramento and Yolo Bypasses.

For flood events greater than 1/100 ACE event when releases from Folsom Dam would go above 115,000 cfs (such as a 1/200 ACE event in which the Folsom release goes up to 160,000 cfs), there would be an increase in flows in the Sacramento Bypass of approximately 15,000 cfs. In the Yolo Bypass, this equates to an increase of approximately 0.10-foot of water surface elevation. During the 200-year event, the Yolo Bypass is already flooded from levee to levee with depths of up to 21 feet. The addition of these flows would equate to approximately one or two tenths of a foot, which would amount to less than 1 foot of additional width on both levee slopes. This amounts to a total addition of approximately 4.8 acres of flooded area along the existing levee slopes of the Yolo Bypass.

### 2.2.7 Additional North Sacramento Streams Project Components

**Erosion Protection**

The only erosion protection currently envisioned includes placement of rip rap on waterside benches where waterside toe slurry walls are constructed. Following construction, levee slopes and other areas disturbed by construction would be revegetated and brought back to pre-project conditions. Locations where erosion is identified along the waterside levee slope and riverbank have been evaluated to determine whether levee integrity or stability may be affected. Insufficient embankment protection may cause a levee to be undermined by erosive forces due to wave action and/or high flow velocities along the levee bank. In many cases, the placement of embankment protection material, such as engineered armoring (rip-rap), would dissipate wave and velocity forces and reduce the potential for erosion to occur. Other factors to be considered prior to installing embankment protection material include grading the levee waterside slope to address stability issues, and environmental impacts within the vicinity of the embankment repair site.

**Utility Relocation**

SAFCA prepared an inventory and assessment of existing encroachments and penetrations within the NSS Levee Improvements Project area. Known utilities that cross or are adjacent to the levee include gas pipelines; storm drainage and pump station discharge pipes; and numerous water supply mains, culverts, electrical conduits, and sanitary sewers. The construction contractor can work around many of these utilities. However, some utilities may need to be temporarily removed or relocated prior to construction. Temporary bypass pumping may be required for sanitary sewers. SAFCA and the construction contractor would coordinate closely with utility owners to manage the utilities in advance of construction. Disturbed utilities would be restored after construction consistent with CVFPB requirements. Coordination between SAFCA and the utility owner would be required for those utilities that do not currently have CVFPB encroachment permits.

**Stormwater Pollution Prevention**

Temporary erosion/runoff best management control measures would be implemented during construction to minimize stormwater pollution resulting from erosion and sediment migration from the construction, borrow, and staging areas. These temporary control measures may include implementing construction staging in a manner that minimizes the amount of area disturbed at any one time; secondary containment for storage of fuel and oil; and the management of stockpiles and disturbed areas by means of earth berms, diversion ditches, straw wattles, straw bales, silt fences, gravel filters, mulching, revegetation, and temporary covers as appropriate. Erosion and stormwater pollution control measures would be consistent with National Pollutant Discharge Elimination System (NPDES) permit requirements and would be included in a Stormwater Pollution Prevention Plan (SWPPP).

After completion of construction activities, the temporary facilities (construction trailers and batch plants) would be removed and the site would be restored to pre-project conditions. Site restoration activities for areas disturbed by construction activities, including borrow areas and staging areas, will include a combination of regrading, reseeding, constructing permanent diversion ditches, using straw wattles and bales, and applying straw mulch and other measures deemed appropriate.

**Proposed Sequence of Project Construction**

It is anticipated that the North Sacramento Streams levee improvements would be implemented in one construction season (2016). The construction season would take place from April 15 to November 1. An approximate construction sequence includes the following:

- **Mobilization:** Mobilization would include setting up construction offices and the slurry batch plant and transporting heavy earthmoving equipment to the site. These activities may take up to 1 month.
- **Vegetation and encroachment removal:** Trees and other encroachments that impact remedial measures would be removed consistent with established SAFCA policies regarding vegetation and encroachments. These activities may take 1–4 weeks depending upon the reach being remediated.
- **Levee degradation for cutoff wall installation:** Beginning of levee degradation would follow vegetation and encroachment removal and precede cutoff wall installation. Degradation would take a total of about 4 months but it would not likely be conducted in one simultaneous operation. Rather, levee reaches would be degraded for specific lengths of cutoff wall to minimize the total length of degraded levee at any one time. Construction would take approximately 3 months.
- **Cutoff wall installation:** This activity would begin with construction of the work pad once a sufficient length of levee was degraded and was available for construction. Assuming four headings, construction would take approximately 4 months.
- **Drainage blanket construction:** Drainage blanket would be constructed prior to placing overlying slope reconstruction fill. Portions of drainage blanket extending up levee cut slopes would be placed as the adjacent slope reconstruction material is placed. Construction would take approximately 1 month since such construction is a small part of the proposed project.
- **Toe cutoff wall erosion protection:** Toe cutoff wall rip rap erosion protection would be placed after the toe cutoff wall bench has been completed to final lines and grades. Construction would take approximately 2 months.

- **Utility relocation:** Any required utility relocation would be conducted concurrent with the levee degradation, toe cutoff wall bench construction, and reconstruction operations. Construction would take approximately 4 months.
- **Levee reconstruction:** Levee reconstruction would begin once there was sufficient length completed cutoff wall to efficiently begin reconstructing the levee embankment. Total time estimated for levee reconstruction is about 6 months.
- **Seepage Wells:** Seepage wells can be installed at any time during the construction season. Installation and development of relief wells and reconstruction of paved channel and basin inverts would likely take about 2 month.
- **Site restoration and demobilization:** Upon completion of the main construction activities, the levee patrol road would be resurfaced, disturbed areas would be revegetated, staging and borrow areas would be restored, and the contractor would demobilize the site(s). These activities are expected to take about 2 months.

Construction would be staged and sequenced with the appropriate stakeholders: the City, County, Reclamation District, utility and service providers, biological resource construction work windows, and other environmental and land use/real estate constraints, to the greatest extent practical to minimize impacts and effects on the community.

**High Hazard Levee Encroachment and Vegetation Removal**

**Encroachment Management**

The National Flood Insurance Program (NFIP) standards for levee accreditation and the State's ULDC both require removal or modification of encroachments that pose an unacceptably high risk to the performance and safety of a levee either by undermining its structural integrity or by interfering with necessary inspection, operation, and maintenance activities. To address this requirement, SAFCA has identified and evaluated all of the encroachments in the NSS Levee Improvements area. Each of these encroachments has been evaluated to determine whether it constitutes an unacceptably high risk to the performance of the levee either by undermining the stability of the levee or by interfering with necessary patrolling, operation, and maintenance activities. Based on this evaluation, the encroachments have been classified as either:

- High-risk – poses a threat to levee integrity, removable prior to the levee being accredited;
- High-risk – impedes operation, maintenance, and inspection, removable within 3 years after the levee is accredited; or
- Low-risk – not identified as high hazard.

In the NSS Levee Improvements area, high-risk encroachments to be removed are limited to residential landscaping located at approximately 10 locations along the landside of the south and north levees of Arcade Creek (mainly between Marysville Boulevard and Rio Linda Boulevard) and along the Robla Creek South Levee, east of Rio Linda Boulevard.

**Vegetation Management**

The levee accreditation element of the proposed project also includes a vegetation management component. Although the NFIP does not identify specific standards for managing vegetation on levees, ULDC provides criteria that reflect the underlying risk management objectives of the NFIP. Under these criteria, vegetation on levees must be modified or removed if it presents an unacceptable risk to the structural integrity or impedes operation and maintenance of the levee.
In the NSS Levee Improvements area, approximately 8 high-risk trees along Arcade Creek have been identified for removal. All of the trees are either nonnative (7) or snags (3). Five are located on the waterside of the levees. These trees are in addition to any trees that would be removed as a result of implementation of levee improvements in the NSS Levee Improvements area.

## 2.3 Operation and Maintenance

Operation and maintenance (O&M) of the levees in the Sacramento area are the responsibility of the local maintaining agencies, including the American River Flood Control District, Maintenance Area 9, the California Department of Water Resources, and the City of Sacramento. The applicable O&M Manual for the Sacramento area levees is the Standard Operation and Maintenance Manual for the Sacramento River Flood Control Project. Typical levee O&M in the Sacramento area currently includes the following actions:

- Vegetation maintenance up to four times a year by mowing or applying herbicide.
- Control of burrowing rodent activity monthly by baiting with pesticide.
- Slope repair, site-specific and as needed, by re-sloping and compacting.
- Patrol road reconditioning up to once a year by placing, spreading, grading, and compacting aggregate base or substrate.
- Visual inspection at least monthly, by driving on the patrol road on the crown and maintenance roads at the base of the levee.
- Post-construction, groundwater levels would be monitored using the piezometers.

Following construction, the O&M manual for these reaches would be adjusted to reflect the vegetation variance and the SWIF plan. Under the adjusted O&M manual, large trees that are protected in place under the variance would be allowed to remain on the waterside slopes, but smaller shrubs would be removed and grasses would be regularly mowed to allow for inspection and access.

Vegetation maintenance includes keeping maintenance roads clear of overhanging branches. Some of the vegetation along the levees includes elderberry shrubs. As part of long-term O&M, elderberry shrubs will be trimmed by the three levee maintenance districts. The following table describes the maximum amount of elderberry acreage that will be trimmed each year as a result of O&M. Trimming consists of cutting overhanging branches along the levee slopes on both the landside and waterside. Some shrubs may be located adjacent to the levee with branches hanging over the levee maintenance road. Up to a third of a shrub will be trimmed in a single season. Trimming will occur between November 1 and March 15. Loss of habitat will be offset through the development of a conservation area as described in the conservation measures below. Each year the local maintaining authority will document the amount of valley elderberry longhorn beetle habitat that they have trimmed and report that number to the Corps to ensure compliance with this biological opinion. If the local maintaining agency has a need to exceed the amount of valley elderberry longhorn beetle habitat which needs to be trimmed or affected due to routine maintenance then they will request the Corps reinitiate consultation on this biological opinion for those actions.

## 2.4 Full Consultation Biological Assessment Approach

The description of baseline conditions and the evaluation of potential impacts have been organized by waterway, which includes the American River, Sacramento River, NEMDC, Arcade Creek, Dry/Robla Creek, Magpie Creek, and the Sacramento Weir/Bypass areas. For species that are described and covered in this consultation, habitat preferences and distributions are based on published data, agency documents, and review of the California Natural Diversity Database (CNDDB) (CDFW 2013a). Species distributions were assessed throughout the ARCF study area, and where appropriate, within specific regions.

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

Table 7 summarizes the species addressed in this Biological Assessment and where the Corps assumes their habitat is present within the study area.

**Table 7. Presence of Listed Species within the Study Area.**

| | Valley Elderberry Longhorn Beetle | Vernal Pool Fairy Shrimp | Vernal Pool Tadpole Shrimp | Giant Garter Snake | Winter-run Chinook Salmon | Spring-run Chinook Salmon | Central Valley Steelhead | Green Sturgeon | Delta Smelt | Western Yellow-billed Cuckoo |
|---|---|---|---|---|---|---|---|---|---|---|
| **American River** | Yes | No | No | No | Yes | Yes | Yes | Critical Habitat to Highway 160 | No | Yes |
| **Sacramento River** | Yes | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| **Natomas East Main Drainage Canal** | Yes | No | No | No | No | No | Yes | No | No | No |
| **Arcade Creek** | Yes | No | No | No | No | No | No | No | No | No |
| **Dry/Robla Creek** | Yes | No | No | No | No | No | Yes | No | No | No |
| **Magpie Creek** | Yes | Yes | Yes | No | No | No | No | No | No | No |
| **Sacramento Bypass** | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | No |

## 2.5 Proposed Conservation and Mitigation Measures

### 2.5.1 Compensation Timing

Compensation timing refers to the time between the initiation of construction at a particular site and the attainment of the habitat benefits to protected species from designated compensation sites. In general, compensation time is the time required for on-site plantings to provide significant amounts of shade or structural complexity from instream woody material recruitment. Significant long-term benefits have often been considered as appropriate to offset small short-term losses in habitat for listed species in the past, as long as the overall action contributes to recovery of the listed species. The authority to compensate prior to or concurrent with project construction is given under WRDA 1986 (33 United States Code [USC] § 2283).

### 2.5.2 Valley Elderberry Longhorn Beetle Conservation and Mitigation Measures

The following is a summary of measures that would be implemented during construction based on the *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Conservation Guidelines) (USFWS 1999a). These measures will be implemented to minimize any potential effects on valley elderberry longhorn beetles or their habitat, including restoration and maintenance activities, long-term, protection, and compensation if shrubs cannot be avoided. If shrubs cannot be avoided, compensation shall be implemented as shown in Tables 10 and 11 below. These measures could be adjusted in compliance with the most current guidance at the time of construction.

- The Corps assumes complete avoidance of the valley elderberry longhorn beetle when a 100-foot (or wider) buffer is established and maintained around elderberry shrubs.
- When work will occur within the 100-foot buffer, a setback of 20 feet from the dripline of each elderberry shrub will be maintained whenever possible.
- During construction activities, all areas to be avoided will be fenced and flagged.
- Contractors will be briefed on the need to avoid damaging elderberry shrubs and the possible penalties for not complying with these requirements.
- Signs will be erected every 50 feet along the edge of the avoidance area, identifying the area as an environmentally sensitive area.
- Any damage done to the buffer area will be restored.
- Buffer areas will continue to be protected after construction.

- No insecticides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used in the buffer areas.
- Elderberry shrubs that cannot be avoided would be transplanted to an appropriate riparian area at least 100 feet from construction activities.
- If possible, elderberry shrubs would be transplanted during their dormant season (approximately November, after they have lost their leaves, through the first two weeks in February). If transplantation occurs during the growing season, increased mitigation will apply.
- Elderberry compensation would be planted in the American River Parkway. The Corps has six existing sites which are offsetting previous Corps flood control projects along the lower American River and near Folsom Dam. The Corps will find areas within the lower American River parkway which will either expand existing compensation areas or provide for connectivity between conserved valley elderberry longhorn beetle habitat. Sites within the Parkway will be coordinated with County Parks and the Service during the design phase of the project. Sites will be designed and developed prior to any effects to valley elderberry longhorn beetle habitat. The Corps will create 69.91 acres of riparian habitat which supports valley elderberry longhorn beetle within the lower American River parkway.
- The Corps will work to develop compensation areas prior to or concurrent with any take of valley elderberry longhorn beetle habitat.
- Management of these lands will include all measures specified in USFWS's conservation guidelines (1999a) related to weed and litter control, fencing, and the placement of signs.
- Monitoring will occur for ten consecutive years or for seven non-consecutive years over a 15-year period. Annual monitoring reports will be submitted to USFWS.
- Off-site areas will be protected in perpetuity and have a funding source for maintenance (e.g., endowment).

### 2.5.3 Giant Garter Snake Conservation and Mitigation Measures

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

- Unless approved otherwise by USFWS, construction will be initiated only during the giant garter snakes' active period (May 1–October 1, when they are able to move away from disturbance).
- Construction personnel will participate in USFWS-approved worker environmental awareness program.

- A giant garter snake survey would be conducted 24 hours prior to construction in potential habitat. Should there be any interruption in work for greater than two weeks, a biologist would survey the project area again no later than 24 hours prior to the restart of construction.
- Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own.
- Movement of heavy equipment to and from the construction site will be restricted to established roadways. Stockpiling of construction materials will be restricted to designated staging areas, which will be located more than 200 feet away from giant garter snake aquatic habitat.
- Giant garter snake habitat within 200 feet of construction activities will be designated as an environmentally sensitive area and delineated with signs or fencing. This area will be avoided by all construction personnel to the maximum extent feasible.
- Habitat temporarily affected for one season (the 5.5 acre borrow site along the NEMDC and the 75 acres along the toe drain of the Sacramento Bypass levee) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants. If for any reason construction extends into another active season the Corps will replace the habitat on-site and purchase credits at a ratio of 1:1 at a Service approved conservation bank.
- Habitat temporarily affected for more than three or more seasons will be restored and twice as much habitat will be created.
- Habitat permanently affected in the Sacramento Bypass in the form of drainage ditches and irrigation canals will be compensated for through the purchase of 135 acres of credits at a USFWS-approved conservation bank.
- One year of monitoring will be conducted for the 80.5 acres that are temporarily affected.
- The Corps will purchase credits at a conservation bank prior to any permanent disturbance of giant garter snake habitat.

For SAFCA's NSS project, the following measures are additionally proposed to reduce impacts to GGS from use of Borrow Site 2:

- A biological monitor shall be on-site during all ground-disturbing activities at Borrow Site 2.
- At least 10 days prior to the commencement of ground disturbing activities and after May 1, exclusionary fencing will be erected around the perimeter of Borrow Site 2K. Prior to fencing installation, the fence line shall be mowed (with a minimum height of 6 inches) in order to conduct a surface survey of potential burrows. Fencing shall be installed with a minimum of 6 inches buried in the ground and a minimum of 24 inches above ground. Fence staking shall

be installed on the inside of the exclusion area. One-way escape funnels shall be installed every 50 to 100 feet and sealed along the fence line, to provide an escape for any giant garter snake that may be within the exclusion area. The fencing shall enclose the entirety of the site, or additional exclusionary fencing can be extended 200 to 400 feet beyond the proposed entrance area. The fencing will be inspected before the start of each work day and maintained by the project proponents until completion of the project. The fencing will be removed only when project activities within Borrow Site 2 are completed.

### 2.5.4 Vernal Pool Crustacean Conservation and Mitigation Measures

The following measures from the 2004 Biological Opinion from the Magpie Creek Flood Control Project would be implemented to avoid and minimize impacts to potential vernal pools in the vicinity of the Magpie Creek construction area:

- Preservation component: For every acre of habitat directly or indirectly affected, at least two vernal pool credits will be dedicated within a Service-approved ecosystem preservation bank or, based on Service evaluation of site-specific conservation values, three acres of vernal pool habitat may be preserved on the project site or another nonbank site as approved by the Service.
- Creation component: For every acre of habitat directly affected, at least one vernal pool creation credit will be dedicated within a Service-approved habitat creation bank or, based on Service evaluation of site-specific conservation values, two acres of vernal pool habitat will be created and monitored on the project site or another non-bank site as approved by the Service.
- Listed vernal pool crustacean habitat and associated uplands utilized as on-site compensation will be protected from adverse effects and managed in perpetuity or until the Corps, the applicant, and the Service agree on a process to exchange such areas for credits within a Service-approved conservation banking system. Off-site conservation at a Service-approved non-bank location will be protected and managed in perpetuity through a Service-approved conservation easement, Service-approved management plan, and a sufficient endowment fund to manage the site in perpetuity in accordance with the management plan.
- If habitat is avoided (preserved) on site, then a Service-approved biologist (monitor) will inspect any construction-related activities at the proposed project site to ensure that no unnecessary take of listed species or destruction of their habitat occurs. The biologist will have the authority to stop all activities that may result in such take or destruction until appropriate corrective measures have been completed. The biologist also will be required to immediately report any unauthorized impacts to the Service and the California Department of Fish and Game.

- Adequate fencing will be placed and maintained around any avoided (preserved) vernal pool habitat to prevent impacts from vehicles.
- All on-site construction personnel will receive instruction regarding the presence of listed species and the importance of avoiding impacts to these species and their habitat.
- The applicant will ensure that activities that are inconsistent with the maintenance of the suitability of remaining habitat and associated on-site watershed are prohibited. This includes, but is not limited to: (i) alteration of existing topography or any other alteration or uses for any purposes, including the exploration for or development of mineral extraction; (ii) placement of any new structures on these parcels; (iii) dumping, burning, and/or burying of rubbish, garbage, or any other wastes or fill materials; (iv) building of any new roads or trails; (v) killing, removal, alteration, or replacement of any existing native vegetation; (vi) placement of storm water drains; (vii) fire protection activities not required to protect existing structures at the project site; and (viii) use of pesticides or other toxic chemicals.

The proposed project will result in 0.25 acre of indirect effects to vernal pools/swales of potentially suitable vernal pool shrimp and vernal pool tadpole shrimp habitat. The applicant has identified and agreed to purchase 0.5 vernal pool preservation credits at a Service-approved conservation bank or Service-approved fund. Credits will be purchased prior to the effect on any vernal pool habitat. The agreed upon conservation responsibilities of the applicant are as follows:

- Prior to any earth-moving activities at the proposed project site, the applicant shall purchase at least 0.5 vernal pool preservation credits within a Service-approved ecosystem preservation bank or fund account.

### 2.5.5 Western Yellow-Billed Cuckoo Conservation Measures

The following measures would be implemented to avoid and minimize impacts to potential yellow-billed cuckoo habitat in the study area:

- Prior to construction, surveys will be conducted to determine the presence of yellow-billed cuckoos within the project area in accordance with any required Service survey protocols and permits at the time of construction.
- If surveys find cuckoos in the area, vegetation removal will be done outside of the cuckoo nesting season.
- Riparian habitat that is removed due to project construction along the American River will be replanted within the American River Parkway. The Corps intends to expand existing conserved riparian lands within the parkway that could support the yellow-billed cuckoo. The design of replacement riparian areas will be coordinated with the Service to ensure that the habitat benefits both valley elderberry longhorn beetle and yellow-billed cuckoos.

### 2.5.6 Fisheries Conservation and Mitigation Measures

**Green Sturgeon**

The Corps proposes to develop a green sturgeon habitat, mitigation, and monitoring plan (HMMP) to address the long-term negative impacts to green sturgeon designated critical habitat with the specific elements that are described below:

- The green sturgeon HMMP shall be developed in coordination with the Interagency Ecological Program (IEP) green sturgeon project work team and consulted on with NMFS prior to the construction of any work within the designated critical habitat of sDPS green sturgeon related to the ARCF GRR.
- The Corps shall either refine the SAM or develop an alternative green sturgeon survival and growth response model based on using and updating the existing Hydrologic Engineering Center Ecosystem Function Model (HEC-EFM) that reflects green sturgeon's preference for benthic habitat.
- The green sturgeon HMMP shall also be developed with measurable objectives for completely offsetting all adverse impacts to all life stages of sDPS green sturgeon (as modeled using refined approaches described above and considering design refinements that occur in the PED phase of project implementation.
- The HMMP shall also, restore or compensate for the number of acres of soft bottom benthic substrate for sDPS green sturgeon permanently lost to project construction. This mitigation shall be coordinated with the Interagency Working Group (IWG) or a Bank Protection Working Group (BPWG) and must be carried out within the lower Sacramento River/North Delta in order to offset the adverse modification to designated critical habitat.
- Mitigation actions shall be initiated prior to the construction activities affecting sDPS green sturgeon and their critical habitat.
- The sDPS green sturgeon HMMP will include measurable performance standards at agreed upon intervals and will be monitored for a period of at least ten years following construction.

The following additional conservation measures would be implemented to reduce the adverse effects to listed Chinook, steelhead, delta smelt, and green sturgeon:

- In-water construction activities (e.g., placement of rock revetment) will be limited to the work window of August 1 through November 30. If the Corps wants to work outside of this window they will consult with USFWS and NMFS.
- The Corps will purchase 42 acres of delta smelt credits from a USFWS-approved conservation bank to off-set the loss of 14 acres of shallow water habitat.
- The Corps will purchase an additional 32 acres of delta smelt credits from a USFWS-approved conservation bank to off-set the loss of spawning habitat due to the placement of riprap on the river bed.
- Erosion control measures (BMPs), including Storm Water Pollution Prevention Program and Water Pollution Control Program, that minimize soil or sediment from entering the river. BMPs shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects to Federally listed fish and their designated critical habitat.
- Screen any water pump intakes, as specified by NMFS and USFWS screening specifications. Water pumps will maintain an approach velocity of 0.2 feet per second or less when working in areas that may support delta smelt.
- No grading or altering of the lands within the existing Sacramento Bypass will occur as part of the project.
- The Corps shall participate in an existing IWG or work with other agencies to participate in a new BPWG to coordinate stakeholder input into future flood risk reduction actions associated with the ARCF GRR.
- The Corps shall coordinate with NMFS during PED as future flood risk reduction actions are designed to ensure conservation measures are incorporated to the extent practicable and feasible and projects are designed to maximize ecological benefits.
- The Corps shall include as part of the Project, a Riparian Corridor Improvement Plan with the overall goal of maximizing the ecological function and value of the existing levee system within the Sacramento Metropolitan Area.
- The Corps shall develop a HMMP with an overall goal of ensuring the conservation measures achieve a high level of ecological function and value. The HMMP shall include:
    - Specific goals and objectives and a clear strategy for maintaining all of the project conservation elements for the life of the project.
    - Measures to be monitored by the Corps for 10 years following construction and shall update their O&M manual to ensure the HMMP is adopted by the local

sponsor to ensure the goals and objectives of the conservation measures are met for the life of the project.

- Include specific goals and objectives and a clear strategy for achieving full compensation for all project-related impacts to listed fish species.
- The Corps shall continue to coordinate with NMFS during all phases of construction, implementation, and monitoring by hosting annual meetings and issuing annual reports throughout the construction period as described in the HMMP.
- The Corps shall host an annual meeting and issue annual reports for five years following completion of project construction.

- The Corps shall ensure that, for salmon and steelhead, the maximum SAM WRI deficits for each seasonal water surface elevation as determined appropriate with input from the IWG or the BPWG are fully offset through the purchase of credits at a NMFS approved conservation bank (as described in this BA).
- The Corps shall minimize the removal of existing riparian vegetation and IWM to the maximum extent practicable, and where appropriate, removed IWM will be anchored back into place or if not feasible, new IWM will be anchored in place.
- The Corps shall ensure that the planting of native vegetation will occur as described in the HMMP. All plantings must be provided with the appropriate amount of water to ensure successful establishment.
- The Corps shall provide a copy of the BO, or similar documentation, to the prime contractor, making the prime contractor responsible for implementing all requirements and obligations included in the documents and to educate and inform all other contractors involved in the project as to the requirements of the BO.
- A NMFS-approved Worker Environmental Awareness Training Program for construction personnel shall be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. Written documentation of the training will be submitted to NMFS within 30 days of the completion of training.
- The Corps shall consider installing IWM along future flood risk reduction projects associated with the ARCF GRR at 40 to 80 percent shoreline coverage at all seasonal water surface elevations in coordination with the IWG or the BPWG. The purpose is to maximize the refugia and rearing habitats for juvenile fish.
- The Corps shall protect in place all riparian vegetation on the lower waterside slope of any levee unless removal is specifically approved by NMFS.
- The Corps shall develop a Vegetation Variance for all elements of the ARCF GRR that are adjacent to habitat that is occupied by federally listed salmon, steelhead and green sturgeon, including the main channel of the Sacramento River (as proposed) and the Sacramento Bypass.
- Additional mitigative concerns, not considered in a SAM analysis, will be included in the MMP (See Appendix I) along the Sacramento Bypass reach, including potential adult and

juvenile passage issues, loss of shoreline riparian vs. gain in floodplain, and contradicting ESA species habitat requirements. These issues will be considered and appropriate actions will be taken where possible in coordination with other agencies.

For SRA habitat impacted by construction, the following measures would be implemented to compensate for the habitat loss:

- Compensation timing refers to the time between the initiation of construction at a particular site and the attainment of the habitat benefits to protected species from designated compensation sites. In general, compensation time is the time required for on-site plantings to provide significant amounts of shade or structural complexity from instream woody material recruitment. Significant long-term benefits have often been considered as appropriate to offset small short-term losses in habitat for listed species in the past, as long as the overall action contributes to recovery of the listed species. The authority to compensate prior to or concurrent with project construction is given under WRDA 1986 (33 United States Code [USC] §§ 2201–2330).
- For identified designated critical habitat, where feasible all efforts will be made to compensate for impacts where they have occurred or in close proximity. Impacts to designated critical habitat, SRA and instream components combined and the compensation value of replacement habitat will be based on the interagency approved Standard Assessment Model (SAM) used throughout the Sacramento River basin and Delta flood control system.
- Compensation sites would be monitored and vegetation would be replaced as necessary based on performance standards in the Mitigation Monitoring Plan (MMP) as detailed in Appendix I of the EIS/EIR.

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

- Green sturgeon, 15 years;
- Chinook salmon, 5 years;
- Central Valley steelhead, 4 years; and
- Delta smelt, 1 year.

### 2.5.7 Additional Minimization and Conservation Measures

- Obtain an ETL approved vegetation variance exempting sites from vegetation removal prior to final design and construction phase for the Sacramento River.
- Minimize the removal of existing vegetation in the proposed project area. Any disturbance or removal of vegetation will be replaced with native riparian vegetation, outside of the vegetation-free zone, as established in the ETL. Compensation for impacts to native riparian habitat will occur on a 2:1 basis on-site or in close proximity to the impact area. Riparian vegetation impacted under the SAFCA 408/404 actions will be replaced on a 3:1 canopy acreage basis.
- Erosion control measures (BMPs) including Storm Water Pollution Prevention Program and Water Pollution Control Program that minimize soil or sediment from entering the river. BMPs shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects to Federally listed fish and their designated critical habitat.
- Implement BMPs to prevent slurry seeping out to river and require piping system on land side only.
- Stockpile construction materials such as portable equipment, vehicles, and supplies, at designated construction staging areas and barges, exclusive of any riparian and wetlands areas.
- Stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 110% containment system.
- Construction will be scheduled when listed terrestrial and aquatic species would be least likely to occur in the project area. If construction needs to extend into the timeframe that species are present, then coordination/reinitiation with the resource agencies will need to occur.
- Site access will be limited to the smallest area possible in order to minimize disturbance. Litter, debris, unused materials, equipment, and supplies will be removed from the project area daily. Such materials or waste will be deposited at an appropriate disposal or storage site.
- To minimize ground and vegetation disturbance during project construction, project limits shall be clearly marked, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.
- Project-related vehicles shall observe a 20-mile-per-hour speed limit within construction areas, except on County roads and on State and Federal highways.Immediately (within 24 hours) cleanup and report any spills of hazardous materials to the resource agencies. Any

such spills, and the success of the efforts to clean them up, shall also be reported in post-construction compliance reports.

- Designating a Service-approved biologist as the point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped threatened or endangered species. This representative shall be identified to the employees and contractors during an all employee education program conducted by the Corps.

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

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

### 2.5.8 Summary of Environmental Commitments

Items below present a general summary of environmental commitments that the Corps will adhere to as part of the ARCF GRR.

If habitat compensation efforts for listed species or designated critical habitat do not perform, or adequately compensate for habitat losses per established guidelines, then the Corps will purchase compensation at a mitigation bank approved by the USFWS and/or NMFS or work with the Services to determine where appropriate mitigation can be created.

- The Corps will obtain an ETL-approved vegetation variance exempting the Sacramento River sites from vegetation removal in the lower third of the waterside of the levee prior to final construction and design phase. The Corps will be complying with the ETL on the American River via a SWIF. Full ETL compliance would occur on the East Side Tributaries sites. 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.

- The Corps will 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 insure that SRA habitat lost is partially replaced or enhanced. Alternatively, a rock lined soil trench approach could be taken.
- In addition to an approved vegetation variance, the Corps will minimize the removal of existing vegetation in the proposed project area. Disturbance or removal of trees or larger woody vegetation will be replaced with native riparian species, outside of the vegetation-free zone, as established in the ETL.
- Vegetation removal, particularly tree removal, shall 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 will 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 coordination with the resource agencies will occur.

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

- The Corps would assess opportunities for on-site compensation to the maximum extent practicable. 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, the Corps would evaluate other opportunities within the American River Parkway in coordination with County Parks, USFWS, NMFS, and the ARFCD.

- If the above three opportunities are exhausted and further compensation is still required, the Corps would seek credits at a USFWS-approved mitigation bank.

SAFCA will mitigate for impacts to riparian habitat caused by levee improvements along Arcade Creek, and for removal of high-hazard trees that may affect the performance and reliability of existing levees on the Arcade Creek. SAFCA has identified some locations where native riparian vegetation could be established. Planting locations were selected to increase the patch size, improve habitat connectivity, and expand age class and species diversity of woodland habitat. These improvements would enhance nesting opportunities for native bird species.

**Arcade Creek Habitat Improvements**

Impacts caused by levee improvements and high-hazard tree removal along Arcade Creek would be mitigated on-site to the extent feasible by improving and expanding native wetland and riparian habitat adjacent to the low-flow channel within the reach between Rio Linda Boulevard and Marysville Boulevard, which is currently dominated by nonnative annual grasses and broadleaf weeds. Following construction, native wetland vegetation (e.g., Santa Barbara sedge, Baltic rush) would be planted along the banks of Arcade Creek, and one row of large riparian tree species (e.g., valley oak) would be planted along each bank of the low-flow channel. The tree spacing would be determined by the capacity of the floodplain to accommodate vegetation without impacting the desired flood performance. The dense, high overhead canopy of the trees as they mature would provide important shade to the low-flow channel and bank, cover for small mammals and a connected migration corridor for flying and gliding animals (both vertebrates and invertebrates). The SRA habitat along the active channel would benefit water quality by keeping temperatures lower (cooler water retains higher levels of dissolved oxygen needed to sustain native fish and aquatic invertebrates), and provide leaf drop and other organic material to support aquatic food webs. In addition, shade from streamside trees would help suppress some growth of dense red sesbania and willows in the understory to maintain flood conveyance, and prevent new colonization of invasive species.

**Robla Creek Habitat Improvements**

Replacement riparian woodlands are proposed either on Robla Creek Mitigation Site A, approximately 6 acres north of Rio Linda Boulevard, or on Robla Creek Mitigation Site B (approximately 7.1 acres south of Rio Linda Boulevard). Both sites are adjacent to and west of Robla Creek (Figure 18). Site A is a previous borrow site and is at a lower elevation making this area better suited for wetland mitigation. Site B is connected to the Robla Creek floodplain and is the site of a future multi-use recreational trail. SAFCA would provide right-of-way for future construction of the trail.


**Figure 18. North Sacramento Streams Potential Robla Creek Mitigation Sites.**

# 3.0 Federally Protected Species and Critical Habitat

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

## 3.1 Plants

Federally listed plant species are associated with habitat such as, salt marsh, dunes, or cismontane woodland/valley and foothill grasslands. Salt marsh habitat and cismontane woodland/valley and foothill grasslands are also very unlikely to occur along or adjacent to the levees. Due to the general lack of supporting habitat, potential impacts to Federally listed plants are not considered in this BA.

## 3.2 Invertebrates

### 3.2.1 Valley Elderberry Longhorn Beetle

**Status and Distribution**

The valley elderberry longhorn beetle is listed as a threatened species under the ESA (USFWS 1980). USFWS previously issued a proposed rule and a 12-month review finding on October 2, 2012 (77 FR 60238), to remove the valley elderberry longhorn beetle from the Federal endangered species list and to remove the designation of critical habitat for this species. In a proposed rule issued on September 17, 2014 (79 FR 55874), the USFWS withdrew the proposed rule to delist the species based on the best scientific and commercial data available and evaluation that indicated that threats to the species and its habitat have not been reduced such that removal of the species from the Federal endangered species list is appropriate and warranted.

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

500 feet, and beetle exit holes have been detected on elderberry plants at elevations up to 730 feet (Barr 1991).

Critical habitat for the valley elderberry longhorn beetle occurs in two locations near the city of Sacramento (USFWS 1980). One area is enclosed by the Western Pacific railroad tracks and Highway 160, approximately one-half mile north of the American River near its confluence with the Sacramento River. The second site is located along the south bank of the American River at River Bend Park, just upstream of RM 13. Both of these areas are within the study area, however they would not be impacted by the proposed project. No bank protection measures are proposed in the area near Highway 160, and River Bend Park is upstream of the termination of the American River levees.

**Life History and Habitat Requirements**

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

Approximately 50,000 acres of existing riparian habitat in the Central Valley, primarily in the Sacramento Valley, have been protected by Federal, State, and local agencies as well as private organizations. Within the study area, large parcels of suitable habitat for the valley elderberry longhorn beetle have been protected, along the American River Parkway. Restoration of more than 5,000 acres of habitat has been initiated throughout the beetle's range (Talley et al. 2006). Mitigation for previous Corps projects has planted within the American River Parkway through agreements with Sacramento County Parks. Additional lands are currently available for mitigation that may be required for this project.

Valley elderberry longhorn beetle is only found in close association with its host plant, elderberry shrubs (*Sambucus* spp.). Elderberry shrubs are found in or near riparian and oak woodland habitats. The valley elderberry longhorn beetle's life history is assumed to follow a sequence of events similar to those of related taxa. Female beetles deposit eggs in crevices in the bark of living elderberry shrubs. Presumably, the eggs hatch shortly after they are laid, and the larvae bore into the pith of the trunk or stem. When larvae are ready to pupate, they move through the pith of the plant, open an emergence hole through the bark, and return to the pith for pupation. Adults exit through the emergence holes and can sometimes be found on elderberry foliage, flowers, or stems or on adjacent vegetation. The entire life cycle of the valley elderberry longhorn beetle is thought to encompass 1 or 2 years, from the time eggs are laid and hatch until adults emerge and die (USFWS 1984).

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

**Factors Affecting Abundance**

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

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

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

### 3.2.2 Vernal Pool Fairy Shrimp

**Status and Distribution**

The vernal pool fairy shrimp is listed as a threatened species under the ESA (59 FR 48136). Fairy shrimp are endemic to vernal pools in the Central Valley, coast ranges, and a limited number of sites in the Transverse Range and Santa Rosa Plateau of California. . The most accurate indication of the distribution and abundance of vernal pool fairy shrimp is the number of inhabited vernal pool complexes. There are 32 known populations of the vernal pool fairy shrimp, extending from the Stillwater Plain in Shasta County through the Central Valley to Pixley in Tulare County. In addition, the shrimp occur along the central Coast Range from northern Solano County to Pinnacles National Monument in San Benito County.

Critical habitat for the vernal pool fairy shrimp is designated in the vicinity of the study area on lands surrounding Mather Field. There is no critical habitat for vernal pool fairy shrimp in the study area.

**Life History and Habitat Requirements**

Vernal pool fairy shrimp live in vernal pools, an ephemeral freshwater habitat. None are known to occur in riverine waters, marine waters, or other permanent bodies of water. They are ecologically dependent on seasonal fluctuations in their habitat, such as absence or presence of water during specific times of the year, duration of inundation, and other environmental factors that include specific salinity, conductivity, dissolved solids, and pH levels. Water chemistry is one of the most important factors in determining the distribution of fairy shrimp (Belk 1977).

Fairy shrimp and tadpole shrimp play an important role in the community ecology of many ephemeral water bodies (Loring et al. 1988). They are fed upon by waterfowl and other vertebrates, such as western spadefoot toad (*Scaphiopus hammondi*) tadpoles (Ahl 1991).

Fairy shrimp have delicate elongate bodies, large stalked compound eyes, no carapace, and 11 pairs of swimming legs. They swim or glide gracefully upside down by means of complex beating movements of the legs that pass in a wavelike, anterior-to-posterior direction. Nearly all fairy shrimp feed on algae, bacteria, protozoa, rotifers, and bits of detritus. Female shrimp drop their eggs to the pool bottom or eggs remain in the brood sac until the female dies and sinks. The "resting" or "summer" eggs are capable of withstanding heat, cold, and prolonged desiccation. When the pools refill in the same or subsequent seasons some, but not all, of the eggs may hatch. The egg bank in the soil may be comprised of the eggs from several years of breeding (Donald 1983). The eggs hatch when the vernal pools fill with rainwater. The early stages of the fairy shrimp develop rapidly into adults. These non-dormant populations often disappear early in the season long before the vernal pools dry up.

Vernal pools form in regions with Mediterranean climates where shallow depressions fill with water during fall and winter rains and then evaporate in the spring (Collie and Lathrop 1976). Downward percolation is prevented by the presence of an impervious subsurface layer, such as a claypan, hardpan, or volcanic stratum (Holland 1976, 1988). Due to local topography and geology, the pools are usually clustered into pool complexes (Holland and Jain 1988). Pools within a complex typically are separated by distances on the order of meters and may form dense, interconnected mosaics of small pools or a more sparse scattering of larger pools. Temporary inundation makes vernal pools too wet during the wetted period for adjacent upland plant species adapted to drier soil conditions, while rapid drying during late spring makes pool basins unsuitable for typical marsh or aquatic species that require a more permanent source of water. However, many indigenous plant and aquatic invertebrate species have evolved to occupy the extreme environmental conditions found in vernal pool habitats.

**Factors Affecting Abundance**

Vernal pools are in danger due to a variety of human-caused activities, including urban development, water supply and flood control activities, and conversion of land to agricultural use. Changes in hydrologic pattern, overgrazing, and off-road vehicle use also imperil this aquatic habitat . Habitat loss occurs from direct destruction and modification of pools by filling, grading, discing, leveling, and other activities. Vernal pools can also be indirectly impacted when modifications of the surrounding uplands alter the vernal pool watershed (USFWS 1992b). Diversion of watershed runoff feeding the pools can result in premature pool dry-down before the life cycle of the fairy shrimp is complete. The fairy shrimp is also intolerant of flowing water that washes away the egg bank. Supplemental water from outside the natural watershed into vernal pools can change the habitat into a marsh-dominated or a permanent aquatic community that is unsuitable for the
vernal pool shrimp.

Other secondary impacts associated with urbanization include disposal of waste materials into habitat for the four species included in this final rule (Bauder 1986, 1987). Disposal of concrete, tires, refrigerators, sofas, and other trash adversely affects these animals by eliminating habitat, disrupting pool hydrology or, in some cases, through release of toxic substances. Dust and other forms of air or water pollution from commercial development or agriculture projects also may be deleterious to these animals. Introduction of the bullfrog (*Rana catesbeiana*) to areas inhabited by the vernal pool tadpole shrimp appears to increase the threat of predation facing this crustacean.

### 3.2.3 Vernal Pool Tadpole Shrimp

**Status and Distribution**

The vernal pool tadpole shrimp is listed as an endangered species under the ESA (59 FR 48136). They are endemic to vernal pools in the Central Valley, coast ranges, and a limited number of sites in the Transverse Range and Santa Rosa Plateau of California. The most accurate indication of the distribution and abundance of the vernal pool tadpole shrimp is the number of inhabited vernal pool complexes. There are 18 known populations of vernal pool tadpole shrimp in the Central Valley, ranging from east of Redding in Shasta County south to the San Luis National Wildlife Refuge in Merced County.

Critical habitat for the vernal pool tadpole shrimp is designated in the vicinity of the study area on lands surrounding Mather Field. There is no critical habitat for vernal pool fairy shrimp in the study area.

## Life History and Habitat Requirements

The life history of the vernal pool tadpole shrimp is linked to the phenology of the vernal pool habitat. None are known to occur in riverine waters, marine waters, or other permanent bodies of water. After winter rainwater fills the pools, the populations are reestablished from diapaused eggs that lie dormant in the dry pool sediments (Ahl 1991). Tadpole shrimp are primarily benthic animals that swim with their legs down. They climb or scramble over objects, as well as plow along in bottom sediments. Their diet consists of organic detritus and living organisms, such as fairy shrimp and other invertebrates (Pennak 1989).

A female surviving to large size may lay up to six clutches of eggs, totaling about 861 eggs in her lifetime (Ahl 1991). The eggs are sticky and readily adhere to plant matter and sediment particles (Simovich and Fugate 1992). A portion of the eggs hatch immediately and the rest enter diapause and remain in the soil to hatch during later rainy seasons (Ahl 1991). Ahl (1991) found that eggs in one pool hatched within three weeks of inundation and maturated to sexually reproductive adults in another three to four weeks. Simovich and Fugate (1992) reported sexually mature adults occurred in another pool three to four weeks after the pools had been filled. The vernal pool tadpole shrimp matures slowly and is a long-lived species (Ahl 1991). Adults are often present and reproductive until the pools dry up in the spring (Ahl 1991; Simovich et al. 1992).

## Factors Affecting Abundance

Vernal pools are in danger due to a variety of human-caused activities, including urban development, water supply and flood control activities, and conversion of land to agricultural use. Changes in hydrologic pattern, overgrazing, and off-road vehicle use also imperil this aquatic habitat . Habitat loss occurs from direct destruction and modification of pools by filling, grading, discing, leveling, and other activities. Vernal pools can also be indirectly impacted when modifications of the surrounding uplands alter the vernal pool watershed (USFWS 1992b). Diversion of watershed runoff feeding the pools can result in premature pool dry-down before the life cycle of the tadpole shrimp is complete. The tadpole shrimp is also intolerant of flowing water that washes away the egg bank. Supplemental water from outside the natural watershed into vernal pools can change the habitat into a marsh-dominated or a permanent aquatic community that is unsuitable for the vernal pool tadpole shrimp.

Other secondary impacts associated with urbanization include disposal of waste materials into habitat for the four species included in this final rule (Bauder 1986, 1987). Disposal of concrete, tires, refrigerators, sofas, and other trash adversely affects these animals by eliminating habitat, disrupting pool hydrology or, in some cases, through release of toxic substances. Dust and other forms of air or water pollution from commercial development or agriculture projects also may be deleterious to these animals. Introduction of the bullfrog (*Rana catesbeiana*) to areas inhabited by the vernal pool tadpole shrimp appears to increase the threat of predation facing this crustacean.

## 3.3 Fish

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

### 3.3.1 Sacramento River Winter-Run Chinook Salmon Evolutionarily Significant Unit

**Status and Distribution**

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

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

In 1988, winter-run Chinook salmon escapement was estimated at 696 adults. Escapement continued to decline, diminishing to an estimated 430 fish in 1989 and 211 fish in 1990 (CDFW 2013b). The rapid decline in escapement during the late 1980s and early 1990s prompted listing of the winter-run Chinook salmon as endangered under the California ESA and the Federal ESA. Escapement in 1991 was estimated to be 1,240 fish, indicating good survival of the 1988 class. NMFS data indicates that the population has increased during the late 1990s through 2001. In 1995, returning spawners numbered 1,337 fish and in 2012, returning adults were estimated to be 6,123 (CDFW 2013b). Despite increased efforts to maintain and enhance the population of winter-run Chinook salmon by various entities, in their final listing determination of June 28, 2005, NMFS again found "that the Sacramento River winter-run Chinook salmon ESU in total is in danger of extinction throughout all or a significant portion of its range" and concludes that the ESU continues to warrant listing as an endangered species under the Federal ESA (NMFS 2005a).

**Life History**

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

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

Winter-run Chinook salmon smolts (i.e., juveniles that are physiologically ready to enter seawater) may migrate through the Delta and San Francisco Bay to the ocean from November through May (Yoshiyama et al. 1998). The Sacramento River channel is the main migration route through the Delta. However, the Yolo Bypass also provides significant outmigration passage during higher flow events.

During winter in the Sacramento–San Joaquin system, juveniles rear on seasonally inundated floodplains. Sommer et al. (2001) found higher growth and survival rates of juvenile Chinook salmon reared on the Yolo Bypass floodplain, than those that reared in the mainstem Sacramento River.

**Factors Affecting Abundance**

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

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

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

**Critical Habitat/Essential Fish Habitat**

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

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

### 3.3.2 Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit

**Status and Distribution**

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

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

The abundance of Central Valley spring-run Chinook salmon escapement, as measured by the number of adults returning to spawn from 1960 to 2013, averaged 10,236 adults for in-river natural spawners and 2,364 average adults returning to hatcheries (CDFW 2013b). Spring-run Chinook salmon spawn in the early fall and have interbred with fall-run Chinook salmon in the Sacramento and Feather Rivers. Genetically uncontaminated populations may exist in Deer Creek, Mill Creek, Butte Creek, and other eastside tributaries of the Sacramento River.

**Life History**

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

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

**Factors Affecting Abundance**

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

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

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

**Critical Habitat/Essential Fish Habitat**

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

EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All reaches within the ARCF study area are considered to be EFH for spring-run Chinook salmon.

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

**Status and Distribution**

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

The Central Valley fall-/late fall–run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the Sacramento and San Joaquin river basins and their tributaries. Central Valley fall-/late fall–run Chinook salmon are currently the most abundant and widespread salmon runs in California (Mills et al. 1997), representing about 80% of the total Chinook salmon produced in the Sacramento River drainage (Kjelson et al. 1982). The most abundant spawning populations of fall-/late fall–run Chinook salmon occur in the Sacramento, Feather, Yuba, and American rivers (Mills and Fisher 1994). Fall-run Chinook salmon in the Sacramento, Feather, and American rivers have a relatively large hatchery component, from 1952 to 2013 the average was 57,508 fish. The average escapement in-river on the Sacramento and San Joaquin system from 1960 to 2013 was 264,475 (CDFW 2013b).

**Life History**

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

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

**Factors Affecting Abundance**

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

**Critical Habitat/Essential Fish Habitat**

Critical habitat is not designated for fall-/late fall–run Chinook salmon, however EFH is designated for this species. EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All reaches within the ARCF GRR study area are considered to be EFH for fall-/late fall-run Chinook salmon.

### 3.3.4 Central Valley Steelhead Distinct Population Segment

**Status and Distribution**

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

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

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

**Life History**

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

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

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

**Factors Affecting Abundance**

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

**Critical Habitat/Essential Fish Habitat**

Habitat for endangered or threatened anadromous fish is designated as critical habitat under the ESA and as EFH under the MSA. EFH has been designated for Chinook salmon, but not for steelhead. Critical habitat for Central Valley steelhead includes the stream channels and the lateral extent as defined by the ordinary high-waterline or bank-full elevation in the designated stream reaches of the Sacramento and American River, NEMDC and Dry/Robla creek portions of the ARCF GRR. Primary constituent elements of critical habitat are as described for spring-run Chinook salmon (NMFS 2006b).

### 3.3.5 Delta Smelt

**Status and Distribution**

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

**Life History**

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

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

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

**Factors Affecting Abundance**

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

**Critical Habitat/Essential Fish Habitat**

Critical habitat for delta smelt consists of all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the contiguous waters in the Delta (USFWS 1994). Critical habitat for delta smelt is designated in the following California counties: Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo (USFWS 2003). Critical habitat in the ARCF GRR study area includes the Sacramento River up to the I Street Bridge and the Yolo Bypass just above Interstate 80 at the railroad tracks. Primary constituent elements of critical habitat determined to be essential to the conservation of the species include: physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (USFWS 2006a).

### 3.3.6 Green Sturgeon Southern Distinct Population Segment

**Status and Distribution**

On January 23, 2003, NMFS determined that green sturgeon (*Acipenser medirostris*) are comprised of two populations, a northern and a southern DPS (NMFS 2003). The northern DPS includes populations extending from the Eel River northward, and the southern DPS includes populations south of the Eel River to the Sacramento River. The Sacramento River supports the southernmost spawning population of green sturgeon (Moyle 2002). On April 6, 2005, NMFS determined that the northern DPS does not warrant listing under the ESA, but it remains on the Species of Concern List (NMFS 2005c). On April 7, 2006, NMFS determined that the southern DPS of green sturgeon was threatened under the Federal ESA (NMFS 2006c). On October 9, 2009, NMFS (74 CFR 52300) designated critical habitat for the green sturgeon southern DPS throughout most of its occupied range.

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

**Life History**

The green sturgeon is anadromous, but it is the most marine-oriented of the sturgeon species and has been found in near shore marine waters from Mexico to the Bering Sea (NMFS 2005c). The southern DPS has a single spawning population in the Sacramento River (NMFS 2005d) and more recently spawning has been observed in the lower Feather River, a tributary of the Sacramento River (Seesholtz et al. 2012). Adults typically migrate upstream into rivers between late February and late July. Spawning occurs from March to July, with peak spawning from mid-April to mid-June. Green sturgeon are believed to spawn every 3 to 5 years, although recent evidence indicates that spawning may be as frequent as every 2 years (NMFS 2005c). Little is known about the specific spawning habitat preferences of green sturgeon. Adult green sturgeon are believed to broadcast their eggs in deep, fast water over large cobble substrate, where the eggs settle into the interstitial spaces (Moyle 2002). Spawning is generally associated with water temperatures from 46 to 57 degrees Fahrenheit (°F). In the Central Valley, spawning occurs in the Sacramento River upstream of Hamilton City, perhaps as far upstream as Keswick Dam (Adams et al. 2002) and the lower Feather River (Seesholtz et al. 2012).

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

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

**Factors Affecting Abundance**

The historical decline of the southern DPS of green sturgeon has been largely attributed to the reduction of spawning habitat area. Keswick and Shasta Dams on the Sacramento River and Oroville Dam on the Feather River are impassable barriers that prevent green sturgeon from accessing what were likely historical spawning grounds upstream of these dams. Other potential migration barriers or impediments include the Sacramento Deep Water Ship Channel locks, Fremont Weir, Sutter Bypass, the Delta Cross Channel, and Shanghai Bench and Sunset Pumps on the Feather River. Other factors that have been identified as potential threats to green sturgeon are reductions in freshwater outflow in the Delta during larval dispersal and rearing, high water temperatures during spawning and incubation, entrainment by water diversions, contaminants, predation and other impacts by introduced species, and poaching (NMFS 2005c).

**Critical Habitat/Essential Fish Habitat**

There is no EFH designated for green sturgeon. Designated critical habitat for the southern DPS of green sturgeon includes the Sacramento River downstream of Keswick Dam, the Feather River downstream of Oroville Dam, and the Yuba River downstream of Daguerre Dam; portions of Sutter and Yolo Bypasses; the legal Delta, excluding Five Mile Slough, Seven Mile Slough, Snodgrass Slough, Tom Paine Slough and Trapper Slough; and San Francisco, San Pablo, and Suisun bays. Freshwater habitat of green sturgeon of the southern DPS varies in function, depending on location within the Sacramento River watershed. Spawning areas currently are limited to accessible reaches of the Sacramento River upstream of Hamilton City and downstream of Keswick Dam (CDFG 2002) and portions of the Feather River (Seesholtz et al. 2012). Preferred spawning habitats are thought to contain large cobble in deep and cool pools with turbulent water (CDFG 2002; Moyle 2002; Adams et al. 2002). Sufficient flows are needed to sufficiently oxygenate and limit disease and fungal infection of recently laid eggs (Deng et al. 2002). Within the Sacramento River, spawning appears to be triggered by large increases in water flow during spawning (Brown and Michniuk 2007).

## 3.4 Amphibians

Two protected amphibian species were identified in the USFWS database records: the California red-legged frog (*Rana draytonii*) and the California tiger salamander (*Ambystoma californiense*) Amphibians are generally associated with smaller creeks, lentic habitats, and/or vernal pools. These aquatic habitats are generally not found along the ARCF reaches or in adjacent areas. Additionally, there are no known occurrences of these species in the action area. No suitable habitat for the salamander is present in the action area, and the action area is outside of the frog's extant range. Therefore, these listed amphibians are not considered further in this BA.

## 3.5 Reptiles

Two protected reptile species were identified in USFWS database records: the Alameda whipsnake (*Masticophis lateralis euryxanthus*) and giant garter snake (*Thamnophis gigas*). The range of the Alameda whipsnake is limited to Contra Costa and Alameda counties, which is not within the ARCF study area; therefore, Alameda whipsnake is dismissed and not discussed further in this BA.

### 3.5.1 Giant Garter Snake

**<u>Status and Distribution</u>**

The giant garter snake (*Thamnophis gigas*) is Federally listed as a threatened species under the ESA. Currently, this species is only known from 13 isolated population clusters within the Central Valley, from Chico to an area just southwest of Fresno (USFWS 1997). Giant garter snake populations that occur within the ARCF study area are within and adjacent to the Sacramento Bypass, which includes both small canals and rice fields. Additionally GGS is known to occur in the NEMDC north of the pump station at the Dry Creek north levee, however this is north of the ARCF GRR action area. SAFCA's Borrow Site 2 is located north of Dry Creek, so there is some potential for impacts to GGS in the NEMDC area.

**Life History**

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

**Factors Affecting Abundance**

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

## 3.6 Birds

### 3.6.1 Western Yellow-Billed Cuckoo

The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is was Federally listed as threatened in October 2014. Nesting western yellow-billed cuckoos no longer occur on the Sacramento River south of Colusa as the river has been channelized and riprapped from that point into the Sacramento-San Joaquin River Delta. However, nesting western yellow-billed cuckoo do occur south of the Sacramento area, and north of the Sacramento area, so there is some potential for migrant individuals to use the riparian habitats along the American River Parkway as they move between nesting habitat areas. As a result, this species is discussed in greater detail below.

Prior to construction activities, surveys would be conducted within the study area to determine where potential nest sites occur. The surveys would be conducted annually in close proximity to construction locations and within one-half mile of any anticipated construction. If any special status bird species are found, coordination with the resource agencies would occur and appropriate avoidance and minimization measures would be established prior to the start of construction.

**Status and Distribution**

Over the last 100 years, western cuckoo population declined dramatically due to extensive loss of suitable breeding habitat, primarily riparian forests and associated bottomlands dominated by willow (Salix spp.), cottonwood (Populus spp.), or mesquite (Prosopis spp.) (Gaines and Laymon 1984, Laymon and Halterman 1987, Hughes 1999). Once considered a common breeder in California, by 1940 the yellow-billed cuckoo suffered severe population reduction (Grinnell and Miller 1944) and by 1987 was estimated to occupy only 30 percent of its historical range (Laymon and Halterman 1987). California statewide surveys conducted in 1977 (Gaines and Laymon 1984), 1986/1987 (Laymon and Halterman

1987), and 1999 (Halterman et. al 2001) found yellow-billed cuckoo populations were concentrated mostly along the Sacramento River from Red Bluff to Colusa, along the South Fork of the Kern River, and portions of the Lower Colorado River. Population estimates on the Sacramento and Kern Rivers from the 1999 surveys were similar to those of the 1986/1987 surveys, but lower when compared to the 1977 survey. The Lower Colorado River population appeared to suffer severe declines in the 12 years from the 1986/87 to the 1999 surveys.

In 2001, USFWS determined that western yellow-billed cuckoos represent a Distinct Population Segment (DPS), and as such became a candidate for protective listing under the Endangered Species Act (USFWS 2001). In 2002, the listing was determined to be warranted but precluded by higher priority listing actions (due to limited resources) (USFWS 2002). In 2013, USFWS formally proposed that the Western DPS be listed as Threatened under the Endangered Species Act. On October 3, 2014, the proposed rule became effective and finalized the USFWS determination for listing the western yellow-billed cuckoo, but not its critical habitat.

**<u>Life History</u>**

Yellow-billed cuckoos are among the latest-arriving Neotropical migrants. They arrive on their breeding grounds in Arizona and California by June (Hughes 1999). Diet during the breeding season consists primarily of large insects such as grasshoppers, katydids, caterpillars, praying mantids, and cicadas; also tree frogs and small lizards (Hamilton and Hamilton 1965, Laymon 1980, Laymon et al. 1997). Nesting usually occurs between late June and late July, but can begin as early as late May and continue until late September (Hughes 1999). Nests consist of a loose platform of twigs, which are built by both sexes and take one to two days to build (Hughes 1999), though occasionally the nest of another species is used (Jay 1911, Bent 1940, Payne 2005). Clutch size is 1 to 5 (Payne 2005), though up to 8 eggs have been found in one nest due to more than one female laying in the nest (Bent 1940). Eggs are generally laid daily until clutch completion (Jay 1911), and incubation begins once the first egg is laid, lasting 9 to 11 days (Hughes 1999). Young hatch asynchronously and are fed mostly large insects (Laymon and Halterman 1985, Laymon et al. 1997, Halterman et al. 2009) similar to the adult diet. Young fledge after 5 to 9 days (6 days average), but may be dependent on adults for at least three weeks (Laymon and Halterman 1985).

Fall migration is thought to begin in late August, with most birds gone by mid-September (Hughes 1999); however on the Lower Colorado River some individuals appear to begin migrating in early August (McNeil et al. 2011). Their non-breeding range is believed to be the western side of the Andes (Hughes 1999), though little information exists on migration routes and non-breeding range in South America where they can be confused with the endemic pearly-breasted cuckoo (C. euleri), their closest relative (Payne 2005).

**Factors Affecting Abundance**

Habitat losses associated with manmade flood control and water management features that alter watercourse hydrology have contributed to the decline of the species. The natural processes that sustained riparian habitat in western North America have greatly diminished. Loss and degradation of habitat has occurred as a result of livestock overgrazing and encroachment from agriculture. These losses are exacerbated by the conversion of native habitat to predominantly nonnative vegetation. Habitat losses result in additional effects such as increased predation and reduced dispersal potential. These effects are associated with small and widely separated habitat patches. These threats are particularly persistent where small habitat patches are within proximity to human-altered landscapes, especially agricultural fields, resulting in the potential for pesticides to poison individual western yellow-billed cuckoos and reduce their prey base.

# 4.0 Environmental Baseline

This section describes the physical conditions and general vegetation, wildlife, and fisheries resources present within the ARCF action area. These conditions are first presented generally throughout the ARCF action area and then site specific SRA is analyzed as well as affected species in the ARCF action area. The environmental baseline provides information necessary to determine if the proposed action would jeopardize the continued existence of species being considered, and if the project can support long-term survival of these species in the action area.

The ARCF action area includes the mainstem Sacramento River from Freeport (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 also includes the sites completed under the WRDA 1996 and WRDA 1999 authorizations for the project. 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. Consultation has occurred on these sites throughout the construction period on an as-needed basis to ensure compliance with the ESA. The original project construction was coordinated with USFWS as the American River Watershed (Common Features) Project, Sacramento County, California. The Biological Opinions for these sites are on file with USFWS under Reference # 1-1-99-F-0078.

## 4.1 Vegetation

The ARCF study area consists of primarily riparian forest, valley oak woodland, riparian scrub-shrub habitat, and typically non-native annual grassland. Scrub-shrub generally refers to areas where the woody riparian canopy is composed of young trees or shrubs less than 20 feet high. Species that are typically found in riparian forest, valley oak woodland, and scrub habitats include cottonwood, several willow species, sycamore valley oak, black walnut, Oregon ash, white alder, boxelder, blue elderberry, buttonbush, Himalaya blackberry, wild grape, and poison oak. Understory vegetation may consist of an herbaceous layer of sedges, rushes, grasses, and forbs.

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, black walnut, black willow, or valley oak. Dominant species found in the sub canopy may also include alder, ash and box elder. Layers of climbing vegetation make up part of the subcanopy, with wild grape being a major component, but wild cucumber and clematis vines are also found in riparian communities.

Several species of invasive non-native trees, shrubs and vines may be present in some riparian locations, predominantly red sesbania, Himalayan blackberry, tamarix, false bamboo, tree-of-heaven, eucalyptus, and ivy.

The herbaceous ruderal groundcover, primarily nonnative annual grassland, is found on most levees along the Sacramento River. It occurs on the levees and also within gaps in the riparian habitats. Plant species include wild oats, soft chess, ripgut brome, red brome, wild barley, Bermuda grass, and foxtail fescue. Common forbs include broadleaf filaree, red stem filaree, turkey mullein, clovers, and many others. The majority of these plants are not native to the project area.

### 4.1.1 Historical Human Resource Use and Current Riparian Vegetation

Historical precipitation and runoff patterns resulted in the Sacramento River being bordered by up to 500,000 acres of riparian forest, with valley oak woodland covering the higher river terraces (Katibah 1984). However, human activities of the 1800s and 1900s have substantially altered the hydrologic and fluvial geomorphic processes that create and maintain riparian forests within the Sacramento basin, resulting in both marked and subtle effects on riparian communities. Riparian recruitment and establishment models (Mahoney and Rood 1998; Bradley and Smith 1986) and empirical field studies (Scott et al. 1997, 1999) emphasize that hydrologic and fluvial processes play a central role in controlling the elevational and lateral extent of riparian plant species. These processes are especially important for pioneer species that establish in elevations close to the active channel, such as cottonwood and willows (*Salix* spp.). Failure of cottonwood recruitment and establishment is attributed to flow alterations by upstream dams (Roberts et al. 2001) and to isolation of the historic floodplain from the river channel. In addition, many of these formerly wide riparian corridors are now narrow and interrupted by levees and weirs. Finally, draining of wetlands, conversion of floodplains to agricultural fields, and intentional and unplanned introduction of exotic plant species have altered the composition and associated habitat functions of many of the riparian communities that are able to survive under current conditions.

### 4.1.2 Site-Specific Analysis of Riparian Vegetation

Analysis of total linear feet (lf) of SRA was conducted using Google Earth Pro for the reaches only associated with bank protection on the American and Sacramento Rivers in the ARCF action area (Table 8). However, site specific conditions at proposed bank protection sites will evaluate SRA habitat values using the SAM method of analysis to determine impacts and onsite compensation value based on actual designs. The East Side Tributaries were not evaluated because no bank erosion protection is planned. It should be noted however that there is minimal, if any, SRA associated with the tributaries in the reaches where construction is proposed, except Arcade Creek. Approximately 8 acres of trees along the Sacramento River would be removed to construct the new 1,500 foot Sacramento Weir. Additionally, in the area proposed to be incorporated into the Sacramento Bypass, there is approximately 236 acres of newly planted nut orchard trees as of summer 2015. In order to construct the widened bypass, these trees would be removed.

Identification of individual reaches in the ARCF action area can be seen in Figure 2. American River North (ARN) reaches A through I includes the north side of the American River and the East Side Tributaries. American River South (ARS) reaches A through G includes the south side of the American River and the east side of the Sacramento River.

**Table 8. Summary of Reach-Specific SRA Analysis.**

| American River | | Sacramento River | |
|---|---|---|---|
| **Reach** | **Linear Feet (lf) of SRA** | **Reach** | **Linear Feet (lf) of SRA** |
| ARN A | 19,000 | D | 9,200 |
| ARS A | 6,850 | E | 8,850 |
| ARS B | 875 | F | 21,100 |
| ARS C | 3,800 | G | 11,150 |
| Total | 30,525 | Total | 50,300 |

## 4.2 American River Hydraulic Baseline

The American River levee system was originally intended to convey a discharge of 115,000 cfs. When the Joint Federal Project (JFP) is completed at Folsom Dam, in combination with levee repairs currently being completed under the Common Features Project (and other authorities) and the dam 3.5 foot raise, the intent is for the river to be able to convey a discharge of 160,000 cfs, assuming that the levees do not fail from one or more of the potential failure modes (i.e., seepage, stability, insufficient height, or erosion).

In addition, modifications of Folsom Dam operations will shift the way floods are released into the lower river from Folsom Dam. Specifically, frequent flood events, that is, floods which occur say once in every ten to twenty-five years, will have a larger peak discharge compared to those under current dam operations.

### 4.2.1 Folsom Dam Operations

In 2017, the Folsom Joint Federal Project (JFP) auxiliary spillway at Folsom Dam will be completed and a new water control manual will be adopted. This includes a 400,000 acre-feet to 600,000 acre-feet (400/600) variable flood space operation that takes incidental storage space in upstream reservoirs into consideration when determining flood storage requirements at Folsom Dam during the flood season. The JFP will allow dam operators to release larger quantities of water at lower reservoir stages and more efficiently utilize flood space in the reservoir.

While the JFP and new water control manual are not in place, these projects will be in operation prior to any construction occurring on the ARCF project. As a result, including the operation of the JFP as a part of the baseline condition of this project is a reasonable assumption for the ARCF GRR. Therefore, the ARCF GRR assesses the impacts associated with the increase in water within the Yolo Bypass that results from the widening of the Sacramento Weir and Bypass. Additional changes in flows from the operation of the JFP will be addressed in the forthcoming Folsom Dam Water Control Manual Update consultation. However, these flows are represented throughout this BA as a part of the Future Without Project Condition.

Table 9 lists a sample of the current and future peak discharges for a range of flood events. It is anticipated that the values will be updated as part of the Folsom Water Control Manual Update evaluation.

**Table 9. Comparison of Peak Discharges in the American River between Current and Future Events.**

| | Current Conditions | Future Conditions |
|---|---|---|
| 50% (1/2) ACE (2-year) | 30,200 | 25,200 |
| 10% (1/10) ACE (10-year) | 43,100 | 71,700 |
| 4% (1/25) ACE (25-year) | 99,700 | 115,000 |
| 2% (1/50) ACE (50-year) | 115,000 | 115,000 |
| 1% (1/100) ACE (100-year) | 145,000 | 115,000 |
| 0.5% (1/200) ACE (200-year) | 320,000 | 160,000 |

#### 4.2.2 American River Erosion Susceptibility

The Lower American River, Erosion Susceptibility Analysis for Infrequent Flood Events, evaluated the potential for erosion of grass-covered levees and overbanks in response to different stream discharges resulting from releases of various magnitudes from Folsom Dam (Ayers, 2004). This study concluded that the river system is degrading under present operating conditions because the lower American River is starved of sediments by Folsom Dam and Nimbus Dam. Hardpan has been reached in the channel bottom as far downstream as Guy West Bridge (RM 7.0), and this hardpan is slowing further degradation. With the river starved for sediment and unable to further scour its channel the river is now eroding laterally to satisfy its need for sediment. Erosion of the riverbank is occurring even at low flow conditions of 7,000 cfs, which was the peak flow from the 2003 runoff season. Ongoing erosion has scarred the channel banks leaving them susceptible to further erosion, especially during high flow events. Lateral erosion is further reducing the amount of berm separating the main channel from the levee. The loss of vegetation on the berm and bank is leaving bare soil, which is more susceptible to erosion at a lower velocity than if the berm or bank was covered with vegetation.

Figure 19 shows the velocities for a discharge of 115,000 cfs, which average about 6 to 8 feet per second in the channel with maximum velocities ranging up to about 12 feet per second. Figure 20 shows the velocities for a discharge of 160,000 cfs which average about 6 to 9 feet per second in the channel with maximum velocities ranging up to about 13 feet per second. Of concern in both of these figures are the proximities of the relatively high velocities to the levees along the Lower American River. Additionally, the range of the computed velocities is of concern since the magnitude of the velocities is great enough to erode many of the relatively fine grained material present in the channel lining. The results of the analysis indicate that the large discharge events are capable of eroding the material typically found along the Lower American River channel.

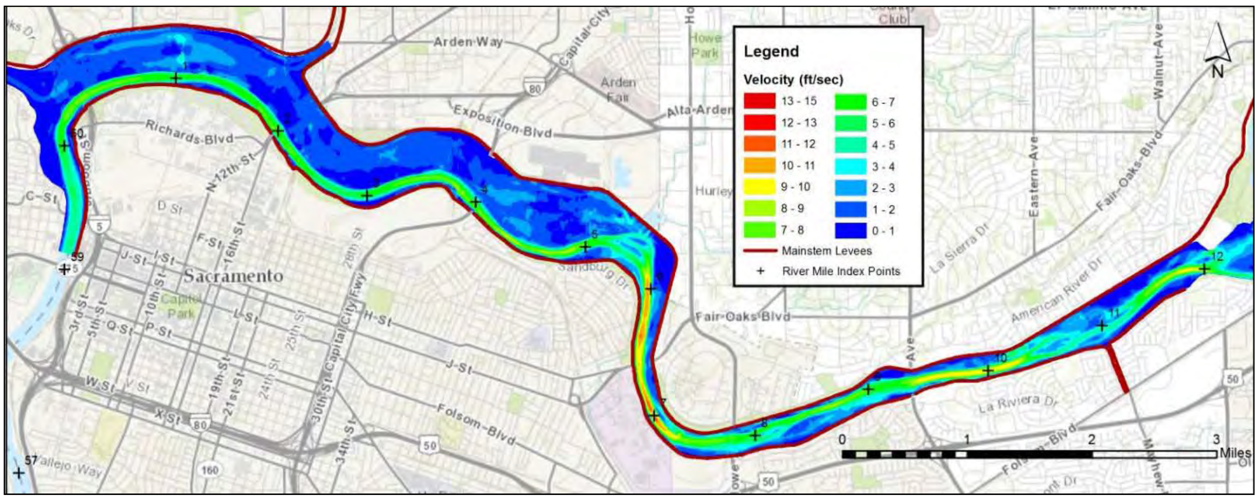


**Figure 19. Velocities in the Lower American River at 115,000 cfs.**

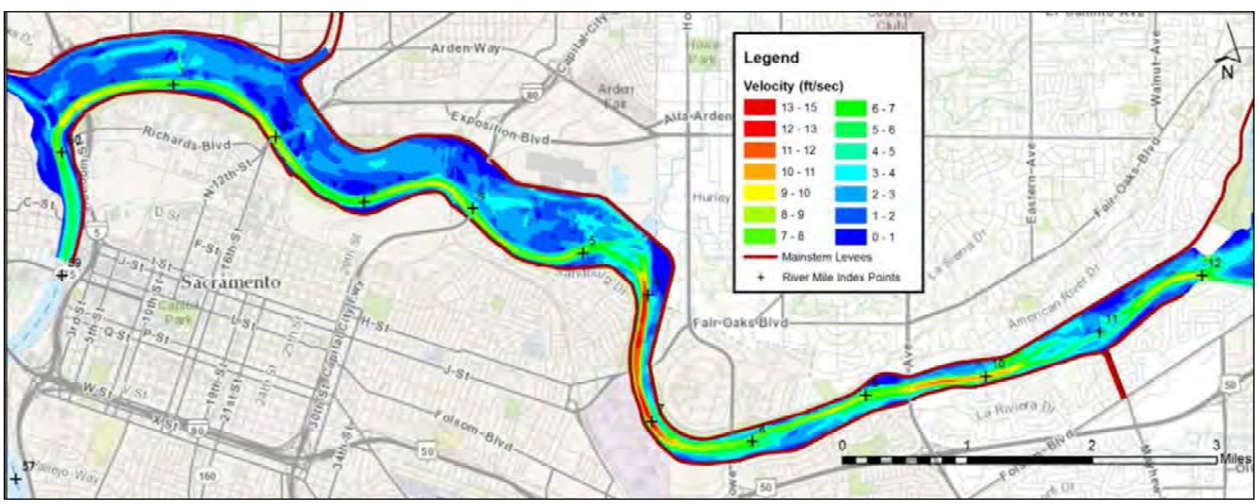


**Figure 20. Velocities in the Lower American River at 160,000 cfs.**

Figure 21 shows velocity contours in the area where erosion is greatest, between RM 6 and RM 7.5. As can be seen in Figure 21, velocities reach 11 feet per second for flows of 115,000 cfs, and get as high as 14 feet per second for 160,000 cfs. The study concluded that a flow of 145,000 cfs could cause damage at most of the study's identified priority sites, and could cause a levee failure to occur for at least one of the sites (Ayers, 2004). This reach of river represents the worst conditions regarding velocity (11 to 14 feet per second). Downstream and upstream of this reach, velocities in general for the same peak releases average in the 6 to 9 feet per second range.

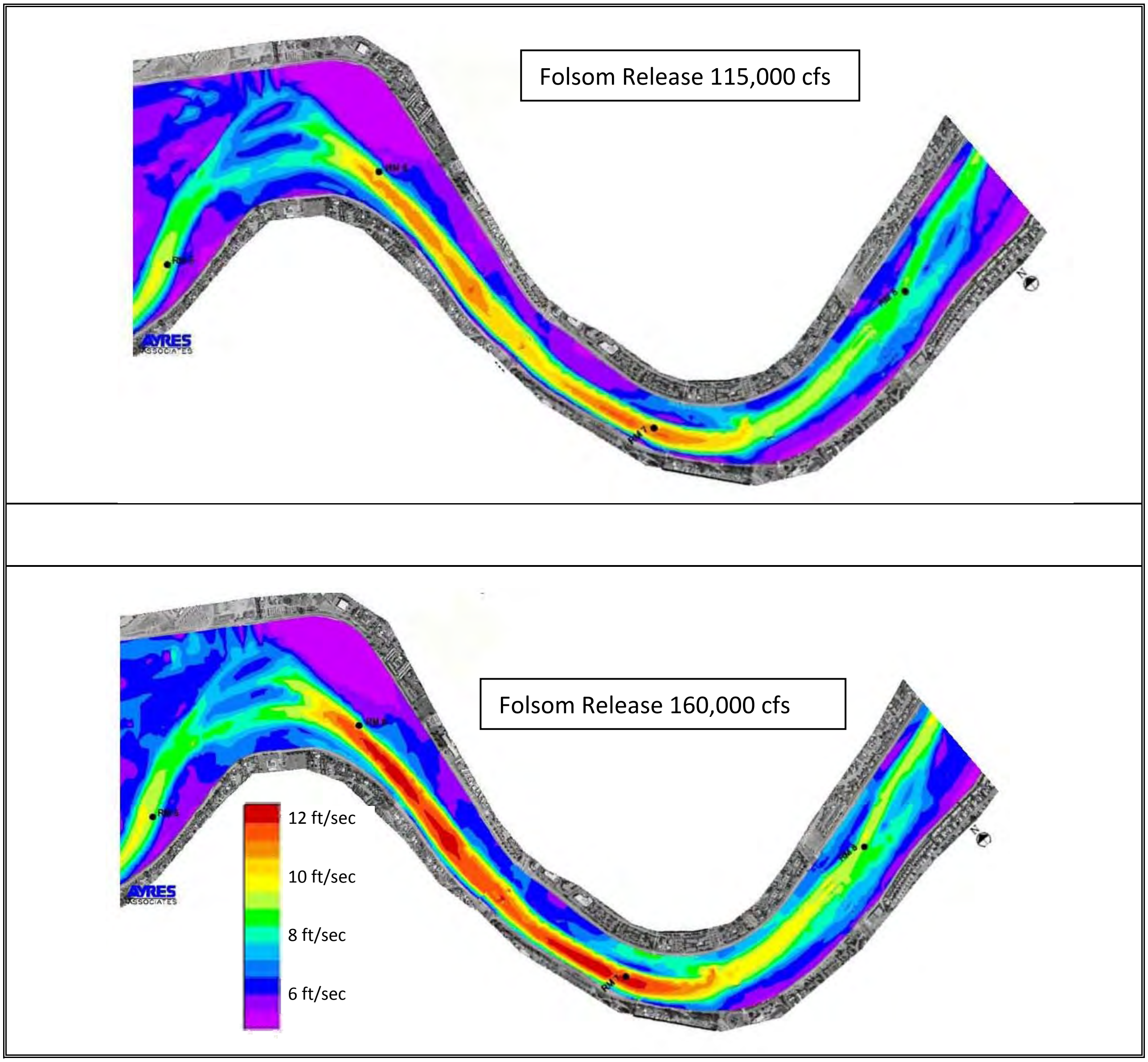


**Figure 21. American River Velocity Contours.**

Bare soil can withstand approximately 1.5 to 2.5 feet per second. Soil with good turf cover can withstand between 3.5 to 8 feet per second. The conditions of grass cover along the American River are not good and erosion occurs at velocities much less than the 11 to 14 feet per second in the RM 6 to RM 7.5 reach. This is illustrated by the fact that emergency erosion repairs have needed to occur as far downstream as near Highway 160 (RM 1.8) and as far upstream as between Watt Avenue and the Mayhew Drain (RM 10.2).

## 4.3 Affected Species in the Action Area

### 4.3.1 Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is listed as a threatened species under the ESA (USFWS 1980). The valley elderberry longhorn beetle's range extends from southern Shasta County to Fresno County (Talley et al. 2006). Along the eastern edge of the species' range, adult beetles have been found in the foothills of the Sierra Nevada at elevations up to 2,220 feet, and beetle exit holes have been located on elderberry plants at elevations up to 2,940 feet. Along the western edge of the species' range, adult beetles have been found on the eastern slopes of the Coast Ranges at elevations of up to 500 feet, and beetle exit holes have been detected on elderberry plants at elevations up to 730 feet (Barr 1991).

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

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

The valley elderberry longhorn beetle distribution decline is most likely related to the extensive loss of riparian forests in the Central Valley, which has reduced the amount of available habitat for the species, and has most likely decreased and fragmented the species' range (USFWS 1984). Insecticide drift from cultivated fields and orchards adjacent to elderberry plants may affect valley elderberry longhorn beetle populations, if drift occurs at a time when adults are present on the shrubs (Barr 1991). Herbicide drift from agricultural fields and orchards can likewise affect the health of elderberry plants, thereby reducing their quantity and quality as valley elderberry longhorn beetle habitat.

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

Critical habitat for the valley elderberry longhorn beetle occurs in two locations near the City of Sacramento (USFWS 1980). One area is enclosed by the Western Pacific railroad tracks and Highway 160, approximately one-half mile north of the American River near its confluence with the Sacramento River. The second site is located along the south bank of the American River at Goethe Park, just upstream of RM 13.

VELB are known to occur throughout the ARCF GRR study area. The Corps conducted surveys in 2011 of the levee systems within the action area. The survey area consisted of the levee structures and 15 feet on both the waterside and landside; where access was available. The survey located elderberry clusters, however, actual shrubs, stem size, nor exit hole presence were determined. The surveys found the greatest amount of clusters on the south side of the American River and determined that both basins contain shrubs. All shrubs are considered to be in a riparian zone. Within the East Side Tributaries surveys were conducted identical to the American and Sacramento River. The only area where shrubs were located was along Arcade Creek, which contained two clusters of shrubs.

The American River Parkway has been the focus of a number of mitigation efforts from the confluence of the American and Sacramento Rivers (mitigation site 0.9, located at river mile [RM] 0.9 on the right side of the American River) up to Lake Natoma (Sailor Bar mitigation site located at RM 21 on the right side of the American River), elderberry mitigation sites create connectivity for potential translocation of valley elderberry longhorn beetles.

Additional VELB habitat within the Parkway has been created as part of previous Corps construction efforts, including:

- Site 0.9 on the right bank of American River at RM 0.9.
- Cal Expo: three distinct mitigation sites located between RM 3 and RM 4 on the right side of the American River.
- Site 11.5: elderberry mitigation site located near RM 11.5 on the right side of the American River.

- Mayhew: elderberry mitigation site located near RM 11 on the left side of the American River.
- River Bend Park: multiple mitigation sites located near RM 14 on the on the left side of the American River.
- Sailor Bar: mitigation site located near RM 21 on the right side of the American River.

These sites are currently being monitored and maintained by the Corps with annual reports provided to USFWS. Both the critical habitat are located in areas Operated and Maintained by the American River Flood Control District. The mitigation sites are maintained by SAFCA. Habitat maps of the American River Parkway showing locations of elderberry shrubs are included as Appendix F of the BA. Existing mitigation sites in the Parkway are identified in the maps in Appendix G of the BA.

Additional sites established by other agencies also exist along both sides of the American River, increasing connectivity to existing areas of critical habitat for the VELB. Additionally, future plans of restoration and mitigation could increase connectivity in large areas such as Woodlake, Bushy Lake, and Rossmoor. Smaller sites along the American River, including restoration efforts within the ARCF GRR construction footprint, would increase connectivity between these larger sites and the existing habitat within the American River Parkway. These additional sites would be assessed during the design phase of the ARCF GRR project for viability of future compensation efforts associated with this action.

#### 4.3.2 Chinook Salmon and Steelhead

Four distinct runs of Chinook salmon occur in the ARCF action area: winter-run, spring-run, fall-run, and late fall–run. The runs are named after the season of adult migration, with each run having a distinct combination of adult migration, spawning, juvenile residency, and smolt migration periods. In general, fall- and late fall-run Chinook salmon spawn soon after entering their natal streams, while spring- and winter-run Chinook salmon typically hold in their natal streams for up to several months before spawning. Central Valley Steelhead also occurs in the ARCF action area. Immigration of adult steelhead in the Sacramento and American River's peaks in late September and October (Moyle 2002). The steelhead spawning season typically stretches from December through April. After several months, fry emerge from the gravel and begin to feed. Juveniles rear in fresh water from 1 to 4 years (usually 2 years), then migrate to the ocean as smolts in the spring (March through June).

During higher winter flow events in the East Side Tributaries there is suitable habitat in NEMDC, Arcade Creek and Dry/Robla Creek for the presence of fall/late-fall salmon. Central Valley steelhead are expected to occur in NEMDC as adults, migrating upstream to their spawning habitat, and as juveniles and smolts, rearing and migrating toward the ocean. Central Valley steelhead would not typically occur in Arcade Creek or Robla Creek, as these streams regularly lacks water quality conditions for spawning. NEMDC includes critical habitat for Central Valley steelhead, which uses this locations for juvenile rearing, juvenile migration, and adult migration (NMFS 2014). There is no critical fish habitat designation for Arcade and Robla Creeks.

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

### 4.3.3 Green Sturgeon

Green sturgeon are known to occur in the lower reaches of large rivers, including the Sacramento River (Moyle 2002) and more recently spawning has been observed in the lower Feather River, a tributary of the Sacramento River (Seesholtz et al. 2012). Adults of this species tend to be associated with marine environments more than the more common white sturgeon, although spawning populations have been identified in the Sacramento and Klamath Rivers (Corps 1993). Juvenile rearing (natal stream to estuary) can occur year round in the Sacramento River action area.

Critical habitat for the green sturgeon extends into the American River upstream to the Highway 160 bridge where there is a potential to encounter adults and/or rearing juvenile green sturgeon. The Sacramento Bypass, when flooded, can support juvenile green sturgeon during downstream migration and rearing.

### 4.3.4 Delta Smelt

Adult delta smelt begin spawning migration into the upper Delta in December or January. Migration may continue over several months. Spawning occurs between January and July, with peak spawning during April through mid-May (Moyle 2002). Spawning occurs along the channel edges in the upper Delta, including the Sacramento River above Rio Vista, Cache Slough, Lindsey Slough, and Barker Slough. Spawning has been observed in the Sacramento River up to Garcia Bend below the confluence of the American River on the Sacramento River action area during drought conditions, possibly attributable to adult movement farther inland in response to saltwater intrusion (Wang and Brown 1993). The typical pattern is for delta smelt to inhabit the oligohaline to freshwater portion of the estuary for much of the year until late winter and early spring, when many migrate upstream to spawn (Sommer et al. 2011). There is evidence that some may not migrate to spawn. After hatching, their larvae and post-larvae subsequently migrate downstream in spring towards the brackish portion of the estuary (Dege and Brown 2004; Sommer and Mejia 2013).

Key progress in our understanding of delta smelt is that they are strongly associated with turbid water (Feyrer et al. 2007). Their results showed that, during fall, delta smelt are only present at locations where Secchi depth is less than 1 meter. This finding is consistent with Grimaldo et al. (2009), who found that delta smelt were not present in upstream areas when turbidities were less than about 12 NTU

(Sommer and Mejia 2013). It is likely that the lack of turbidity in the American River would be unsuitable for delta smelt.

The general pattern is that delta smelt cannot tolerate temperatures higher than 25 °C (Swanson et al. 2000). Hence, the 25 °C is used as a general guideline to assess the upper limits for delta smelt habitat (Wagner et al. 2011; Cloern et al. 2011). Downstream of the Delta, the smallest channel where adults and juveniles have been reported is Spring Branch Slough in Suisun Marsh, which averages about 15-m wide (Meng et al. 1994; Matern et al. 2002; Sommer and Mejia 2013). Due to higher temperatures and lack of suitable channel width the East Side Tributaries would not be suitable habitat for the delta smelt.

The northern-most reach of delta smelt critical habitat in the study area includes the Sacramento River up to the I Street Bridge on the east side and on the west side the critical habitat extends up the Yolo Bypass to the Union Pacific Railroad tracks just below the Sacramento Bypass along the I-80 corridor.

### 4.3.5 Giant Garter Snake

The giant garter snake inhabits agricultural wetlands and other waterways such as irrigation and drainage canals, sloughs, ponds, small lakes, low gradient streams, and adjacent uplands in the Central Valley. Because of the direct loss of natural habitat, the giant garter snake relies heavily on rice fields in the Sacramento Valley, but also uses managed marsh areas in Federal National Wildlife Refuges and State Wildlife Areas. Habitat loss and fragmentation, flood control activities, changes in agricultural and land management practices, predation from introduced species, parasites, water pollution, and continuing threats are the main causes for the decline of this species.

Rice fields and their adjacent irrigation and drainage canals serve an important role as aquatic habitat for giant garter snake as is the case adjacent to the Sacramento Bypass. The land proposed to be incorporated into the Sacramento Bypass is currently agricultural fields producing row crops and nut orchards. The associated drainage ditches and farm canals in this area are considered aquatic GGS habitat.

Habitat elements for GGS do occur along the east side of the NEMDC and other waterways of the east side tributaries, however, due to current habitat conditions, such as close proximity to urban development, high levels of human disturbance, scarcity of upland habitat, and riparian vegetation along the banks of most channel reaches, giant garter snakes are unlikely to occur in the Arcade, Dry/Robla, and Magpie Creek and the southern portion of NEMDC below Dry/Robla Creek. Large waterways, such as the Sacramento and American Rivers, do not provide suitable habitat for giant garter snake.

### 4.3.6 Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp lives in vernal pools and swales containing clear to turbid water and grassy bottoms in unplowed grasslands. The shrimp is ecologically dependent on seasonal fluctuations in its habitat, such as presence or absence of water during specific times of the year, duration of water, temperature, and quantities of dissolved oxygen (USFWS 1992b).

There are 32 known populations of the vernal pool fairy shrimp, extending from the Stillwater Plain in Shasta County through the Central Valley to Pixley in Tulare County. In addition, the shrimp occur along the central Coast Range from northern Solano County to Pinnacles National Monument in San Benito County. Critical habitat is designated for a number of sub-populations of fairy shrimp throughout California. The closest critical habitat to the action area is a sub-population of vernal pool fairy shrimp in vernal pools near Mather Field in south-eastern Sacramento County. In the action area, vernal pools are known to occur near Magpie Creek, and there are recorded occurrences of vernal pool fairy shrimp in the CNDDB from 1995 (CNDDB 2015).

Vernal pool habitat is known to occur near Magpie Creek. Alongside the Magpie Creek Diversion Canal, there are some lands which could support vernal pools or vernal pool fairy shrimp that would be impacted by project construction. At this time, a wetland delineation has not been conducted to verify the occurrence of vernal pools; however, a wetland delineation would occur prior to project construction. Since the ARCF GRR is adopting the design of the 2004 Magpie Creek Flood Control Project, the impacts to vernal pools at this time were assessed based on that project’s consultation. The proposed project would result in 0.25-acre of indirect effects to vernal pools/swales of potentially suitable vernal pool fairy shrimp habitat.

Seasonal wetlands, which may provide suitable habitat for vernal pool invertebrates, occur in the vicinity of the NSS project’s Robla woodland mitigation site A, however any vernal pools in this area would be avoided by these activities. With the implementation of at 250-foot buffer between vernal pools and construction activities there would be no direct or indirect impacts from activities at Robla woodland mitigation site A. As a result, any mitigation efforts at the Robla woodland mitigation site would are not likely to adversely affect vernal pool fairy shrimp.

### 4.3.7 Vernal Pool Tadpole Shrimp

The vernal pool tadpole shrimp lives in vernal pools and swales containing clear to highly turbid water. The shrimp is ecologically dependent on seasonal fluctuations in its habitat, such as presence or absence of water during specific times of the year, duration of water, temperature, and quantities of dissolved oxygen (USFWS 1992b).

There are 18 known populations of vernal pool tadpole shrimp in the Central Valley, ranging from east of Redding in Shasta County south to the San Luis National Wildlife Refuge in Merced County. In the action area, vernal pools are known to occur near Magpie Creek, and there are recorded occurrences of vernal pool tadpole shrimp in the CNDDB from 1998 (CNDDB 2015).

Vernal pool habitat is known to occur near Magpie Creek. Alongside the Magpie Creek Diversion Canal, there are some lands which could support vernal pools or vernal pool tadpole shrimp that would be impacted by project construction. At this time, a wetland delineation has not been conducted to verify the occurrence of vernal pools; however, a wetland delineation would occur prior to project construction. Since the ARCF GRR is adopting the design of the 2004 Magpie Creek Flood Control Project, the impacts to vernal pools at this time were assessed based on that project's consultation. The proposed project would result in 0.25-acre of indirect effects to vernal pools/swales of potentially suitable vernal pool tadpole shrimp habitat.

Seasonal wetlands, which may provide suitable habitat for vernal pool invertebrates, occur in the vicinity of the NSS project's Robla woodland mitigation site A, however any vernal pools in this area would be avoided by these activities. With the implementation of at 250-foot buffer between vernal pools and construction activities there would be no direct or indirect impacts from activities at Robla woodland mitigation site A. As a result, any mitigation efforts at the Robla woodland mitigation site would are not likely to adversely affect vernal pool tadpole shrimp.

#### 4.3.8 Western Yellow-Billed Cuckoo

Western yellow-billed cuckoo is Federally listed as threatened. The cuckoo is typically found in riparian forests with dense deciduous trees and shrubs. Over the last 100 years, western cuckoo population declined dramatically due to extensive loss of suitable breeding habitat, primarily riparian forests and associated bottomlands dominated by willow (Salix spp.), cottonwood (Populus spp.), or mesquite (Prosopis spp.) (Gaines and Laymon 1984, Laymon and Halterman 1987, Hughes 1999, Halterman et al. 2001). Once considered a common breeder in California, by 1940 the Yellow-billed Cuckoo suffered severe population reduction and by 1987 was estimated to occupy only 30 percent of its historical range (Laymon and Halterman 1987).

Nesting usually occurs between late June and late July, but can begin as early as late May and continue until late September (Hughes 1999). Nests consist of a loose platform of twigs, which are built by both sexes and take one to two days to build (Hughes 1999), though occasionally the nest of another species is used (Jay 1911, Bent 1940, Payne 2005). There are no recent CNDDB occurrences in the vicinity of the action area, but migrant individuals are likely to pass through the area in transit to breeding sites along the Sacramento River north of Colusa. Cuckoos are unlikely to nest in the study area, although potential dispersal and foraging habitat is present in the American River Parkway and along the Sacramento River.

# 5.0 Effects of the Proposed Action

## 5.1 Invertebrates

### 5.1.1 Valley Elderberry Longhorn Beetle

Effects to valley elderberry longhorn beetle may occur if elderberry shrubs are incidentally damaged by construction personnel or equipment. Impacts may also occur if elderberry shrubs need to be transplanted because they are located in areas that cannot be avoided by construction activities. During the design phase of the project, a site-specific assessment would occur in coordination with County Parks, project stakeholders, and the Services to determine which erosion protection measure is appropriate for each location in the Parkway. This assessment would take into account hydraulic conditions as well as environmental conditions of the site and would avoid and minimize impacts to riparian habitat and elderberry shrubs to the maximum extent practicable within the framework of the proposed project. Impacts that cannot be avoided or minimized would be mitigated, as described in Section 2.5 above.

Potential impacts due to damage or transplantation include direct mortality of beetles and/or disruption of their lifecycle. Since the project would occur over a 10 year period and construction would occur during beetle flight season, there could be direct mortality caused by construction activities. Elderberry shrubs that cannot be avoided would be transplanted between November and mid-February when the plants are doormat. Transplanting procedures will comply with the Conservation Guidelines for the Valley Elderberry Longhorn Beetle, USFWS, 9 July 1999.

Along the American River portion of the project, there is approximately 65 acres of riparian habitat that would be impacted, which includes elderberry shrubs. In this 65 acres, approximately 250 shrubs would be transplanted within the American River Parkway outside of the 15 foot vegetation free zone. The habitat maps in Appendix F show the locations of elderberry shrubs within the Parkway in 2013. Impacts to shrubs would be limited to approximately 40-feet waterward of the levee in most places. While impacts to these 250 shrubs would likely result in adverse effects to VELB, the majority of the shrubs in the Parkway, including the mitigation and restoration sites delineated on the maps in Appendix G, would not be impacted by the project. The majority of the impacts to VELB would occur on the stretch of the American River between Howe and Watt Avenues. Without implementation of compensation within this reach, connectivity of VELB habitat could be adversely impacted by the proposed measures.

Seedlings and native plants could be planted on top of the constructed trench to create similar connectivity as the existing conditions, or on the protected berms above bank protection sites. However, temporal loss of habitat may occur due to transplantation of elderberry shrubs. With transplants, new shrubs, and associated natives installed on the surface of the launchable rock trenches between Howe and Watt Avenues, and other compensation proposed in Section 2.5, connectivity for the beetle would be similar to the existing condition. Although compensation measures include restoration and creation of habitat, mitigation plantings would likely require one or more years to become large enough to provide supporting habitat. Furthermore, associated riparian habitats may take 25 years or longer to reach their full value.

Along the Sacramento River reach of the project, there is approximately 110 acres of riparian habitat that would be impacted, which includes elderberry shrubs. In this 110 acres, approximately 13 elderberry shrubs would be transplanted between November and mid-February. These shrubs would be transplanted to the River Bend Park mitigation site within the American River Parkway, or a new site coordinated with County Parks during the design phase of the project. Additionally, there is some potential for shrubs to be transplanted on site, where space is available, or to potential future mitigation sites in the Sacramento River corridor. Connectivity for the beetle could be affected by the reduction in shrubs if on-site compensation is not possible; however, impacts along this reach of the project are limited to the top half of the levee, which would be degraded in order to construct the slurry wall. The majority of the shrubs in this reach would likely not be located on the levee prism and would remain in place and provide sufficient connectivity.

For the NSS project, elderberry shrubs were not observed along Arcade Creek, NEMDC, or Borrow Site 2 during field surveys. Encroachment removal along Robla Creek would be limited to trimming back residential landscaping from a fence line and would have no potential for adverse impact to any elderberry shrubs, if present nearby. Elderberry shrubs could be present adjacent to potential woodland mitigation sites, including along Robla Creek. However, tree mitigation efforts would occur on open grassland areas and avoid disturbance of elderberry shrubs that may be nearby. Buffers would be established around elderberry shrubs in these areas as described in Section 2.5 above and would be maintained during all encroachment removal and mitigation installation activities. Further, implementation of the avoidance and minimization measures listed in Section 2.5 above would avoid the potential for direct and indirect effects on elderberry shrubs through the establishment of appropriate buffers.

Elderberry surveys done in 2011 by the Corps looked at the project area including the levee itself and 15 feet landside and 15 feet waterside. Only the locations of the shrubs were surveyed in order to get an idea of the magnitude of potential impacts. In order to determine affects to the beetle, detail elderberry shrub surveys from previous projects within the American River Parkway are being used as a representative sample for this project. The previous surveys were completed for other ARCF Projects along the American River Parkway within the project vicinity. These representative samples take into effect all project-related impacts to elderberry shrubs that would require mitigation, including incidental trimming of full stems for the purposes of providing access for project activities. The representative sample calculations are as follows; each shrub contains 13 stems measuring between 1 and 3 inches with no exit holes; 5 stems between 3 and 5 inches with .02 exit holes; and 2 stems greater than 5 inches with .07 exit holes. All shrubs are assumed to be in riparian habitat. Tables 10 and 11 include calculations of stems that would be affected with the implementation of this project and proposed compensation.

**Table 10. American River Elderberry Shrub Effects and Proposed Compensation.**

| Location | Stems | Exit Holes | No. of Stems | Elderberry Ratios[1,2] | Elderberry Plantings | Associated Native Planting | Associated Native Ratios |
|---|---|---|---|---|---|---|---|
| non-riparian | greater than or = 1" & less than or = 3" | No | 0 | 1 | 0 | 0 | 1 |
| | | yes | 0 | 2 | 0 | 0 | 2 |
| non-riparian | greater than 3" & less than 5" | No | 0 | 2 | 0 | 0 | 1 |
| | | yes | 0 | 4 | 0 | 0 | 2 |
| non-riparian | greater than or = 5" | No | 0 | 3 | 0 | 0 | 1 |
| | | yes | 0 | 6 | 0 | 0 | 2 |
| riparian | greater than or = 1" & less than or = 3" | No | 1,998 | 2 | 3,996 | 3,996 | 1 |
| | | yes | 0 | 4 | 0 | 0 | 2 |
| riparian | greater than 3" & less than 5" | No | 790 | 3 | 2,370 | 2,370 | 1 |
| | | yes | 16 | 6 | 96 | 192 | 2 |
| riparian | greater than or = 5" | No | 312 | 4 | 1,248 | 1,248 | 1 |
| | | yes | 23 | 8 | 184 | 368 | 2 |
| **TOTAL** | | | **3,139** | | **7,894** | **8,174** | |
| | | | | | | | |
| | | | | Calculations: | natives-elderberries | 280 | |
| | | | | basins or credits | 1,578.8 | 28 | |
| | | | | | | | |
| | | | | total basins or credits= | 1,606.8 | | |
| | | | | | 2,892,240 | | |
| | | | | total acres need for compensation | 66.39669421 | | |

1 Affected elderberry plant minimization ratios based on location, stem diameter, and presence of exit holes

2 Multiply No. of stems by this for planting counts

**Table 11. Sacramento River Elderberry Shrub Effects and Proposed Compensation.**

| Location | Stems | Exit Holes | No. of Stems | Elderberry Ratios[1,2] | Elderberry Plantings | Associated Native Plantings | Associated Native ratios |
|---|---|---|---|---|---|---|---|
| non-riparian | greater than or = 1" & less than or = 3" | No | 0 | 1 | 0 | 0 | 1 |
| | | yes | 0 | 2 | 0 | 0 | 2 |
| non-riparian | greater than 3" & less than 5" | No | 0 | 2 | 0 | 0 | 1 |
| | | yes | 0 | 4 | 0 | 0 | 2 |
| non-riparian | greater than or = 5" | No | 0 | 3 | 0 | 0 | 1 |
| | | yes | 0 | 6 | 0 | 0 | 2 |
| riparian | greater than or = 1" & less than or = 3" | No | 104 | 2 | 208 | 208 | 1 |
| | | yes | 0 | 4 | 0 | 0 | 2 |
| riparian | greater than 3" & less than 5" | No | 40 | 3 | 120 | 120 | 1 |
| | | yes | 1 | 6 | 6 | 12 | 2 |
| riparian | greater than or = 5" | No | 16 | 4 | 64 | 64 | 1 |
| | | yes | 2 | 8 | 16 | 32 | 2 |
| **TOTAL** | | | **163** | | **414** | **436** | |
| | | | | | | | |
| | | | | Calculations: | natives-elderberries | 22 | |
| | | | | basins or credits | 82.8 | 2.2 | |
| | | | | | | | |
| | | | | total basins or credits= | 85 | | |
| | | | | | 153000 | | |
| | | | | total acres need for compensation | 3.512396694 | | |

1 Affected elderberry plant minimization ratios based on location, stem diameter, and presence of exit holes
2 Multiply No. of stems by this for planting counts

**Operation and Maintenance**

As part of long-term O&M, elderberry shrubs will be trimmed by the three levee maintenance districts. Table 12 describes the maximum amount of elderberry acreage that will be trimmed each year as a result of O&M. Trimming consists of cutting overhanging branches along the levee slopes on both the landside and waterside. Some shrubs may be located adjacent to the levee with branches hanging over the levee maintenance road. Up to a third of a shrub will be trimmed in a single season. Trimming will occur between November 1 and March 15. Loss of habitat will be offset through the development of a conservation area as described in the conservation measures below. Each year the local maintaining authority will document the amount of valley elderberry longhorn beetle habitat that they have trimmed and report that number to the Corps to ensure compliance with this biological opinion. If the local maintaining agency has a need to exceed the amount of valley elderberry longhorn beetle habitat which needs to be trimmed or affected due to routine maintenance then they will request the Corps reinitiate consultation on this biological opinion for those actions.

**Table 12. O&M Elderberry Shrub Effects and Compensation.**

| O&M Agency | Annual Acreage Trimmed[1] | Life of Project Acreage[2] |
|---|---|---|
| American River Flood Control District | 0.5 acre | 25 acres |
| Maintenance Area 9 | 0.2 acre | 10 acres |
| City of Sacramento | 0.1 acre | 5 acres |

[1] Acreage was estimated based on a measurement of 0.009-acre per every 1/3rd of a shrub trimmed.
[2] Life of project is estimated to be 50 years.

### 5.1.2 Vernal Pool Fairy Shrimp

Effects to vernal pool fairy shrimp associated with the ARCF GRR's proposed Magpie Creek measures were addressed in the 2004 Biological Opinion for the Magpie Creek Flood Control Project (Appendix E).

For the NSS project, seasonal wetland habitat is present in annual grassland north of Robla Creek, including in the eastern portion of Robla woodland mitigation site A. Although riparian planting activities would not directly affect the seasonal wetland habitat, these activities could indirectly affect potentially suitable habitat for vernal pool invertebrates in this area by altering hydrology and/or degrading water quality. These effects could result in temporary loss of individuals, but the population could persist if the habitat is restored to its prior condition. However, implementation of the avoidance and minimization measures listed in Section 2.5 above would avoid and minimize the potential for indirect effects on suitable habitat for vernal pool invertebrates through the establishment of appropriate buffers.

### 5.1.3 Vernal Pool Tadpole Shrimp

Effects to vernal pool tadpole shrimp associated with the ARCF GRR's proposed Magpie Creek measures were addressed in the 2004 Biological Opinion for the Magpie Creek Flood Control Project (Appendix E).

For the NSS project, seasonal wetland habitat is present in annual grassland north of Robla Creek, including in the eastern portion of Robla woodland mitigation site A. Although riparian planting activities would not directly affect the seasonal wetland habitat, these activities could indirectly affect potentially suitable habitat for vernal pool invertebrates in this area by altering hydrology and/or degrading water quality. These effects could result in temporary loss of individuals, but the population could persist if the habitat is restored to its prior condition. However, implementation of the avoidance and minimization measures listed in Section 2.5 above would avoid and minimize the potential for indirect effects on suitable habitat for vernal pool invertebrates through the establishment of appropriate buffers.

## 5.2 Fish Species

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

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

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

The operation and maintenance of the bank protection sites would include allowing the vegetation to grow to maturity and provide SRA habitat. There would be no sediment removal or clearing of vegetation along the planted bench after construction. The following statements will be added to the O&M manual once construction is completed to ensure sustainability of the created habitat. Therefore, affects from O&M activities would not be affect listed fish species and are not discussed in detail below.

*Trees, either preserved or planted, on the berm within the project footprint of the bank protection site shall not be removed as part of normal maintenance as long as they remain healthy. As unhealthy trees are removed or fall over, any subsequent cavities in the rock must be filled in a timely manner with rock material equal to the surrounding repair. Leave the fallen trees in place.*

*Mitigation plantings installed on this site shall be left in a natural state. Following successful establishment of the habitat, no additional maintenance such as irrigation or mowing shall be required as a part of normal maintenance.*

*Soil placed on/in rock as a part of the original repair and all associated vegetation (grasses & woody shrubs/trees) within the footprint of the bank protection site does not require replacement as a part of normal maintenance. In other words if the soil is washed out it does not need to be replaced and re-vegetated.*

During typical summer-fall conditions, focus fish species which include salmon, steelhead, green sturgeon, and delta smelt are generally absent in the Sacramento and Yolo Bypass. During winter-spring conditions, assuming inundation, the Yolo Bypass provides a large amount of available floodplain habitat for migration and rearing. Under the “worst case scenario” assumptions, project actions along the Sacramento Bypass levee reach would result in the removal of all trees and vegetation; due to the abundance of floodplain habitat during increased inundation with the widening of the Sacramento Bypass, it is highly unlikely that the loss of these shoreline habitat features would impact overall habitat that would be available and most likely utilized by salmon, steelhead, green sturgeon, and delta smelt in the Sacramento Bypass during winter-spring conditions.

### 5.2.1 Sacramento River Winter-Run Chinook Salmon

Potential project effects from the actions are described below for each life stage and its habitat. Effects on designated critical habitat are addressed via description of habitat effects for each applicable species.

**Construction-Related Effects**

**Adult Migration**

Construction activities may affect but are not likely to adversely affect winter-run adults because construction will avoid the primary migration period (December through July), will be restricted to the channel edge, and will include implementation of the avoidance and minimization measures described in Section 2.5. The work windows for all listed fish species that could be impacted by the project are shown on Table 13 below.

**Spawning**

Winter-run Chinook salmon do not spawn in the ARCF GRR action area. Therefore, the project will have no effect on winter-run Chinook salmon spawning or spawning habitat.

**Juvenile Rearing and Migration**

Rearing and emigrating juveniles and smolts may be found in the action area during the fall, winter, and spring. The abundance of juvenile winter-run Chinook salmon moving downstream peaks at Red Bluff in September and October and continues until mid March in drier years (Vogel and Marine 1991). Downstream migration may be triggered by storm events and the resulting high flow and turbidity, although the relative importance of various outmigration cues remains unclear.

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

Restricting in-water activities to the August 1 through November 30 work window (beginning on July 1 for sites upstream of RM 60) and implementing the avoidance and minimization measures described in Section 2.5 will minimize, but may affect and is likely to adversely affect potential construction-related effects on juveniles and smolts.

**Table 13. Assumed Life Stage Timing and Distribution of Special Status Fish Species.**

| Life Stage | Distribution | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Late Fall–Run Chinook Salmon** | | | | | | | | | | | | | |
| Adult Migration | SF Bay to Upper Sac River and Tributaries | | | | | | | | | | | | |
| Spawning | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Egg Incubation | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Juvenile Rearing (Natal Stream) | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Smolt Outmigration | Sacramento River and tributaries, Delta | | | | | | | | | | | | |
| Juvenile Movement and Rearing | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| **Fall-Run Chinook Salmon** | | | | | | | | | | | | | |
| Adult Migration and Holding | SF Bay to Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Spawning[1] | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Egg Incubation[1] | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Juvenile Rearing (Natal Stream) | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Smolt Outmigration | Sacramento River and tributaries, Delta | | | | | | | | | | | | |
| Juvenile Movement | Upper Sacramento River and Tributaries to SF Bay | | | | | | | | | | | | |
| **Spring-Run Chinook Salmon** | | | | | | | | | | | | | |
| Adult Migration and Holding | SF Bay to Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Spawning | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Egg Incubation | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Juvenile Rearing (Natal Stream) | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Smolt Outmigration | Sacramento River and tributaries, Delta | | | | | | | | | | | | |
| Juvenile Movement | Upper Sacramento River and Tributaries to SF Bay | | | | | | | | | | | | |
| **Winter-Run Chinook Salmon** | | | | | | | | | | | | | |
| Adult Migration and Holding | SF Bay to Upper Sacramento River | | | | | | | | | | | | |
| Spawning | Upper Sacramento River | | | | | | | | | | | | |
| Egg Incubation | Upper Sacramento River | | | | | | | | | | | | |
| Juvenile Rearing (Natal Stream) | Upper Sacramento River to SF Bay | | | | | | | | | | | | |
| Smolt Outmigration | Sacramento River and tributaries, Delta | | | | | | | | | | | | |
| Juvenile Movement and Rearing | Upper Sacramento River to SF Bay | | | | | | | | | | | | |
| **Central Valley Steelhead** | | | | | | | | | | | | | |
| Adult Migration | SF Bay to Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Spawning | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Egg Incubation | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Juvenile Rearing | Upper Sacramento River and Tributaries to SF Bay | | | | | | | | | | | | |
| Smolt Outmigration | Sacramento River and tributaries, Delta | | | | | | | | | | | | |

| Life Stage | Distribution | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Juvenile Movement | Upper Sacramento River and Tributaries to SF Bay | | | | | | | | | | | | |
| **Delta Smelt** | | | | | | | | | | | | | |
| Adult Migration | Delta | | | | | | | | | | | | |
| Spawning | Delta, Suisun Marsh | | | | | | | | | | | | |
| Larval and Early Juvenile Rearing | Delta, Suisun Marsh | | | | | | | | | | | | |
| Estuarine Rearing: Juveniles/Adults | Lower Delta, Suisun Bay | | | | | | | | | | | | |
| **Green Sturgeon** | | | | | | | | | | | | | |
| Adult Migration | Delta to Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Spawning | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Egg Incubation | Upper Sacramento River and Tributaries | | | | | | | | | | | | |
| Juvenile Movement and Rearing | Sacramento River and Tributaries to SF Bay | | | | | | | | | | | | |

Notes: SF Bay = San Francisco Bay.
[1] Spawning and incubation occurs from October to February in the Feather, American, and Mokelumne Rivers
Sources: Brown 1991; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996; McEwan 2001; Moyle 2002; Hallock 1989; U.S. Army Corps of Engineers 2006.

**Long-Term Effects**

The ARCF GRR action area does not support spawning habitat for winter-run Chinook salmon, therefore the projects long-term effects will have no effect to spawning habitat.

Winter-run Chinook salmon are expected to show a long term positive response to project actions in the Sacramento River Standard Assessment Methodology (SAM) and American River SAM analysis reach over the lifetime of the project (Appendix B). Figures 22 through 24 below show the long term condition changes at a typical bank protection site over 10 years. Chinook salmon should exhibit a positive response by year 5. Short term habitat deficits are expected within the recommended recovery period for Chinook salmon. The maximum habitat deficit identified is -1,291 ft for the juvenile migration life stage of Spring-run Chinook salmon in the fall of year 11. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions.

Winter-run Chinook salmon are expected to show a small long term negative response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project. Winter-run Chinook salmon should exhibit a negative response by year 1. The maximum habitat deficit identified is -188 ft for the juvenile migration life stage of Winter-run Chinook salmon in the spring of year 2. Short term and long term habitat deficits will result from the loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions during and after the construction of the extension to the Sacramento Bypass Weir.

**Figure 22. Bank Protection Site R4 in Planting Year 2001 on the American River.**

**Figure 23. Bank Protection Site 4R in 2005**

**Figure 24. Bank Protection Site 4R in 2010.**

### 5.2.2 Central Valley Spring-Run Chinook Salmon

Potential project effects for spring-run Chinook salmon are described below for each life stage and its habitat, including effects on designated critical habitat.

**Construction-Related Effects**

**Adult Migration**

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

**Spawning**

Spring-run Chinook salmon do not spawn in the ARCF GRR action area. Therefore, the project will have no effect on spring-run Chinook salmon spawning or spawning habitat.

**Juvenile Rearing and Migration**

Similar to winter-run Chinook salmon, spring-run Chinook salmon typically spend up to 1 year rearing in fresh water before migrating to sea. Therefore, potential for construction-related effects will be similar to that described for winter-run Chinook salmon above.

Restricting in-water activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Section 2.5 will minimize, but may affect and is likely to adversely affect potential construction-related effects on juveniles and smolts.

**Long-Term Effects**

The ARCF GRR area does not support spawning habitat for spring-run Chinook salmon, therefore the projects long-term effects will have no effect to spawning habitat.

Spring-run Chinook salmon are expected to show a long term positive response to project actions in the Sacramento River SAM and American River analysis reaches over the lifetime of the project (Appendix B). Figures 22 through 24 show the long term condition changes at a typical bank protection site over 10 years. Spring-run Chinook salmon should exhibit a positive response by year 5. Short term habitat deficits are expected within the recommended recovery period for spring-run Chinook salmon. The maximum habitat deficit identified is -1,440 feet for the juvenile migration life stage of spring-run Chinook salmon in the summer of year 10. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions. For juvenile spring-run Chinook salmon, the bank protection measures will generally provide long-term increases in bank shading at project sites. The plantings of native grasses and willows are designed to benefit juvenile Chinook salmon by increasing the availability (habitat area) and quality (shallow water and instream cover) of nearshore aquatic habitat and SRA relative to current conditions. Long term effects may affect but are not likely to adversely affect critical habitat for spring-run Chinook salmon juvenile rearing and migration.

Spring–run Chinook salmon are expected to show a small long term negative response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project. Chinook salmon should exhibit a negative response by year 1. The maximum habitat deficit identified is -188 feet for the juvenile migration life stage of spring-run Chinook salmon in the spring of year 2. Short term and long term habitat deficits will result from the loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions during and after the construction of the extension to the Sacramento Bypass Weir.

### 5.2.3 Central Valley Steelhead

Potential project effects for steelhead are described below for the relevant life stages and their habitat, including effects on designated critical habitat.

**Construction-Related Effects**

The levees along NEMDC are devoid of any tall vegetation or instream woody material and subsequently, construction activities would be approximately 100 feet from the east levee toe, outside of the wetted channel. As a result, the NSS levee improvements would not result in construction-related effects to steelhead.

**Adult Migration**

In the Sacramento River, adult steelhead migrate upstream during most months of the year, beginning in July, peaking in September, and continuing through February or March. Adults use the river channel in the action area as a migration pathway to upstream spawning habitat, and may also use deep pools with instream cover as resting and holding habitat. The potential for construction-related effects on migrating adult steelhead would be similar to that described above for adult winter-run Chinook salmon with the determination being that the construction-related activities may affect but are not likely to adversely affect adult migration.

**Spawning**

Within the ARCF GRR action area, potential spawning habitat is present in the American River, NEMDC, and Dry/Robla Creek. Steelhead spawn in late winter and late spring outside of the August 1-November 30 construction window; therefore, construction-related effects may affect but are not likely to adversely affect steelhead spawning or their spawning habitat.

**Juvenile Rearing and Migration**

Central Valley steelhead rear year-round in the cool upstream reaches of the mainstem Sacramento River and its major tributaries. Juveniles and smolts are most likely to be present in the action area during their downstream migration to the ocean, which may begin as early as December and peaks from January to May. The importance of main channel and floodplain habitats in the lower Sacramento River to rearing steelhead is becoming more understood.

Steelhead smolts have been found in the Yolo Bypass during the period of winter and spring inundation (Sommer 2002). Sommer et al. (2001) found that Juvenile Chinook salmon that reared within a large, engineered floodplain of the Sacramento River (the Yolo Bypass) had higher rates of growth and survival than fish that reared in the main-stem river channel during their migration. For purposes of this analysis, rearing juvenile steelhead are assumed to use nearshore and off-channel habitat in the action area. The potential for construction-related effects on steelhead juveniles and smolts and their habitat will therefore be similar to that described above for winter-run Chinook salmon which may affect and is likely to adversely affect.

**Long-Term Effects**

Steelhead are expected to show a long term positive response to project actions in the Sacramento River SAM and American River SAM analysis reaches over the lifetime of the project (Appendix B). Figures 22 through 24 show the long term condition changes at a typical bank protection site over 10 years. Steelhead should exhibit a positive response by year 5. Short term habitat deficits are expected within the recommended recovery period for Steelhead. The maximum habitat deficit identified is -1,330 ft for the juvenile migration life stage of Steelhead in the fall of year 11. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions.

Steelhead are expected to show a small long term negative response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project. Steelhead should exhibit a negative response by year 1. The maximum habitat deficit identified is -174 ft for the juvenile migration life stage in the spring of year 2. Short term and long term habitat deficits will result from the loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions during and after the construction of the extension to the Sacramento Bypass Weir.

The NSS project would result in long-term indirect effects on steelhead through modification of riparian and aquatic habitat, including channel bed and bank substrate. Additionally, SRA habitat would be impacted through the removal of approximately 5 trees. These impacts would be unlikely to adversely affect steelhead with the implementation of the measures described in Section 2.5 above.

### 5.2.4 Delta Smelt

**Primary Constituent Elements**

In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation (50 CFR 424.12[b]). The Service is required to list the known primary constituent elements together with a description of any critical habitat that is proposed. Such physical and biological features (i.e., primary constituent elements) include, but are not limited to, the following:

- Space for individual and population growth, and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and
- Generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The primary constituent elements essential to the conservation of the delta smelt are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (NMFS 1994a).

**Spawning Habitat**

Delta smelt adults seek shallow, fresh or slightly brackish backwater sloughs and edgewaters for spawning. To ensure egg hatching and larval viability, spawning areas also must provide suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation). Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. The spawning season varies from year to year and may start as early as December and extend until July (NMFS 1994a).

### Larval and Juvenile Transport

To ensure that delta smelt larvae are transported from the area where they are hatched to shallow, productive rearing or nursery habitat, the Sacramento and San Joaquin Rivers and their tributary channels must be protected from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversions that result in entrainment and in-channel barriers or tidal gates). Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Additionally, river flow must be adequate to prevent interception of larval transport by the State and Federal water projects and smaller agricultural diversions in the Delta. To ensure that suitable rearing habitat is available in Suisun Bay, the 2 ppt isohaline must be located westward of the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water-year type. Reverse flows that maintain larvae upstream in deep-channel regions of low productivity and expose them to entrainment interfere with these transport requirements. Suitable water quality must be provided so that maturation is not impaired by pollutant concentrations. The specific geographic area important for larval transport is confined to waters contained within the legal boundary of the Delta, Suisun Bay, and Montezuma Slough and its tributaries. The specific season when habitat conditions identified above are important for successful larval transport varies from year to year, depending on when peak spawning occurs and on the water-year type. The Service identified situations in the biological opinion for the delta smelt (1994) where additional flows might be required in the July-August period to protect delta smelt that were present in the south and central Delta from being entrained in the State and Federal project pumps, and to avoid jeopardy to the species. The long-term biological opinion on CVP-SWP operations will identify situations where additional flows may be required after the February through June period identified by EPA for its water quality standards to protect delta smelt in the south and central Delta ( USFWS 1994).

### Rearing Habitat

Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality (low concentrations of pollutants) within the Estuary is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. This placement of the 2 ppt isohaline also serves to protect larval, juvenile, and adult delta smelt from entrainment in the State and Federal water projects. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when the historical salinity conditions described above are implemented. Protection of rearing habitat conditions may be required from the beginning of February through the summer (USFWS 1994).

**Adult Migration**

Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods (USFWS 1994).

**Construction-Related Effects**

Delta smelt in the Sacramento River have been documented upstream as far as the city of Sacramento (RM 60) (Moyle 2002), and may be present throughout their life cycle. Potential project effects are described below for relevant life stages and their habitats, including effects on designated critical habitat.

**Adult Migration**

Adult Delta smelt migrate upstream between December and January and spawn between January and July, with a peak in spawning activity between April and mid-May (Moyle 2002). Potential construction-related effects to physical habitat, water, river flow, and salinity concentrations for migrating adult Delta Smelt will be avoided or minimized by restricting in water construction activities on the Sacramento River to the August 1 through November 30 work window allowing for unrestricted access to suitable and important spawning habitat. If there is any change in effect due to construction constraints outside the work window, consultation will be initiated. Construction-related effects may affect but are not likely to adversely affect adult migration.

**Spawning**

Potential spawning habitat includes shallow channel edge waters in the Delta and Sacramento River. Specific areas that have been identified below the ARCF GRR project area as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. As a result, potential construction-related effects to delta smelt physical habitat would include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae, alteration of spawning and incubation habitat, and loss of shallow water habitat for spawning.

The erosion repair is likely to somewhat reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment prospective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and especially the Yuba River systems. All of the available sediment in the American River watershed is being contained behind

Folsom Dam. The site specific designs will be constrained from allowing any velocity increases outside the erosion repair site (Schlunegger 2014).

In response to a USFWS request for more data on July 23, 2014, the Corps conducted an analysis of existing shallow water habitat in the ARCF GRR project area, and the effect of the proposed project on that habitat. The results of this analysis are included as Appendix C to this report. This analysis was based on a cross section geometry with the assumption that the sediment or sand will be converted to rock revetment. The conclusion of the analysis was that approximately 14 acres of shallow water habitat would be permanently lost as a result of implementation of the ARCF GRR with 46 acres of spawning habitat being affected by a long-term change in substrate from sand to rock. The footprint could be minimized as site-specific designs are developed during the PED phase of the project and will be further coordinated with USFWS at that time. Compensation would involve the purchase of 42 credits of shallow water habitat replacement and 32 credits to compensate for the permanent change in spawning substrate at a USFWS-approved mitigation bank.

Construction-related effects on delta smelt spawning and incubation will be minimized by restricting in-water construction activities on the Sacramento River and Sacramento Weir and Bypass to the August 1 through November 30 work window, thereby avoiding the seasons when spawning is most likely to occur, however construction activities may affect and is likely to adversely affect delta smelt spawning habitat.

**Juvenile Rearing and Migration**

Juvenile delta smelt may be subject to disturbance or displacement caused by construction activities that would alter physical habitat, water, and river flow in the form of increased noise, turbidity, and suspended sediment. Delta smelt may not be readily able to move away from channel or nearshore areas that are directly affected by construction activities (i.e., removal or placement of instream woody material, placement of rock revetment). Larvae may be disrupted during summer months as they migrate downstream to rear in the Delta. Incidental take of delta smelt may occur from direct mortality or injury during a construction activity, or by the impairment of essential behavior patterns (i.e., feeding, escape from predators). Salinity concentrations would not be affected by the construction activity. Construction-related effects on delta smelt rearing and migration will be minimized by restricting in-water construction activities on the Sacramento River to the August 1 through November 30 work window, thereby avoiding the seasons when these life stages are most likely to occur. Construction-related activities may affect and is likely to adversely affect juvenile rearing and migration.

**Long-Term Effects**

Non-native species may exploit the warmer water temperature in the shallow bench habitat created as an on-site mitigation feature and prey on delta smelt eggs and larvae; however, bench habitat would most likely not bring in more predatory fish that don't already exist in the project area. A 2013 long-term aquatic monitoring program draft report by FishBio for the Corps noted that Black bass (largemouth and smallmouth bass) have the highest probability of habitat occupancy at both Sacramento River Bank Protection Project (SRBPP) sites with bench features and sites with no bench features. Unlike previous years, when highest bass abundance was typically associated with wetland trench designs (not included in the suite of monitored sites in 2013), the highest likelihood of encountering black bass was observed at no bench and bench sites, in particular those near rivermile 70, well above the project area (Corps 2013b). Proposed planting of emergent vegetation will enhance habitat complexity by providing cover and incubation habitat, especially during high winter and spring flows.

### 5.2.5 Green Sturgeon

Potential project effects are described below for each life stage of green sturgeon and its habitat. An accurate assessment of potential project effects on green sturgeon and its habitat is difficult due to the limited information available on distribution, seasonal abundance, habitat preferences, and other life history requirements of this species.

**Construction-Related Effects**

**Adult Migration**

Adult green sturgeon are believed to move upstream through the Sacramento River ARCF action area from February through late July (NMFS 2005c). Construction activities occurring outside of these time periods are not likely to affect migrating green sturgeon adults. Construction activities during July, however, may have adverse impacts on any adult green sturgeon that are still migrating upstream. Because construction activities will largely avoid the peak migration period, will be restricted to the channel edge, and will implement the avoidance and minimization measures described in Section 2.5, construction-related activities may affect but are not likely to adversely affect adult migration.

**Spawning**

Spawning migrations of Green Sturgeon typically occur during the months of March through June (Thomas et al. 2013). The Sacramento River downstream of Knights Landing (RM 90) is not believed to have suitable spawning habitat for green sturgeon, primarily due to lack of suitable coarse bottom substrate such as large cobbles (Corps 2012). Therefore, the ARCF GRR project will have no affect on spawning green sturgeon or their habitat.

**Juvenile Rearing and Migration**

Based on general knowledge of green sturgeon life history, larvae may occur in the Sacramento River and Delta shortly after spawning, from February through late July (peak spawning from April through June) (Emmett et al. 1991 as cited in Moyle 2002). Restricting in-water construction activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Section 2.5, will minimize potential impacts of in-water construction activities on green sturgeon larvae. However, if larvae or juveniles are present during construction, in-water activities could result in localized displacement and possible injury or mortality to individuals that do not readily move away from the channel or nearshore areas. Project actions associated with bank protection measures may increase sediment, silt, and pollutants, which may affect and is likely to adversely affect rearing habitat or reduce food production, such as aquatic invertebrates, for larval and juvenile green sturgeon.

Widening of the weir and bypass will increase the entrainment and stranding exposure and rates of juveniles. When the weir is overtopping and water is flowing down the bypass, adult fish are attracted to the flow and follow it upstream in an attempt to reach their holding and spawning habitat. Widening the weir and bypass would increase the amount of water going over the weir and increase the attraction rate of sturgeon, salmon, and steelhead. Without fish passage in place, the stranding rates of these fish would increase. This is significant, especially for sturgeon. Population viability modeling, funded in part by the Corps, concluded that without the fish rescue that took place, the loss of the green sturgeon stranded behind the Fremont and Tisdale weirs in 2011 would have significantly reduced the viability the species and increased their extinction risk (Thomas, et. al, 2013). We believe that because of its location and design, the Sacramento weir poses a similar risk and widening the weir would add to the effect. Given that green sturgeon are long-lived species that have the strongest upstream migration and cohort replacement rates during wet water years and especially after high river flow conditions, the effect of the stranding occurring only two to three times over a 50 year period could adversely impact juvenile green sturgeon.

**Long-Term Effects**

SRBPP onsite mitigative features were designed to maximize habitat response for salmonid species. SAM values for green sturgeon generally indicate a negative response or no response to typical onsite mitigative features. Green sturgeon are expected to show long term negative response to project actions in the Sacramento River SAM analysis reach for several life stages at all seasonal habitat conditions over the lifetime of the project. Project actions in the American River SAM analysis reach will also mimic SRBPP repair site onsite mitigative features. SRBPP onsite mitigative features were designed to maximize habitat response for salmonid species; green sturgeon will exhibit a negative response for juvenile rearing in the summer/fall to these onsite mitigative features. However, during the winter/spring green sturgeon juvenile rearing life stages will exhibit a positive response to these onsite mitigative features. Green Sturgeon are expected to show a long term positive response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project for the fry and juvenile rearing life stages in the winter/spring/summer/fall of year 1 (See Appendix B of the ARCF GRR BA for a more detailed analysis).

Long-term changes in nearshore habitat are expected to have negligible effects on adult green sturgeon because adult sturgeon use deep, mid-channel habitat during migration. If juvenile green sturgeon use nearshore areas of the Sacramento River as foraging habitat or refuge from predators, the general long-term effects of bank protection on nearshore habitat values may affect, and is likely to adversely affect rearing juvenile green sturgeon critical habitat.

## 5.3 Giant Garter Snake

Much of the project area is unlikely to provide GGS aquatic habitat because it consists of larger rivers and flood control features, often surrounded by riparian vegetation and steep banks. GGS have not been documented in the east side tributaries (CDFW 2014), and historical habitat conditions are thought to have limited dispersal of the species east of NEMDC (E. Hansen, pers. comm., 2015). Based on these factors and current habitat conditions, such as close proximity to urban development, high levels of human disturbance, scarcity of upland habitat, and riparian vegetation along the banks of most channel reaches, GGS are unlikely to occur in the east side tributaries and the southern portion of NEMDC. Therefore, all proposed project elements that would occur in these areas are unlikely to directly or indirectly impact GGS or adversely affect habitat occupied by the species.

The quality of habitat for GGS improves along NEDMC north of Dry Creek, where aquatic habitat is more extensive, very little riparian vegetation is present, urban development is less extensive, and large areas of open grasslands are present landside of the levees. GGS are known to occur in rice fields, associated canals, and managed marshes in the Natomas Basin. Additionally, the Sacramento Bypass is considered GGS habitat.

**Short-Term Effects**

There is the potential for short-term effects to GGS upland habitat during construction of the Sacramento Bypass widening. Construction activities could disturb GGS due to vibration, noise, and dust. During construction, equipment could possibility harm or kill a snake if the snakes are present. In addition to these short-term construction related effects, there would be temporary impacts to approximately 25 acres of aquatic GGS habitat and 50 acres of upland habitat from the relocation of the Sacramento Bypass levee toe drain. To minimize potential impacts to GGS, the avoidance and minimization measures discussed in Section 2.5 above would be implemented. These short-term effects are anticipated to occur over a single construction season and would return to the pre-existing conditions once completed. If construction were to occur in GGS habitat areas for more than one construction season, then additional mitigation would be required in accordance with the measures discussed in Section 2.5 above.

Based on habitat conditions and known occurrences of giant garter snake, NSS project's Borrow Site 2 is located immediately east of NEMDC and supports suitable upland habitat for GGS. If GGS are present during borrow activities, these activities would result in direct and indirect effects to this species. Approximately 5.5 acres of GGS upland habitat would be impacted by the borrow activities. Ground disturbing activities at Borrow Site 2, where uplands adjacent to suitable aquatic habitat would be disturbed, could result in direct displacement, injury, or death of snakes if the habitat is used for basking, hibernating, or aestivating. Indirect effects could occur if snakes are displaced from occupied habitat or disturbed by nearby construction activities. Displacement and disturbance resulting from human activity, construction noise, and equipment vibrations could affect the ability of snakes to conduct essential life history functions, such as dispersal, movement, or foraging, and could result in increased competition for food and space and vulnerability to predation.

However, all project-related impacts at Borrow Site 2 would occur within one active season and, therefore, are considered temporary. Borrow Site 2 would be restored/enhanced and re-graded to a condition that exceeds the pre-project condition by lowering the land surface closer to the low flow channel elevation and through establishment of a more diverse mosaic of aquatic and wetland habitat components. Additionally, with the implementation of the proposed avoidance and minimization measures discussed in Section 2.5, the use of Borrow Site 2 may affect, but is not likely to adversely affect GGS.

**Table 14. Impacts to Giant Garter Snake Habitat.**

| **Location** | **Area of Impact (acres) / Impact Type** |
|---|---|
| NEMDC/NSS Borrow Site 2 | 5.5 acres / Temporary Upland |
| Sacramento Bypass Drainage Ditches/Irrigation Canals | 15 acres / Permanent Aquatic<br>30 acres / Permanent Upland |
| Sacramento Bypass Levee Toe Drain | 25 acres / Temporary Aquatic<br>50 acres / Temporary Upland |
| **Total Impacts to GGS Habitat** | **Permanent Aquatic - 15 acres**<br>**Permanent Upland – 30 acres**<br>**Temporary Aquatic – 25 acres**<br>**Temporary Upland – 55.5 acres** |

**<u>Long-Term Effects</u>**

GGS habitat at the NSS Borrow Site 2 would be restored to pre-project conditions, resulting in no long-term loss of upland GGS habitat in this portion of the project area. The Borrow Site will be planted to create freshwater marsh and seasonal wetland habitat, which will provide mitigation for potential unavoidable impacts to jurisdictional wetland habitat occurring during the North Sacramento

Streams Levee Improvement Project. Upland areas disturbed during borrow activities will be seeded with native perennial grasses.

In the Sacramento Bypass, there would be a permanent loss of approximately 15 acres of GGS aquatic habitat from the removal of the drainage ditches and farm canals in the extended Bypass area and approximately 30 acres of associated upland habitat. Compensation would occur through the purchase of credits at a USFWS-approved mitigation bank. This compensation would be in accordance with the ratios established in Section 2.5.

Additionally, since the land within the expanded bypass area would be removed from agricultural production and added to the wildlife area, there is the potential for wetlands to form in this area, which could improve the habitat conditions of the area long term. Long-term adverse impacts could result from O&M activities. These activities include mowing, rodent control, and grouting any new rodent holes that form in the new levee. Additionally, driving near habitat could disturb GGS due to vibration, noise, and dust. Maintenance activities would occur during the GGS active season to reduce impacts to the snake. Overall, these activities are considered less than significant, because they are short term activities and because O&M reduces the potential impacts associated with future levee repairs.

Operation of the expanded Sacramento Weir and Bypass was described in Section 2.2.6 above, and would result in an increase of water surface elevation of approximately 0.5-foot on the levee slopes on either side of the Yolo Bypass. However, when this increase would occur, during a 200-year flood event, the Yolo Bypass levees already contain water up to a 21 foot depth. As a result, GGS burrows would likely already be saturated before the additional water associated with the widened Sacramento Bypass is a factor. The additional 0.5-foot resulting from this action would not significantly change the timing or duration of this flooding and would not result in further impacts to GGS habitat. As a result, operation of the widened Sacramento Weir and Bypass may affect, but is not likely to adversely impact the GGS.

## 5.4 Western Yellow-Billed Cuckoo

The project area is unlikely to support western yellow-billed cuckoo nesting habitat. However, migrant individuals are likely to pass through the area in transit to breeding sites along the Sacramento River north of Colusa. Overall, cuckoos are unlikely to occur in the action area, although potential dispersal and foraging habitat is present in the American River Parkway and along the Sacramento River.

### Short-Term Effects

Prior to construction, surveys would be conducted to determine the presence of cuckoos within the project area in accordance with any required USFWS survey protocols and permits at the time of construction. If cuckoos are determined to be present, there is the potential for short term, temporary impacts during construction from dust, noise, and vibration. However, since construction would occur in the summer months when the cuckoo is nesting (June 1 through September 30), and cuckoos are unlikely to be nesting in the study area, these effects would not adversely effect the species. If cuckoos are determined to the present prior to construction, the Corps would reinitiate consultation in order to coordinate the appropriate avoidance and minimization measures that should be implemented in order to reduce impacts to the cuckoo.

**Long-Term Effects**

Potential long-term effects to the cuckoo could result from the loss of 65 acres of riparian habitat in the footprint of the rock trench sites within the American River Parkway. For the American River, impacts to trees would be the width of the launchable rock trenches (currently proposed at approximately 40-feet wide) for a total of approximately 65 acres. This habitat is suitable for the yellow-billed cuckoo due to the significant width of the riparian corridor along the American River Parkway, ranging from approximately 75 feet in some of the more narrow stretches to over 1,000 feet in other locations. The Corps would compensate for riparian vegetation removed as a result of construction within the Parkway and on-site to the maximum extent practicable. There would remain a significant temporal loss of riparian habitat for the cuckoo during their migration, however in time it is anticipated that with the implementation of the compensation proposed by the Corps, the riparian corridor would recover and would provide a suitable level of habitat for the cuckoo long-term.

Additionally, approximately 70 acres of riparian habitat would be impacted along the Sacramento River; however the Sacramento River's riparian corridor is very narrow (approximately 100 feet wide in most locations) and would not likely provide quality habitat for the cuckoo, who require a minimum of 20 hectares of riparian corridor to nest. However, they are expected to use this area as a migration corridor. Impacts to riparian vegetation along the Sacramento River could remove approximately a 60-foot wide segment of the 100-foot wide riparian corridor. However, with the implementation of on-site mitigative features associated with the construction of the bank protection, as described in Section 2.2.3, the project would add an additional 25-foot wide corridor of SRA/riparian vegetation along the river bank. The result would be a remaining impact of approximately 35 feet of riparian corridor loss, or approximately 40 acres. This remaining impact would be compensated either through the creation of off-site mitigation near the Sacramento River, or through the purchase of credits from a USFWS-approved mitigation bank. With the implementation of compensation for the loss of riparian habitat, the long-term effect of the removal of riparian vegetation along the Sacramento and American Rivers may affect, but is not likely to adversely affect the western yellow-billed cuckoo.

## 5.5 Ongoing Project Actions

As described in Section 2.5, in-water construction work will be completed during established work windows for salmonids and delta smelt. Maintenance activities may occur year-round in the dry areas. Effects from on-going activities (e.g., maintenance) are expected to be similar to effects described in Section 5.2, although the effects' magnitudes will be less.

## 5.6 Effects on the Environmental Baseline

Effects of the proposed action include reductions in nearshore aquatic and riparian habitat that is used by aquatic and terrestrial species. Placement of revetment on earthen banks alters natural fluvial processes that sustain high-value nearshore and floodplain habitats in alluvial river systems.

## 5.7 Effects on Essential Elements of Critical Habitat

The project actions may adversely modify designated critical habitat for the valley elderberry longhorn beetle, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and green sturgeon. Any project action within the Sacramento River waterway from the confluence of the American River downstream to Freeport RM 46 may also affect designated critical habitat for delta smelt (USFWS 2003). Potential impacts of the project actions on critical habitat for listed species are discussed separately for each species in the effects analysis discussion above (Sections 5.1 to 5.3).

## 5.8 Cumulative Effects

### 5.8.1 ESA Cumulative Effects Analysis

The ESA requires the action agency, NMFS, and USFWS to evaluate the cumulative effects of the proposed actions on listed species and designated critical habitat, and to consider cumulative effects in formulating Biological Opinions (USFWS and NMFS 2002c). The ESA defines cumulative effects as "those effects of future State or private actions, not involving Federal activities that are reasonably certain to occur within the action area" of the proposed action subject to consultation (USFWS and NMFS 2002b). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Federal ESA. For the purposes of this BA, the area of cumulative effects analysis is defined as the Sacramento River watershed.

A number of other commercial and private activities, including hatchery operations, timber harvest, recreation, as well as urban and rural development, could potentially affect listed species in the Sacramento River basin. Levee maintenance activities by state agencies and local reclamation districts are likely to continue, although any effects on listed species will be addressed through Section 10 of the ESA. Ongoing non-federal activities that affect listed salmonids, green sturgeon, delta smelt, valley elderberry longhorn beetle, giant garter snake and their habitat, will likely continue in the short-term, at intensities similar to those of recent years. However, some activities associated with the State's proposed Central Valley Flood Protection Plan or state or local efforts to implement the ETL could result in increased effects on listed species. The extent and pace of those activities are not yet known.

Cumulative effects may also include non-federal rock revetment projects. Some non-federal rock revetment projects carried out by State or local agencies (e.g., reclamation districts) that do not fill wetlands or occur above the ordinary high water line will not need Section 404 (Clean Water Act) permits from the Corps and resulting Section 7 (ESA) consultation, but any effects on listed species should be addressed through Section 10 of the ESA. These types of actions are possible at many locations throughout the ARCF action area and could contribute to cumulative impacts to waters of the U.S. These impacts could include similar effects to those associated with the ARCF proposed bank protection measure, including loss of Delta smelt shallow water and spawning habitat, loss of green sturgeon benthic habitat, loss of SRA habitat, and loss of riparian habitat along the Sacramento and American River corridors. Without appropriate mitigation, these effects would contribute to an adverse effect on these species. However, since the ARCF project is proposing to restore impacted SRA and riparaian habitat and compensate for any permanent loss of in-water habitat, the ARCF project would not be expected to combine to create an adverse cumulative effect with these actions.

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

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

### 5.8.2 Federal Cumulative Effects Analysis

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

The purpose of the West Sacramento Project is to investigate and determine the extent of Federal interest in plans that reduce flood risk to the City of West Sacramento. The proposed alternative for this project consists of levee improvements to 50 miles of existing levees surrounding the city and extending down along the Sacramento Deep Water Ship Channel to address identified seepage, stability, and erosion concerns through the construction of slurry walls and bank protection. In addition, the project proposes to set back the Sacramento River levee in the Southport area of West Sacramento. The West Sacramento Project includes the geographic area and project features that are also being considered in the Southport Early Implementation Project. The Southport Early Implementation Project is being proposed by the West Sacramento Area Flood Control Agency and the State of California to provide 200-year protection consistent with the State's goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. The Southport Early Implementation Project's proposed alternative includes the Sacramento River setback levee in the Southport area of West Sacramento. The Southport project is planned to begin construction in 2015.

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

Potential cumulative impacts from the combination of these projects to each of the listed species included in this consultation are below. The construction periods and related effects from these projects could all occur simultaneously. For the ARCF and West Sacramento projects, this means that similar construction-related effects such as rock placement or tree removal could be occurring at the same time for the stretch of the projects from the I Street Bridge to the Stone Locks. During preconstruction engineering and design, the Corps designs will avoid impacts to special status species, where possible, or otherwise minimize effects to each of these species including designs to have negligible effects on velocities. There may be localized effects; the change in bank composition to rock may result in short term slight increase of velocities, but installation of vegetation on site would result in a much greater long-term reduction of velocities. The site would be designed to ensure that any increase in velocity does not extend downstream of the sites. Additionally, the two projects would coordinate to ensure that construction sites are offset from each other (i.e., sites directly across the Sacramento River from each other where there is bank protection being installed, specifically from the I-Street Bridge downstream to the Barge canal, would not be constructed in the same construction season). These are also different styles of bank protection. The West Sacramento side has some berm between the levee and the channel, and therefore it is really a "bank" fix, while the ARCF side has levee toe underwater and includes rock berm.

**Valley Elderberry Longhorn Beetle**

Concurrent construction of multiple projects over the next 10 to 15 years within the Sacramento Metropolitan area would likely cause mortality to beetles due to construction operations. Construction activities for the multiple projects would occur each year during the flight season of beetles. Since construction activities would be adjacent to known VELB locations it is likely that some mortality may occur. No designated critical habitat would be affected with the construction of any of the projects.

Shrubs within the each project footprint would be transplanted to areas in close proximately to the current locations. Additionally, compensation would be located within the vicinity of impacted shrubs. Transplanting of shrubs and planting of seedlings and natives within the project vicinity would provide connectivity for the beetle within the American River Parkway. Connectivity is a primary cause of the beetle decline and an important element in the recovery and sustainability for the beetle. Habitat maps of the Parkway that show individual shrub locations are included in Appendix F. Appendix G includes maps of the Corps' existing compensation sites within the Parkway. The Corps would coordinate with County Parks to determine appropriate locations for newly established elderberry mitigation sites within the Parkway, with connectivity being one of the goals in site selection. The transplanting of shrubs and compensation within the same area as the potential impacts would result in effects to the beetle but not result in jeopardy to the valley elderberry longhorn beetle.

**Salmon, Steelhead, and Sturgeon**

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

The erosion repair activities of these combined projects would likely reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment perspective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and especially the Yuba River systems. All of the available sediment in the American River watershed is being contained behind Folsom Dam. The site specific designs will be constrained from allowing any velocity increases outside the erosion repair site (Schlunegger 2014).

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

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

**Delta Smelt**

The proposed projects, with the implementation of site specific designs and purchase of credits at a USFWS-approved mitigation bank, would provide long-term net benefits to delta smelt as explained above in for the other fish species. However, there are four specific significant threats to the delta smelt that have been identified by the USFWS: direct entrainments by State and Federal water export facilities, summer and fall increases in salinity, summer and fall increases in water clarity, or effects from introduced species (USFWS 2015). Bank protection has also been identified as a significant threat to delta smelt shallow water habitat for spawning, incubation, and rearing within the Sacramento River portion of the ARCF project area.

Implementation of the various projects would not affect direct entrainments by State and Federal water export facilities. The ARCF project would release of more water down the Sacramento Bypass into the Yolo Bypass during high water events. The excess water that would normally be moving downriver through the Sacramento area would enter the system farther down in the Delta area. Since adult delta smelt are moving up the system to spawn at this time this would not affect entrainment in the water export facilities.

Summer and fall increases in salinity is driven more by low flow drought years and water releases in the Sacramento tributaries then site specific designs for erosion protection in the project areas. Summer and fall increases in water clarity are associated with, among other factors, invasive non-native clam species and non-native plant species, which are generally located down in the Delta below the project areas, that are filtering out vital chlorophyll and plankton that would normally increase turbidity which helps the delta smelt avoid predators. However, as mentioned above, the erosion repair component of the ARCF, West Sacramento, and SRBPP would likely reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, as explained above, from a system sediment perspective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and especially the Yuba River systems.

Increases of bank substrate size over sand and sediment resulting in reductions in instream habitat are assumed to reduce the availability and suitability of habitat for spawning, incubation, and rearing. As a result, potential cumulative effects include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae. A permanent loss of approximately 14 acres with an additional 46 affected acres of sandy shallow water spawning and incubation habitat in the ARCF GRR project area would result from sand to rock conversion and would eliminate areas for successful egg deposition and survival due to the change in preferred substrate. However, the ARCF project would mitigate for the loss of shallow water habitat through the purchase of credits at a USFWS-approved mitigation bank. As a result, the cumulative impact of these projects may affect, but is not likely to adversely affect the Delta Smelt.

**Giant Garter Snake**

The giant garter snake could be affected by multiple projects being constructed within the Sacramento Metropolitan area over the next 10 to 15 years. Primarily habitat loss would occur on the West Sacramento side of the Sacramento River adjacent to the Sacramento Bypass and the West Sacramento and Southport construction areas. Short term impacts would occur for a single construction season along haul routes and within borrow sites. To minimize potential impacts to snakes work within giant garter snake habitat would be conducted between May 1 and October 1 when snakes are active and can move out of the construction area. Snake mortality could occur during construction along haul routes, however, the snakes are mobile and would likely move out of the way from construction equipment. There would be a permanent loss of a few irrigation canals in the Sacramento Bypass and some existing wetlands adjacent to the levees in the West Sacramento study area.

**Western Yellow-Billed Cuckoo**

Concurrent construction of the ARCF, West Sacramento, and SRBPP projects over the next 10 to 15 years within the Sacramento Metropolitan area could result in adverse effects to Western yellow-billed cuckoo through the removal of trees within the riparian corridors. Construction activities for the multiple projects would occur each year during nesting season, which could disrupt nesting birds, if present. However, the cuckoo is not known to nest in the Sacramento River or its tributaries below Colusa, therefore the tree removal would not effect Western yellow-billed cuckoo nesting habitat. Additionally, any tree removal would likely occur outside of the nesting season. No designated critical habitat would be affected with the construction of any of the projects.

Prior to construction, each project would be required to conduct surveys to determine the presence of the cuckoo. Nesting birds are not expected to be present, but migrating cuckoos could use riparian habitat in these reaches as they pass through the area. If cuckoos are found during surveys, additional measures would be proposed by each of the projects, which may include biological monitoring.

Planting of seedlings and native trees within the project vicinity would mitigate for the loss of trees within the riparian corridor and would likely improve the habitat in the area long-term by filling gaps in the riparian canopy. While the short term impact would be significant, over time these compensation measures within the same area as the potential impacts would result in less than significant effects to the cuckoo. Since the cuckoo is not likely to be nesting within the area, and while the cumulative impact to the riparian corridor from tree removal would be significant, there still remains a significant amount of trees that could be used by the cuckoo, particularly in the American River Parkway, as described in Section 5.9.5 above. As a result, the cumulative effect from these projects may affect, but is not likely to adversely affect the yellow-billed cuckoo.

## 5.9 Conclusion and Effects Determination for Listed Species

### 5.9.1 Valley Elderberry Longhorn Beetle

The project construction would result in the transplanting of a maximum of 270 elderberry shrubs during the 13 year construction timeframe. Compensation for the transplanting of the shrubs would be on-site where possible and within the same region when off-site. The replacement plantings would result in habitat connectivity for the beetle within the project area. In consideration of this information, the project actions are unlikely to result in long-term habitat losses to valley elderberry longhorn beetle, as long as the applicable mitigation and compensation measures are implemented. However, ARCF GRR project actions may adversely affect valley elderberry longhorn beetles due to potential take during construction.

Additionally, approximately 90 shrubs could be trimmed each year by the maintaining agencies for O&M activities. The trimming are not expected to reduce the habitat overall for the beetle as the shrubs would remain in the existing location. The maintaining agencies would purchase credits in a mitigation bank to offset any potential affects that may occur due to trimming.

### 5.9.2 Fish

**Anadromous Fish Species**

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

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

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

These features will increase the availability of high quality shallow water habitat for juvenile Chinook salmon and steelhead, incubating delta smelt, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Because we will not be removing any trees on the lower one-third of the waterside of the levees in the Sacramento River area, SRA will not be compromised thus maximizing existing SRA values in the action area. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species.

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

**Determinations**

Section 7 of the Endangered Species Act requires that Federal agencies ensure, in consultation with the U.S. Fish and Wildlife Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. Effects to critical habitat are discussed for each fish species in Section 5.2. Based on those assessments, project actions:

- May affect, likely to adversely affect designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and Green sturgeon;
- May affect, likely to adversely affect designated critical habitat for delta smelt within the ARCF GRR project area which includes the Sacramento River upstream to approximately RM 60 (U.S. Fish and Wildlife Service 2003a).

### 5.9.3 Giant Garter Snake

To minimize the potential for adverse effects on GGS in the Sacramento Bypass, GGS habitat will be designated as an environmentally sensitive area delineated with signs or fencing, and if possible, avoided by all construction personnel. Additional measures and habitat compensation as outlined in Section 2.5.3 will also be implemented to avoid and minimize potential temporary effects to GGS during construction. There would be approximately 15 acres of GGS aquatic habitat permanently removed due to removal of the drainage canals within the widened bypass. Compensation for this loss would occur in accordance with the measures discussed in Section 2.5.3. Temporary effects during construction would disturb approximately 30 acres of upland GGS habitat for one construction season. Compensation for these temporary impacts would occur in accordance with the measures discussed in Section 2.5.3.

In consideration of the above information, the project actions are unlikely to result in long-term habitat losses to the giant garter snake, as long as the applicable mitigation and compensation measures are implemented. However, even with on-site mitigation and off-site compensation, the project actions may adversely affect giant garter snakes due to: (1) take during construction and O&M activities; and (2) habitat fragmentation. Ground disturbing activities at NSS Borrow Site 2 could result in direct displacement, injury, or death of snakes. These effects, which could affect the ability of snakes to conduct essential life history functions, such as dispersal, movement, or foraging, would be temporary (occurring during one active season). Construction activities could temporarily degrade aquatic habitat, but the overall result of implementing the proposed site restoration at Borrow Site 2 would be an enhancement of habitat quality.

### 5.9.4 Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

Approximately 0.25-acre of vernal pool habitat has the potential to be indirectly impacted by project construction near Magpie Creek. The Corps proposes to either purchase 1 acre of credits at a mitigation bank, or compensate for the loss of 1 acre of habit through enhancement of the habitat in the 79 acres of land being acquired under this project as a flood overflow area. The project actions are unlikely to result in long-term habitat losses to the vernal pool fairy shrimp and vernal pool tadpole shrimp, with the implementation of the mitigation and compensation measures proposed. As a result, the project actions may affect, but are not likely to adversely affect the vernal pool fairy shrimp and vernal pool tadpole shrimp.

### 5.9.5 Western Yellow-billed Cuckoo

Potential long-term effects to the cuckoo could result from the loss of 175 acres of riparian habitat. However, this long term effect would be significantly reduced with the receipt of a vegetation variance and implementation of the SWIF. There would remain a significant temporal loss of riparian habitat for the cuckoo during their migration, however in time it is anticipated that the riparian corridor would recover with the implementation of the compensation proposed by the Corps. While the removal of trees from the construction footprint is a significant effect, the majority of the trees within the cuckoo's migration corridor would not be impacted by construction activities, particularly within the American River Parkway. In the Parkway, the maximum footprint of impact would be 65 feet from the levee toe, while portions of the Parkway include a corridor of150 to 500 feet wide. As a result, the long-term effect of the removal of riparian vegetation may affect, but is not likely to adversely affect the western yellow-billed cuckoo.

## 5.10 Effects of the Proposed Action on Essential Fish Habitat

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

EFH of Pacific salmon pursuant to Section 305 (b) (2) of the MSA appropriate determinations for EFH as either; (1) will not adversely effect, or (2) may adversely affect. Important components of EFH for Chinook salmon spawning, rearing, and migration include:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
- Freshwater rearing sites with:
    a) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    b) Water quality and forage supporting juvenile development; and
    c) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- Estuarine areas free of obstruction and excessive predation with:
    a) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
    b) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and
    c) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The ARCF GRR includes habitat on the Sacramento River, American River, and the Sacramento Bypass that have been designated as EFH for Chinook salmon, a major contributor to Pacific Coast salmon fisheries. The Pacific Coast salmon fishery EFH extends along the Pacific Coast from Washington to Point Conception in California. Freshwater EFH includes all habitats currently and historically accessible to salmon and is based on descriptions of habitat used by coho and Chinook salmon. The EFH excludes areas above naturally occurring barriers such as waterfalls, which have been present for several hundred years, and impassible dams identified on large rivers (NMFS 1997). The following analysis of EFH does not include effects to the fish species, just the species habitat as defined in the MSA. Results for the effects of EFH for winter-run, spring-run, and fall/late-fall-run Chinook salmon in the ARCF GRR action area were based on the SAM analysis detailed in Appendix B.

#### 5.10.1 Effects of the Proposed Action on EFH

Site specific project designs were unavailable for the ARCF GRR project reach at the time of this SAM analysis. The following data sources were used to characterize SAM habitat conditions (as defined by bank slope, floodplain availability, substrate size, instream structure, aquatic vegetation, and overhanging shade) within the ARCF GRR project area under existing or pre-project conditions:

- The Corps' Sacramento River revetment database – This database was used to stratify the project reach into subreaches that encompass relatively uniform bank conditions based on their general physical characteristics (USACE 2007). This database was used to characterize existing habitat conditions within individual subreaches where more recent data were unavailable.
- Aerial images of the ARCF GRR project reach (Google™ Earth), provided current and historical images of bank conditions that were used to address gaps or uncertainties related to existing cover characteristics within individual subreaches.

The SAM employs six habitat variables to characterize near-shore and floodplain habitats of the winter-run, spring-run, and fall/late-fall-run Chinook species:

- Bank slope—average bank slope of each average seasonal water surface elevation;
- Floodplain availability—ratio of wetted channel and floodplain area during the 2-year flood, to the wetted channel area during average winter and spring flows;
- Bank substrate size—the median particle diameter of the bank (i.e., D50) along each average seasonal water surface elevation;
- Instream structure—percent of shoreline coverage of instream woody material along each average seasonal water surface elevation;
- Aquatic vegetation—percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation; and
- Overhanging shade—percent of the shoreline coverage of shade along each average seasonal water surface elevation.

**Sacramento River SAM EFH Analysis**

The Sacramento River SAM analysis reach includes the entire left bank (east side) of the Sacramento River from the American River confluence to approximately 4,020 linear feet (lf) below the Freeport Bridge.

**Short Term**

Short term construction activities may adversely affect Chinook EFH. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions most positively associated with fry and juvenile rearing and migration.

**Long Term**

Long term construction actions will not adversely affect EFH on the Sacramento River portion of the ARCF GRR action area. EFH is expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach over the lifetime of the project. Positive EFH response would be most likely associated with long term growth of SRA (overhanging shade) and aquatic vegetation.

**American River SAM EFH Analysis**

The American River SAM analysis (ARN A-B and ARS A-C) reaches include portions of the right and left bank of the American River from Goethe Park to the confluence of the Sacramento. It also includes portions of NEMDC, Arcade Creek, Magpie Creek, and Dry/Robla Creek.

**Short Term**

Short term construction activities may adversely affect Chinook EFH. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions most positively associated with fry and juvenile rearing and migration.

**Long Term**

Long term construction actions will not adversely affect EFH on the Sacramento River portion of the ARCF GRR action area. EFH is expected to show a long term positive response to project actions in the American River SAM (Appendix B) analysis reach over the lifetime of the project. Positive EFH response would be most likely associated with long term growth of SRA (overhanging shade) and aquatic vegetation.

**Sacramento Bypass SAM EFH Analysis**

The Sacramento Bypass SAM analysis reach includes the right bank (north side) of the Sacramento Bypass levee in its entirety from the confluence of the Sacramento River to its termination at the Yolo Bypass.

**Short Term**

Short term construction activities may adversely affect Chinook EFH. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at the portion of the Sacramento Bypass associated with the removal of the SRA habitat to allow expansion of the Sacramento Bypass Weir. There is no planned vegetation removal for the levee widening.

**Long Term**

Chinook salmon are expected to show a small long term negative response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project. Chinook salmon should exhibit a negative response by year 1. The maximum habitat deficit identified is -188 ft for the juvenile migration life stage of spring-run and winter-run Chinook salmon in the spring of year 2. Long term habitat deficits would be associated with the permanent removal of SRA habitat for the expansion of the weir portion of the project not the levee portion.

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# Appendix A

# Species Lists

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

Document Number: 141222022932

Current as of: December 22, 2014

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## Quad Lists

## CLARKSBURG (497A)
### Listed Species

#### Invertebrates

*Branchinecta conservatio*
- Conservancy fairy shrimp (E)

*Branchinecta lynchi*
- vernal pool fairy shrimp (T)

*Desmocerus californicus dimorphus*
- valley elderberry longhorn beetle (T)

*Lepidurus packardi*
- vernal pool tadpole shrimp (E)

#### Fish

*Acipenser medirostris*
- green sturgeon (T) (NMFS)

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

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

*Oncorhynchus tshawytscha*
- Central Valley spring-run chinook salmon (T) (NMFS)
- Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
- Critical habitat, winter-run chinook salmon (X) (NMFS)
- winter-run chinook salmon, Sacramento River (E) (NMFS)

#### Amphibians

*Ambystoma californiense*
- California tiger salamander, central population (T)

*Rana draytonii*
- California red-legged frog (T)

#### Reptiles

*Thamnophis gigas*
- giant garter snake (T)

#### Birds

*Coccyzus americanus occidentalis*
Western yellow-billed cuckoo (T)

## RIO LINDA (512B)
### Listed Species

#### Invertebrates

*Branchinecta lynchi*
vernal pool fairy shrimp (T)

*Desmocerus californicus dimorphus*
valley elderberry longhorn beetle (T)

*Lepidurus packardi*
vernal pool tadpole shrimp (E)

#### Fish

*Hypomesus transpacificus*
delta smelt (T)

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

*Oncorhynchus tshawytscha*
Central Valley spring-run chinook salmon (T) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

#### Amphibians

*Ambystoma californiense*
California tiger salamander, central population (T)

*Rana draytonii*
California red-legged frog (T)

#### Reptiles

*Thamnophis gigas*
giant garter snake (T)

## SACRAMENTO EAST (512C)
### Listed Species

#### Invertebrates

*Branchinecta lynchi*
vernal pool fairy shrimp (T)

*Desmocerus californicus dimorphus*
Critical habitat, valley elderberry longhorn beetle (X)
valley elderberry longhorn beetle (T)

*Lepidurus packardi*
vernal pool tadpole shrimp (E)

#### Fish

*Acipenser medirostris*
green sturgeon (T) (NMFS)

*Hypomesus transpacificus*
delta smelt (T)

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

*Oncorhynchus tshawytscha*
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

### Amphibians

*Ambystoma californiense*
California tiger salamander, central population (T)

*Rana draytonii*
California red-legged frog (T)

### Reptiles

*Thamnophis gigas*
giant garter snake (T)

### Birds

*Coccyzus americanus occidentalis*
Western yellow-billed cuckoo (T)

## SACRAMENTO WEST (513D)
## Listed Species

### Invertebrates

*Branchinecta lynchi*
vernal pool fairy shrimp (T)

*Desmocerus californicus dimorphus*
valley elderberry longhorn beetle (T)

*Lepidurus packardi*
vernal pool tadpole shrimp (E)

### Fish

*Acipenser medirostris*
green sturgeon (T) (NMFS)

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

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

*Oncorhynchus tshawytscha*
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

### Amphibians

*Ambystoma californiense*
California tiger salamander, central population (T)

*Rana draytonii*
California red-legged frog (T)

Reptiles

*Thamnophis gigas*
giant garter snake (T)

Birds

*Coccyzus americanus occidentalis*
Western yellow-billed cuckoo (T)

*Vireo bellii pusillus*
Least Bell's vireo (E)

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## County Lists

No county species lists requested.

## Key:

(E) *Endangered* - Listed as being in danger of extinction.

(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.

(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.

(NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.

*Critical Habitat* - Area essential to the conservation of a species.

(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.

(C) *Candidate* - Candidate to become a proposed species.

(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.

(X) *Critical Habitat* designated for this species

## Important Information About Your Species List

### How We Make Species Lists

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

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

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

### Plants

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

## Surveying

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

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

## Your Responsibilities Under the Endangered Species Act

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

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

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

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

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

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

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

## Critical Habitat

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

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

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

## Candidate Species

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

## Species of Concern

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

## Wetlands

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

## Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be March 22, 2015.

# Appendix B

# American River Common Features GRR SAM Analysis

# American River Common Features General Reevaluation Report

# Standard Assessment Methodology Analysis

## July 2015

# Contents

1.0 Introduction ........ 1
1.1 Background ........ 1
1.2 SAM Modeling Approach ........ 1
2.0 Habitat Analysis ........ 4
2.1 Project Description ........ 4
2.1.1 Sacramento River ........ 4
2.1.2 American River ........ 4
2.1.3 East Side Tributaries ........ 5
2.1.4 Sacramento Weir and Bypass ........ 5
2.1.5 Construction Schedule ........ 6
2.1.6 Vegetation on Levees ........ 8
2.2 Characterization of Existing Conditions ........ 10
2.2.1 Bank Slope ........ 10
2.2.2 Floodplain Availability ........ 10
2.2.3 Bank Substrate Size ........ 11
2.2.4 Instream Structure ........ 11
2.2.5 Aquatic Vegetation ........ 12
2.2.6 Overhanging Shade ........ 12
2.3 Characterization of With-Project Conditions ........ 12
2.3.1 Bank Slope ........ 13
2.3.2 Floodplain Availability ........ 13
2.3.3 Bank Substrate Size ........ 14
2.3.4 Instream Structure ........ 14
2.3.5 Aquatic Vegetation ........ 14
2.3.6 Overhanging Shade ........ 15
3.0 Results ........ 16
3.1 Sacramento River SAM Analysis (ARS_DEFG) ........ 16
3.1.1 Spring/ Fall/ Late-Fall/ Winter Run Chinook Salmon ........ 16
3.1.2 Steelhead ........ 17
3.1.3 Green Sturgeon ........ 17
3.2 American River SAM Analysis (ARN_AB and ARS_ABC) ........ 17
3.2.1 Spring/ Fall Chinook Salmon ........ 17

3.2.2 Steelhead ..... 18
3.2.3 Green Sturgeon ..... 18
3.3 Sacramento Bypass and Weir SAM Analysis ..... 18
3.3.1 Spring/ Fall/ Late-Fall/ Winter Run Chinook Salmon ..... 19
3.3.2 Steelhead ..... 19
3.3.3 Green Sturgeon ..... 19
**4.0 Discussion ..... 20**
4.1 Chinook Salmon ..... 21
4.2 Steelhead ..... 22
4.3 Green Sturgeon ..... 22
**7.0 References ..... 75**

# 1.0 Introduction

This document provides the background data and assumptions for the Standard Assessment Methodology (SAM) effects analysis of the American River Common Features General Reevaluation Report (ARCF GRR) project on the following focus fish species (Table 1).

**Table 1. ARCF GRR Project Focus Fish Species.**

| Species/ESUs | Federal Status |
|---|---|
| Chinook salmon (*Oncorhynchus tshawytscha*) | |
| Central Valley spring-run ESU | Threatened |
| Central Valley fall-run ESU | Species of concern |
| Central Valley late fall-run ESU | Species of concern |
| Sacramento River winter-run ESU | Endangered |
| Central Valley steelhead DPS (*Oncorhynchus mykiss*) | Threatened |
| green sturgeon (*Acipenser medirostris*) | Threatened |

## 1.1 Background

The U.S. Army Corps of Engineers (Corps) initiated formal Section 7 consultation with the National Marine Fisheries Service (NMFS) for the ARCF GRR on June 27, 2014. The original SAM analysis included in the Section 7 consultation for the ARCF GRR was determined to be insufficient in detail. Through internal discussions and interagency coordination with the NMFS, a revised set of parameters was developed to better assess the project's impact on focus fish species and their habitat. This report documents and provides justification for the revised SAM analysis and should replace the analysis included in the original Biological Assessment (BA) Appendix B.

## 1.2 SAM Modeling Approach

Long-term effects of the ARCF GRR project on focus fish species and their habitat were estimated using the SAM. The SAM computations were performed using the SAM Electronic Calculation Template (ECT) Version 4.0 (April 2012) developed by the Corps and Stillwater Sciences, in consultation with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife Service (CDFW), and California Department of Water Resources (DWR), academic contributions from the University of California at Davis and Humboldt State University, and peer reviewed by sixteen professionals in fish biology, river geomorphology, environmental sciences, and engineering (USACE 2012). The SAM allows agencies to quantitatively assess the potential effects of bank protection and stream restoration projects to ensure that these activities do not jeopardize Chinook salmon, steelhead, and green sturgeon, or destroy or adversely modify their critical habitat. The

SAM can also determine suitable compensation for habitat loss, by evaluating the benefits of certain design features (e.g., planted emergent vegetation) to target fish species.

The SAM employs six habitat variables to characterize near-shore and floodplain habitats of listed fish species:

- *bank slope*—average bank slope of each average seasonal water surface elevation;
- *floodplain availability—ratio of wetted channel and floodplain area during the 2-year flood, to the wetted channel area during average winter and spring flows;*
- *bank substrate size—the median particle diameter of the bank (i.e., D50) along each average seasonal water surface elevation;*
- *instream structure*—percent of shoreline coverage of instream woody material along each average seasonal water surface elevation;
- *aquatic vegetation*—percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation; and
- *overhanging shade*—percent of the shoreline coverage of shade along each average seasonal water surface elevation.

The SAM does not directly model changes in the above variables. Instead, habitat changes are estimated separately by the user and entered into an input data file to an electronic calculation template (ECT) developed within an MS Access database to track species responses to project actions over time. Changes in habitat variables may be fixed in time, such as installation of revetment at a particular slope and substrate size. In other circumstances, habitat evolution over time may be represented by more gradual changes in variables such as changes in floodplain inundation due to meander migration or changes in shade due to growth of planted vegetation. Typically, habitat evolution modeling is restricted to shade estimates from riparian growth models, but the SAM accommodates any number of other habitat modeling approaches such as meander migration modeling or large woody debris recruitment modeling.

Once a particular time series of habitat variable estimates is developed and entered into an ECT input file fish responses are calculated using previously developed relationships between habitat variables and species/life stage responses (USACE 2012). The response indices vary from 0 to 1, with 0 representing unsuitable conditions and 1 representing optimal conditions for survival, growth, and/or reproduction. For a given site and scenario (e.g., with- or without-project), the ECT uses these relationships to determine the responses of individual species and life stages to the measured or predicted values of each variable, for each season and target year; the ECT then multiplies these values together to generate an overall species response index. This index is then multiplied by the linear distance or area of bank to which it applies; the product is then integrated through time, generating a weighted species response index (WRI expressed as ft or $ft^2$) in each year of the analysis. The WRI provides a common metric that can be used to quantify habitat values over time, compare project designs to existing conditions, and evaluate the effectiveness of on-site and off-site habitat compensation actions.

# 2.0 Habitat Analysis

Following procedures described in the SAM (USACE 2012), construction activities at each site were translated into habitat variables for pre-project and with project conditions in each of four seasons using available data sources. The relevant habitat conditions to encode the conceptual response models for the focus fish species from the present to the future (t = 0, 1, 5, 15, 25, and 50 yrs), and under pre-project and with-project conditions are described below. Revisions to the original SAM analysis are summarized in the discussion.

## 2.1 Project Description

The ARCF GRR project tentatively selected plan – Alternative 2 – Sacramento Bypass and Improve Levees, involves the construction of fix-in-place levee remediation measures along the Sacramento River, American River, and north side tributaries as well as widening of the Sacramento Weir and Bypass. Proposed repair actions for each waterway are presented below (Table 2). This SDAM analysis groups project actions into 4 SAM reaches based on hydrologic connectivity: American River North (ARN_AB), American River South (ARS_ABC), Sacramento River South (ARS_DEFG), and the Sacramento Bypass (SBP).

### 2.1.1 Sacramento River

The levees along the Sacramento River under Alternative 2 would be improved to address identified seepage, stability, erosion, and a minimal amount of height concerns. Most height concerns along the Sacramento River would be addressed by a widening of the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass.

### 2.1.2 American River

Levees along the American River under Alternative 2 require improvements to address erosion. The proposed measures for these levees consist of waterside armoring to prevent erosion to the river bank and levee, which could potentially undermine the levee foundation. There are two measures proposed for the American River levees: (1) bank protection, and (2) launchable rock trench. Both of these measures are described in detail in the BA.

### 2.1.3 East Side Tributaries

Natomas East Main Drain Canal (NEMDC) requires improvements to address seepage and stability at locations where historic creeks had intersected the current levee alignment. A conventional open trench cutoff wall would be constructed at these locations to address the seepage and stability problems. The NEMDC east levee also has height issues which will be addressed with construction of a new floodwall. The floodwall would be placed at the waterside hinge point of the levee and would be designed to disturb a minimal amount of waterside slope and levee crown for construction.

We will be doing no in-water work on NEMDC under the Alternative 2 scenario and after consultation with NMFS, NEMDC was left out of the SAM analyses.

### 2.1.4 Sacramento Weir and Bypass

Under Alternative 2, the width of the Sacramento Weir and Bypass would be roughly doubled to accommodate increased bypass flows. The expanded Sacramento Weir and Bypass would generally result in an additional 25,000 cfs flow during high water conditions. The frequency of water diversion is expected to be the same, which is to use the current Sacramento Weir operation based on a stream gage at the I Street Bridge (Schlunegger 2014). Under normal flow conditions the Sacramento Weir and Bypass would be operating at pre-existing conditions described in detail in the ARCF GRR biological assessment (USACE 2014). Implementation of this action would result in the degradation of the existing north levee of the Sacramento Bypass and construction of a new levee approximately 1,500 feet to the north. The existing Sacramento Weir would be expanded to match the wider bypass. At this time, it is not known whether the new segment of weir would be constructed consistent with the 1916 design described above, or whether it would be designed to be a gravity-type weir. The new north levee of the bypass would be designed to be consistent with the existing Sacramento Bypass north levee, however, it would also include a 300-foot-wide seepage berm on the landside with a system of relief wells.

**Table 2. ARCF GRR Project Alternative 2 – Proposed Remediation Measures by Waterway.**

| Waterway | Seepage Measures | Stability Measures | Erosion Protection Measures | Overtopping Measures |
|---|---|---|---|---|
| American River[1] | --- | --- | Bank Protection, Launchable Rock Trench | --- |
| Sacramento River | Cutoff Wall | Cutoff Wall | Bank Protection | Sacramento Bypass and Weir Widening, Levee Raise |
| NEMDC | Cutoff Wall | Cutoff Wall | --- | Floodwall |
| Arcade Creek | Cutoff Wall | Cutoff Wall | --- | Floodwall |
| Dry/Robla Creeks | --- | --- | --- | Floodwall |
| Magpie Creek[2] | --- | --- | --- | Floodwall, Levee Raise |

[1]American River seepage, stability, and overtopping measures were addressed in the American River Common Features, WRDA 1996 and 1999 construction projects.
[2]In addition to the Floodwall, Magpie Creek will include construction of a new levee along Raley Boulevard south of the creek, and construction of a detention basin on both sides of Raley Boulevard. In addition, some improvements would need to occur on Raley Boulevard, including widening of the Magpie Creek Bridge, raising the elevation of the roadway, and removing the Don Julio Creek culvert.

### 2.1.5 Construction Schedule

The ARCF GRR project reach will be implemented in increments. The timing of each project reach (Table 3) is based on the proposed schedule provided in the Biological Assessment: American River Common Features General Reevaluation Report (USACE 2014).

**Table 3. Tentative Construction Schedule for the Recommended Plan.**

| PRIORITY | WATERWAY | REACH[1] | YEAR OF PROJECT CONSTRUCTION | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1 | Sacramento River | ARS F | | | | | | | | | | | | | |
| 2 | Sacramento River | ARS E | | | | | | | | | | | | | |
| 3 | American River | ARS A | | | | | | | | | | | | | |
| 4 | Sacramento River | ARS G | | | | | | | | | | | | | |
| 5 | Sacramento River | ARS D | | | | | | | | | | | | | |
| 6 | American River | ARS B | | | | | | | | | | | | | |
| 7 | American River | ARN A | | | | | | | | | | | | | |
| 8 | American River | ARS C | | | | | | | | | | | | | |
| 9 | American River | ARN B | | | | | | | | | | | | | |
| 10 | Sacramento Weir & Bypass | -- | | | | | | | | | | | | | |
| 11 | Arcade Creek | ARN D | | | | | | | | | | | | | |
| 12 | NEMDC | ARN F | | | | | | | | | | | | | |
| 13 | Arcade Creek | ARN E | | | | | | | | | | | | | |
| 14 | NEMDC | ARN C | | | | | | | | | | | | | |
| 15 | Dry/Robla Creek | ARN G | | | | | | | | | | | | | |
| 16 | Magpie Creek | ARN I | | | | | | | | | | | | | |

### 2.1.6 Vegetation on Levees

Compliance with Engineering Technical Letter 1110-2-571 (ETL) vegetation requires implementation of a vegetation-free zone within 15 ft of the waterside and landside toes of a levee. The levees along the Sacramento and American rivers were often set close to the river which has resulted in limited riparian vegetation in the project reach. The Corps is seeking a variance from the ETL vegetation requirements along the Sacramento River and American River portions of this project. This SAM analysis assumes that a Vegetation Variance Request (VVR) was assumed to be in place for the Sacramento and American River reaches. The Corps will obtain an ETL-approved vegetation variance exempting the Sacramento River sites from vegetation removal in the lower third of the waterside of the levee prior to final construction and design phase. The Corps will be complying with the ETL on the American River via a System Wide Implementation Framework (SWIF). The VVR is not assumed to apply to the SBP.

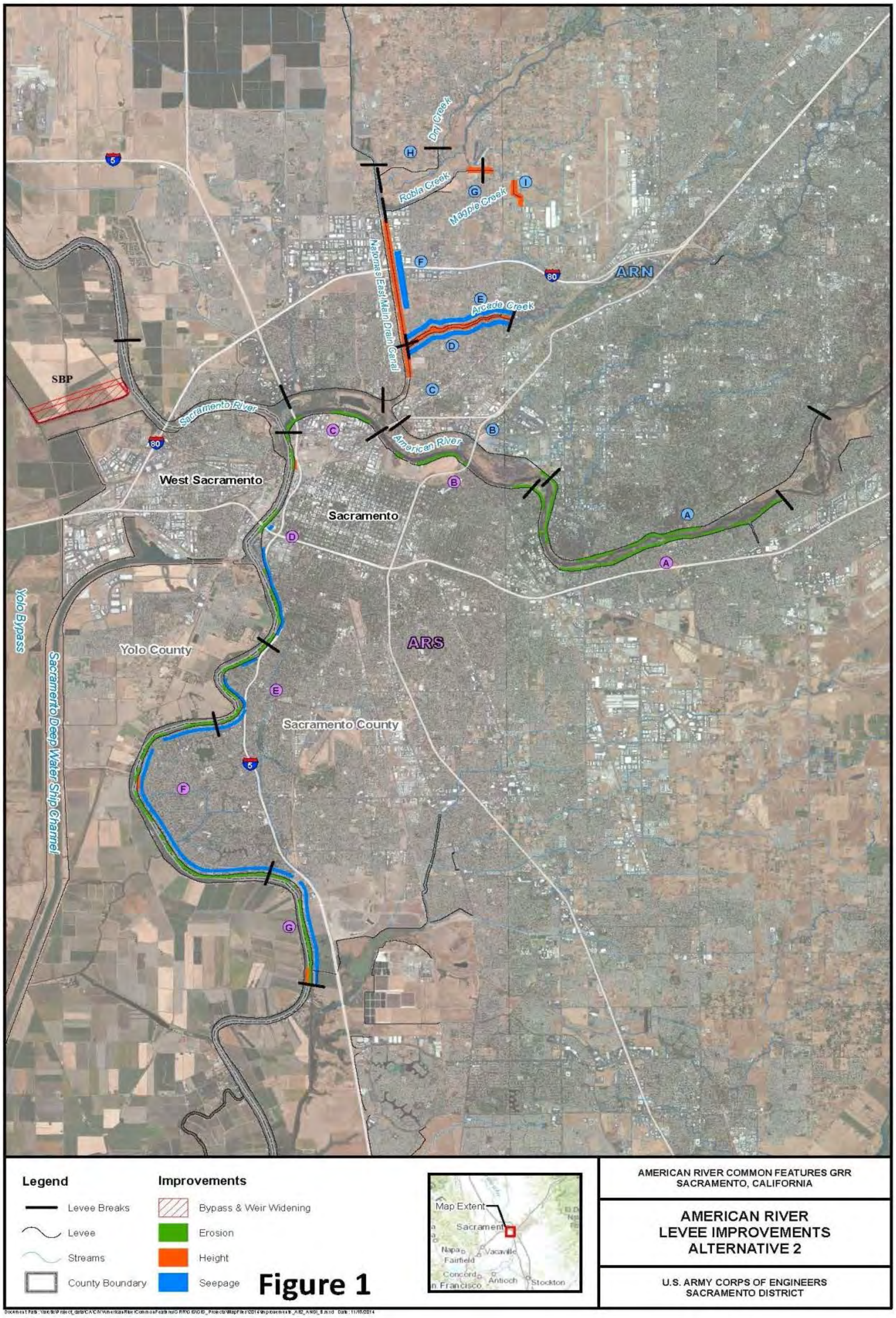



**Figure 1. ARCF GRR Study Area with Reach Identification.**

## 2.2 Characterization of Existing Conditions

The following data sources were used to characterize SAM habitat conditions (as defined by bank slope, floodplain availability, substrate size, instream structure, aquatic vegetation, and overhanging shade) within the ARCF GRR project area under existing or pre-project conditions.

Sacramento River Revetment Database – This database was used to stratify the project reach into subreaches that encompass relatively uniform bank conditions based on their general physical characteristics (USACE 2007). This database was used to characterize existing habitat conditions within individual reaches where more recent data were unavailable.

Aerial images of the ARCF GRR project reach (Google™ Earth Pro), provided current and historical images of bank conditions that were used to address gaps or uncertainties related to existing cover characteristics within individual subreaches.

The following describes how input values for each of these attributes were derived for existing conditions in the SAM assessment. Specific input values for each site can be seen below at the end of report in (Tables 6-25).

### 2.2.1 Bank Slope

In the SAM, bank slope serves as an indicator of the availability of shallow-water habitat and is obtained from point estimates of bank slope (horizontal change to vertical change, dW:dH) along each seasonal shoreline (i.e., the line where the water surface intersects the bank on average fall, winter, spring, and summer) (USACE 2012). Existing bank slopes were extrapolated from cross sections along the Sacramento River, American River, and existing SAM analyses performed on regionally analogous sites. Bank slope along all reaches was assumed to be 2 for existing conditions.

### 2.2.2 Floodplain Availability

In the SAM, floodplain habitat availability is considered important for juvenile life stages and is defined by areas that are flooded by the 2-year flood event (Q2) and measured by calculating a Floodplain Inundation Ratio (USACE 2012). This ratio is calculated by dividing the wetted channel and inundated floodplain areas during the 2- year flood event (AQ2) by the wetted channel area (AQavg) during average winter and spring flows. The amount of available floodplain habitat is consequently proportional to the ratio's positive deviation from unity (i.e., values greater than 1) (USACE 2012).

In this SAM analysis, it was assumed that the with-project floodplain inundation ratios would be the same as pre-project values, which is consistent with assumptions made during the pre-construction SAM analyses. As a result, no impacts to habitat quality at the ARCF GRR reaches are expected with respect to this habitat variable.

### 2.2.3 Bank Substrate Size

The median substrate size ($D_{50}$) along the summer-fall and winter-spring shorelines of the project reach was determined through by referencing the Revetment Database (USACE 2007) and current and historical aerial images. Based on previous analysis of Sacramento River Bank Protection Project (SRBPP) sites (USACE 2008, USACE 2013) sections of shoreline with natural substrate were assigned a $D_{50}$ of 0.25 inches. Sections of shoreline with rock revetment were assigned a $D_{50}$ of 10 inches.

### 2.2.4 Instream Structure

The shoreline coverage of Instream Woody Material (IWM) along the average summer-fall and winter-spring shorelines of the ARCF GRR project reach were determined by referencing the revetment database (USACE 2007). The revetment database uses four classes of instream structure, based on ranges of percent shoreline having IWM. Table 4 indicates how these revetment database attribute values were converted to a single value for input to SAM. These values were assumed to be appropriate for both the summer-fall and winter-spring seasons. For sub-reaches without available data, an estimate was based on shoreline conditions assessed from aerial images. Shorelines with dense riparian canopy were assigned 5% shoreline coverage of IWM. Shorelines without dense riparian canopy were assigned 0% shoreline coverage of IWM.

**Table 4. Conversion of Revetment Database Instream Woody Material Classes to SAM Attribute Value for Instream Structure.**

| Revetment Database IWM Class | SAM Input Value |
|---|---|
| None | 0% |
| 1 - 10% | 5% |
| 11 - 50% | 30% |
| > 50% | 75% |

### 2.2.5 Aquatic Vegetation

The revetment database attribute for Emergent Vegetation was used for summer-fall aquatic vegetation characterization, and the Ground Cover attribute was used for winter-spring characterization. Within the ARCF GRR project reaches, this approach generally gave a vegetation value of zero for summer-fall conditions, which is appropriate given the scarcity of emergent aquatic vegetation. Table 5 summarizes the conversion of revetment database attribute values for input to the SAM analysis.

**Table 5. Conversion of Revetment Database Emergent Vegetation and Ground Cover Classes to SAM Attribute Values for Vegetation.**

| | Revetment Database IWM Class | SAM Input Value |
|---|---|---|
| Summer and Fall | False | 0% |
| Revetment Database: | PEM 1 - 5% | 3% |
| "Emergent Vegetation" Attribute | PEM 6 - 25% | 15% |
| | PEM 26 – 75% | 50% |
| | PEM >75% | 85% |
| Winter and Spring | <25% | 13% |
| Revetment Database: | 26-50% | 38% |
| "Ground Cover" Attribute | 51-75% | 63% |
| | >75% | 88% |

### 2.2.6 Overhanging Shade

The extent of overhanging shade along the summer-fall and winter-spring shorelines was determined through analysis of current and historic aerial images. Summer-fall conditions were analyzed using imagery from late summer and early fall months, typically representative of low water conditions. Winter-spring conditions were analyzed using imagery from late winter and early spring months, typically representative of high water conditions. Values for overhanging shade at winter and spring habitat conditions were modified by factors of 0.25 and 0.75 respectively to account for seasonal defoliation.

## 2.3 Characterization of With-Project Conditions

The with-project conditions were characterized using the project description outlined for Alternative 2 in the ARCF GRR BA. This analysis was conducted at a feasibility level of design; specific project designs will be developed under a Planning and Engineering Design phase. In the absence of more specific designs, this SAM analysis was developed using a set of "reasonable worst-case" parameters. The parameters were developed by evaluating the applicability of past levee repair designs to the project reach. Past levee repairs were conducted under the Sacramento River Bank Protection Project (SRBPP) within each of the sub-reaches (USACE 2008, USACE 2013). Applicability of design features was evaluated using the professional judgment and experience of the project team. In cases where the applicability of a particular design feature for a particular reach was in question, the analysis erred on the side of caution and applied reduced values or omitted the feature from final analysis. The set of reasonable worst-case parameters is designed to provide a maximum estimation of impact for the purpose of consultation at feasibility planning level. A Vegetation Variance Request (VVR) was assumed to be in place for the Sacramento and American River reaches. The Corps will obtain an ETL-approved vegetation variance exempting the Sacramento River sites from vegetation removal in the lower third of the waterside of the levee prior to final construction and design phase. The Corps will be complying with the ETL on the American River via a SWIF. The VVR is not assumed to apply to the SBP. Specific habitat attributes are provided by site in (Tables 6-25) and specific justifications for each variable is also provided in those tables.

The following describes how input values for each of the SAM habitat attributes were derived for with-project conditions:

### 2.3.1 Bank Slope

In the SAM, bank slope serves as an indicator of the availability of shallow-water habitat and is obtained from point estimates of bank slope (horizontal change to vertical change, dW:dH) along each seasonal shoreline (i.e., the line where the water surface intersects the bank on average fall, winter, spring, and summer) (USACE 2004). With-project bank slopes were based on the description of project actions for each reach. Bank slopes for the Sacramento and American River reaches were assumed to be analogous to associated SRBPP repair sites that were in close proximity to the reach being analyzed. Consequently, bank slopes with a summer-fall slope of 3 and winter-spring slope of 10 were used.

### 2.3.2 Floodplain Availability

The with-project floodplain inundation ratios used in this SAM analysis remained unchanged from existing conditions. Levee repair and bank stabilization actions typically do not increase floodplain availability (with exception of constructing setback levees). In the absence of levee setback actions, the amount of available floodplain areas and channel cross sections would not be greatly altered during levee repair activities.

In this SAM analysis, it was assumed that the with-project floodplain inundation ratios would be the same as pre-project values. As a result, no impacts to habitat quality at the ARCF GRR reaches are expected with respect to this habitat variable.

### 2.3.3 Bank Substrate Size

The median substrate size ($D_{50}$) along the summer-fall and winter-spring shorelines of the project reach were based on the description of project actions for each sub-reach. Bank substrate size along the American River sub-reaches were assumed to be 18 inch rock revetment at summer-fall shoreline and 0.25 inch natural substrate at winter-spring shoreline. Bank substrate size along the Sacramento River sub-reaches were assumed to be 12 inch rock revetment at summer-fall shoreline and 0.25 inch natural substrate at winter-spring shoreline.

### 2.3.4 Instream Structure

The shoreline coverage of IWM along the average summer-fall and winter-spring shorelines was based on the description of project actions for each reach. In the SAM analysis, IWM coverage along the Sacramento and American River reaches were assumed to include installation of 40% shoreline coverage at summer-fall and winter-spring shoreline conditions.

### 2.3.5 Aquatic Vegetation

The shoreline coverage of aquatic vegetation along the average summer-fall and winter-spring shorelines was based on the description of project actions for each sub-reach. Aquatic vegetation along the Sacramento and American River sub-reaches were assumed to be analogous to SRBPP repair sites. The vegetation growth models below applied to the Sacramento and American River sub-reaches were taken from previous SAM analysis'. For the American River (ARN_AB, ARS_ABC) four previously constructed SRBPP sites within the ARCF GRR project area were used for analysis (LAR 0.3L, LAR 2.8L, LAR 10.0L, and LAR 10.6L)(USACE, 2013). For the Sacramento River 15 previously constructed SRBPP sites within the ARCF GRR project area were used for analysis (SAC 49.7L, SAC 52.3L, and SAC 53.5R)(USACE 2013) and (RM 47.0L, RM 47.9R, RM 48.2R, RM 49.6R, RM 49.9L, RM 50.2L, RM 50.4L, RM 50.8L, RM 51.5 L, RM 52.4L, RM 53.1L, and RM 56.7L)(USACE 2008). Relevant O&M activities were considered but excluded from this analysis. The assumed vegetation variance would apply to woody vegetation only and O&M activities would be expected to result in the removal of shrubs on the slope of the levee; however, it was assumed that typical SRBPP repair designs would locate the planted riparian bench at appropriate elevations and distance from the levee to allow for revegetation efforts. Any removal of shrubby vegetation as the result of O&M activities would take place on the upper slope of the levee and would not impact the habitat considered in a typical SAM analysis.

### 2.3.6 Overhanging Shade

The shoreline coverage of overhanging shade along the average summer-fall and winter-spring shorelines was based on the description of project actions for each sub-reach. Overhanging shade along the Sacramento and American River sub-reaches were assumed to be analogous to SRBPP repair sites. It was assumed that a variance would be in place allowing for retention of woody vegetation along the lower 2/3 of the levee slope. As the result of constructing a planted bench, it was assumed that the with-project seasonal shoreline would be shifted away from the existing shade providing canopy. Under this assumption, existing summer-fall values for overhanging shade were taken as the starting point for with-project winter-spring conditions. The with-project winter-spring values were further reduced by 75% (winter) and 25% (spring ) to account for defoliation. As a final step, these winter-spring values were reduced by 20% to account for trees removed for construction equipment access. With-project overhanging shade values were expected to start at 0% as the result of a constructed bench shifting the shoreline away from the existing canopy. The shade growth models below were applied to the starting seasonal values for overhanging shade described above along the Sacramento and American River sub-reaches. These shade growth models were taken from previous SRBPP SAM analysis' conducted within the ARCF GRR project area.

# 3.0 Results

The SAM results are presented as weighted response indices (WRI), that give a relative indication of fish response to a project action over time. A negative WRI can be interpreted as a reduction in habitat value and a positive WRI can be interpreted as a increase in habitat value Although the WRI values are not directly representative of actual lengths or areas, the resource agencies have used those values as proxies in determining mitigative requirements. Appropriate mitigation is typically determined by identifying the maximum negative WRI for critical life stages (spawning and egg incubation, fry and juvenile rearing, and juvenile migration) on a site-by-site basis. Therefore this section will present results with a focus on the identification of maximum negative WRIs.

As described above, the ARCF GRR project reaches were grouped into four SAM analysis reaches based on hydrologic connectivity. Results are presented below by reach and species and are summarized in tables 30-32 and figures 2-22 at the end of the document.

## 3.1 Sacramento River SAM Analysis (ARS_DEFG)

The Sacramento River SAM analysis reach includes the entire left bank (east side) of the Sacramento River from the American River confluence to approximately 4,020 linear feet (lf) below the Freeport Bridge. The response of all runs of Chinook salmon, steelhead, and green sturgeon to project actions were included in the analysis of this reach. The green sturgeon spawning and egg incubation life stage was excluded from the analysis because spawning does not occur in the project area.

### 3.1.1 Spring/ Fall/ Late-Fall/ Winter Run Chinook Salmon

Chinook salmon are expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach over the lifetime of the project. Chinook salmon should exhibit a positive response by year 5 in the winter-spring when most juvenile Chinook salmon are expected in the ARCF GRR project area. Short term negative WRI are expected within the recommended recovery period for Chinook salmon. The maximum negative WRI identified is -4,258 ft for the juvenile migration life stage of Chinook salmon in the summer of year 9. Short term negative WRI values will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions. The SAM data iterations for the various life stages for Chinook salmon can be seen in (Table 28 ). The WRI response curves for juvenile migration and rearing can be located in (Figures 4 and 7). The NMFS SAM effects analysis summary tables can be seen in (Table 32).

### 3.1.2 Steelhead

Steelhead are expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach over the lifetime of the project. Steelhead should exhibit a positive response by year 4 in the winter-spring when most juvenile steelhead will be migrating and rearing through the project area. The maximum negative WRI identified is -3,985 ft for the juvenile migration life stage of steelhead in the fall of year 10. Short term negative WRI values will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions. The WRI response curves for juvenile migration and rearing can be located in (Figures 10 and 13).

### 3.1.3 Green Sturgeon

SRBPP onsite mitigative features were designed to maximize habitat response for salmonid species. SAM WRI's for green sturgeon generally indicate a negative response or no response to typical onsite mitigative features. Green sturgeon are expected to show long term negative response to project actions in the Sacramento River SAM analysis reach for several life stages at all seasonal habitat conditions over the lifetime of the project. The maximum negative WRI identified is -5,009 for fry and juvenile rearing in the summer of year 1. Negative WRI displayed a general trend toward decreasing beyond the lifetime of the project for fry and juvenile rearing life stages. Negative WRI values for adult life stages will result from the creation of a 10:1 planted bench at winter/spring habitat conditions. The WRI response curves for juvenile rearing can be located in (Figure 16).

## 3.2 American River SAM Analysis (ARN_AB and ARS_ABC)

The American River SAM analysis reaches include portions of the right and left bank of the American River from Goethe Park to the confluence of the Sacramento. The response of spring and fall runs of Chinook salmon, steelhead, and green sturgeon were included in the analysis of these reaches. Additional seasonal fall run juvenile migration life stage analysis was conducted after consultation with NMFS. Green sturgeon analysis was also included because of critical habitat in the lowest sub-reach (ARS_C) of the American River project area.

### 3.2.1 Spring/ Fall Chinook Salmon

Chinook salmon are expected to show a long term positive response to project actions in the American River SAM analysis reaches over the lifetime of the project when both IWM and planted benches are incorporated into the with-project conditions. Chinook salmon should exhibit a positive response by year 5. Short term habitat deficits are expected within the recommended recovery period for Chinook salmon. The maximum negative WRI value identified for the American River SAM ARN_AB and ARS_ABC is -3,129 ft for the juvenile migration life stage of fall-run Chinook salmon in the summer of year 1. Short term negative WRI values will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions. The SAM data iterations for the various life stages for Chinook salmon can be seen in (Tables 26-27). The WRI response curves for juvenile migration and rearing can be located in (Figures 2,3,5,and 6). Additional fall-run Chinook salmon juvenile migration life stages not normally set as default in SAM were included on the American River reaches per NMFS request.

#### 3.2.2 Steelhead

Steelhead are expected to show a long term positive response to project actions in the American River SAM analysis reach over the lifetime of the project. Steelhead should exhibit a positive response by year 4. Short term habitat deficits are expected within the recommended recovery period for steelhead. The maximum negative WRI value identified for the American River SAM analysis is -3,061 ft for the adult residence life stage in the summer of year 1 (Figures 20 and 21). Short term negative WRI values will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions. The WRI response curves for juvenile migration and rearing can be located in (Figures 8,9,11, and 12).

#### 3.2.3 Green Sturgeon

Project actions in the American River SAM analysis reach will mimic SRBPP repair site onsite mitigative features. SRBPP onsite mitigative features were designed to maximize habitat response for salmonid species; green sturgeon will exhibit a negative response for juvenile rearing in the summer/fall to these onsite mitigative features. However, during the winter/spring green sturgeon juvenile rearing life stages will exhibit a positive response to these onsite mitigative features. The maximum negative WRI value identified is -7,118 ft for the fry and juvenile rearing life stage in the summer of year 1. The WRI response curves for juvenile rearing can be located in (Figures 14 and 15).

### 3.3 Sacramento Bypass and Weir SAM Analysis

The Sacramento Bypass SAM analysis reach includes the right bank (north side) of the Sacramento Bypass levee in its entirety from the confluence of the Sacramento River to its termination at the Yolo Bypass. The response of all runs of Chinook salmon, steelhead, and green sturgeon were included in the analysis of this reach.

### 3.3.1 Spring/ Fall/ Late-Fall/ Winter Run Chinook Salmon

Chinook salmon are expected to show a small long term negative response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project. Chinook salmon should exhibit a negative response by year 1. The maximum negative WRI value identified is -188 ft for the juvenile migration life stage of Spring and Winter-run Chinook salmon in the spring of year 2. Short term and long term negative WRI values will result from the loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions during and after the construction of the extension to the Sacramento Bypass Weir. The SAM data iterations for the various life stages for Chinook salmon can be seen in (Table 29 ). The NMFS SAM effects analysis summary tables can be seen in (Table 33).

### 3.3.2 Steelhead

Steelhead are also expected to show a small long term negative response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project. Steelhead should exhibit a negative response by year 1. The maximum negative WRI value identified is -174 ft for the juvenile migration life stage in the spring of year 2. Short term and long term negative WRI values will result from the loss of aquatic vegetation and over hanging shade at fall/summer/winter/spring habitat conditions during and after the construction of the extension to the Sacramento Bypass Weir. The NMFS SAM effects analysis summary tables can be seen in (Table 33).

### 3.3.3 Green Sturgeon

Green Sturgeon are expected to show a long term positive response to project actions in the Sacramento Bypass SAM analysis reach over the lifetime of the project for the fry and juvenile rearing life stages in the winter/spring/summer/fall of year 1. The maximum negative WRI value identified is -8 ft for the adult residence life stage of green sturgeon in the winter/spring/summer of year 1 which carries over through the life of the project into year 50. The SAM data iterations for the various life stages for green sturgeon can be seen in (Table 29). The NMFS SAM effects analysis summary tables can be seen in (Table 33).

## 4.0 Discussion

The SAM analysis indicates that the project actions in the Sacramento River SAM analysis reach, American River SAM analysis reach, and the Sacramento Bypass SAM analysis reach would result in short and longer-term impacts for focus fish species. Impacts to Chinook salmon, Central Valley steelhead, and green sturgeon are generally the result of reduction in the available natural substrate, shade and the alteration of near-shore slope resulting from bank armoring. Long term recovery of onsite vegetation, addition of IWM, and retention of existing vegetation are all expected to minimize impact as well as contribute to long term gains in habitat value.

This SAM analysis employed a set of worst case scenario parameters developed to capture the maximum potential impacts of the project for the Section 7 consultation process. Future implementation of the project is expected to result in significantly lower impacts. Project actions along portions of the American River reach will likely not include bank armoring in their final design, which will significantly reduce estimated impacts to fish species. Additional mitigative design features or improved erosion repair designs may result in reduced impact compared to the legacy designs used for the basis of this analysis. Site specific designs will be implemented on a site by site basis in consultation with resource agencies and project partners to minimize impacts as well as maximize opportunities for implementing onsite mitigative features.

During project implementation, site specific SAM analyses will be run on final designs to better evaluate impact. SAM results will be used by the Corps and NMFS in the negotiation of appropriate mitigation for project actions. Although short term impacts are generally self mitigating through the development of onsite mitigative features, the Corps will compensate for the temporal impacts to habitat through the purchase of offsite mitigative credits. Typically appropriate mitigation will be based on the identification of maximum negative WRI values. By mitigating for the maximum negative WRI, lesser impacts are expected to be appropriately mitigated. As a general rule, the SAM applies any habitat characteristics at summer/fall conditions to winter/spring conditions with the assumption that those characteristics would provide similar value during inundation. Onsite mitigation at summer/fall conditions is expected to provide similar habitat benefit for winter/spring conditions. Offsite mitigation is expected to provide mitigative value at all seasonal habitat conditions. Longer term impacts to habitat may not recover to baseline conditions over the life of the project due to design restrictions. These impacts to habitat will be compensated through the purchase of offsite mitigative credits as well as the incorporation of additional onsite mitigative features (ie. low water plantings, additional IWM, additional revegetation).

Additional mitigative concerns, not considered in a SAM analysis, will be addressed along the Sacramento Bypass reach, including potential adult and juvenile passage issues, loss of shoreline riparian vs. gain in floodplain, and contradicting ESA species habitat requirements. These issues will be considered and appropriate actions will be taken where possible in coordination with other agencies.

## 4.1 Chinook Salmon

Impacts to Chinook salmon were analyzed for the Sacramento River SAM analysis reach (ARS_DEFG), American River SAM analysis reach (ARN_AB, ARS_ABC) and the Sacramento Bypass SAM analysis reach. In the Sacramento River SAM analysis reach, negative WRI values are due to short term removal of aquatic vegetation and overhanging shade caused by the repair action. The SAM analysis indicates that repair actions would result in a maximum negative WRI value of -4,258 ft. This value is based on the maximum negative WRI value observed for juvenile migration life stage of Chinook salmon in the summer of year 9. USACE will mitigate for -4,258 ft of equivalent habitat as described above in Section 4.0.

In the American River SAM analysis reaches ARN_AB and ARS_ABC negative WRI values are due to short term removal of aquatic vegetation and overhanging shade caused by the repair action. The SAM analysis incorporating planted benches and IWM indicates that repair actions would result in a maximum habitat deficit of -3,129 ft. This value is based on the maximum negative WRI value observed for the juvenile migration life stage of spring and fall-run Chinook salmon in the summer and fall of year 1. USACE will mitigate for -3,129 ft of equivalent habitat as described above in Section 4.0.

There were no initial construction impact negative WRI values for the juvenile rearing life stage of Chinook salmon in the winter and spring water levels on the American and Sacramento River reaches. A possible explanation is that the SAM ECT does not produce an output at Year-0. It does not calculate the difference from the baseline to with-Project results. SAM at Year-0 is zero. The relative response for Year-1 is actually the Year-0 results+Year-1 results divided by 2, see pages 5-29 to 5-31 in the SAM Certification Update for SAM formula detailed explanation. In Year-0 revetment will be added, vegetation will be removed and slope will have a positive change. In Year-1 IWM will be added, soil and planting on the bench will occur, and the VVR will kick in. Year-0 habitat deficits would be more than the Year-1 deficits where the positive and negative deficits are equal.

In the Sacramento Bypass SAM analysis reach negative WRI values are due to short and long term removal of aquatic vegetation and overhanging shade for the upstream extension of the Sacramento Bypass Weir. The SAM analysis indicates that repair and removal actions would result in a maximum negative WRI value of -146 ft. This value is based on the maximum negative WRI value observed for juvenile migration of Chinook salmon in the winter of year 1. USACE will mitigate for -146 ft of equivalent habitat as described above in Section 4.0.

## 4.2 Steelhead

Impacts to steelhead were analyzed for the Sacramento River SAM analysis reach, American River SAM analysis reach, and the Sacramento Bypass SAM analysis reach. The Sacramento River SAM analysis indicates that repair actions would result in maximum negative WRI values of -3,985 ft. This value is based on the maximum negative WRI value observed for the juvenile migration life stage of steelhead in the fall of year 10.

The American River SAM analysis ARN_AB and ARS_ABC indicates that repair actions would result in negative WRI values of -3,061 ft. This negative WRI is expected to be adequately compensated through mitigation of a greater negative WRI for Chinook salmon.

There were no initial construction impact negative WRI values for the juvenile rearing life stage of steelhead in the winter and spring water levels on the Sacramento River reaches. A possible explanation is that the SAM ECT does not produce an output at Year-0. It does not calculate the difference from the baseline to with-Project results. SAM at Year-0 is zero. The relative response for Year-1 is actually the Year-0 results+Year-1 results divided by 2, see pages 5-29 to 5-31 in the SAM Certification Update for SAM formula detailed explanation. In Year-0 revetment will be added, vegetation will be removed and slope will have a positive change. In Year-1 IWM will be added, soil and planting on the bench will occur, and the VVR will kick in. Year-0 habitat deficits would be more than the Year-1 habitat deficits where the positive and negative deficits are equal.

The Sacramento Bypass SAM analysis indicates that repair actions would result in maximum negative WRI values of -174 ft. This value is based on the maximum negative WRI value observed for the juvenile migration life stage of steelhead in the spring of year 4. This negative WRI is expected to be adequately compensated through mitigation of a greater negative WRI for Chinook salmon.

## 4.3 Green Sturgeon

Impacts to green sturgeon were analyzed for the Sacramento and American River SAM and Sacramento Bypass analysis reaches. Green sturgeon critical habitat in the American River extends from the confluence of the Sacramento River to the Highway 160 bridge (ARS_C). Additional SAM elements were incorporated to address potential green sturgeon effects in the American River reaches (ARN_AB and ARS_AB), as per NMFS request, even though use of these reaches by green sturgeon has not been documented. Recently a white sturgeon (161mm) was collected in a rotary screw trap (RST) by the U.S. Fish and Wildlife Service (USFWS) at the Watt Avenue bridge, the first such documented catch of a sturgeon since records have been kept dating back to approximately 1996. There have been no green sturgeon collected, and the correlation of green sturgeon presence to white sturgeon presence is not well understood for larval life stages in this region of the river. This additional analysis allowed for a more conservative estimate of impacts and may not necessarily reflect the true impacts from the project.

The habitat requirements of green sturgeon are not well understood; assumptions built into the SAM on fish response to shoreline features were based on limited information. Habitat use of the American River, Sacramento River, and Sacramento Bypass project reaches by green sturgeon are likely limited to use as a migration corridor by adults and potential rearing area by juvenile life stages. Although the SAM indicates negative response to habitat by adult life stages, it is unlikely that shoreline repair activities would significantly impact the river for residence or as a migration corridor. SRBPP style repairs are designed to mimic naturally occurring habitat types and are not expected to significantly alter the width of the river. USACE does not expect any significant impacts to the adult residence or adult migration life stages in the American or Sacramento River and does not propose any additional mitigation.

No suitable spawning habitat exists in the Sacramento River, American River, and Sacramento Bypass project reaches. Green sturgeon spawning with concurrent egg incubation and early life history primarily takes place upriver of Colusa on the Sacramento River and in the lower Feather River outside of the project area. Because no suitable spawning habitat is present in the project reaches under existing conditions, USACE does not expect any significant impacts to the spawning and egg incubation life stage of green sturgeon and does not propose any additional mitigation.

The American River SAM analysis ARN_AB and ARS_ABC indicates that repair actions would result in a maximum negative WRI values of -7,118 ft. for fry and juvenile rearing in the summer of year one. The Sacramento River SAM analysis ARS_DEFG indicates that repair actions would result in a maximum negative WRI values of -5,009 for fry and juvenile rearing in the summer of year one.

The Sacramento Bypass SAM analysis indicates that repair actions would result in maximum negative WRI values of -8 ft in response to the removal of aquatic vegetation and SRA for the expansion of the Sacramento Bypass and Weir. This value is based on the maximum negative WRI values observed for the adult residence life stage of green sturgeon in the winter/spring /summer of year 1 continuing through the life of the project to year 50.

Little is known about the fry and juvenile rearing and juvenile migration life stages of green sturgeon. The SAM does not evaluate response to specific habitat attributes for the juvenile migration life stage. For the purpose of this analysis it is assumed that these life stages exhibit similar responses to analogous life stages of Chinook and steelhead. This approach assumes that fry and juvenile rearing and juvenile migration life stages of green sturgeon will exhibit a positive response to “good riparian habitat” (i.e. increased shoreline coverage of overhanging shade, aquatic vegetation, and IWM). During the planning and design phase of the project, opportunities for the incorporation of additional onsite mitigative features will be evaluated in coordination with resource agencies to ensure the projected longer term impacts are appropriately compensated for green sturgeon. Potential onsite mitigative features include the planting of vegetation at the low water line, the incorporation of additional IWM, and limitations in instream revetment.

**Table 6**

**SAM data summary of existing conditions at site Lower American River RM 10.0L and 10.6L (ARN_AB).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2024 | 18,576 | 18,576 | 18,576 | 18,576 |
| | 2074 | 18,576 | 18,576 | 18,576 | 18,576 |
| Bank Slope (dH:dV) [2] | 2024 | 2 | 2 | 2 | 2 |
| | 2074 | 2 | 2 | 2 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2024 | 1 | 1 | 1 | 1 |
| | 2074 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2024 | 2.5 | 2.5 | 2.5 | 2.5 |
| | 2074 | 2.5 | 2.5 | 2.5 | 2.5 |
| Instream Structure (% shoreline) [5] | 2024 | 31 | 31 | 31 | 31 |
| | 2074 | 31 | 31 | 31 | 31 |
| Vegetation (% shoreline) [6] | 2024 | 0 | 88 | 88 | 0 |
| | 2074 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [7] | 2024 | 60 | 15 | 45 | 60 |
| | 2074 | 60 | 15 | 45 | 60 |

[1] Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
[2] Existing slopes taken from 2 SRBPP repair sites modeled by SAM.
[3] Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
[4] Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a $D_{50}$ of 10 inches.
[5] Instream Structure data taken from USACE Revetment Database (2007).
[6] Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
[7] Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 7**

**SAM data summary of with-project conditions at site Lower American River RM 10.0L and 10.6L (ARN_AB).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2024 | 18,576 | 18,576 | 18,576 | 18,576 |
| | 2074 | 18,576 | 18,576 | 18,576 | 18,576 |
| Bank Slope (dH:dV) [2] | 2024 | 2 | 3 | 3 | 3 |
| | 2025 | 3 | 10 | 10 | 3 |
| | 2074 | 3 | 10 | 10 | 3 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2024 | 1 | 1 | 1 | 1 |
| | 2074 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2024 | 2.5 | 18 | 18 | 18 |
| | 2025 | 18 | 0.25 | 0.25 | 18 |
| | 2074 | 18 | 0.25 | 0.25 | 18 |
| Instream Structure (% shoreline) [5] | 2024 | 31 | 0 | 0 | 0 |
| | 2025 | 40 | 40 | 40 | 40 |
| | 2074 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2024 | 0 | 0 | 0 | 0 |
| | 2025 | 0 | 25 | 50 | 0 |
| | 2029 | 0 | 88 | 88 | 0 |
| | 2039 | 0 | 88 | 88 | 0 |
| | 2049 | 0 | 88 | 88 | 0 |
| | 2074 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2024 | 0 | 13 | 38 | 0 |
| | 2025 | 0 | 13 | 40 | 0 |
| | 2029 | 0 | 25 | 75 | 0 |
| | 2039 | 100 | 25 | 75 | 100 |
| | 2049 | 100 | 25 | 75 | 100 |
| | 2074 | 100 | 25 | 75 | 100 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.

[1] Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).

[2] Assume no significant change to Bank Slope.

[3] Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.

[4] Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.

[5] Assume installation of rock revetment at summer/fall ($D_{50}$ of 18 in) and natural substrate at winter/spring ($D_{50}$ of 0.25 in).

[6] Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.

[6] Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee.

**Table 8**

**SAM data summary of existing conditions at site Lower American River RM 10.0L and 10.6L (ARS_A).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2020 | 14,345 | 14,345 | 14,345 | 14,345 |
| | 2070 | 14,345 | 14,345 | 14,345 | 14,345 |
| Bank Slope (dH:dV) [2] | 2020 | 2.00 | 2.00 | 2.00 | 2.00 |
| | 2070 | 2.00 | 2.00 | 2.00 | 2.00 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2020 | 1 | 1 | 1 | 1 |
| | 2070 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2020 | 1.2 | 1.2 | 1.2 | 1.2 |
| | 2070 | 1.2 | 1.2 | 1.2 | 1.2 |
| Instream Structure (% shoreline) [5] | 2020 | 1.7 | 1.7 | 1.7 | 1.7 |
| | 2070 | 1.7 | 1.7 | 1.7 | 1.7 |
| Vegetation (% shoreline) [6] | 2020 | 0 | 63 | 63 | 0 |
| | 2070 | 0 | 63 | 63 | 0 |
| Shade (% shoreline) [7] | 2020 | 42 | 11 | 32 | 42 |
| | 2070 | 42 | 11 | 32 | 42 |

1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Existing slopes taken from 2 SRBPP repair sites modeled by SAM.
3 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
4 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
5 Instream Structure data taken from USACE Revetment Database (2007).
6 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
7 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 9**

**SAM data summary of with-project conditions at site Lower American River RM 10.0L and 10.6L (ARS_A).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2020 | 14,345 | 14,345 | 14,345 | 14,345 |
| | 2070 | 14,345 | 14,345 | 14,345 | 14,345 |
| Bank Slope (dH:dV) [2] | 2020 | 2.0 | 3.0 | 3.0 | 3.0 |
| | 2021 | 3.0 | 10.0 | 10.0 | 3.0 |
| | 2070 | 3.0 | 10.0 | 10.0 | 3.0 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2020 | 1 | 1 | 1 | 1 |
| | 2070 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2020 | 1.2 | 18 | 18 | 18 |
| | 2021 | 18 | 0.25 | 0.25 | 18 |
| | 2070 | 18 | 0.25 | 0.25 | 18 |
| Instream Structure (% shoreline) [5] | 2020 | 1.7 | 0.0 | 0.0 | 0 |
| | 2021 | 40 | 40 | 40 | 40 |
| | 2070 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2020 | 0 | 0 | 0 | 0 |
| | 2021 | 0 | 25 | 50 | 0 |
| | 2025 | 0 | 88 | 88 | 0 |
| | 2035 | 0 | 88 | 88 | 0 |
| | 2045 | 0 | 88 | 88 | 0 |
| | 2070 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2020 | 0 | 9 | 27 | 0 |
| | 2021 | 0 | 9 | 29 | 0 |
| | 2025 | 0 | 24 | 74 | 0 |
| | 2035 | 100 | 25 | 75 | 100 |
| | 2045 | 100 | 25 | 75 | 100 |
| | 2070 | 100 | 25 | 75 | 100 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.

[1] Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).

[2] Assume no significant change to Bank Slope.

[3] Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.

[4] Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.

[5] Assume installation of rock revetment at summer/fall ($D_{50}$ of 18 in) and natural substrate at winter/spring ($D_{50}$ of 0.25 in).

[6] Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.

[6] Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 10**

**SAM data summary of existing conditions at site Lower American River RM 2.8L (ARS_B).**

| Habitat Parameter | Water Year | Seasonal Values | | | |
|---|---|---|---|---|---|
| | | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2023 | 5,472 | 5,472 | 5,472 | 5,472 |
| | 2073 | 5,472 | 5,472 | 5,472 | 5,472 |
| Bank Slope (dH:dV) [2] | 2023 | 2 | 2 | 2 | 2 |
| | 2073 | 2 | 2 | 2 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2023 | 1 | 1 | 1 | 1 |
| | 2073 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2023 | 1.5 | 1.5 | 1.5 | 1.5 |
| | 2073 | 1.5 | 1.5 | 1.5 | 1.5 |
| Instream Structure (% shoreline) [5] | 2023 | 5 | 5 | 5 | 5 |
| | 2073 | 5 | 5 | 5 | 5 |
| Vegetation (% shoreline) [6] | 2023 | 0 | 65 | 65 | 0 |
| | 2073 | 0 | 65 | 65 | 0 |
| Shade (% shoreline) [7] | 2023 | 30 | 7 | 22 | 30 |
| | 2073 | 30 | 7 | 22 | 30 |

1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Existing slopes taken from 1 SRBPP repair site modeled by SAM.
3 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
4 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
5 Instream Structure data taken from USACE Revetment Database (2007).
6 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
7 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 11**

**SAM data summary of with-project conditions at site Lower American River RM 2.8L (ARS_B).**

| Habitat Parameter | Water Year | Seasonal Values | | | |
|---|---|---|---|---|---|
| | | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2023 | 5,472 | 5,472 | 5,472 | 5,472 |
| | 2073 | 5,472 | 5,472 | 5,472 | 5,472 |
| Bank Slope (dH:dV) [2] | 2023 | 2 | 3 | 3 | 3 |
| | 2024 | 3 | 10 | 10 | 3 |
| | 2073 | 3 | 10 | 10 | 3 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2023 | 1 | 1 | 1 | 1 |
| | 2073 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2023 | 1.5 | 18 | 18 | 18 |
| | 2024 | 18 | 0.25 | 0.25 | 18 |
| | 2073 | 18 | 0.25 | 0.25 | 18 |
| Instream Structure (% shoreline) [5] | 2023 | 5 | 0 | 0 | 0 |
| | 2024 | 40 | 40 | 40 | 40 |
| | 2073 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2023 | 0 | 0 | 0 | 0 |
| | 2024 | 0 | 25 | 50 | 0 |
| | 2028 | 0 | 88 | 88 | 0 |
| | 2038 | 0 | 88 | 88 | 0 |
| | 2048 | 0 | 88 | 88 | 0 |
| | 2073 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2023 | 0 | 7 | 20 | 0 |
| | 2024 | 0 | 7 | 22 | 0 |
| | 2028 | 0 | 22 | 67 | 0 |
| | 2038 | 100 | 25 | 75 | 100 |
| | 2048 | 100 | 25 | 75 | 100 |
| | 2073 | 100 | 25 | 75 | 100 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.
1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Assume no significant change to Bank Slope.
3 Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.
4 Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Assume installation of rock revetment at summer/fall (D50 of 18 in) and natural substrate at winter/spring (D50 of 0.25 in).
6 Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.
6 Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 12**

**SAM data summary of existing conditions at site Lower American River RM 0.3L (ARS_C).**

| Habitat Parameter | Water Year | Seasonal Values | | | |
|---|---|---|---|---|---|
| | | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2026 | 3,988 | 3,988 | 3,988 | 3,988 |
| | 2076 | 3,988 | 3,988 | 3,988 | 3,988 |
| Bank Slope (dH:dV) [2] | 2026 | 2 | 2 | 2 | 2 |
| | 2076 | 2 | 2 | 2 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2026 | 1 | 1 | 1 | 1 |
| | 2076 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2026 | 0.25 | 0.25 | 0.25 | 0.25 |
| | 2076 | 0.25 | 0.25 | 0.25 | 0.25 |
| Instream Structure (% shoreline) [5] | 2026 | 5 | 5 | 5 | 5 |
| | 2076 | 5 | 5 | 5 | 5 |
| Vegetation (% shoreline) [6] | 2026 | 0 | 88 | 88 | 0 |
| | 2076 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [7] | 2026 | 67 | 16 | 50 | 67 |
| | 2076 | 67 | 16 | 50 | 67 |

1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Existing slopes taken from 1 SRBPP repair site modeled by SAM.
3 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
4 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
5 Instream Structure data taken from USACE Revetment Database (2007).
6 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
7 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 13**

**SAM data summary of with-project conditions at site Lower American River RM 0.3L (ARS_C).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2026 | 3,988 | 3,988 | 3,988 | 3,988 |
| | 2076 | 3,988 | 3,988 | 3,988 | 3,988 |
| Bank Slope (dH:dV) [2] | 2026 | 2 | 3 | 3 | 3 |
| | 2027 | 3 | 10 | 10 | 3 |
| | 2076 | 3 | 10 | 10 | 3 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2026 | 1 | 1 | 1 | 1 |
| | 2076 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2026 | 0.25 | 18 | 18 | 18 |
| | 2027 | 18 | 0.25 | 0.25 | 18 |
| | 2076 | 18 | 0.25 | 0.25 | 18 |
| Instream Structure (% shoreline) [5] | 2026 | 5 | 0 | 0 | 0 |
| | 2027 | 40 | 40 | 40 | 40 |
| | 2076 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2026 | 0 | 0 | 0 | 0 |
| | 2027 | 0 | 25 | 50 | 0 |
| | 2031 | 0 | 88 | 88 | 0 |
| | 2041 | 0 | 88 | 88 | 0 |
| | 2051 | 0 | 88 | 88 | 0 |
| | 2076 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2026 | 0 | 14 | 42 | 0 |
| | 2027 | 0 | 14 | 44 | 0 |
| | 2031 | 0 | 25 | 75 | 0 |
| | 2041 | 100 | 25 | 75 | 100 |
| | 2051 | 100 | 25 | 75 | 100 |
| | 2076 | 100 | 25 | 75 | 100 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.
1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Assume no significant change to Bank Slope.
3 Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.
4 Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Assume installation of rock revetment at summer/fall (D50 of 18 in) and natural substrate at winter/spring (D50 of 0.25 in).
6 Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.
6 Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 14**

**SAM data summary of existing conditions at site Sacramento River RM 56.7L (ARS_D).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) 1 | 2025 | 9,131 | 9,131 | 9,131 | 9,131 |
| | 2075 | 9,131 | 9,131 | 9,131 | 9,131 |
| Bank Slope (dH:dV) 2 | 2025 | 1.8 | 1.8 | 1.8 | 1.8 |
| | 2075 | 1.8 | 1.8 | 1.8 | 1.8 |
| Floodplain Inundation Ratio (AQ2:AQavg) 3 | 2025 | 1 | 1 | 1 | 1 |
| | 2075 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) 4 | 2025 | 7.6 | 7.6 | 7.6 | 7.6 |
| | 2075 | 7.6 | 7.6 | 7.6 | 7.6 |
| Instream Structure (% shoreline) 5 | 2025 | 22 | 22 | 22 | 22 |
| | 2075 | 22 | 22 | 22 | 22 |
| Vegetation (% shoreline) 6 | 2025 | 0 | 88 | 88 | 0 |
| | 2075 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) 7 | 2025 | 40 | 10 | 30 | 40 |
| | 2075 | 40 | 10 | 30 | 40 |

1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Existing slopes taken from 1 SRBPP repair site modeled by SAM.
3 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
4 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
5 Instream Structure data taken from USACE Revetment Database (2007).
6 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
7 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 15**

**SAM data summary of with-project conditions at site Sacramento River RM 56.7L (ARS_D).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2025 | 9,131 | 9,131 | 9,131 | 9,131 |
| | 2075 | 9,131 | 9,131 | 9,131 | 9,131 |
| Bank Slope (dH:dV) [2] | 2025 | 2.5 | 1.5 | 1.5 | 1.5 |
| | 2026 | 1.5 | 6.5 | 6.5 | 1.5 |
| | 2075 | 1.5 | 6.5 | 6.5 | 1.5 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2025 | 1 | 1 | 1 | 1 |
| | 2075 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2025 | 7.6 | 12 | 12 | 12 |
| | 2026 | 12 | 0.25 | 0.25 | 12 |
| | 2075 | 12 | 0.25 | 0.25 | 12 |
| Instream Structure (% shoreline) [5] | 2025 | 22 | 0 | 0 | 0 |
| | 2026 | 0 | 0 | 0 | 0 |
| | 2075 | 0 | 0 | 0 | 0 |
| Vegetation (% shoreline) [6] | 2025 | 0 | 0 | 0 | 0 |
| | 2026 | 0 | 0 | 0 | 0 |
| | 2030 | 10 | 60 | 60 | 10 |
| | 2040 | 10 | 88 | 88 | 10 |
| | 2050 | 10 | 88 | 88 | 10 |
| | 2075 | 10 | 88 | 88 | 10 |
| Shade (% shoreline) [6] | 2025 | 0 | 8 | 24 | 0 |
| | 2026 | 0 | 8 | 25 | 0 |
| | 2030 | 0 | 9 | 35 | 0 |
| | 2040 | 61 | 13 | 66 | 61 |
| | 2050 | 97 | 15 | 75 | 97 |
| | 2075 | 99 | 15 | 75 | 99 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.
1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Assume no significant change to Bank Slope.
3 Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.
4 Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Assume installation of rock revetment at summer/fall (D50 of 12 in) and natural substrate at winter/spring (D50 of 0.25 in).
6 Assume no installation of shoreline coverage of IWM at summer/fall and winter/spring.
6 Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 16**

**SAM data summary of existing conditions at site Sacramento River RM 53.1L and RM 53.5R (ARS_E).**

| Habitat Parameter | Water Year | Seasonal Values | | | |
|---|---|---|---|---|---|
| | | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2021 | 9,149 | 9,149 | 9,149 | 9,149 |
| | 2071 | 9,149 | 9,149 | 9,149 | 9,149 |
| Bank Slope (dH:dV) [2] | 2021 | 1.7 | 1.7 | 1.7 | 1.7 |
| | 2071 | 1.7 | 1.7 | 1.7 | 1.7 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2021 | 1 | 1 | 1 | 1 |
| | 2071 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2021 | 7 | 7 | 7 | 7 |
| | 2071 | 7 | 7 | 7 | 7 |
| Instream Structure (% shoreline) [5] | 2021 | 30 | 30 | 30 | 30 |
| | 2071 | 30 | 30 | 30 | 30 |
| Vegetation (% shoreline) [6] | 2021 | 0 | 88 | 88 | 0 |
| | 2071 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [7] | 2021 | 60 | 15 | 45 | 60 |
| | 2071 | 60 | 15 | 45 | 60 |

[1] Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
[2] Existing slopes taken from 2 SRBPP repair sites modeled by SAM.
[3] Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
[4] Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a $D_{50}$ of 10 inches.
[5] Instream Structure data taken from USACE Revetment Database (2007).
[6] Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
[7] Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 17**

**SAM data summary of with-project conditions at site Sacramento River RM 53.1L and 53.5R (ARS_E).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2021 | 9,149 | 9,149 | 9,149 | 9,149 |
| | 2071 | 9,149 | 9,149 | 9,149 | 9,149 |
| Bank Slope (dH:dV) [2] | 2021 | 1.7 | 2 | 2 | 2 |
| | 2022 | 2 | 6 | 6 | 2 |
| | 2071 | 2 | 6 | 6 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2021 | 1 | 1 | 1 | 1 |
| | 2071 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2021 | 7 | 12 | 12 | 12 |
| | 2022 | 12 | 0.25 | 0.25 | 12 |
| | 2071 | 12 | 0.25 | 0.25 | 12 |
| Instream Structure (% shoreline) [5] | 2021 | 30 | 0 | 0 | 0 |
| | 2022 | 40 | 40 | 40 | 40 |
| | 2071 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2021 | 0 | 0 | 0 | 0 |
| | 2022 | 0 | 50 | 50 | 0 |
| | 2026 | 0 | 88 | 88 | 0 |
| | 2036 | 0 | 88 | 88 | 0 |
| | 2046 | 0 | 88 | 88 | 0 |
| | 2071 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2021 | 0 | 12 | 36 | 0 |
| | 2022 | 0 | 12 | 37 | 0 |
| | 2026 | 0 | 13 | 42 | 0 |
| | 2036 | 61 | 17 | 75 | 61 |
| | 2046 | 97 | 19 | 75 | 97 |
| | 2071 | 99 | 19 | 75 | 99 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.

[1] Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).

[2] Assume no significant change to Bank Slope.

[3] Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.

[4] Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.

[5] Assume installation of rock revetment at summer/fall ($D_{50}$ of 12 in) and natural substrate at winter/spring ($D_{50}$ of 0.25 in).

[6] Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.

[6] Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 18**

**SAM data summary of existing conditions at site Sacramento River RM 48.2L-52.4L (ARS_F).**

| Habitat Parameter | Water Year | Seasonal Values: Fall | Winter | Spring | Summer |
|---|---|---|---|---|---|
| Shoreline Length (feet) [1] | 2020 | 21,379 | 21,379 | 21,379 | 21,379 |
| | 2070 | 21,379 | 21,379 | 21,379 | 21,379 |
| Bank Slope (dH:dV) [2] | 2020 | 1.8 | 1.8 | 1.8 | 1.8 |
| | 2070 | 1.8 | 1.8 | 1.8 | 1.8 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2020 | 1 | 1 | 1 | 1 |
| | 2070 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2020 | 8.7 | 8.7 | 8.7 | 8.7 |
| | 2070 | 8.7 | 8.7 | 8.7 | 8.7 |
| Instream Structure (% shoreline) [5] | 2020 | 17 | 17 | 17 | 17 |
| | 2070 | 17 | 17 | 17 | 17 |
| Vegetation (% shoreline) [6] | 2020 | 0 | 88 | 88 | 0 |
| | 2070 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [7] | 2020 | 73 | 18 | 54 | 73 |
| | 2070 | 73 | 18 | 54 | 73 |

1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Existing slopes taken from 10 SRBPP repair sites modeled by SAM.
3 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
4 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
5 Instream Structure data taken from USACE Revetment Database (2007).
6 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
7 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 19**

**SAM data summary of with-project conditions at site Sacramento River RM 48.2L-52.4L (ARS_F).**

| Habitat Parameter | Water Year | Seasonal Values Fall | Winter | Spring | Summer |
|---|---|---|---|---|---|
| Shoreline Length (feet) [1] | 2020 | 21,379 | 21,379 | 21,379 | 21,379 |
| | 2070 | 21,379 | 21,379 | 21,379 | 21,379 |
| Bank Slope (dH:dV) [2] | 2020 | 1.8 | 2.0 | 2.0 | 2 |
| | 2021 | 2 | 6 | 6 | 2 |
| | 2070 | 2 | 6 | 6 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2020 | 1 | 1 | 1 | 1 |
| | 2070 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2020 | 8.7 | 12 | 12 | 12 |
| | 2021 | 12 | 0.25 | 0.25 | 12 |
| | 2070 | 12 | 0.25 | 0.25 | 12 |
| Instream Structure (% shoreline) [5] | 2020 | 17 | 0 | 0 | 0 |
| | 2021 | 40 | 40 | 40 | 40 |
| | 2070 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2020 | 0 | 0 | 0 | 0 |
| | 2021 | 0 | 50 | 50 | 0 |
| | 2025 | 0 | 88 | 88 | 0 |
| | 2035 | 0 | 88 | 88 | 0 |
| | 2045 | 0 | 88 | 88 | 0 |
| | 2070 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2020 | 0 | 14 | 43 | 0 |
| | 2021 | 0 | 14 | 44 | 0 |
| | 2025 | 0 | 15 | 54 | 0 |
| | 2035 | 61 | 19 | 75 | 61 |
| | 2045 | 97 | 21 | 75 | 97 |
| | 2070 | 99 | 21 | 75 | 99 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.
1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Assume no significant change to Bank Slope.
3 Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.
4 Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Assume installation of rock revetment at summer/fall (D50 of 12 in) and natural substrate at winter/spring (D50 of 0.25 in).
6 Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.
6 Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 20**

**SAM data summary of existing conditions at site Sacramento River RM 47.0L and 47.9R (ARS_G).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2024 | 11,066 | 11,066 | 11,066 | 11,066 |
| | 2074 | 11,066 | 11,066 | 11,066 | 11,066 |
| Bank Slope (dH:dV) [2] | 2024 | 2 | 2 | 2 | 2 |
| | 2074 | 2 | 2 | 2 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2024 | 1 | 1 | 1 | 1 |
| | 2074 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2024 | 9.40 | 9.40 | 9.40 | 9.40 |
| | 2074 | 9.40 | 9.40 | 9.40 | 9.40 |
| Instream Structure (% shoreline) [5] | 2024 | 5.5 | 5.5 | 5.5 | 5.5 |
| | 2074 | 5.5 | 5.5 | 5.5 | 5.5 |
| Vegetation (% shoreline) [6] | 2024 | 0 | 88 | 88 | 0 |
| | 2074 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [7] | 2024 | 90 | 22 | 67 | 90 |
| | 2074 | 90 | 22 | 67 | 90 |

1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Existing slopes taken from 2 SRBPP repair sites modeled by SAM.
3 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of one for all seasons in all ARCF GRR Reaches.
4 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
5 Instream Structure data taken from USACE Revetment Database (2007).
6 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
7 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 21**

SAM data summary of with-project conditions at site Sacramento River RM 47.0L and 47.9R (ARS_G).

| Habitat Parameter | Water Year | Seasonal Values | | | |
|---|---|---|---|---|---|
| | | Fall | Winter | Spring | Summer |
| Shoreline Length (feet) [1] | 2024 | 11,066 | 11,066 | 11,066 | 11,066 |
| | 2074 | 11,066 | 11,066 | 11,066 | 11,066 |
| Bank Slope (dH:dV) [2] | 2024 | 2.5 | 3 | 3 | 3 |
| | 2025 | 3 | 10 | 10 | 3 |
| | 2074 | 3 | 10 | 10 | 3 |
| Floodplain Inundation Ratio (AQ2:AQavg) [3] | 2024 | 1 | 1 | 1 | 1 |
| | 2074 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [4] | 2024 | 9.4 | 12 | 12 | 12 |
| | 2025 | 12 | 0.25 | 0.25 | 12 |
| | 2074 | 12 | 0.25 | 0.25 | 12 |
| Instream Structure (% shoreline) [5] | 2024 | 5.5 | 0 | 0 | 0 |
| | 2025 | 40 | 40 | 40 | 40 |
| | 2074 | 40 | 40 | 40 | 40 |
| Vegetation (% shoreline) [6] | 2024 | 0 | 0 | 0 | 0 |
| | 2025 | 0 | 50 | 50 | 0 |
| | 2029 | 0 | 88 | 88 | 0 |
| | 2039 | 0 | 88 | 88 | 0 |
| | 2049 | 0 | 88 | 88 | 0 |
| | 2074 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) [6] | 2024 | 0 | 18 | 54 | 0 |
| | 2025 | 0 | 18 | 55 | 0 |
| | 2029 | 0 | 19 | 65 | 0 |
| | 2039 | 100 | 23 | 75 | 100 |
| | 2049 | 100 | 25 | 75 | 100 |
| | 2074 | 100 | 25 | 75 | 100 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.
1 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
2 Assume no significant change to Bank Slope.
3 Assume no significant increase in floodplain between seasonal water surface elevations or as a result of project construction.
4 Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Assume installation of rock revetment at summer/fall (D50 of 12 in) and natural substrate at winter/spring (D50 of 0.25 in).

6 Assume installation of 40% shoreline coverage of IWM at summer/fall and winter/spring.
6 Assume a variance in place allowing existing woody vegetation to remain in place on bottom 2/3 of levee

**Table 22**

SAM data summary of existing conditions at site Sacramento River 50.0L (SBP Levee).

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Wetted Area (square feet) [1] | 2012 | 8,799,296 | 8,799,296 | 8,799,296 | 8,799,296 |
| | 2062 | 8,799,296 | 8,799,296 | 8,799,296 | 8,799,296 |
| Shoreline Length (feet) [2] | 2012 | 9,047 | 9,047 | 9,047 | 9,047 |
| | 2062 | 9,047 | 9,047 | 9,047 | 9,047 |
| Bank Slope (dH:dV) [3] | 2012 | 2 | 2 | 2 | 2 |
| | 2062 | 2 | 2 | 2 | 2 |
| Floodplain Inundation Ratio (AQ2:AQavg) [4] | 2012 | 1 | 1 | 1 | 1 |
| | 2062 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [5] | 2012 | 2.4 | 2.4 | 2.4 | 2.4 |
| | 2062 | 2.4 | 2.4 | 2.4 | 2.4 |
| Instream Structure (% shoreline) [6] | 2012 | 3.9 | 3.9 | 3.9 | 3.9 |
| | 2062 | 3.9 | 3.9 | 3.9 | 3.9 |
| Vegetation (% shoreline) [7] | 2012 | 0 | 71 | 71 | 0 |
| | 2062 | 0 | 71 | 71 | 0 |
| Shade (% shoreline) [8] | 2012 | 48 | 12 | 36 | 48 |
| | 2062 | 48 | 12 | 36 | 48 |

1 Wetted area estimated from aerial images in Google Earth Pro. Length x Width
2 USACE Revetment Database (2007) and Google Earth Pro.
3 Repairs not expected to affect slope, assume slope of 2 for consistency with USACE standards.
4 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
6 Instream Structure data taken from USACE Revetment Database (2007).
7 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
8 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation.

**Table 23**
**SAM data summary of with-project conditions at site Sacramento River RM 50.0L (SBP Levee).**

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Wetted Area (square feet) [1] | 2012 | 23,022,296 | 23,022,296 | 23,022,296 | 23,022,296 |
| | 2062 | 23,022,296 | 23,022,296 | 23,022,296 | 23,022,296 |
| Shoreline Length (feet) [2] | 2012 | 9,047 | 9,047 | 9,047 | 9,047 |
| | 2062 | 9,047 | 9,047 | 9,047 | 9,047 |
| Bank Slope (dH:dV) | 2012 | 2.5 | 2.5 | 2.5 | 2.5 |
| | 2013 | 2.5 | 2.5 | 2.5 | 2.5 |
| | 2062 | 2.5 | 2.5 | 2.5 | 2.5 |
| Floodplain Inundation Ratio (AQ2:AQavg) | 2012 | 1 | 1 | 1 | 1 |
| | 2062 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [3] | 2012 | 2.4 | 2.4 | 2.4 | 2.4 |
| | 2013 | 2.4 | 2.4 | 2.4 | 2.4 |
| | 2062 | 2.4 | 2.4 | 2.4 | 2.4 |
| Instream Structure (% shoreline) [3] | 2012 | 3.9 | 3.9 | 3.9 | 3.9 |
| | 2013 | 3.9 | 3.9 | 3.9 | 3.9 |
| | 2062 | 3.9 | 3.9 | 3.9 | 3.9 |
| Vegetation (% shoreline) [3] | 2012 | 0 | 71 | 71 | 0 |
| | 2013 | 0 | 71 | 71 | 0 |
| | 2017 | 0 | 71 | 71 | 0 |
| | 2027 | 0 | 71 | 71 | 0 |
| | 2037 | 0 | 71 | 71 | 0 |
| | 2062 | 0 | 71 | 71 | 0 |
| Shade (% shoreline)[3] | 2012 | 48 | 12 | 36 | 48 |
| | 2013 | 48 | 12 | 36 | 48 |
| | 2017 | 48 | 12 | 36 | 48 |
| | 2027 | 48 | 12 | 36 | 48 |
| | 2037 | 48 | 12 | 36 | 48 |
| | 2062 | 48 | 12 | 36 | 48 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.
1 Wetted area calculated by aerial images and a length x width with-project conditions
2 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).
3 Assumed to stay the same due to only degrading and moving levee

**Table 24**

SAM data summary of existing conditions at site Sacramento River RM 50.0L (SBP Weir).

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Wetted Area (square feet) 1 | 2012 | 283,968 | 283,968 | 283,968 | 283,968 |
| | 2062 | 283,968 | 283,968 | 283,968 | 283,968 |
| Shoreline Length (feet) 2 | 2012 | 1,500 | 1,500 | 1,500 | 1,500 |
| | 2062 | 1,500 | 1,500 | 1,500 | 1,500 |
| Bank Slope (dH:dV) 3 | 2012 | 2.5 | 2.5 | 2.5 | 2.5 |
| | 2062 | 2.5 | 2.5 | 2.5 | 2.5 |
| Floodplain Inundation Ratio (AQ2:AQavg) 4 | 2012 | 1 | 1 | 1 | 1 |
| | 2062 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) 5 | 2012 | 10 | 10 | 10 | 10 |
| | 2062 | 10 | 10 | 10 | 10 |
| Instream Structure (% shoreline) 6 | 2012 | 0 | 0 | 0 | 0 |
| | 2062 | 0 | 0 | 0 | 0 |
| Vegetation (% shoreline) 7 | 2012 | 0 | 88 | 88 | 0 |
| | 2062 | 0 | 88 | 88 | 0 |
| Shade (% shoreline) 8 | 2012 | 48 | 12 | 36 | 48 |
| | 2062 | 48 | 12 | 36 | 48 |

1 Wetted area estimated from aerial images in Google Earth Pro. Length x Width
2 USACE Revetment Database (2007) and Google Earth Pro.
3 Repairs not expected to affect slope, assume slope of 2 for consistency with USACE standards.
4 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Bank substrate data taken from USACE Revetment Database (2007) and confirmed with aerial imagery. Natural substrate assigned a D50 of 0.25 inches. Revetment substrate assigned a D50 of 10 inches.
6 Instream Structure data taken from USACE Revetment Database (2007).
7 Shoreline coverage of Vegetation taken from USACE Revetment Database and evaluated against aerial imagery. Summer/Fall values taken from "Emergent Veg" attribute. Winter/ Spring values taken from "Veg Cover%" attribute.
8 Attribute coverage determined from analysis of aerial imagery. Winter/ Spring values modified by 0.25/ 0.75 respectively to represent seasonal defoliation

**Table 25**

SAM data summary of with-project conditions at site Sacramento River RM 50.0L (SBP Weir).

| | | Seasonal Values | | | |
|---|---|---|---|---|---|
| Habitat Parameter | Water Year | Fall | Winter | Spring | Summer |
| Wetted Area (square feet) [1] | 2012 | 742,968 | 742,968 | 742,968 | 742,968 |
| | 2062 | 742,968 | 742,968 | 742,968 | 742,968 |
| Shoreline Length (feet) [2] | 2012 | 1,500 | 1,500 | 1,500 | 1,500 |
| | 2062 | 1,500 | 1,500 | 1,500 | 1,500 |
| Bank Slope (dH:dV) [3] | 2012 | 2.5 | 2.5 | 2.5 | 2.5 |
| | 2013 | 2.5 | 2.5 | 2.5 | 2.5 |
| | 2062 | 2.5 | 2.5 | 2.5 | 2.5 |
| Floodplain Inundation Ratio (AQ2:AQavg) [4] | 2012 | 1 | 1 | 1 | 1 |
| | 2062 | 1 | 1 | 1 | 1 |
| Bank Substrate Size (D50 in inches) [5] | 2012 | 10 | 10 | 10 | 10 |
| | 2013 | 10 | 10 | 10 | 10 |
| | 2062 | 10 | 10 | 10 | 10 |
| Instream Structure (% shoreline) [6] | 2012 | 0 | 0 | 0 | 0 |
| | 2013 | 0 | 0 | 0 | 0 |
| | 2062 | 0 | 0 | 0 | 0 |
| Vegetation (% shoreline) [6] | 2012 | 0 | 0 | 0 | 0 |
| | 2013 | 0 | 0 | 0 | 0 |
| | 2017 | 0 | 0 | 0 | 0 |
| | 2027 | 0 | 0 | 0 | 0 |
| | 2037 | 0 | 0 | 0 | 0 |
| | 2062 | 0 | 0 | 0 | 0 |
| Shade (% shoreline) [6] | 2012 | 0 | 0 | 0 | 0 |
| | 2013 | 0 | 0 | 0 | 0 |
| | 2017 | 0 | 0 | 0 | 0 |
| | 2027 | 0 | 0 | 0 | 0 |
| | 2037 | 0 | 0 | 0 | 0 |
| | 2062 | 0 | 0 | 0 | 0 |

-WY = water year; spans fall, winter, spring and summer; rock and soil placement and IWM installation assumed during Winter in the initial WY and revegetation planting assumed during Spring of the initial WY.

1 Wetted area calculated by aerial images and a length x width with-project conditions

2 Shoreline Length Estimated from Aerial images. Attribute surveyed in the field following the field data collection protocol for the USACE Revetment Database (2007).

3 Repairs not expected to affect slope, assume slope of 2.5 for consistency with USACE standards.

4 Assume no significant increase in floodplain between seasonal water surface elevations. Assume floodplain inundation ratio of 1 for all seasons in all ARCF GRR Reaches.
5 Assume installation of rock revetment at summer/fall (D50 of 12 in) and natural substrate at winter/spring (D50 of 0.25 in).
6 Assume no vegetation variance and no placement of IWM and O&M activities

**Table 26 American River SAM Analysis Reach**

ARN_AB

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Spring-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | | | | | 0 | | |
| 1 | | | -366 | -1,945 | | | | 59 | -3,002 | | | | 124 | | | | | -421 | | |
| 2 | | | -365 | -2,166 | | | | 411 | -1,357 | | | | 634 | | | | | -392 | | |
| 3 | | | -365 | -2,240 | | | | 564 | -662 | | | | 827 | | | | | -383 | | |
| 4 | | | -364 | -2,277 | | | | 667 | -201 | | | | 941 | | | | | -378 | | |
| 5 | | | -364 | -2,299 | | | | 751 | 167 | | | | 1,024 | | | | | -375 | | |
| 6 | | | -361 | -2,303 | | | | 816 | 450 | | | | 1,085 | | | | | -370 | | |
| 7 | | | -353 | -2,288 | | | | 863 | 653 | | | | 1,129 | | | | | -360 | | |
| 8 | | | -341 | -2,260 | | | | 897 | 805 | | | | 1,161 | | | | | -348 | | |
| 9 | | | -328 | -2,225 | | | | 925 | 924 | | | | 1,187 | | | | | -334 | | |
| 10 | | | -314 | -2,183 | | | | 946 | 1,018 | | | | 1,207 | | | | | -319 | | |
| 11 | | | -298 | -2,138 | | | | 964 | 1,096 | | | | 1,224 | | | | | -303 | | |
| 12 | | | -282 | -2,089 | | | | 979 | 1,160 | | | | 1,238 | | | | | -287 | | |
| 13 | | | -265 | -2,038 | | | | 991 | 1,215 | | | | 1,250 | | | | | -270 | | |
| 14 | | | -248 | -1,985 | | | | 1,002 | 1,261 | | | | 1,260 | | | | | -252 | | |
| 15 | | | -230 | -1,930 | | | | 1,011 | 1,302 | | | | 1,268 | | | | | -234 | | |
| 25 | | | -124 | -1,600 | | | | 1,063 | 1,529 | | | | 1,317 | | | | | -126 | | |
| 50 | | | -44 | -1,352 | | | | 1,102 | 1,699 | | | | 1,354 | | | | | -45 | | |
| Fall-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | | 0 | 0 | 0 | | | | | 0 | |
| 1 | -877 | 0 | -366 | -1,945 | | -759 | 0 | 59 | -3,002 | | | 0 | 124 | -2,681 | | | | | -3,129 | |
| 2 | -853 | 0 | -365 | -2,166 | | -339 | 0 | 411 | -1,357 | | | 0 | 634 | -755 | | | | | -2,759 | |
| 3 | -845 | 0 | -365 | -2,240 | | -180 | 0 | 564 | -662 | | | 0 | 827 | -80 | | | | | -2,635 | |
| 4 | -841 | 0 | -364 | -2,277 | | -87 | 0 | 667 | -201 | | | 0 | 941 | 282 | | | | | -2,573 | |
| 5 | -839 | 0 | -364 | -2,299 | | -20 | 0 | 751 | 167 | | | 0 | 1,024 | 519 | | | | | -2,536 | |
| 6 | -828 | 0 | -361 | -2,303 | | 29 | 0 | 816 | 450 | | | 0 | 1,085 | 686 | | | | | -2,501 | |
| 7 | -804 | 0 | -353 | -2,288 | | 64 | 0 | 863 | 653 | | | 0 | 1,129 | 805 | | | | | -2,457 | |
| 8 | -773 | 0 | -341 | -2,260 | | 90 | 0 | 897 | 805 | | | 0 | 1,161 | 894 | | | | | -2,408 | |
| 9 | -736 | 0 | -328 | -2,225 | | 111 | 0 | 925 | 924 | | | 0 | 1,187 | 963 | | | | | -2,356 | |
| 10 | -695 | 0 | -314 | -2,183 | | 127 | 0 | 946 | 1,018 | | | 0 | 1,207 | 1,018 | | | | | -2,302 | |
| 11 | -652 | 0 | -298 | -2,138 | | 141 | 0 | 964 | 1,096 | | | 0 | 1,224 | 1,064 | | | | | -2,245 | |
| 12 | -606 | 0 | -282 | -2,089 | | 152 | 0 | 979 | 1,160 | | | 0 | 1,238 | 1,102 | | | | | -2,188 | |
| 13 | -559 | 0 | -265 | -2,038 | | 161 | 0 | 991 | 1,215 | | | 0 | 1,250 | 1,134 | | | | | -2,129 | |
| 14 | -511 | 0 | -248 | -1,985 | | 170 | 0 | 1,002 | 1,261 | | | 0 | 1,260 | 1,161 | | | | | -2,069 | |
| 15 | -462 | 0 | -230 | -1,930 | | 177 | 0 | 1,011 | 1,302 | | | 0 | 1,268 | 1,185 | | | | | -2,009 | |
| 25 | -164 | 0 | -124 | -1,600 | | 216 | 0 | 1,063 | 1,529 | | | 0 | 1,317 | 1,318 | | | | | -1,647 | |
| 50 | 59 | 0 | -44 | -1,352 | | 245 | 0 | 1,102 | 1,699 | | | 0 | 1,354 | 1,418 | | | | | -1,375 | |

4.0 defaults used for all response curves

Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 26 (cont.)**

**American River SAM Analysis Reach**

ARN_AB

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Steelhead | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 | 0 |
| 1 | -1,554 | | -701 | | -1,554 | -1,558 | 0 | -36 | | -1,558 | -1,635 | 0 | -1 | -2,096 | -1,635 | | | -833 | -3,013 | -3,061 |
| 2 | -1,508 | | -708 | | -1,508 | -701 | 0 | 519 | | -701 | -739 | 0 | 734 | -520 | -739 | | | -774 | -2,634 | -2,262 |
| 3 | -1,493 | | -711 | | -1,493 | -381 | 0 | 750 | | -381 | -411 | 0 | 1,009 | 23 | -411 | | | -755 | -2,507 | -1,996 |
| 4 | -1,486 | | -712 | | -1,486 | -195 | 0 | 900 | | -195 | -225 | 0 | 1,168 | 309 | -225 | | | -745 | -2,444 | -1,862 |
| 5 | -1,481 | | -712 | | -1,481 | -63 | 0 | 1,018 | | -63 | -96 | 0 | 1,282 | 491 | -96 | | | -739 | -2,406 | -1,782 |
| 6 | -1,463 | | -707 | | -1,463 | 34 | 0 | 1,109 | | 34 | -3 | 0 | 1,365 | 617 | -3 | | | -729 | -2,369 | -1,714 |
| 7 | -1,423 | | -693 | | -1,423 | 103 | 0 | 1,174 | | 103 | 63 | 0 | 1,424 | 708 | 63 | | | -712 | -2,323 | -1,639 |
| 8 | -1,371 | | -674 | | -1,371 | 155 | 0 | 1,222 | | 155 | 113 | 0 | 1,469 | 775 | 113 | | | -691 | -2,271 | -1,559 |
| 9 | -1,309 | | -651 | | -1,309 | 196 | 0 | 1,260 | | 196 | 152 | 0 | 1,504 | 828 | 152 | | | -666 | -2,215 | -1,477 |
| 10 | -1,242 | | -626 | | -1,242 | 228 | 0 | 1,290 | | 228 | 183 | 0 | 1,531 | 870 | 183 | | | -639 | -2,156 | -1,392 |
| 11 | -1,170 | | -599 | | -1,170 | 254 | 0 | 1,315 | | 254 | 209 | 0 | 1,554 | 904 | 209 | | | -611 | -2,095 | -1,307 |
| 12 | -1,095 | | -571 | | -1,095 | 276 | 0 | 1,335 | | 276 | 230 | 0 | 1,573 | 933 | 230 | | | -582 | -2,033 | -1,220 |
| 13 | -1,017 | | -541 | | -1,017 | 295 | 0 | 1,353 | | 295 | 248 | 0 | 1,589 | 957 | 248 | | | -551 | -1,970 | -1,133 |
| 14 | -937 | | -511 | | -937 | 311 | 0 | 1,367 | | 311 | 263 | 0 | 1,603 | 978 | 263 | | | -520 | -1,906 | -1,044 |
| 15 | -855 | | -480 | | -855 | 325 | 0 | 1,380 | | 325 | 276 | 0 | 1,615 | 996 | 276 | | | -489 | -1,841 | -956 |
| 25 | -362 | | -293 | | -362 | 402 | 0 | 1,453 | | 402 | 351 | 0 | 1,681 | 1,097 | 351 | | | -298 | -1,450 | -422 |
| 50 | 8 | | -153 | | 8 | 460 | 0 | 1,507 | | 460 | 407 | 0 | 1,731 | 1,173 | 407 | | | -156 | -1,157 | -22 |
| Green Sturgeon | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | -3,250 | -2,873 | 0 | -11 | 0 | -3,250 | -5,020 | 0 | -2,750 | 0 | -3,250 | -5,020 | 0 | -2,750 | 0 | -6,500 | -7,118 | 0 | -942 |
| 2 | 0 | -4,875 | -4,304 | 0 | -16 | 0 | -1,625 | -3,280 | 0 | -3,194 | 0 | -1,625 | -3,280 | 0 | -3,194 | 0 | -6,500 | -6,426 | 0 | -482 |
| 3 | 0 | -5,417 | -4,781 | 0 | -18 | 0 | -1,083 | -2,699 | 0 | -3,343 | 0 | -1,083 | -2,699 | 0 | -3,343 | 0 | -6,500 | -6,196 | 0 | -328 |
| 4 | 0 | -5,688 | -5,019 | 0 | -19 | 0 | -812 | -2,409 | 0 | -3,417 | 0 | -812 | -2,409 | 0 | -3,417 | 0 | -6,500 | -6,081 | 0 | -252 |
| 5 | 0 | -5,850 | -5,162 | 0 | -20 | 0 | -650 | -2,235 | 0 | -3,461 | 0 | -650 | -2,235 | 0 | -3,461 | 0 | -6,500 | -6,011 | 0 | -206 |
| 6 | 0 | -5,958 | -5,258 | 0 | -20 | 0 | -541 | -2,119 | 0 | -3,491 | 0 | -541 | -2,119 | 0 | -3,491 | 0 | -6,500 | -5,965 | 0 | -175 |
| 7 | 0 | -6,036 | -5,326 | 0 | -20 | 0 | -464 | -2,036 | 0 | -3,512 | 0 | -464 | -2,036 | 0 | -3,512 | 0 | -6,500 | -5,932 | 0 | -153 |
| 8 | 0 | -6,094 | -5,377 | 0 | -20 | 0 | -406 | -1,974 | 0 | -3,528 | 0 | -406 | -1,974 | 0 | -3,528 | 0 | -6,500 | -5,908 | 0 | -137 |
| 9 | 0 | -6,139 | -5,417 | 0 | -20 | 0 | -361 | -1,926 | 0 | -3,540 | 0 | -361 | -1,926 | 0 | -3,540 | 0 | -6,500 | -5,888 | 0 | -124 |
| 10 | 0 | -6,175 | -5,448 | 0 | -21 | 0 | -325 | -1,887 | 0 | -3,550 | 0 | -325 | -1,887 | 0 | -3,550 | 0 | -6,500 | -5,873 | 0 | -114 |
| 11 | 0 | -6,205 | -5,475 | 0 | -21 | 0 | -295 | -1,855 | 0 | -3,558 | 0 | -295 | -1,855 | 0 | -3,558 | 0 | -6,500 | -5,860 | 0 | -105 |
| 12 | 0 | -6,229 | -5,496 | 0 | -21 | 0 | -271 | -1,829 | 0 | -3,565 | 0 | -271 | -1,829 | 0 | -3,565 | 0 | -6,500 | -5,850 | 0 | -98 |
| 13 | 0 | -6,250 | -5,515 | 0 | -21 | 0 | -250 | -1,807 | 0 | -3,570 | 0 | -250 | -1,807 | 0 | -3,570 | 0 | -6,500 | -5,841 | 0 | -92 |
| 14 | 0 | -6,268 | -5,530 | 0 | -21 | 0 | -232 | -1,787 | 0 | -3,575 | 0 | -232 | -1,787 | 0 | -3,575 | 0 | -6,500 | -5,833 | 0 | -87 |
| 15 | 0 | -6,283 | -5,544 | 0 | -21 | 0 | -216 | -1,771 | 0 | -3,579 | 0 | -216 | -1,771 | 0 | -3,579 | 0 | -6,500 | -5,827 | 0 | -83 |
| 25 | 0 | -6,370 | -5,620 | 0 | -21 | 0 | -130 | -1,678 | 0 | -3,603 | 0 | -130 | -1,678 | 0 | -3,603 | 0 | -6,500 | -5,790 | 0 | -58 |
| 50 | 0 | -6,435 | -5,677 | 0 | -21 | 0 | -65 | -1,608 | 0 | -3,621 | 0 | -65 | -1,608 | 0 | -3,621 | 0 | -6,500 | -5,762 | 0 | -40 |

4.0 defaults used for all response curves
Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

4.0 defaults used for all response curves
Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 27**

**American River SAM Analysis Reach**

ARS_ABC

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Spring-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | | | | | 0 | | |
| 1 | | | -200 | -620 | | | | 114 | -333 | | | | 194 | | | | | -229 | | |
| 2 | | | -192 | -507 | | | | 366 | 912 | | | | 561 | | | | | -207 | | |
| 3 | | | -201 | -522 | | | | 467 | 1,280 | | | | 689 | | | | | -214 | | |
| 4 | | | -212 | -557 | | | | 571 | 1,647 | | | | 816 | | | | | -225 | | |
| 5 | | | -217 | -568 | | | | 691 | 2,137 | | | | 965 | | | | | -228 | | |
| 6 | | | -224 | -588 | | | | 779 | 2,453 | | | | 1,068 | | | | | -234 | | |
| 7 | | | -229 | -602 | | | | 861 | 2,736 | | | | 1,169 | | | | | -239 | | |
| 8 | | | -229 | -595 | | | | 947 | 3,058 | | | | 1,278 | | | | | -237 | | |
| 9 | | | -224 | -577 | | | | 1,019 | 3,328 | | | | 1,368 | | | | | -232 | | |
| 10 | | | -216 | -549 | | | | 1,079 | 3,554 | | | | 1,441 | | | | | -223 | | |
| 11 | | | -206 | -513 | | | | 1,131 | 3,748 | | | | 1,502 | | | | | -212 | | |
| 12 | | | -193 | -471 | | | | 1,175 | 3,915 | | | | 1,553 | | | | | -199 | | |
| 13 | | | -179 | -422 | | | | 1,213 | 4,056 | | | | 1,596 | | | | | -184 | | |
| 14 | | | -163 | -369 | | | | 1,246 | 4,177 | | | | 1,634 | | | | | -167 | | |
| 15 | | | -145 | -312 | | | | 1,275 | 4,283 | | | | 1,666 | | | | | -150 | | |
| 25 | | | -11 | 126 | | | | 1,440 | 4,881 | | | | 1,849 | | | | | -14 | | |
| 50 | | | 100 | 488 | | | | 1,564 | 5,329 | | | | 1,986 | | | | | 99 | | |
| Fall-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | | 0 | 0 | 0 | | | | | 0 | |
| 1 | 9 | 0 | -200 | -620 | | 456 | 0 | 114 | -333 | | | 0 | 194 | 52 | | | | | -967 | |
| 2 | 284 | 0 | -192 | -507 | | 783 | 0 | 366 | 912 | | | 0 | 561 | 1,529 | | | | | -681 | |
| 3 | 347 | 0 | -201 | -522 | | 886 | 0 | 467 | 1,280 | | | 0 | 689 | 1,860 | | | | | -694 | |
| 4 | 399 | 0 | -212 | -557 | | 994 | 0 | 571 | 1,647 | | | 0 | 816 | 2,176 | | | | | -728 | |
| 5 | 463 | 0 | -217 | -568 | | 1,119 | 0 | 691 | 2,137 | | | 0 | 965 | 2,612 | | | | | -705 | |
| 6 | 497 | 0 | -224 | -588 | | 1,202 | 0 | 779 | 2,453 | | | 0 | 1,068 | 2,845 | | | | | -723 | |
| 7 | 536 | 0 | -229 | -602 | | 1,282 | 0 | 861 | 2,736 | | | 0 | 1,169 | 3,072 | | | | | -735 | |
| 8 | 592 | 0 | -229 | -595 | | 1,367 | 0 | 947 | 3,058 | | | 0 | 1,278 | 3,353 | | | | | -712 | |
| 9 | 646 | 0 | -224 | -577 | | 1,436 | 0 | 1,019 | 3,328 | | | 0 | 1,368 | 3,577 | | | | | -681 | |
| 10 | 701 | 0 | -216 | -549 | | 1,492 | 0 | 1,079 | 3,554 | | | 0 | 1,441 | 3,758 | | | | | -642 | |
| 11 | 758 | 0 | -206 | -513 | | 1,539 | 0 | 1,131 | 3,748 | | | 0 | 1,502 | 3,908 | | | | | -598 | |
| 12 | 815 | 0 | -193 | -471 | | 1,580 | 0 | 1,175 | 3,915 | | | 0 | 1,553 | 4,034 | | | | | -548 | |
| 13 | 875 | 0 | -179 | -422 | | 1,614 | 0 | 1,213 | 4,056 | | | 0 | 1,596 | 4,141 | | | | | -494 | |
| 14 | 936 | 0 | -163 | -369 | | 1,643 | 0 | 1,246 | 4,177 | | | 0 | 1,634 | 4,232 | | | | | -436 | |
| 15 | 999 | 0 | -145 | -312 | | 1,669 | 0 | 1,275 | 4,283 | | | 0 | 1,666 | 4,311 | | | | | -374 | |
| 25 | 1,452 | 0 | -11 | 126 | | 1,815 | 0 | 1,440 | 4,881 | | | 0 | 1,849 | 4,755 | | | | | 89 | |
| 50 | 1,821 | 0 | 100 | 488 | | 1,926 | 0 | 1,564 | 5,329 | | | 0 | 1,986 | 5,088 | | | | | 469 | |

4.0 defaults used for all response curves

Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 27 (cont.)**

**American River SAM Analysis Reach**

ARS_ABC

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Steelhead | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 | 0 |
| 1 | 203 | | -406 | | 203 | 979 | 0 | 83 | | 979 | 1,019 | 0 | 146 | -10 | 1,019 | | | -482 | -970 | 90 |
| 2 | 763 | | -399 | | 763 | 1,642 | 0 | 489 | | 1,642 | 1,715 | 0 | 686 | 1,201 | 1,715 | | | -437 | -677 | 707 |
| 3 | 899 | | -419 | | 899 | 1,857 | 0 | 633 | | 1,857 | 1,938 | 0 | 857 | 1,465 | 1,938 | | | -454 | -688 | 821 |
| 4 | 1,016 | | -444 | | 1,016 | 2,080 | 0 | 779 | | 2,080 | 2,169 | 0 | 1,026 | 1,715 | 2,169 | | | -477 | -720 | 926 |
| 5 | 1,156 | | -458 | | 1,156 | 2,337 | 0 | 955 | | 2,337 | 2,437 | 0 | 1,231 | 2,066 | 2,437 | | | -485 | -694 | 1,084 |
| 6 | 1,235 | | -474 | | 1,235 | 2,507 | 0 | 1,077 | | 2,507 | 2,615 | 0 | 1,366 | 2,250 | 2,615 | | | -500 | -711 | 1,160 |
| 7 | 1,325 | | -487 | | 1,325 | 2,673 | 0 | 1,190 | | 2,673 | 2,789 | 0 | 1,497 | 2,431 | 2,789 | | | -512 | -722 | 1,248 |
| 8 | 1,442 | | -489 | | 1,442 | 2,849 | 0 | 1,312 | | 2,849 | 2,974 | 0 | 1,643 | 2,656 | 2,974 | | | -511 | -697 | 1,375 |
| 9 | 1,552 | | -484 | | 1,552 | 2,990 | 0 | 1,414 | | 2,990 | 3,122 | 0 | 1,762 | 2,835 | 3,122 | | | -504 | -663 | 1,492 |
| 10 | 1,660 | | -472 | | 1,660 | 3,106 | 0 | 1,499 | | 3,106 | 3,243 | 0 | 1,859 | 2,980 | 3,243 | | | -490 | -621 | 1,606 |
| 11 | 1,765 | | -456 | | 1,765 | 3,203 | 0 | 1,571 | | 3,203 | 3,343 | 0 | 1,939 | 3,099 | 3,343 | | | -472 | -573 | 1,716 |
| 12 | 1,872 | | -435 | | 1,872 | 3,286 | 0 | 1,634 | | 3,286 | 3,427 | 0 | 2,007 | 3,198 | 3,427 | | | -450 | -519 | 1,827 |
| 13 | 1,980 | | -411 | | 1,980 | 3,356 | 0 | 1,687 | | 3,356 | 3,499 | 0 | 2,065 | 3,283 | 3,499 | | | -425 | -460 | 1,938 |
| 14 | 2,089 | | -384 | | 2,089 | 3,416 | 0 | 1,732 | | 3,416 | 3,560 | 0 | 2,114 | 3,355 | 3,560 | | | -396 | -397 | 2,051 |
| 15 | 2,200 | | -354 | | 2,200 | 3,468 | 0 | 1,773 | | 3,468 | 3,614 | 0 | 2,157 | 3,418 | 3,614 | | | -366 | -330 | 2,164 |
| 25 | 2,988 | | -124 | | 2,988 | 3,766 | 0 | 2,002 | | 3,766 | 3,914 | 0 | 2,399 | 3,769 | 3,914 | | | -131 | 171 | 2,967 |
| 50 | 3,627 | | 67 | | 3,627 | 3,991 | 0 | 2,175 | | 3,991 | 4,140 | 0 | 2,581 | 4,033 | 4,140 | | | 64 | 583 | 3,616 |
| Green Sturgeon | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | -2,510 | -714 | 0 | 564 | 0 | -2,510 | -876 | 0 | -980 | 0 | -2,510 | -876 | 0 | -980 | 0 | -5,020 | -2,496 | 0 | 417 |
| 2 | 0 | -3,765 | -1,071 | 0 | 846 | 0 | -1,255 | 468 | 0 | -1,323 | 0 | -1,255 | 468 | 0 | -1,323 | 0 | -5,020 | -1,962 | 0 | 772 |
| 3 | 0 | -4,183 | -1,190 | 0 | 940 | 0 | -1,156 | 654 | 0 | -1,482 | 0 | -1,156 | 654 | 0 | -1,482 | 0 | -5,339 | -2,046 | 0 | 846 |
| 4 | 0 | -4,632 | -1,344 | 0 | 1,021 | 0 | -1,106 | 807 | 0 | -1,661 | 0 | -1,106 | 807 | 0 | -1,661 | 0 | -5,738 | -2,183 | 0 | 916 |
| 5 | 0 | -5,092 | -1,512 | 0 | 1,096 | 0 | -885 | 1,104 | 0 | -1,821 | 0 | -885 | 1,104 | 0 | -1,821 | 0 | -5,977 | -2,183 | 0 | 1,013 |
| 6 | 0 | -5,399 | -1,624 | 0 | 1,147 | 0 | -854 | 1,249 | 0 | -1,943 | 0 | -854 | 1,249 | 0 | -1,943 | 0 | -6,253 | -2,236 | 0 | 1,061 |
| 7 | 0 | -5,718 | -1,707 | 0 | 1,197 | 0 | -831 | 1,416 | 0 | -2,072 | 0 | -831 | 1,416 | 0 | -2,072 | 0 | -6,550 | -2,276 | 0 | 1,109 |
| 8 | 0 | -6,045 | -1,771 | 0 | 1,247 | 0 | -727 | 1,634 | 0 | -2,193 | 0 | -727 | 1,634 | 0 | -2,193 | 0 | -6,772 | -2,268 | 0 | 1,171 |
| 9 | 0 | -6,299 | -1,820 | 0 | 1,286 | 0 | -647 | 1,803 | 0 | -2,287 | 0 | -647 | 1,803 | 0 | -2,287 | 0 | -6,945 | -2,263 | 0 | 1,218 |
| 10 | 0 | -6,502 | -1,860 | 0 | 1,317 | 0 | -582 | 1,939 | 0 | -2,362 | 0 | -582 | 1,939 | 0 | -2,362 | 0 | -7,084 | -2,258 | 0 | 1,256 |
| 11 | 0 | -6,668 | -1,893 | 0 | 1,343 | 0 | -529 | 2,050 | 0 | -2,423 | 0 | -529 | 2,050 | 0 | -2,423 | 0 | -7,197 | -2,254 | 0 | 1,287 |
| 12 | 0 | -6,807 | -1,920 | 0 | 1,364 | 0 | -485 | 2,142 | 0 | -2,475 | 0 | -485 | 2,142 | 0 | -2,475 | 0 | -7,292 | -2,251 | 0 | 1,313 |
| 13 | 0 | -6,924 | -1,943 | 0 | 1,382 | 0 | -448 | 2,220 | 0 | -2,518 | 0 | -448 | 2,220 | 0 | -2,518 | 0 | -7,371 | -2,249 | 0 | 1,335 |
| 14 | 0 | -7,024 | -1,962 | 0 | 1,397 | 0 | -416 | 2,287 | 0 | -2,555 | 0 | -416 | 2,287 | 0 | -2,555 | 0 | -7,440 | -2,247 | 0 | 1,354 |
| 15 | 0 | -7,111 | -1,979 | 0 | 1,411 | 0 | -388 | 2,346 | 0 | -2,587 | 0 | -388 | 2,346 | 0 | -2,587 | 0 | -7,499 | -2,245 | 0 | 1,370 |
| 25 | 0 | -7,599 | -2,075 | 0 | 1,486 | 0 | -233 | 2,671 | 0 | -2,767 | 0 | -233 | 2,671 | 0 | -2,767 | 0 | -7,832 | -2,234 | 0 | 1,461 |
| 50 | 0 | -7,964 | -2,146 | 0 | 1,542 | 0 | -116 | 2,915 | 0 | -2,902 | 0 | -116 | 2,915 | 0 | -2,902 | 0 | -8,081 | -2,226 | 0 | 1,529 |

4.0 defaults used for all response curves

Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 28**

**Sacramento River SAM Analysis Reach**

ARS_DEFG

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Spring-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | 0 | |
| 1 | -1,101 | | -400 | -2,119 | | -892 | | 97 | -3,451 | | -946 | | 193 | -3,484 | | -2,136 | | -460 | -3,759 | |
| 2 | -1,075 | | -427 | -2,526 | | -415 | | 571 | -1,306 | | -453 | | 900 | -1,147 | | -1,776 | | -468 | -3,638 | |
| 3 | -1,058 | | -434 | -2,738 | | -121 | | 836 | 15 | | -141 | | 1,302 | 289 | | -1,525 | | -462 | -3,479 | |
| 4 | -1,125 | | -459 | -2,923 | | -16 | | 940 | 430 | | -23 | | 1,470 | 753 | | -1,514 | | -483 | -3,555 | |
| 5 | -1,197 | | -498 | -3,127 | | 44 | | 1,046 | 642 | | 47 | | 1,638 | 990 | | -1,604 | | -526 | -3,809 | |
| 6 | -1,266 | | -532 | -3,373 | | 110 | | 1,183 | 999 | | 124 | | 1,847 | 1,366 | | -1,659 | | -559 | -4,037 | |
| 7 | -1,342 | | -551 | -3,601 | | 160 | | 1,296 | 1,340 | | 187 | | 2,017 | 1,726 | | -1,679 | | -575 | -4,171 | |
| 8 | -1,381 | | -558 | -3,738 | | 200 | | 1,390 | 1,645 | | 241 | | 2,159 | 2,045 | | -1,676 | | -578 | -4,237 | |
| 9 | -1,394 | | -555 | -3,815 | | 233 | | 1,472 | 1,926 | | 289 | | 2,282 | 2,337 | | -1,656 | | -573 | -4,258 | |
| 10 | -1,385 | | -544 | -3,845 | | 261 | | 1,545 | 2,187 | | 333 | | 2,393 | 2,608 | | -1,621 | | -561 | -4,244 | |
| 11 | -1,357 | | -527 | -3,838 | | 286 | | 1,611 | 2,421 | | 374 | | 2,490 | 2,847 | | -1,571 | | -542 | -4,201 | |
| 12 | -1,311 | | -504 | -3,806 | | 308 | | 1,668 | 2,621 | | 411 | | 2,574 | 3,047 | | -1,507 | | -518 | -4,138 | |
| 13 | -1,252 | | -478 | -3,752 | | 329 | | 1,719 | 2,797 | | 446 | | 2,648 | 3,218 | | -1,433 | | -490 | -4,059 | |
| 14 | -1,183 | | -448 | -3,683 | | 348 | | 1,765 | 2,952 | | 480 | | 2,714 | 3,366 | | -1,351 | | -459 | -3,968 | |
| 15 | -1,105 | | -415 | -3,602 | | 366 | | 1,807 | 3,091 | | 512 | | 2,774 | 3,495 | | -1,263 | | -426 | -3,867 | |
| 25 | -396 | | -144 | -2,879 | | 497 | | 2,094 | 3,968 | | 731 | | 3,136 | 4,242 | | -491 | | -150 | -3,038 | |
| 50 | 298 | | 94 | -2,269 | | 631 | | 2,366 | 4,728 | | 914 | | 3,419 | 4,810 | | 251 | | 91 | -2,349 | |
| Fall-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | | 0 | | 0 | 0 | | | | 0 | 0 | | 0 | | 0 | 0 | |
| 1 | -1,101 | | -400 | -2,119 | | -892 | | 97 | -3,451 | | | | 193 | -3,484 | | -2,136 | | -460 | -3,759 | |
| 2 | -1,075 | | -427 | -2,526 | | -415 | | 571 | -1,306 | | | | 900 | -1,147 | | -1,776 | | -468 | -3,638 | |
| 3 | -1,058 | | -434 | -2,738 | | -121 | | 836 | 15 | | | | 1,302 | 289 | | -1,525 | | -462 | -3,479 | |
| 4 | -1,125 | | -459 | -2,923 | | -16 | | 940 | 430 | | | | 1,470 | 753 | | -1,514 | | -483 | -3,555 | |
| 5 | -1,197 | | -498 | -3,127 | | 44 | | 1,046 | 642 | | | | 1,638 | 990 | | -1,604 | | -526 | -3,809 | |
| 6 | -1,266 | | -532 | -3,373 | | 110 | | 1,183 | 999 | | | | 1,847 | 1,366 | | -1,659 | | -559 | -4,037 | |
| 7 | -1,342 | | -551 | -3,601 | | 160 | | 1,296 | 1,340 | | | | 2,017 | 1,726 | | -1,679 | | -575 | -4,171 | |
| 8 | -1,381 | | -558 | -3,738 | | 200 | | 1,390 | 1,645 | | | | 2,159 | 2,045 | | -1,676 | | -578 | -4,237 | |
| 9 | -1,394 | | -555 | -3,815 | | 233 | | 1,472 | 1,926 | | | | 2,282 | 2,337 | | -1,656 | | -573 | -4,258 | |
| 10 | -1,385 | | -544 | -3,845 | | 261 | | 1,545 | 2,187 | | | | 2,393 | 2,608 | | -1,621 | | -561 | -4,244 | |
| 11 | -1,357 | | -527 | -3,838 | | 286 | | 1,611 | 2,421 | | | | 2,490 | 2,847 | | -1,571 | | -542 | -4,201 | |
| 12 | -1,311 | | -504 | -3,806 | | 308 | | 1,668 | 2,621 | | | | 2,574 | 3,047 | | -1,507 | | -518 | -4,138 | |
| 13 | -1,252 | | -478 | -3,752 | | 329 | | 1,719 | 2,797 | | | | 2,648 | 3,218 | | -1,433 | | -490 | -4,059 | |
| 14 | -1,183 | | -448 | -3,683 | | 348 | | 1,765 | 2,952 | | | | 2,714 | 3,366 | | -1,351 | | -459 | -3,968 | |
| 15 | -1,105 | | -415 | -3,602 | | 366 | | 1,807 | 3,091 | | | | 2,774 | 3,495 | | -1,263 | | -426 | -3,867 | |
| 25 | -396 | | -144 | -2,879 | | 497 | | 2,094 | 3,968 | | | | 3,136 | 4,242 | | -491 | | -150 | -3,038 | |
| 50 | 298 | | 94 | -2,269 | | 631 | | 2,366 | 4,728 | | | | 3,419 | 4,810 | | 251 | | 91 | -2,349 | |

4.0 defaults used for all response curves

Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 28 (cont.)**

**Sacramento River SAM Analysis Reach**

ARS_DEFG

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall |  |  |  |  | Winter |  |  |  |  | Spring |  |  |  |  | Summer |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Late-fall-run Chinook |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0 | 0 |  | 0 | 0 |  | 0 |  | 0 | 0 |  | 0 |  | 0 |  |  |  |  | 0 |  |  |
| 1 | -1,101 |  | -400 | -2,119 |  | -892 |  | 97 | -3,451 |  | -946 |  | 193 |  |  |  |  | -460 |  |  |
| 2 | -1,075 |  | -427 | -2,526 |  | -415 |  | 571 | -1,306 |  | -453 |  | 900 |  |  |  |  | -468 |  |  |
| 3 | -1,058 |  | -434 | -2,738 |  | -121 |  | 836 | 15 |  | -141 |  | 1,302 |  |  |  |  | -462 |  |  |
| 4 | -1,125 |  | -459 | -2,923 |  | -16 |  | 940 | 430 |  | -23 |  | 1,470 |  |  |  |  | -483 |  |  |
| 5 | -1,197 |  | -498 | -3,127 |  | 44 |  | 1,046 | 642 |  | 47 |  | 1,638 |  |  |  |  | -526 |  |  |
| 6 | -1,266 |  | -532 | -3,373 |  | 110 |  | 1,183 | 999 |  | 124 |  | 1,847 |  |  |  |  | -559 |  |  |
| 7 | -1,342 |  | -551 | -3,601 |  | 160 |  | 1,296 | 1,340 |  | 187 |  | 2,017 |  |  |  |  | -575 |  |  |
| 8 | -1,381 |  | -558 | -3,738 |  | 200 |  | 1,390 | 1,645 |  | 241 |  | 2,159 |  |  |  |  | -578 |  |  |
| 9 | -1,394 |  | -555 | -3,815 |  | 233 |  | 1,472 | 1,926 |  | 289 |  | 2,282 |  |  |  |  | -573 |  |  |
| 10 | -1,385 |  | -544 | -3,845 |  | 261 |  | 1,545 | 2,187 |  | 333 |  | 2,393 |  |  |  |  | -561 |  |  |
| 11 | -1,357 |  | -527 | -3,838 |  | 286 |  | 1,611 | 2,421 |  | 374 |  | 2,490 |  |  |  |  | -542 |  |  |
| 12 | -1,311 |  | -504 | -3,806 |  | 308 |  | 1,668 | 2,621 |  | 411 |  | 2,574 |  |  |  |  | -518 |  |  |
| 13 | -1,252 |  | -478 | -3,752 |  | 329 |  | 1,719 | 2,797 |  | 446 |  | 2,648 |  |  |  |  | -490 |  |  |
| 14 | -1,183 |  | -448 | -3,683 |  | 348 |  | 1,765 | 2,952 |  | 480 |  | 2,714 |  |  |  |  | -459 |  |  |
| 15 | -1,105 |  | -415 | -3,602 |  | 366 |  | 1,807 | 3,091 |  | 512 |  | 2,774 |  |  |  |  | -426 |  |  |
| 25 | -396 |  | -144 | -2,879 |  | 497 |  | 2,094 | 3,968 |  | 731 |  | 3,136 |  |  |  |  | -150 |  |  |
| 50 | 298 |  | 94 | -2,269 |  | 631 |  | 2,366 | 4,728 |  | 914 |  | 3,419 |  |  |  |  | 91 |  |  |
| Winter-run Chinook |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0 | 0 |  | 0 | 0 |  | 0 |  | 0 | 0 |  | 0 |  | 0 | 0 |  | 0 |  | 0 |  |  |
| 1 | -1,101 |  | -400 | -2,119 |  | -892 |  | 97 | -3,451 |  | -946 |  | 193 | -3,484 |  | -2,136 |  | -460 |  |  |
| 2 | -1,075 |  | -427 | -2,526 |  | -415 |  | 571 | -1,306 |  | -453 |  | 900 | -1,147 |  | -1,776 |  | -468 |  |  |
| 3 | -1,058 |  | -434 | -2,738 |  | -121 |  | 836 | 15 |  | -141 |  | 1,302 | 289 |  | -1,525 |  | -462 |  |  |
| 4 | -1,125 |  | -459 | -2,923 |  | -16 |  | 940 | 430 |  | -23 |  | 1,470 | 753 |  | -1,514 |  | -483 |  |  |
| 5 | -1,197 |  | -498 | -3,127 |  | 44 |  | 1,046 | 642 |  | 47 |  | 1,638 | 990 |  | -1,604 |  | -526 |  |  |
| 6 | -1,266 |  | -532 | -3,373 |  | 110 |  | 1,183 | 999 |  | 124 |  | 1,847 | 1,366 |  | -1,659 |  | -559 |  |  |
| 7 | -1,342 |  | -551 | -3,601 |  | 160 |  | 1,296 | 1,340 |  | 187 |  | 2,017 | 1,726 |  | -1,679 |  | -575 |  |  |
| 8 | -1,381 |  | -558 | -3,738 |  | 200 |  | 1,390 | 1,645 |  | 241 |  | 2,159 | 2,045 |  | -1,676 |  | -578 |  |  |
| 9 | -1,394 |  | -555 | -3,815 |  | 233 |  | 1,472 | 1,926 |  | 289 |  | 2,282 | 2,337 |  | -1,656 |  | -573 |  |  |
| 10 | -1,385 |  | -544 | -3,845 |  | 261 |  | 1,545 | 2,187 |  | 333 |  | 2,393 | 2,608 |  | -1,621 |  | -561 |  |  |
| 11 | -1,357 |  | -527 | -3,838 |  | 286 |  | 1,611 | 2,421 |  | 374 |  | 2,490 | 2,847 |  | -1,571 |  | -542 |  |  |
| 12 | -1,311 |  | -504 | -3,806 |  | 308 |  | 1,668 | 2,621 |  | 411 |  | 2,574 | 3,047 |  | -1,507 |  | -518 |  |  |
| 13 | -1,252 |  | -478 | -3,752 |  | 329 |  | 1,719 | 2,797 |  | 446 |  | 2,648 | 3,218 |  | -1,433 |  | -490 |  |  |
| 14 | -1,183 |  | -448 | -3,683 |  | 348 |  | 1,765 | 2,952 |  | 480 |  | 2,714 | 3,366 |  | -1,351 |  | -459 |  |  |
| 15 | -1,105 |  | -415 | -3,602 |  | 366 |  | 1,807 | 3,091 |  | 512 |  | 2,774 | 3,495 |  | -1,263 |  | -426 |  |  |
| 25 | -396 |  | -144 | -2,879 |  | 497 |  | 2,094 | 3,968 |  | 731 |  | 3,136 | 4,242 |  | -491 |  | -150 |  |  |
| 50 | 298 |  | 94 | -2,269 |  | 631 |  | 2,366 | 4,728 |  | 914 |  | 3,419 | 4,810 |  | 251 |  | 91 |  |  |

4.0 defaults used for all response curves

Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 28 (cont.)**

**Sacramento River SAM Analysis Reach**

ARS_DEFG

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Steelhead | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | | 0 |
| 1 | -1,747 | | -820 | -2,239 | -1,747 | -1,747 | | -77 | -3,044 | -1,747 | -1,801 | | -36 | -3,082 | -1,801 | -3,793 | | -964 | | -3,793 |
| 2 | -1,656 | | -871 | -2,645 | -1,656 | -772 | | 649 | -1,266 | -772 | -774 | | 946 | -1,173 | -774 | -3,047 | | -970 | | -3,047 |
| 3 | -1,609 | | -887 | -2,848 | -1,609 | -170 | | 1,060 | -188 | -170 | -132 | | 1,508 | -16 | -132 | -2,536 | | -952 | | -2,536 |
| 4 | -1,702 | | -938 | -3,038 | -1,702 | 56 | | 1,206 | 116 | 56 | 119 | | 1,722 | 324 | 119 | -2,465 | | -998 | | -2,465 |
| 5 | -1,780 | | -1,021 | -3,256 | -1,780 | 195 | | 1,339 | 234 | 195 | 280 | | 1,917 | 463 | 280 | -2,574 | | -1,089 | | -2,574 |
| 6 | -1,865 | | -1,094 | -3,513 | -1,865 | 345 | | 1,525 | 482 | 345 | 450 | | 2,177 | 731 | 450 | -2,634 | | -1,161 | | -2,634 |
| 7 | -1,984 | | -1,139 | -3,749 | -1,984 | 457 | | 1,684 | 735 | 457 | 581 | | 2,397 | 1,002 | 581 | -2,644 | | -1,196 | | -2,644 |
| 8 | -2,040 | | -1,156 | -3,887 | -2,040 | 545 | | 1,818 | 961 | 545 | 688 | | 2,583 | 1,244 | 688 | -2,617 | | -1,206 | | -2,617 |
| 9 | -2,053 | | -1,154 | -3,961 | -2,053 | 617 | | 1,936 | 1,170 | 617 | 779 | | 2,747 | 1,467 | 779 | -2,566 | | -1,199 | | -2,566 |
| 10 | -2,030 | | -1,137 | -3,985 | -2,030 | 678 | | 2,042 | 1,367 | 678 | 858 | | 2,896 | 1,675 | 858 | -2,492 | | -1,177 | | -2,492 |
| 11 | -1,974 | | -1,106 | -3,971 | -1,974 | 732 | | 2,137 | 1,544 | 732 | 928 | | 3,027 | 1,861 | 928 | -2,394 | | -1,143 | | -2,394 |
| 12 | -1,890 | | -1,065 | -3,929 | -1,890 | 780 | | 2,220 | 1,696 | 780 | 991 | | 3,141 | 2,017 | 991 | -2,274 | | -1,098 | | -2,274 |
| 13 | -1,784 | | -1,016 | -3,866 | -1,784 | 824 | | 2,293 | 1,828 | 824 | 1,048 | | 3,240 | 2,152 | 1,048 | -2,139 | | -1,047 | | -2,139 |
| 14 | -1,661 | | -960 | -3,786 | -1,661 | 864 | | 2,359 | 1,946 | 864 | 1,101 | | 3,329 | 2,269 | 1,101 | -1,990 | | -989 | | -1,990 |
| 15 | -1,524 | | -900 | -3,692 | -1,524 | 901 | | 2,420 | 2,051 | 901 | 1,151 | | 3,409 | 2,372 | 1,151 | -1,832 | | -926 | | -1,832 |
| 25 | -343 | | -391 | -2,871 | -343 | 1,167 | | 2,823 | 2,718 | 1,167 | 1,472 | | 3,899 | 2,973 | 1,472 | -528 | | -407 | | -528 |
| 50 | 734 | | 58 | -2,166 | 734 | 1,431 | | 3,200 | 3,301 | 1,431 | 1,733 | | 4,282 | 3,433 | 1,733 | 641 | | 50 | | 641 |
| Green Sturgeon | | | | | | | | | | | | | | | | | | | | |
| 0 | | | 0 | 0 | | 0 | | 0 | | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| 1 | | | -708 | 0 | | 0 | | -4,397 | | -1,551 | 0 | | -4,397 | 0 | -1,551 | 0 | | -5,009 | 0 | -1,298 |
| 2 | | | -1,391 | 0 | | 0 | | -3,248 | | -1,199 | 0 | | -3,248 | 0 | -1,199 | 0 | | -4,297 | 0 | -765 |
| 3 | | | -1,830 | 0 | | 0 | | -2,485 | | -966 | 0 | | -2,485 | 0 | -966 | 0 | | -3,767 | 0 | -436 |
| 4 | | | -2,032 | 0 | | 0 | | -2,310 | | -923 | 0 | | -2,310 | 0 | -923 | 0 | | -3,709 | 0 | -344 |
| 5 | | | -2,076 | 0 | | 0 | | -2,380 | | -1,146 | 0 | | -2,380 | 0 | -1,146 | 0 | | -3,899 | 0 | -323 |
| 6 | | | -2,305 | 0 | | 0 | | -2,394 | | -1,476 | 0 | | -2,394 | 0 | -1,476 | 0 | | -4,077 | 0 | -288 |
| 7 | | | -2,685 | 0 | | 0 | | -2,368 | | -1,731 | 0 | | -2,368 | 0 | -1,731 | 0 | | -4,203 | 0 | -264 |
| 8 | | | -2,970 | 0 | | 0 | | -2,348 | | -1,923 | 0 | | -2,348 | 0 | -1,923 | 0 | | -4,298 | 0 | -245 |
| 9 | | | -3,191 | 0 | | 0 | | -2,333 | | -2,072 | 0 | | -2,333 | 0 | -2,072 | 0 | | -4,372 | 0 | -231 |
| 10 | | | -3,369 | 0 | | 0 | | -2,321 | | -2,191 | 0 | | -2,321 | 0 | -2,191 | 0 | | -4,431 | 0 | -220 |
| 11 | | | -3,514 | 0 | | 0 | | -2,311 | | -2,288 | 0 | | -2,311 | 0 | -2,288 | 0 | | -4,480 | 0 | -210 |
| 12 | | | -3,634 | 0 | | 0 | | -2,302 | | -2,369 | 0 | | -2,302 | 0 | -2,369 | 0 | | -4,520 | 0 | -203 |
| 13 | | | -3,737 | 0 | | 0 | | -2,295 | | -2,438 | 0 | | -2,295 | 0 | -2,438 | 0 | | -4,554 | 0 | -196 |
| 14 | | | -3,824 | 0 | | 0 | | -2,289 | | -2,497 | 0 | | -2,289 | 0 | -2,497 | 0 | | -4,583 | 0 | -190 |
| 15 | | | -3,900 | 0 | | 0 | | -2,284 | | -2,548 | 0 | | -2,284 | 0 | -2,548 | 0 | | -4,609 | 0 | -185 |
| 25 | | | -4,326 | 0 | | 0 | | -2,255 | | -2,834 | 0 | | -2,255 | 0 | -2,834 | 0 | | -4,751 | 0 | -158 |
| 50 | | | -4,645 | 0 | | 0 | | -2,233 | | -3,048 | 0 | | -2,233 | 0 | -3,048 | 0 | | -4,857 | 0 | -138 |

4.0 defaults used for all response curves

Non-default timing tables (see sheet [Custom Timing Tables] in this workbook)

**Table 29**

**Sacramento Bypass Levee and Weir SAM Analysis Reach**

SBP Weir and Levee

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Spring-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | 0 | |
| 1 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 2 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 3 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 4 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 5 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 6 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 7 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 8 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 9 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 10 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 11 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 12 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 13 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 14 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 15 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 25 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| 50 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | -26 | |
| Fall-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | | | 0 | | 0 | 0 | | | | 0 | | | 0 | | 0 | | |
| 1 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 2 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 3 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 4 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 5 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 6 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 7 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 8 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 9 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 10 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 11 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 12 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 13 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 14 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 15 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 25 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |
| 50 | -60 | | -4 | | | -21 | | -9 | -146 | | | | -21 | | | -60 | | -4 | | |

4.0 defaults used for all response curves

4.0 defaults used for all timing tables

**Table 29 (cont.)**

**Sacramento Bypass Levee and Weir SAM Analysis Reach**

SBP Weir and Levee

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Late-fall-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | | | | | 0 | | |
| 1 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 2 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 3 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 4 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 5 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 6 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 7 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 8 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 9 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 10 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 11 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 12 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 13 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 14 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 15 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 25 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| 50 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | | | | | -4 | | |
| Winter-run Chinook | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | 0 | | 0 | | 0 | | |
| 1 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 2 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 3 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 4 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 5 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 6 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 7 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 8 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 9 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 10 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 11 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 12 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 13 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 14 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 15 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 25 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |
| 50 | -60 | | -4 | -26 | | -21 | | -9 | -146 | | -51 | | -21 | -188 | | -60 | | -4 | | |

4.0 defaults used for all response curves

4.0 defaults used for all timing tables

**Table 29 (cont.)**

**Sacramento Bypass Levee and Weir SAM Analysis Reach**

SBP Weir and Levee

Bankline weighted relative response (feet)

| Focus Fish Species and Water Year | Fall | | | | | Winter | | | | | Spring | | | | | Summer | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence | Adult migration | Spawning and egg incubation | Fry and juvenile rearing | Juvenile migration | Adult residence |
| Steelhead | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 0 | | 0 |
| 1 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 2 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 3 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 4 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 5 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 6 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 7 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 8 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 9 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 10 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 11 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 12 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 13 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 14 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 15 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 25 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| 50 | -100 | | -17 | -35 | -100 | -40 | | -29 | -127 | -40 | -87 | | -55 | -174 | -87 | -100 | | -17 | | -100 |
| Green Sturgeon | | | | | | | | | | | | | | | | | | | | |
| 0 | | | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 2 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 3 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 4 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 5 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 6 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 7 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 8 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 9 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 10 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 11 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 12 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 13 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 14 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 15 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 25 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |
| 50 | | | 115 | 0 | | 0 | | 115 | | -8 | 0 | 0 | 115 | 0 | -8 | 0 | 0 | 115 | 0 | -8 |

4.0 defaults used for all response curves

4.0 defaults used for all timing tables

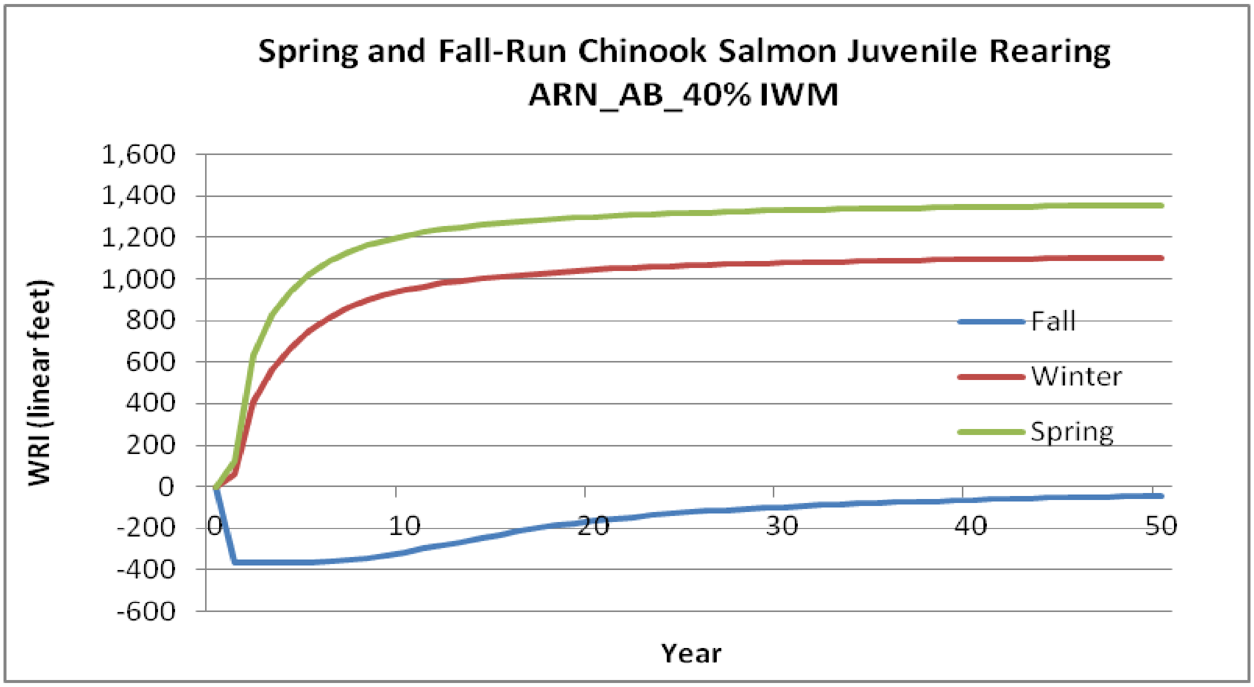



Figure 2. Weighted response indices at 40% IWM placement on the American River (ARN_AB) for spring and fall-run Chinook salmon juvenile rearing.

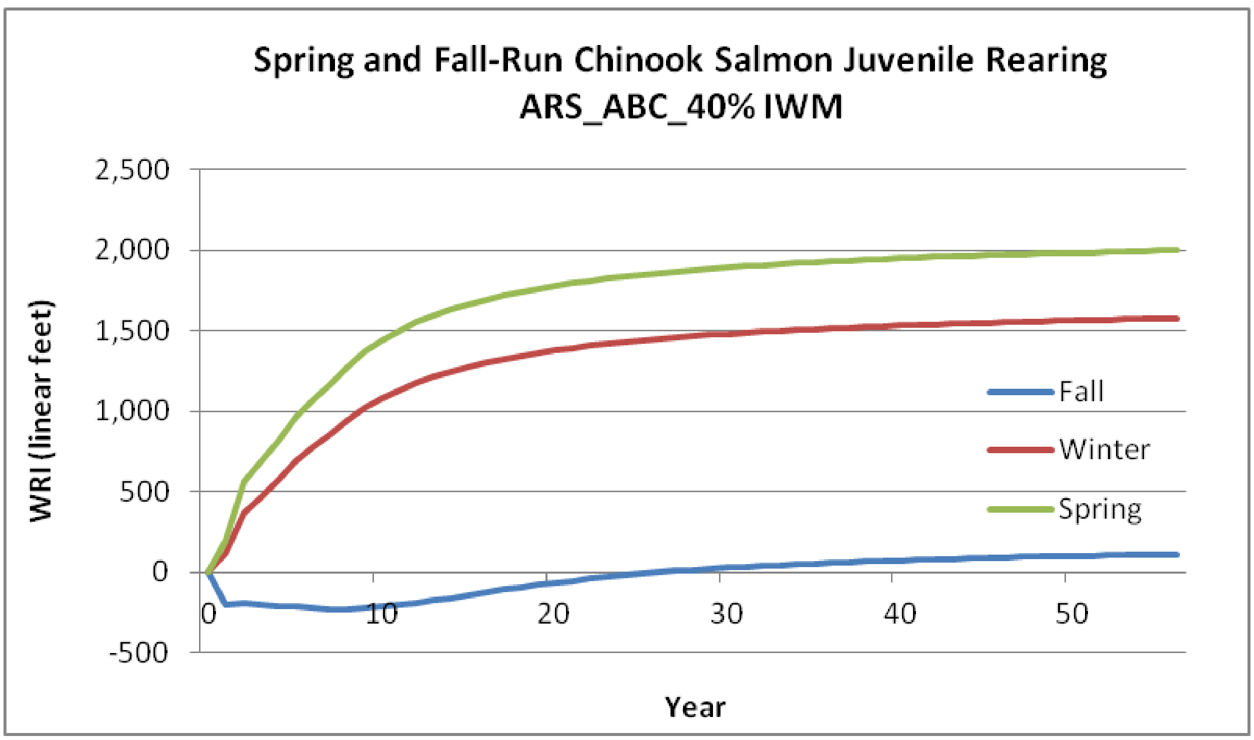



Figure 3. Weighted response indices at 40% IWM placement on the American River (ARS_ABC) for spring and fall-run Chinook salmon juvenile rearing.

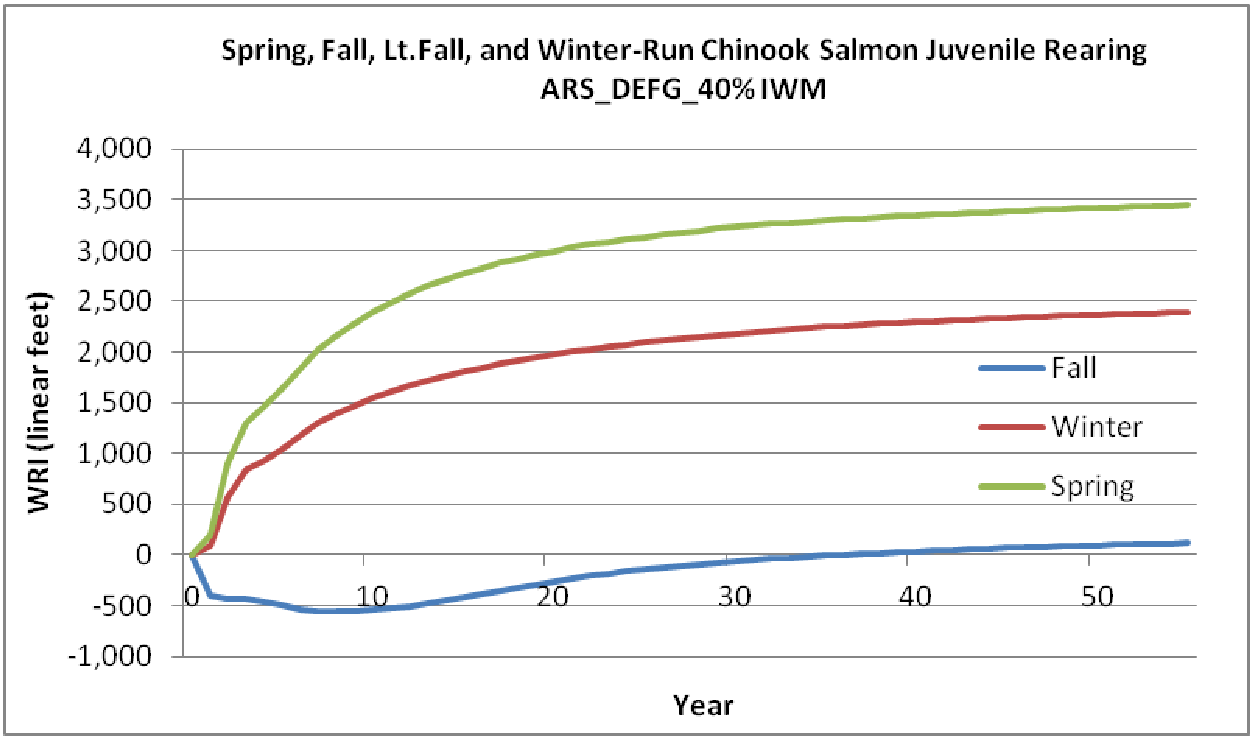



Figure 4. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_DEFG) for Chinook salmon juvenile rearing.

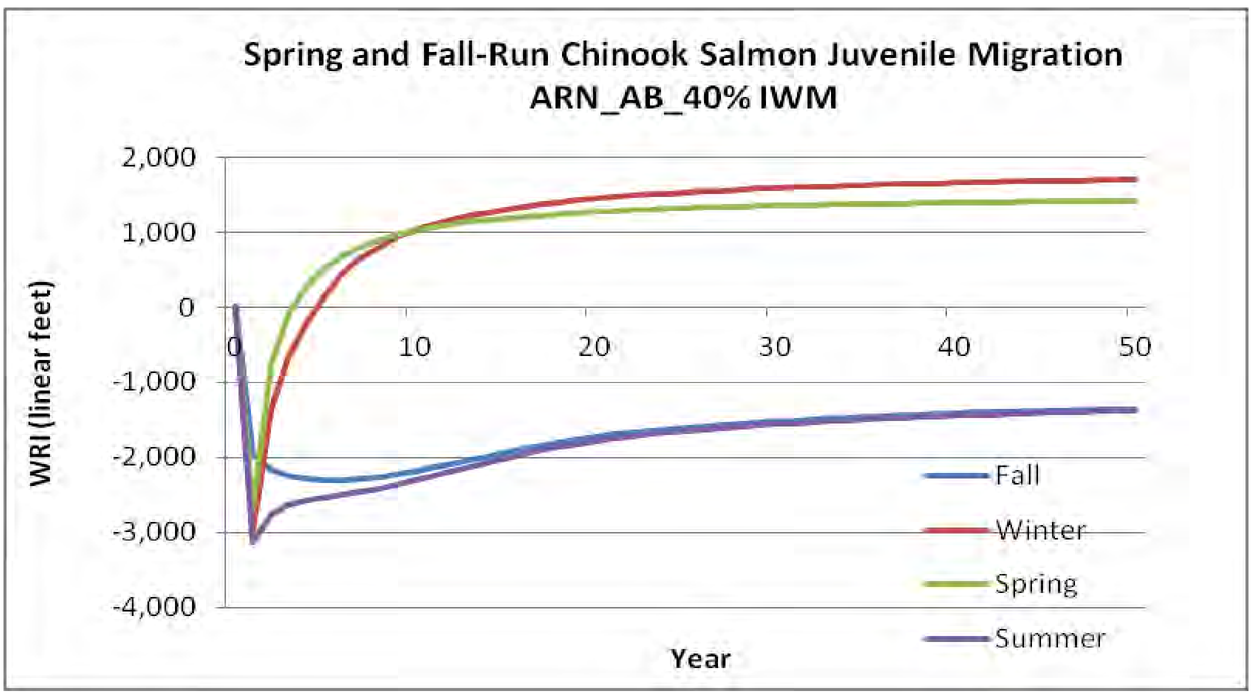



Figure 5. Weighted response indices at 40% IWM placement on the American River (ARN_AB) for spring and fall-run Chinook salmon juvenile migration.

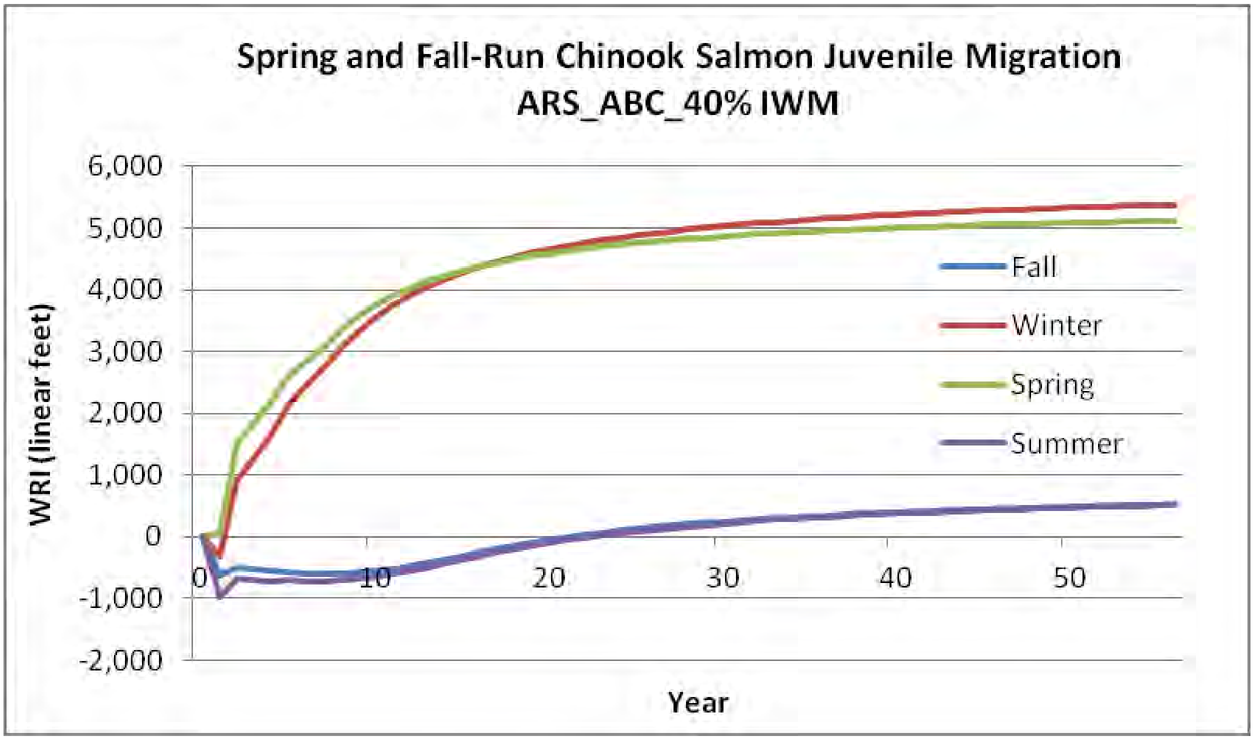



Figure 6. Weighted response indices at 40% IWM placement on the American River (ARS_ABC) for spring and fall-run Chinook salmon juvenile migration.

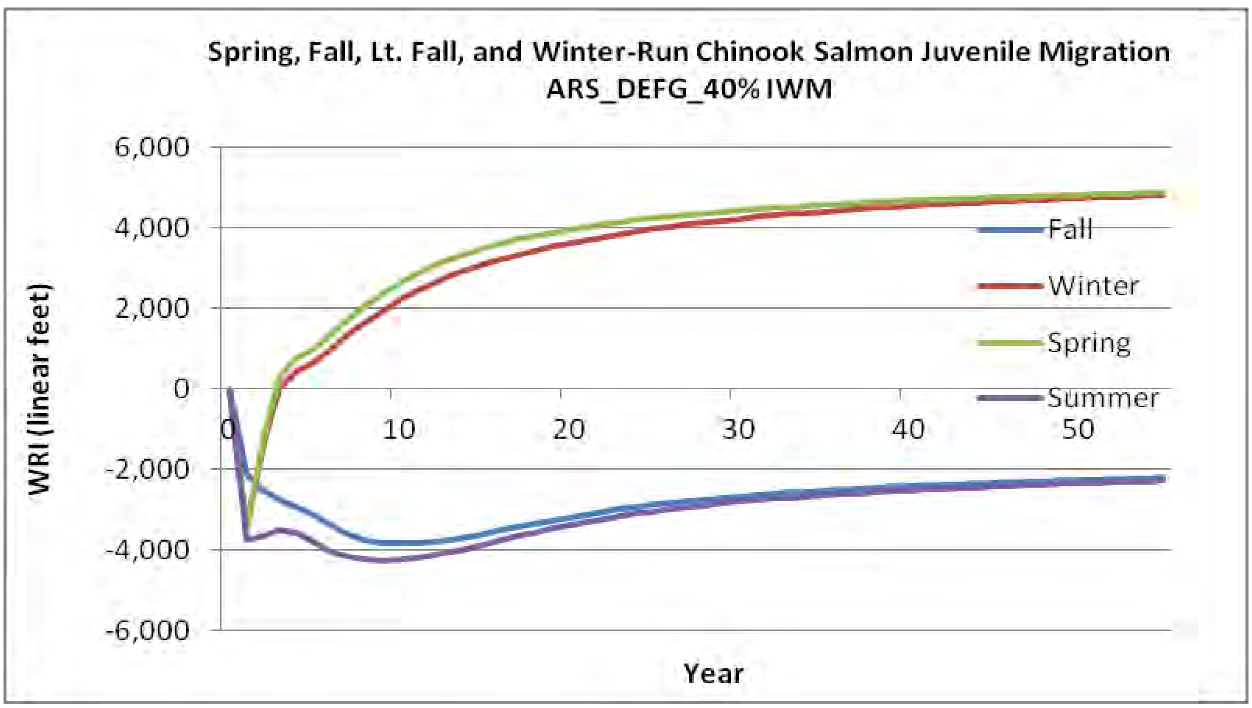



Figure 7. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_DEFG) for Chinook salmon juvenile migration.

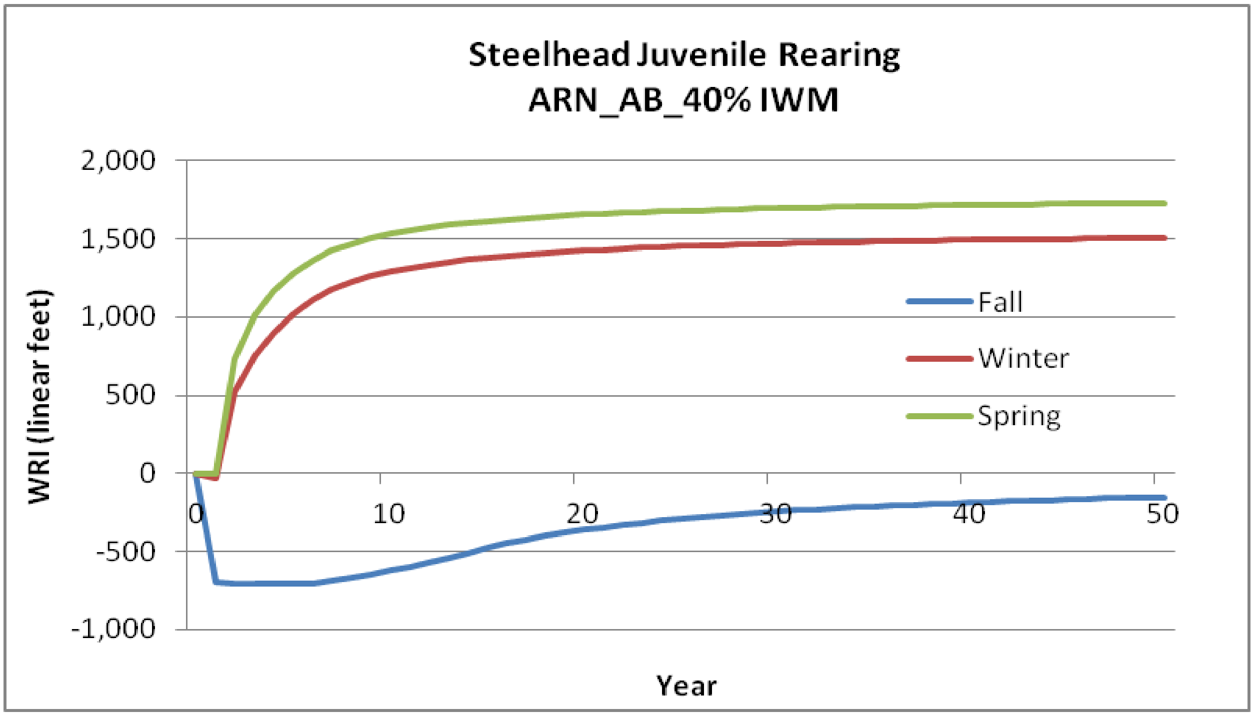



Figure 8. Weighted response indices at 40% IWM placement on the American River (ARN_AB) for steelhead juvenile rearing.

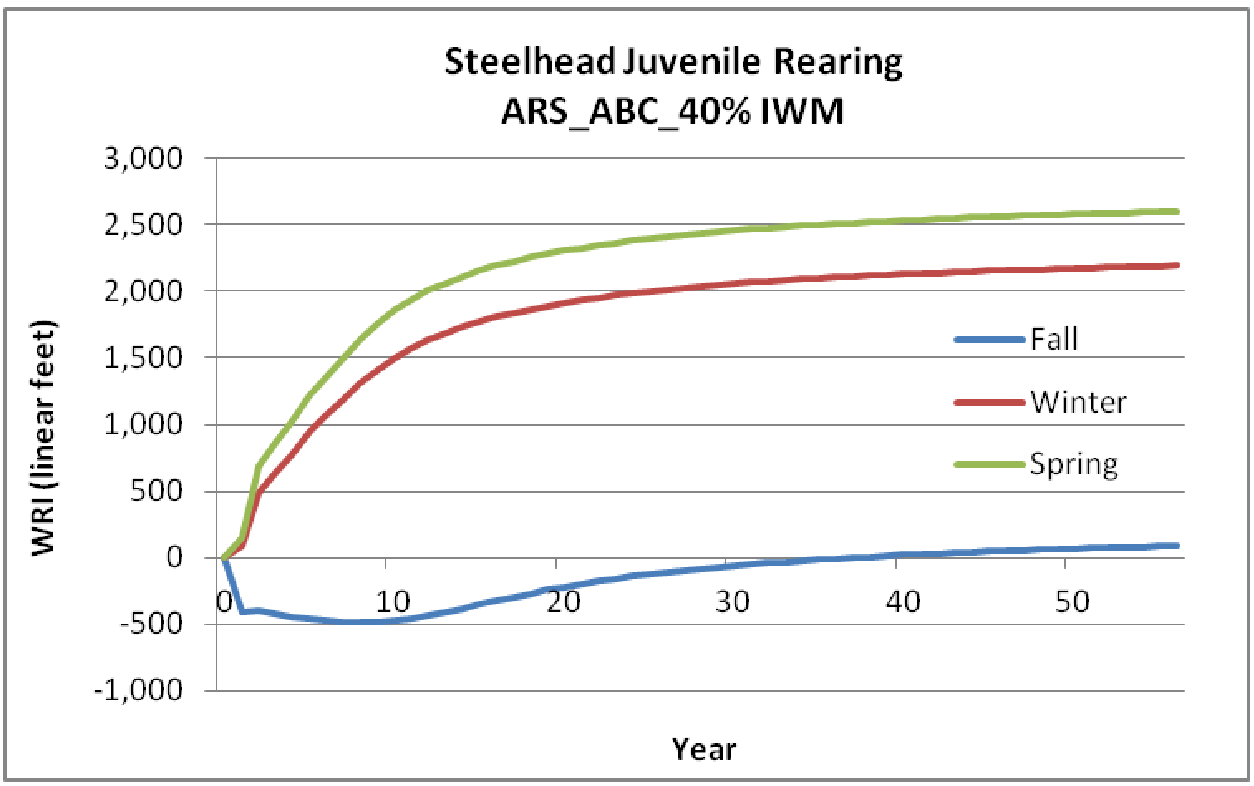



Figure 9. Weighted response indices at 40% IWM placement on the American River (ARS_ABC) for steelhead juvenile rearing.

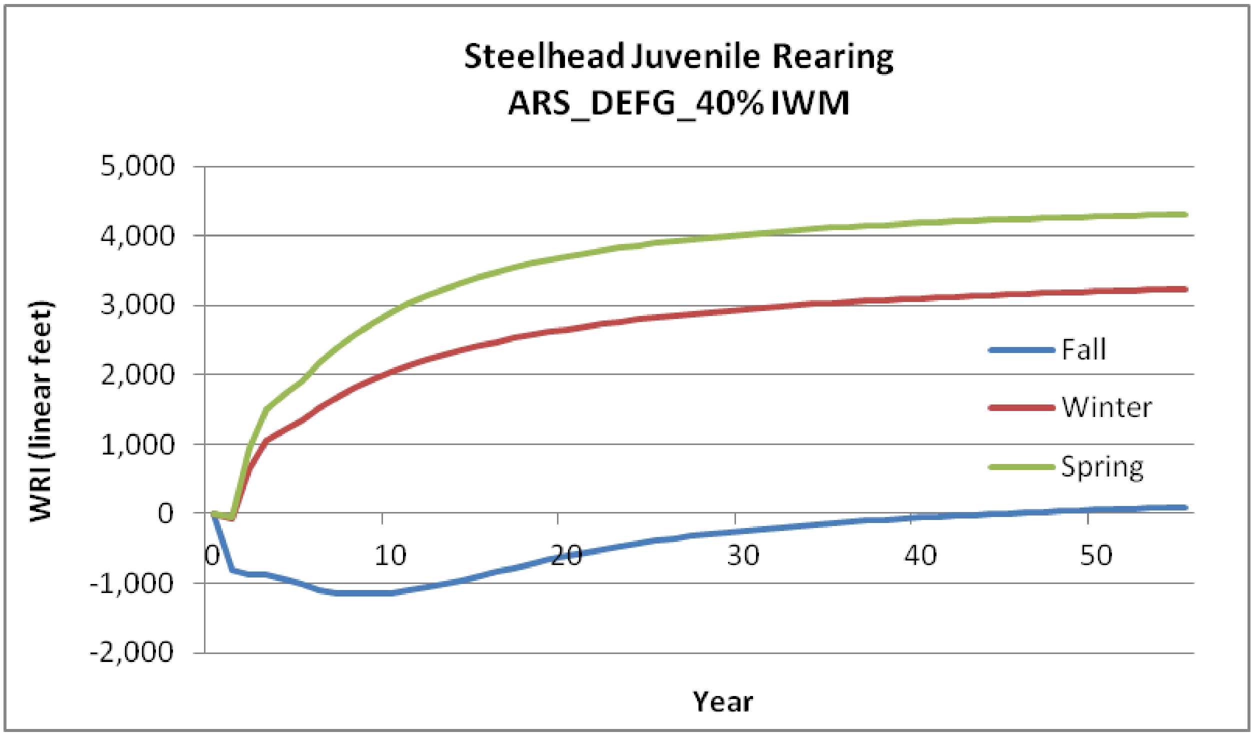



Figure 10. Weighted response indices at 40% IWM placement on the American River (ARS_DEFG) for steelhead juvenile rearing.

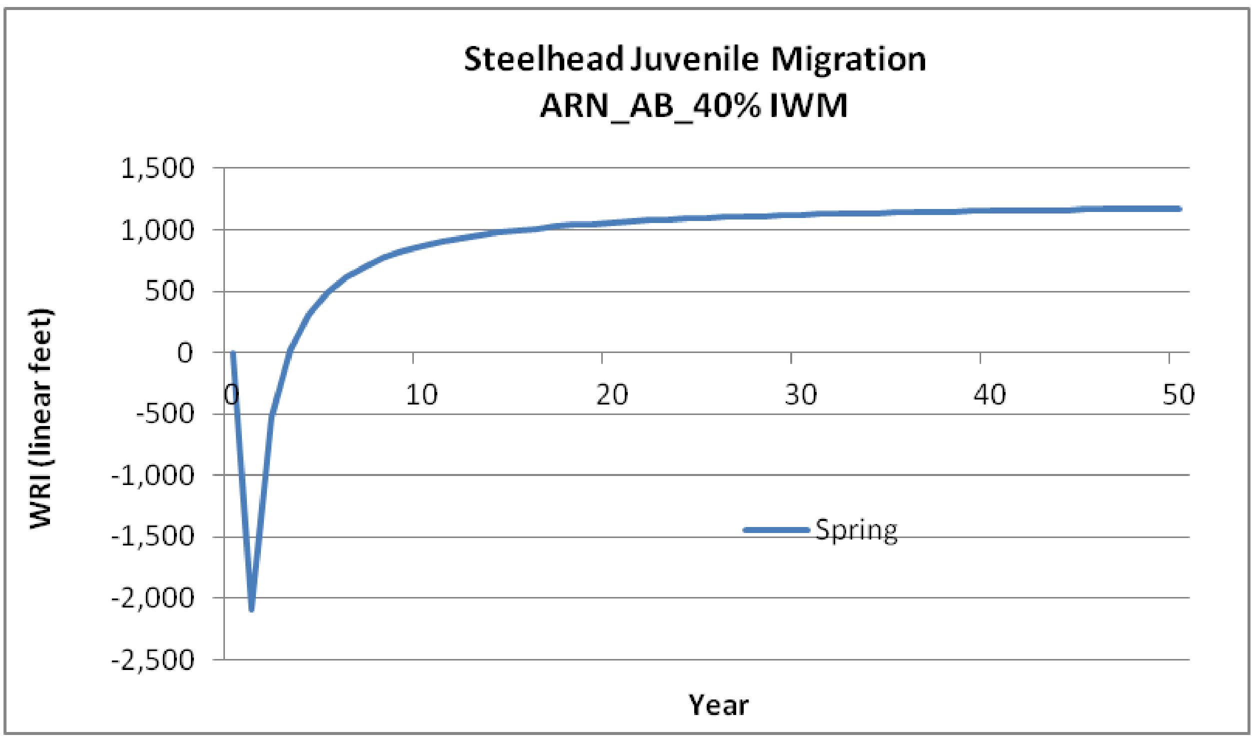



Figure 11. Weighted response indices at 40% IWM placement on the American River (ARN_AB) for steelhead juvenile migration.

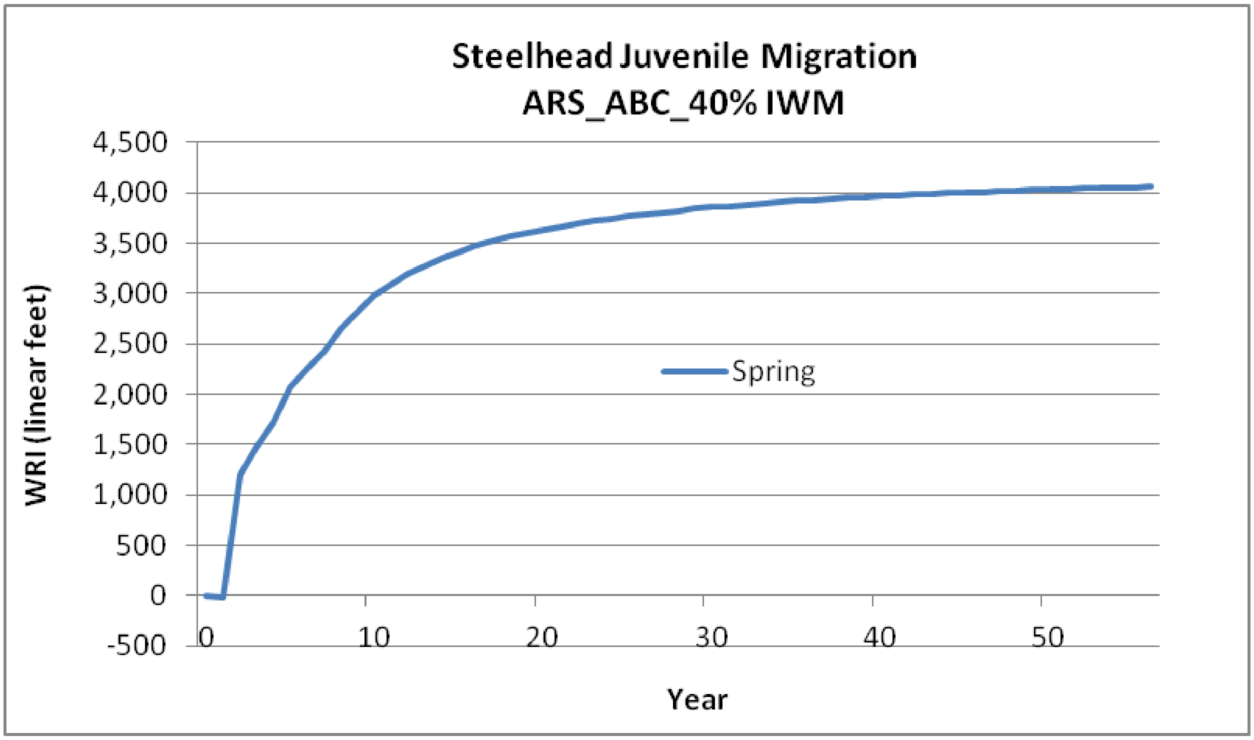



Figure 12. Weighted response indices at 40% IWM placement on the American River (ARS_ABC) for steelhead juvenile migration.

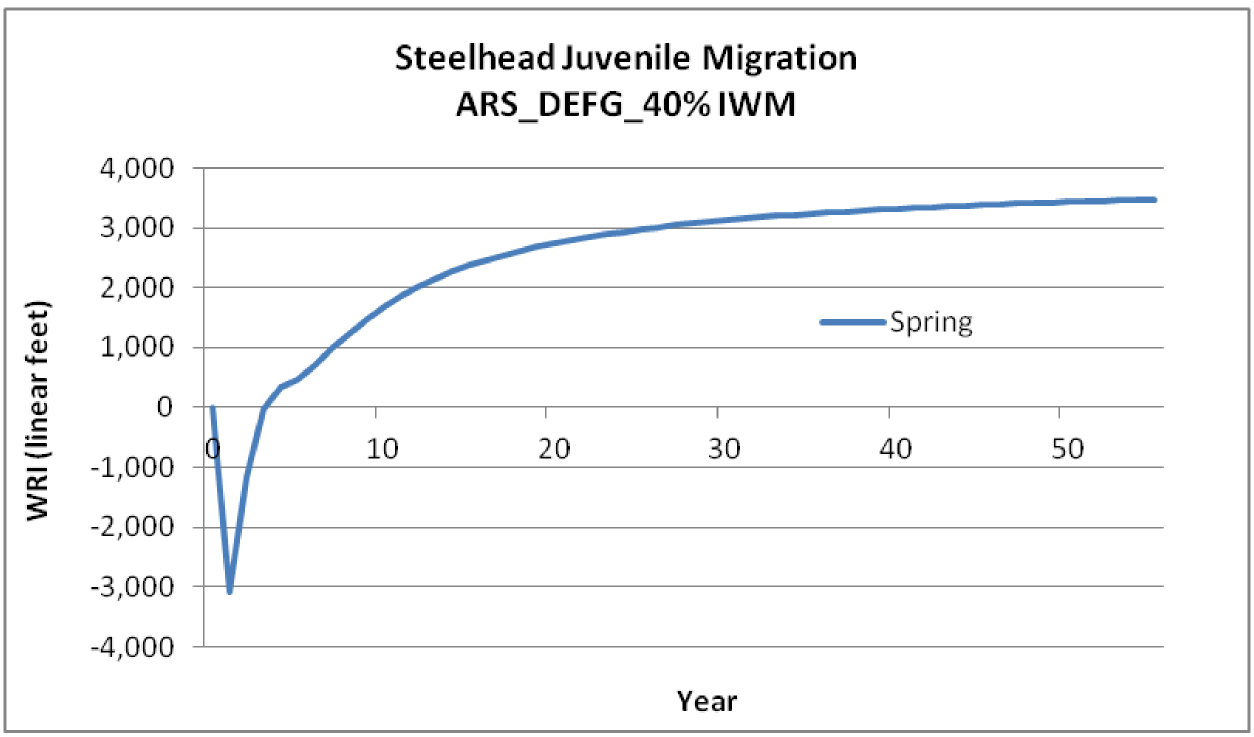



Figure 13. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_DEFG) for steelhead juvenile migration.

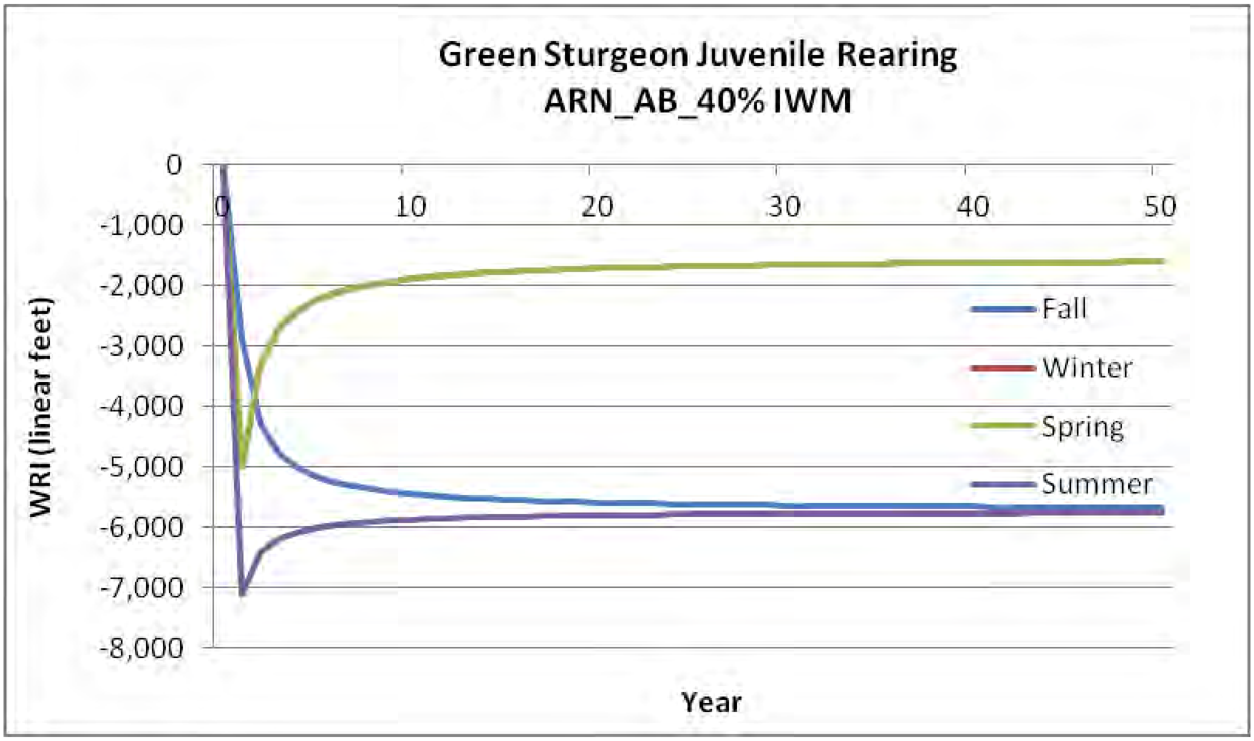



Figure 14. Weighted response indices at 40% IWM placement on the American River (ARN_AB) for green sturgeon juvenile rearing.

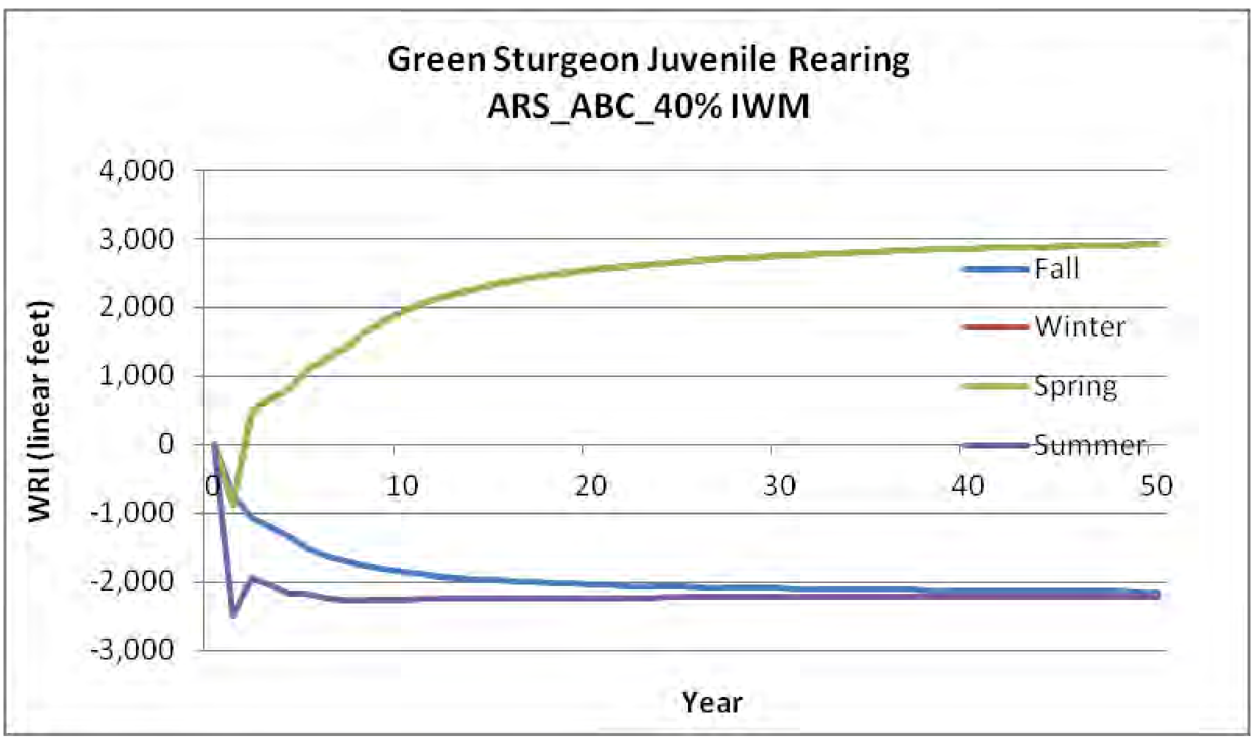



Figure 15. Weighted response indices at 40% IWM placement on the American River (ARS_ABC) for green sturgeon juvenile rearing.


Figure 16. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_DEFG) for green sturgeon juvenile rearing.

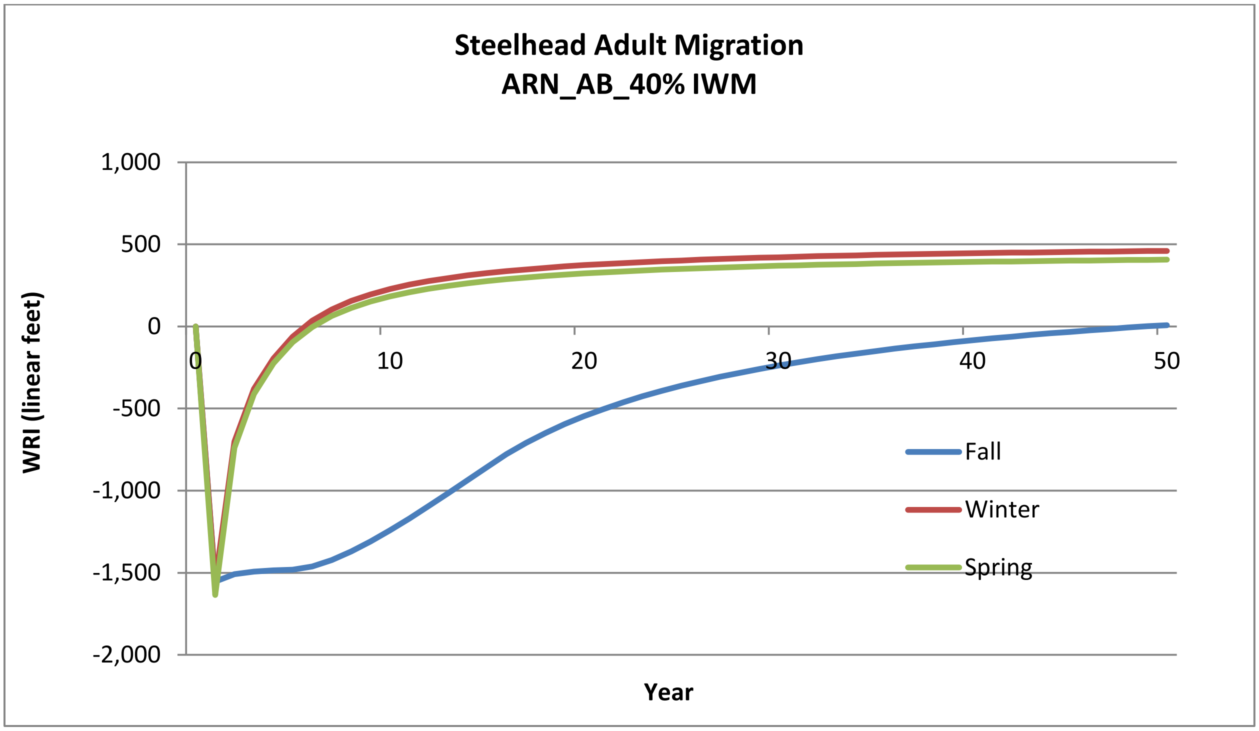



Figure 17. Weighted response indices at 40% IWM placement on the Sacramento River (ARN_AB) for steelhead adult migration.

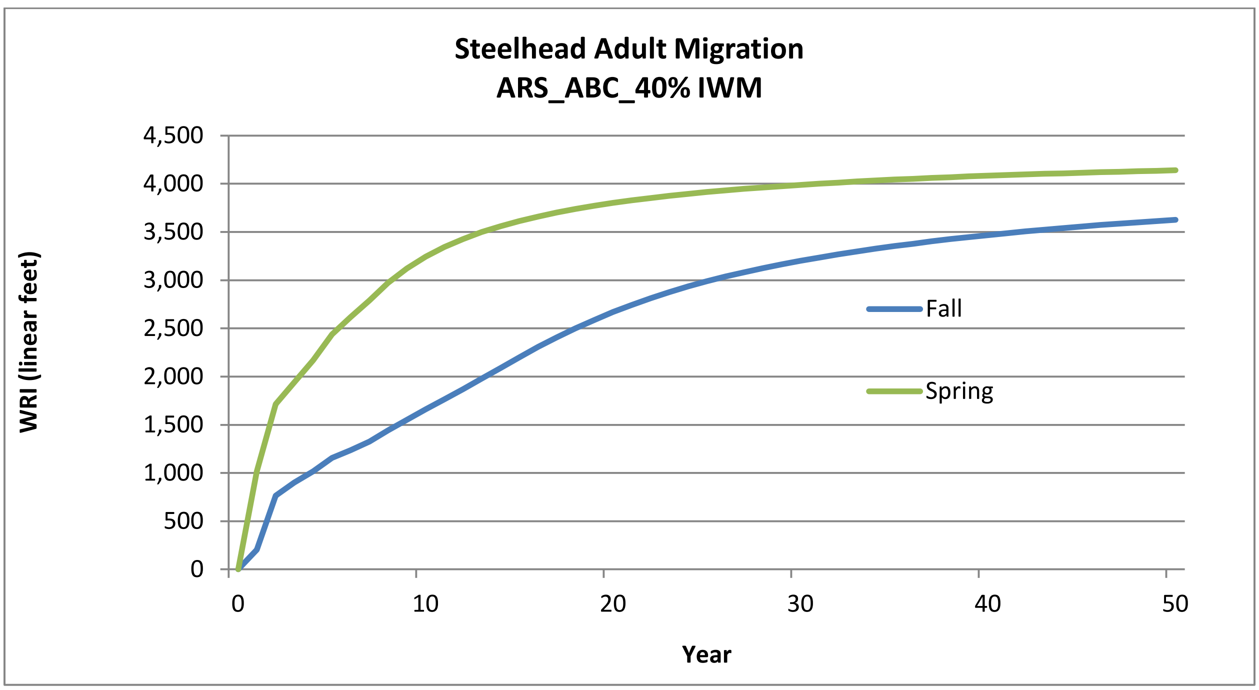



Figure 18. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_ABC) for steelhead adult migration.

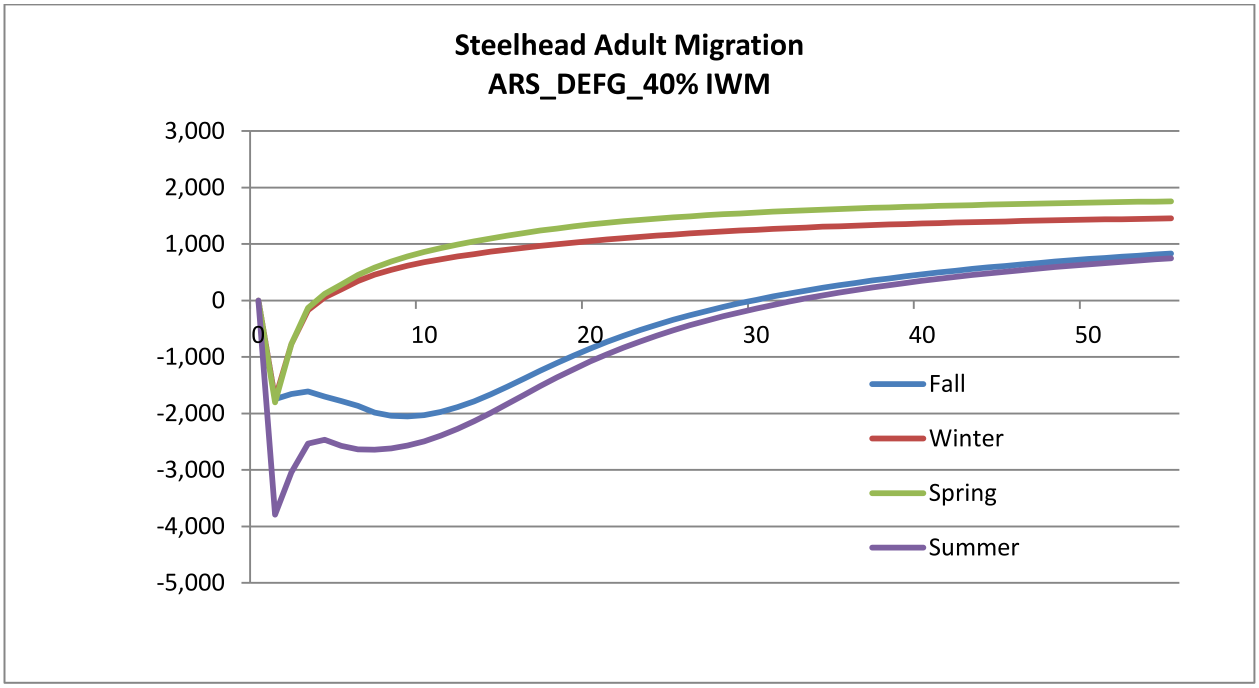



Figure 19. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_DEFG) for steelhead adult migration.

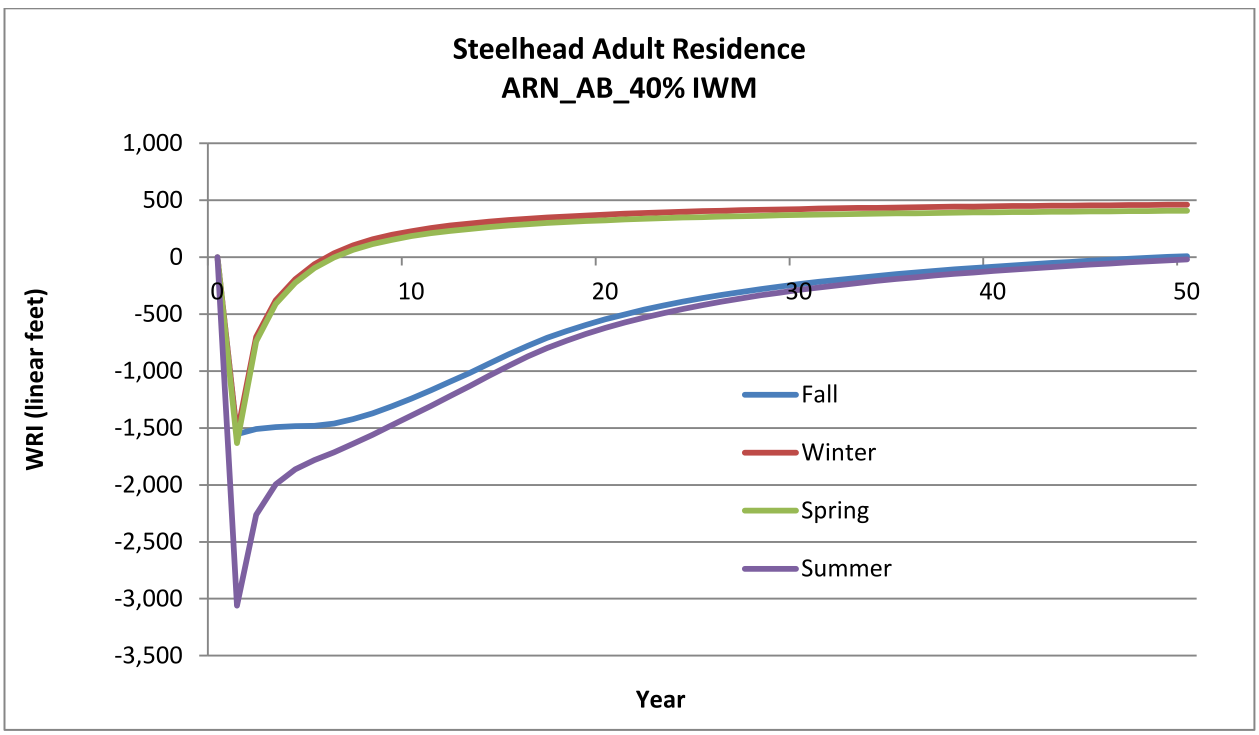



Figure 20. Weighted response indices at 40% IWM placement on the Sacramento River (ARN_AB) for steelhead adult residence.

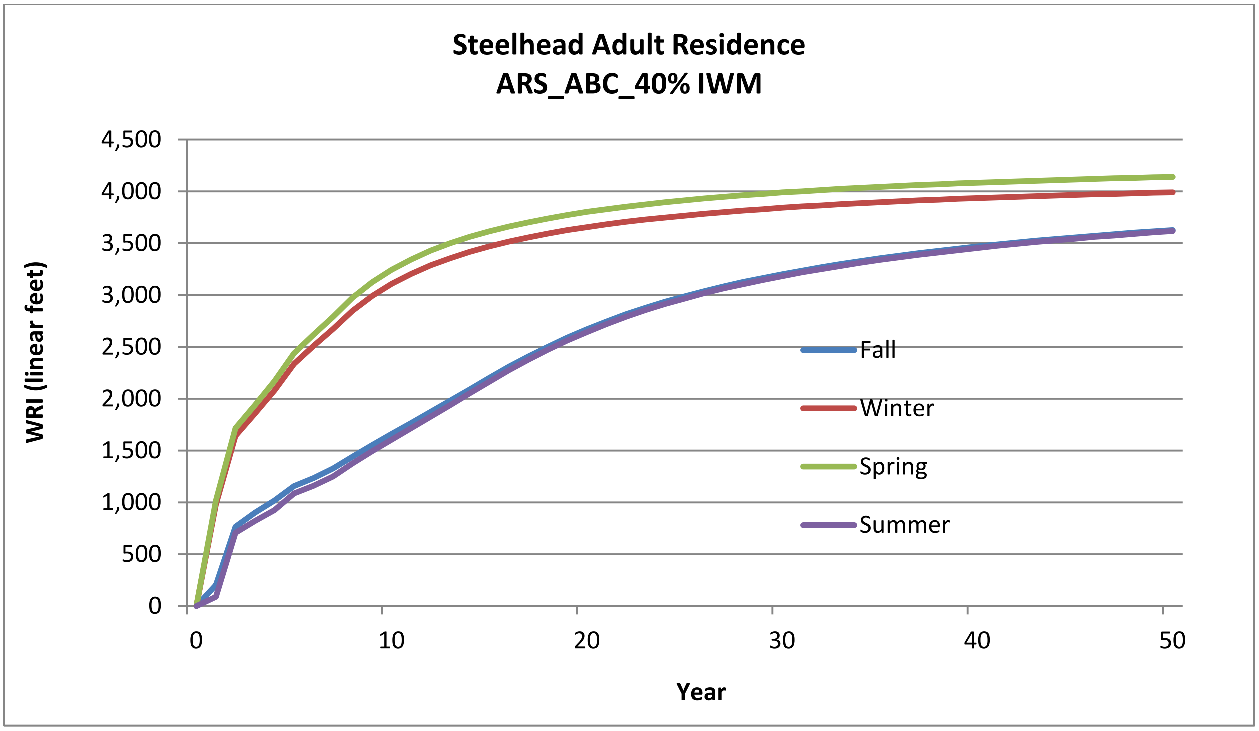



Figure 21. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_ABC) for steelhead adult residence.

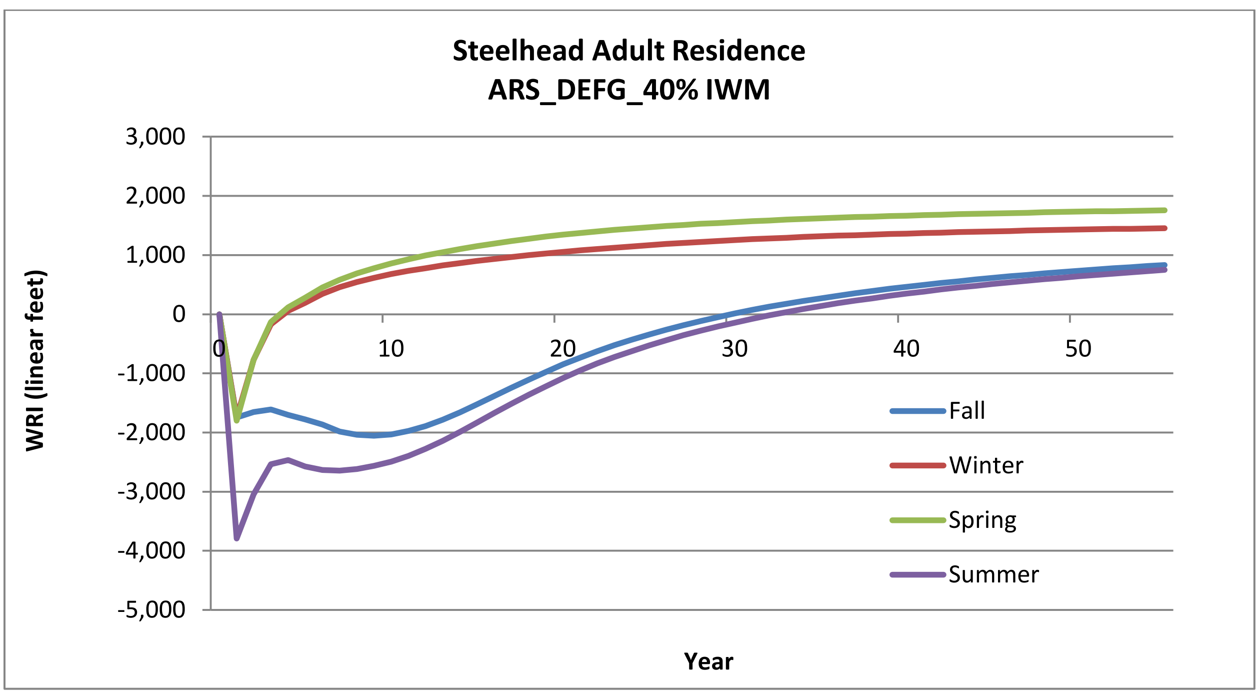



Figure 22. Weighted response indices at 40% IWM placement on the Sacramento River (ARS_DEFG) for steelhead adult residence.

**Table 30**

**ARN_AB_40% IWM**

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| **Spring-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | -366 | 50 | 0 |
| | Juvenile Migration | -2,303 | 50 | 0 |
| Winter | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | 0 | 0 | 1,102 |
| | Juvenile Migration | -3,002 | 2 | 1,699 |
| Spring | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | 0 | 0 | 1,354 |
| | Juvenile Migration | -2,681 | 4 | 1,699 |
| Summer | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | -421 | 50 | 0 |
| | Juvenile Migration | -3,129 | 50 | 0 |
| **Fall-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -877 | 39 | 59 |
| | Fry and Juvenile Rearing | -366 | 50 | 0 |
| | Juvenile Migration | -2,303 | 50 | 0 |
| Winter | Adult Migration | -759 | 5 | 245 |
| | Fry and Juvenile Rearing | 0 | 0 | 1,102 |
| | Juvenile Migration | -3,002 | 4 | 1,699 |
| Spring | Adult Migration | ** | ** | ** |
| | Fry and Juvenile Rearing | 0 | 0 | 1,354 |
| | Juvenile Migration | -2,681 | 3 | 1,418 |
| Summer | Adult Migration | ** | ** | ** |
| | Fry and Juvenile Rearing | -421 | 50 | 0 |
| | Juvenile Migration | -3,129 | 50 | 0 |
| **Steelhead** | | | | |
| Fall | Adult Migration | -1,554 | 48 | 8 |
| | Fry and Juvenile Rearing | -712 | 50 | 0 |
| | Juvenile Migration | *** | *** | *** |
| | Adult Residence | -1,554 | 48 | 8 |
| Winter | Adult Migration | -1,558 | 5 | 460 |

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| | Fry and Juvenile Rearing | -36 | 1 | 1,507 |
| | Juvenile Migration | *** | *** | *** |
| | Adult Residence | -1,558 | 5 | 460 |
| Spring | Adult Migration | -1,635 | 6 | 407 |
| | Fry and Juvenile Rearing | -1 | 1 | 1,731 |
| | Juvenile Migration | -2,096 | 2 | 1,173 |
| | Adult Residence | -1,635 | 6 | 407 |
| Summer | Fry and Juvenile Rearing | -833 | 50 | 0 |
| | Juvenile Migration | -3,013 | 50 | 0 |
| | Adult Residence | -3,061 | 50 | 0 |
| | | | | |
| **Green Sturgeon** | | | | |
| Fall | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -5,677 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -21 | 50 | 0 |
| Winter | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -5,020 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -3,621 | 50 | 0 |
| Spring | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -5,020 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -3,621 | 50 | 0 |
| Summer | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -7,118 | 0 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -942 | 50 | 0 |

* Not applicable, adult spring-run Chinook salmon are not present on the American River

** Not applicable, adult migration of fall-run Chinook begins in early fall.

*** Not applicable, historically juvenile steelhead migration occurs in spring and summer.

**Table 31**

**ARS_ABC_40% IWM**

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| **Spring-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | -229 | 26 | 112 |
| | Juvenile Migration | -620 | 21 | 526 |
| Winter | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | 0 | 0 | 1,578 |
| | Juvenile Migration | -333 | 1 | 5,377 |
| Spring | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | 0 | 0 | 2,001 |
| | Juvenile Migration | 0 | 0 | 5,123 |
| Summer | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | -239 | 26 | 111 |
| | Juvenile Migration | -967 | 22 | 510 |
| **Fall-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | 0 | 0 | 1,860 |
| | Fry and Juvenile Rearing | -229 | 26 | 112 |
| | Juvenile Migration | -620 | 21 | 526 |
| Winter | Adult Migration | 0 | 0 | 1,937 |
| | Fry and Juvenile Rearing | 0 | 0 | 1,578 |
| | Juvenile Migration | -333 | 1 | 5,377 |
| Spring | Adult Migration | ** | ** | ** |
| | Fry and Juvenile Rearing | 0 | 0 | 965 |
| | Juvenile Migration | 0 | 0 | 5,123 |
| Summer | Adult Migration | ** | ** | ** |
| | Fry and Juvenile Rearing | -239 | 26 | 111 |
| | Juvenile Migration | -967 | 22 | 510 |
| **Steelhead** | | | | |
| Fall | Adult Migration | 0 | 0 | 3,696 |
| | Fry and Juvenile Rearing | -489 | 36 | 88 |
| | Juvenile Migration | *** | *** | *** |
| | Adult Residence | 0 | 0 | 3,696 |
| Winter | Adult Migration | 0 | 0 | 4,015 |

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| | Fry and Juvenile Rearing | 0 | 0 | 2,194 |
| | Juvenile Migration | *** | *** | *** |
| | Adult Residence | 0 | 0 | 4,015 |
| Spring | Adult Migration | 0 | 0 | 4,164 |
| | Fry and Juvenile Rearing | 0 | 0 | 2,601 |
| | Juvenile Migration | 0 | 0 | 4,061 |
| | Adult Residence | 0 | 0 | 4,164 |
| **Green Sturgeon** | | | | |
| Fall | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -2,154 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | 0 | 0 | 1,548 |
| Winter | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -876 | 1 | 2,941 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -2,917 | 50 | 0 |
| Spring | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -876 | 1 | 2,941 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -2,917 | 50 | 0 |
| Summer | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -2,496 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | 0 | 0 | 1,537 |

* Not applicable, adult spring-run Chinook salmon are not present on the American River

** Not applicable, adult migration of fall-run Chinook begins in early fall.

*** Not applicable, historically juvenile steelhead migration occurs in spring and summer.

**Table 32**

ARS_DEFG_40% IWM

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| **Spring-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -1,394 | 35 | 362 |
| | Fry and Juvenile Rearing | -558 | 35 | 116 |
| | Juvenile Migration | -3,845 | 50 | 0 |
| Winter | Adult Migration | -892 | 4 | 643 |
| | Fry and Juvenile Rearing | 0 | 0 | 2,390 |
| | Juvenile Migration | -3,451 | 2 | 4,797 |
| Spring | Adult Migration | -946 | 4 | 931 |
| | Fry and Juvenile Rearing | 0 | 0 | 3,445 |
| | Juvenile Migration | -3,484 | 2 | 4,862 |
| Summer | Adult Migration | -2,136 | 37 | 319 |
| | Fry and Juvenile Rearing | -578 | 36 | 113 |
| | Juvenile Migration | -4,258 | 50 | 0 |
| **Fall-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -1,394 | 35 | 362 |
| | Fry and Juvenile Rearing | -558 | 35 | 116 |
| | Juvenile Migration | -3,845 | 50 | 0 |
| Winter | Adult Migration | -892 | 4 | 643 |
| | Fry and Juvenile Rearing | 0 | 0 | 2,390 |
| | Juvenile Migration | -3,451 | 2 | 4,797 |
| Spring | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | 0 | 0 | 3,445 |
| | Juvenile Migration | -3,484 | 2 | 4,862 |
| Summer | Fry and Juvenile Rearing | -578 | 36 | 113 |
| | Juvenile Migration | -4,258 | 50 | 0 |
| **Late-Fall-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -1,394 | 35 | 362 |
| | Fry and Juvenile Rearing | -558 | 35 | 116 |
| | Juvenile Migration | -3,845 | 50 | 0 |
| Winter | Adult Migration | -892 | 4 | 643 |
| | Fry and Juvenile Rearing | 0 | 0 | 2,390 |

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| | Juvenile Migration | -3,451 | 2 | 4,797 |
| Spring | Adult Migration | -946 | 4 | 931 |
| | Fry and Juvenile Rearing | 0 | 0 | 3,445 |
| Summer | Fry and Juvenile Rearing | -578 | 36 | 113 |
| **Winter-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -1,394 | 35 | 362 |
| | Fry and Juvenile Rearing | -558 | 35 | 116 |
| | Juvenile Migration | -3,845 | 50 | 0 |
| Winter | Adult Migration | -892 | 4 | 643 |
| | Fry and Juvenile Rearing | 0 | 0 | 2,390 |
| | Juvenile Migration | -3,451 | 2 | 4,797 |
| Spring | Adult Migration | -946 | 4 | 931 |
| | Fry and Juvenile Rearing | 0 | 0 | 3,445 |
| | Juvenile Migration | -3,484 | 2 | 4,862 |
| Summer | Adult Migration | -2,136 | 37 | 319 |
| | Fry and Juvenile Rearing | -578 | 36 | 113 |
| **Steelhead** | | | | |
| Fall | Adult Migration | -2,053 | 29 | 832 |
| | Fry and Juvenile Rearing | -1,156 | 44 | 99 |
| | Juvenile Migration | -3,985 | 50 | 0 |
| | Adult Residence | -2,053 | 29 | 832 |
| Winter | Adult Migration | -1,747 | 3 | 1,455 |
| | Fry and Juvenile Rearing | -77 | 1 | 3,234 |
| | Juvenile Migration | -3,044 | 3 | 3,355 |
| | Adult Residence | -1,747 | 3 | 1,455 |
| Spring | Adult Migration | -1,801 | 3 | 1,757 |
| | Fry and Juvenile Rearing | -36 | 1 | 4,317 |
| | Juvenile Migration | -3,082 | 3 | 3,474 |
| | Adult Residence | -1,801 | 3 | 1,757 |
| Summer | Adult Migration | -3,793 | 32 | 748 |
| | Fry and Juvenile Rearing | -1,206 | 45 | 92 |

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| | Adult Residence | -3,793 | 32 | 748 |
| **sDPS Green Sturgeon** | | | | |
| Fall | Fry and Juvenile Rearing | -4,674 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| Winter | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | -4,397 | 50 | 0 |
| | Adult Residence | -3,068 | 50 | 0 |
| Spring | Fry and Juvenile Rearing | -4,397 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -3,068 | 50 | 0 |
| | Adult Migration | 0 | 0 | 0 |
| Summer | Fry and Juvenile Rearing | -5,009 | 50 | 0 |
| | Juvenile Migration | 0 | 0 | 0 |
| | Adult Residence | -1,298 | 50 | 0 |

* Not applicable because adult fall-run Chinook salmon migrate in early fall.

**Table 33**

SBP

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| **Spring-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | -4 | 50 | 0 |
| | Juvenile Migration | -26 | 50 | 0 |
| Winter | Adult Migration | * | * | * |
| | Fry and Juvenile Rearing | -9 | 50 | 0 |
| | Juvenile Migration | -146 | 50 | 0 |
| Spring | Adult Migration | -51 | 50 | 0 |
| | Fry and Juvenile Rearing | -21 | 50 | 0 |
| | Juvenile Migration | -188 | 50 | 0 |
| **Winter-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | ** | ** | ** |
| | Fry and Juvenile Rearing | -4 | 50 | 0 |
| | Juvenile Migration | -26 | 50 | 0 |
| Winter | Adult Migration | -21 | 50 | 0 |
| | Fry and Juvenile Rearing | -9 | 50 | 0 |
| | Juvenile Migration | -146 | 50 | 0 |
| Spring | Adult Migration | -51 | 50 | 0 |
| | Fry and Juvenile Rearing | -21 | 50 | 0 |
| | Juvenile Migration | -188 | 50 | 0 |
| **Fall-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -60 | 50 | 0 |
| | Fry and Juvenile Rearing | -4 | 50 | 0 |
| | Juvenile Migration | -26 | 50 | 0 |
| Winter | Adult Migration | -21 | 50 | 0 |
| | Fry and Juvenile Rearing | -9 | 50 | 0 |
| | Juvenile Migration | -146 | 50 | 0 |
| Spring | Adult Migration | *** | *** | *** |
| | Fry and Juvenile Rearing | -21 | 50 | 0 |
| | Juvenile Migration | -188 | 50 | 0 |
| **Late-Fall-Run Chinook Salmon** | | | | |
| Fall | Adult Migration | -60 | 50 | 0 |

| Season | Life Stage | Maximum WRI Deficits | Duration of Deficit (in years) | Maximum WRI Benefits |
|---|---|---|---|---|
| | Fry and Juvenile Rearing | -4 | 50 | 0 |
| | Juvenile Migration | -26 | 50 | 0 |
| Winter | Adult Migration | -21 | 50 | 0 |
| | Fry and Juvenile Rearing | -9 | 50 | 0 |
| | Juvenile Migration | -146 | 50 | 0 |
| Spring | Adult Migration | **** | **** | **** |
| | Fry and Juvenile Rearing | -21 | 50 | 0 |
| | Juvenile Migration | -188 | 50 | 0 |
| **Steelhead** | | | | |
| Fall | Adult Migration | -100 | 50 | 0 |
| | Fry and Juvenile Rearing | -17 | 50 | 0 |
| | Juvenile Migration | -35 | 50 | 0 |
| Winter | Adult Migration | -40 | 50 | 0 |
| | Fry and Juvenile Rearing | -29 | 50 | 0 |
| | Juvenile Migration | -127 | 50 | 0 |
| Spring | Adult Migration | -87 | 50 | 0 |
| | Fry and Juvenile Rearing | -55 | 50 | 0 |
| | Juvenile Migration | -174 | 50 | 0 |
| **sDPS Green Sturgeon** | | | | |
| Fall | Fry and Juvenile Rearing | 0 | 0 | 115 |
| | Juvenile Migration | 0 | 0 | 0 |
| Winter | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | 0 | 0 | 115 |
| Spring | Adult Migration | 0 | 0 | 0 |
| | Fry and Juvenile Rearing | 0 | 0 | 115 |
| | Juvenile Migration | 0 | 0 | 0 |

* Not applicable, adult spring-run Chinook salmon migrate upstream in the spring

** Not applicable, adult winter-run Chinook salmon migrate upstream in the winter

*** Not applicable, adult fall-run Chinook salmon migrate upstream in the fall

**** Not applicable, adult lt.fall-run Chinook salmon migrate upstream in the late fall and winter

# 7.0 References

USACE (U. S. Army Corps of Engineers). 2008. Standard assessment methodology (SAM) analysis of 29 constructed bank repair sites for the Sacramento River Bank Protection Project. Final. Contract No. W91238-07-C-0002. Prepared by Stillwater Sciences, Berkeley, California for USACE, Sacramento District, Sacramento, California. July.

USACE (U. S. Army Corps of Engineers). 2012. Standard Assessment Methodology for the Sacramento River Bank Protection Project, 2010–2012 Certification Update, Final. Prepared for U.S. Army Corps of Engineers, Sacramento District by Stillwater Sciences, Berkeley, California. Contract W91238-09-P-0249 Task Order 3.

USACE (U. S. Army Corps of Engineers). 2013. Standard Assessment Methodology (SAM) for the Sacramento River Bank Protection Project (SRBPP), Cumulative Analysis of 22 Sites. Final June 2013.

# Appendix C

# Delta Smelt Shallow Water Habitat Analysis

## SACRAMENTO RIVER D/S OF AMERICAN RIVER

| RIVER STATION | | AVG. WS ELEV (NAVD88) | | SHA DEPTH |
|---|---|---|---|---|
| (mi) | MHHW | SHALLOW END | SUMMER | (ft) |
| 60.39 | 8.76 | -2.22 | 10.7 | 10.98 |
| 60.39 | 8.76 | -2.22 | 10.7 | 10.98 |
| 60.25 | 8.73 | -2.22 | 10.6 | 10.95 |
| 60.00 | 8.64 | -2.25 | 10.6 | 10.89 |
| 59.75 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.70 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.69 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.69 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.68 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.68 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.68 | 8.59 | -2.25 | 10.5 | 10.84 |
| 59.50 | 8.56 | -2.25 | 10.5 | 10.81 |
| 59.29 | 8.55 | -2.25 | 10.5 | 10.80 |
| 59.29 | 8.55 | -2.25 | 10.5 | 10.80 |
| 59.27 | 8.55 | -2.25 | 10.5 | 10.80 |
| 59.27 | 8.55 | -2.25 | 10.5 | 10.80 |
| 59.25 | 8.55 | -2.25 | 10.5 | 10.80 |
| 59.00 | 8.49 | -2.26 | 10.5 | 10.75 |
| 58.75 | 8.42 | -2.28 | 10.4 | 10.70 |
| 58.52 | 8.36 | -2.29 | 10.4 | 10.65 |
| 58.52 | 8.36 | -2.29 | 10.4 | 10.65 |
| 58.51 | 8.36 | -2.29 | 10.3 | 10.65 |
| 58.50 | 8.36 | -2.29 | 10.3 | 10.65 |
| 58.50 | 8.36 | -2.29 | 10.3 | 10.65 |
| 58.50 | 8.36 | -2.29 | 10.3 | 10.65 |
| 58.49 | 8.35 | -2.29 | 10.3 | 10.64 |
| 58.49 | 8.35 | -2.29 | 10.3 | 10.64 |
| 58.25 | 8.30 | -2.30 | 10.3 | 10.60 |
| 58.00 | 8.25 | -2.30 | 10.2 | 10.55 |
| 57.85 | 8.23 | -2.30 | 10.2 | 10.53 |
| 57.64 | 8.19 | -2.30 | 10.1 | 10.49 |
| 57.50 | 8.18 | -2.30 | 10.1 | 10.48 |
| 57.25 | 8.13 | -2.31 | 10.1 | 10.44 |
| 57.00 | 8.09 | -2.31 | 10.0 | 10.40 |
| 56.75 | 8.05 | -2.31 | 10.0 | 10.36 |
| 56.50 | 8.02 | -2.31 | 10.0 | 10.33 |
| 56.25 | 7.98 | -2.31 | 10.0 | 10.29 |
| 56.00 | 7.95 | -2.32 | 9.9 | 10.27 |
| 55.75 | 7.93 | -2.32 | 9.9 | 10.25 |
| 55.49 | 7.89 | -2.32 | 9.9 | 10.21 |
| 55.25 | 7.87 | -2.32 | 9.9 | 10.19 |
| 55.00 | 7.87 | -2.32 | 9.9 | 10.19 |
| 54.75 | 7.84 | -2.32 | 9.9 | 10.16 |

| | | | | |
|---|---|---|---|---|
| 54.50 | 7.79 | -2.32 | 9.8 | 10.11 |
| 54.25 | 7.76 | -2.32 | 9.8 | 10.08 |
| 54.00 | 7.73 | -2.32 | 9.8 | 10.05 |
| 53.75 | 7.69 | -2.33 | 9.7 | 10.02 |
| 53.50 | 7.64 | -2.33 | 9.7 | 9.97 |
| 53.25 | 7.61 | -2.33 | 9.7 | 9.94 |
| 53.00 | 7.57 | -2.33 | 9.7 | 9.90 |
| 52.75 | 7.50 | -2.35 | 9.6 | 9.85 |
| 52.50 | 7.44 | -2.36 | 9.6 | 9.80 |
| 52.25 | 7.39 | -2.36 | 9.6 | 9.75 |
| 52.00 | 7.37 | -2.36 | 9.5 | 9.73 |
| 51.75 | 7.33 | -2.36 | 9.5 | 9.69 |
| 51.50 | 7.29 | -2.37 | 9.5 | 9.66 |
| 51.25 | 7.21 | -2.37 | 9.4 | 9.58 |
| 51.00 | 7.19 | -2.37 | 9.4 | 9.56 |
| 50.75 | 7.16 | -2.37 | 9.4 | 9.53 |
| 50.50 | 7.12 | -2.38 | 9.4 | 9.50 |
| 50.25 | 7.08 | -2.38 | 9.4 | 9.46 |
| 50.00 | 7.05 | -2.38 | 9.3 | 9.43 |
| 49.75 | 7.00 | -2.38 | 9.3 | 9.38 |
| 49.50 | 6.96 | -2.39 | 9.3 | 9.35 |
| 49.25 | 6.91 | -2.39 | 9.2 | 9.30 |
| 49.00 | 6.87 | -2.39 | 9.2 | 9.26 |
| 48.75 | 6.84 | -2.39 | 9.2 | 9.23 |
| 48.50 | 6.79 | -2.39 | 9.2 | 9.18 |
| 48.25 | 6.75 | -2.40 | 9.1 | 9.15 |
| 48.00 | 6.69 | -2.41 | 9.1 | 9.10 |
| 47.75 | 6.62 | -2.42 | 9.1 | 9.04 |
| 47.50 | 6.57 | -2.42 | 9.0 | 8.99 |
| 47.25 | 6.53 | -2.42 | 9.0 | 8.95 |
| 47.00 | 6.51 | -2.42 | 9.0 | 8.93 |
| 46.75 | 6.49 | -2.42 | 9.0 | 8.91 |
| 46.50 | 6.48 | -2.42 | 9.0 | 8.90 |
| 46.43 | 6.47 | -2.42 | 9.0 | 8.89 |
| 46.42 | 6.47 | -2.42 | 9.0 | 8.89 |
| 46.42 | 6.47 | -2.42 | 9.0 | 8.89 |
| 46.42 | 6.47 | -2.42 | 9.0 | 8.89 |
| 46.25 | 6.44 | -2.42 | 9.0 | 8.86 |
| 46.00 | 6.42 | -2.42 | 9.0 | 8.84 |
| 45.75 | 6.39 | -2.43 | 8.9 | 8.82 |
| 45.50 | 6.37 | -2.43 | 8.9 | 8.80 |
| 45.25 | 6.34 | -2.43 | 8.9 | 8.77 |
| 45.00 | 6.31 | -2.43 | 8.9 | 8.74 |

## SHADED HABITAT AREA

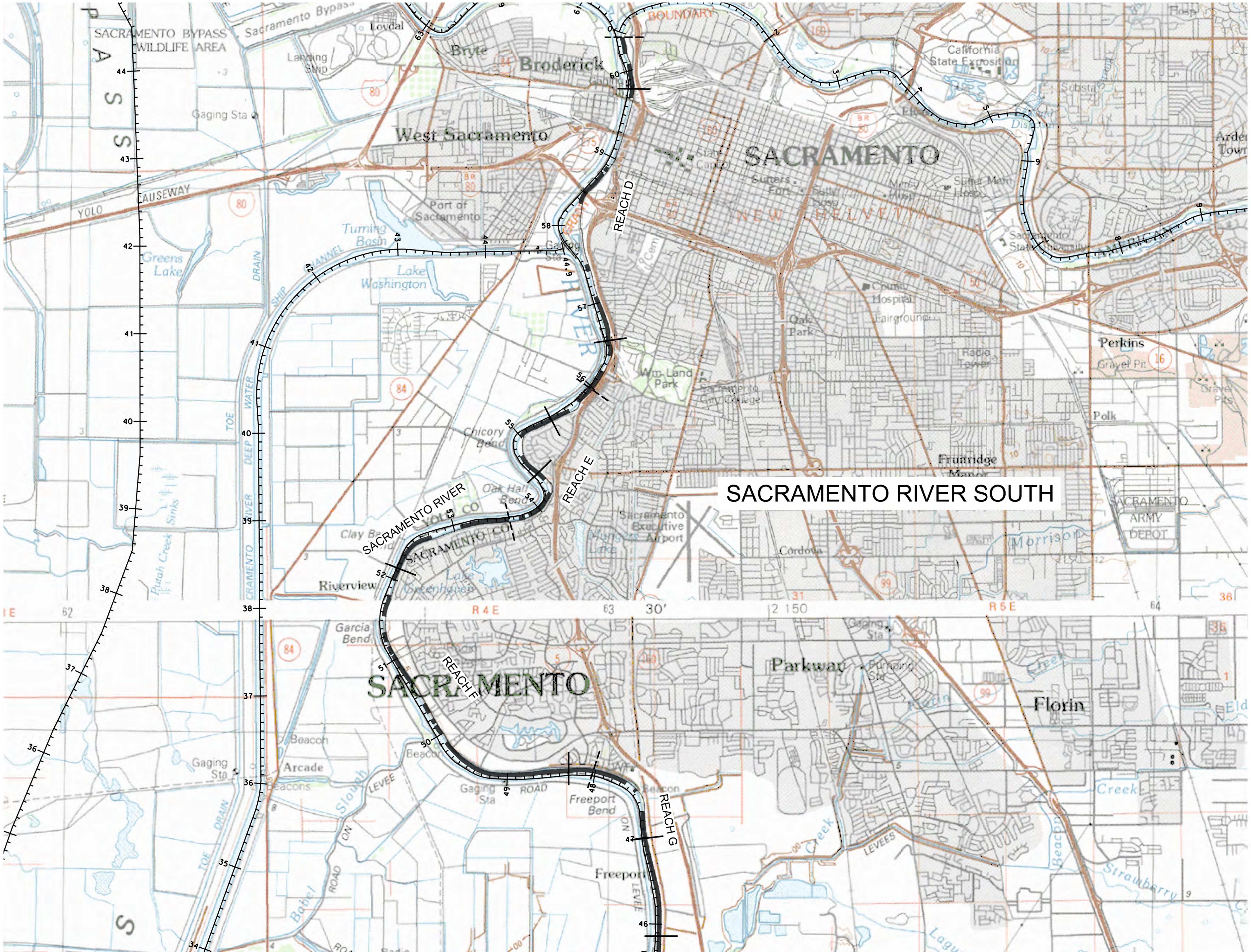
### SECTIONS ANALYZED

| REACH | RM | STA | WATER SURFACE | | |
|---|---|---|---|---|---|
| | | | MHHW | SHALLOW END | SUMMER |
| D | 59.80 | 32+00 | 8.6 | -2.3 | 10.5 |
| D | 56.55 | 195+00 | 8.0 | -2.3 | 10.0 |
| E | 55.41 | 260+00 | 7.9 | -2.3 | 9.9 |
| E | 54.40 | 305+00 | 7.8 | -2.3 | 9.8 |
| F | 52.13 | 430+00 | 7.4 | -2.4 | 9.5 |
| F | 48.30 | 625+00 | 6.8 | -2.4 | 9.1 |
| G | 46.99 | 700+00 | 6.5 | -2.4 | 9.0 |
| G | 45.87 | 760+00 | 6.4 | -2.4 | 8.9 |

## IMPACTED SHADED HABITAT AREA

| REACH | FEATURE LENGTH (ft) | SHA SWATH (ft) | | DIFFERENCE | IMPACTED AREAS | | WORST CASE |
|---|---|---|---|---|---|---|---|
| | | EXISTING | W/PROJECT | | SF | AC | |
| D | 9,200 | 23.93 | 26.54 | 2.61 | 24,000 | 0.55 | |
| D | 9,200 | 53.17 | 26.33 | -26.84 | -246,900 | -5.67 | -5.67 |
| E | 8,850 | 22.84 | 27.97 | 5.13 | 45,400 | 1.04 | |
| E | 8,850 | 48.73 | 26.87 | -21.86 | -193,500 | -4.44 | -4.44 |
| F | 21,100 | 35.94 | 27.92 | -8.02 | -169,200 | -3.88 | -3.88 |
| F | 21,100 | 19.02 | 26.67 | 7.65 | 161,400 | 3.71 | |
| G | 11,150 | 29.55 | 26.17 | -3.38 | -37,700 | -0.87 | -0.87 |
| G | 11,150 | 21.05 | 26.07 | 5.02 | 56,000 | 1.29 | |

| IMPACTED SPAWNING AREAS | | | | |
|---|---|---|---|---|
| | | | | |
| REACH | FEATURE LENGTH (ft) | EXISTING (ft) | SF | AC |
| D | 9200 | 53.17 | 489164 | 11.23 |
| E | 8850 | 48.73 | 431261 | 9.90 |
| F | 21100 | 35.94 | 758334 | 17.41 |
| G | 11150 | 29.55 | 329483 | 7.56 |
| | | | | **46.10** |

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REACH
ANALYSIS SECTION
RIVER MILE STATION

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COMMON FEATURES GRR

SACRAMENTO RIVER
SHA ANALYSIS OVERVIEW

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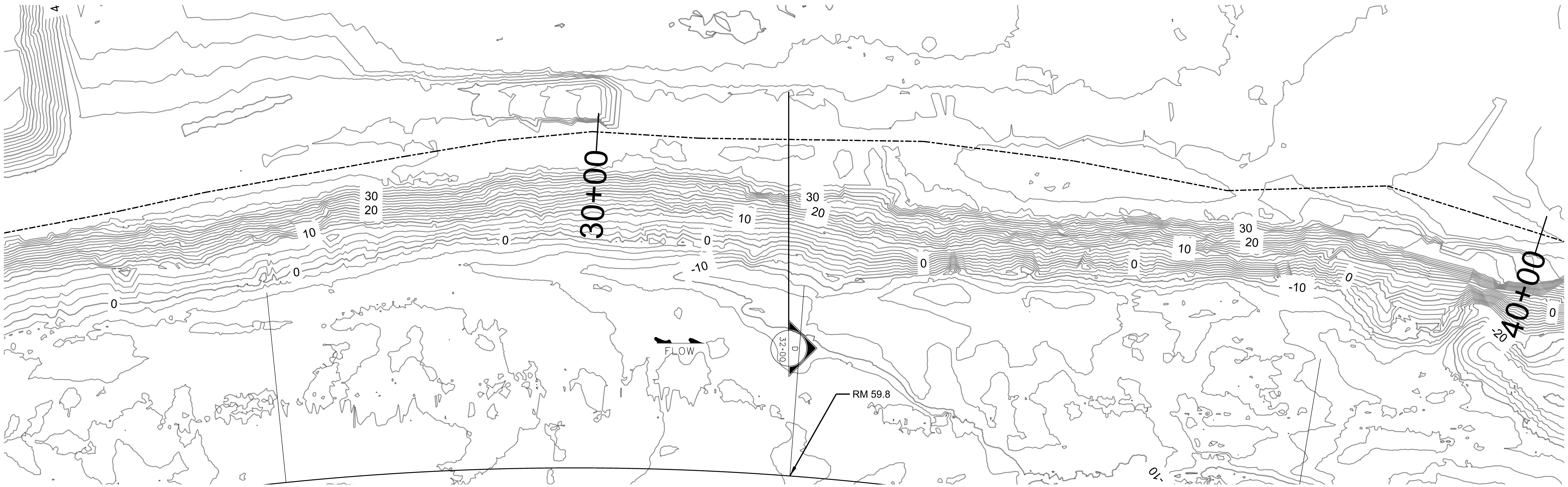


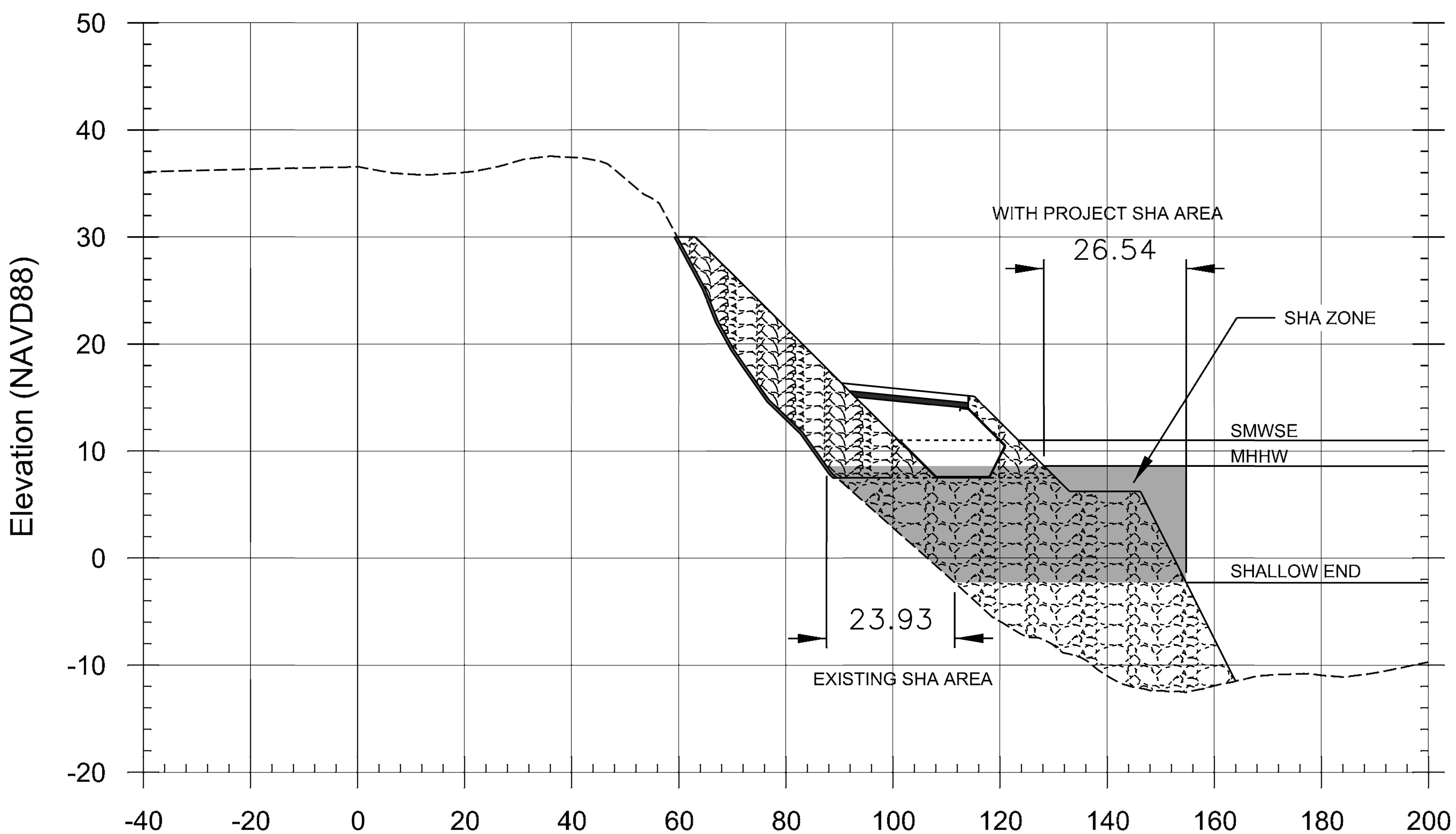


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REACH D - SHA ANALYSIS

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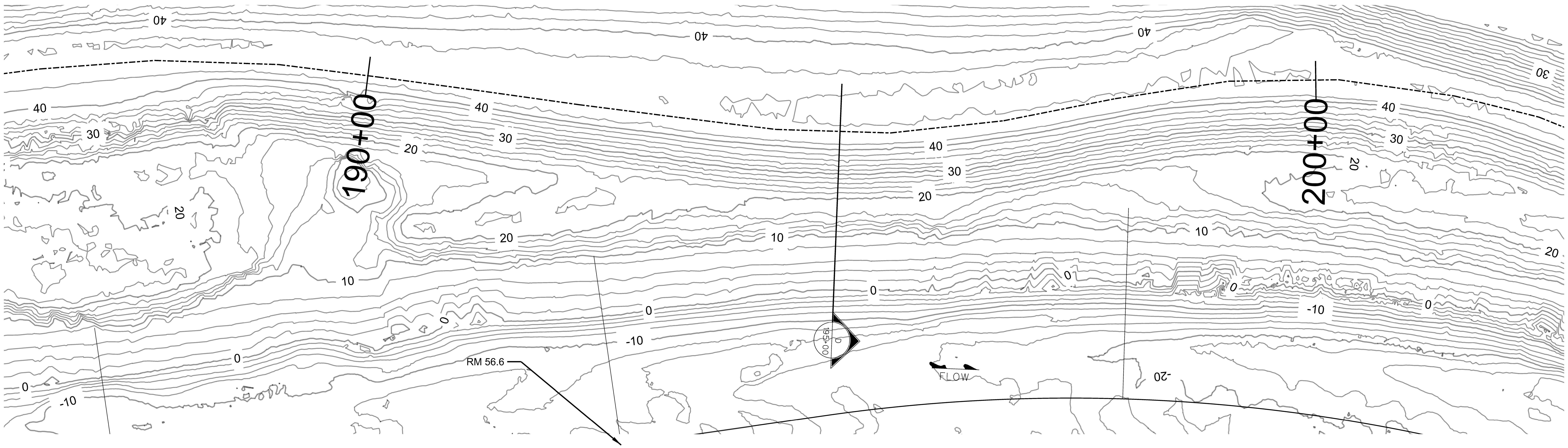


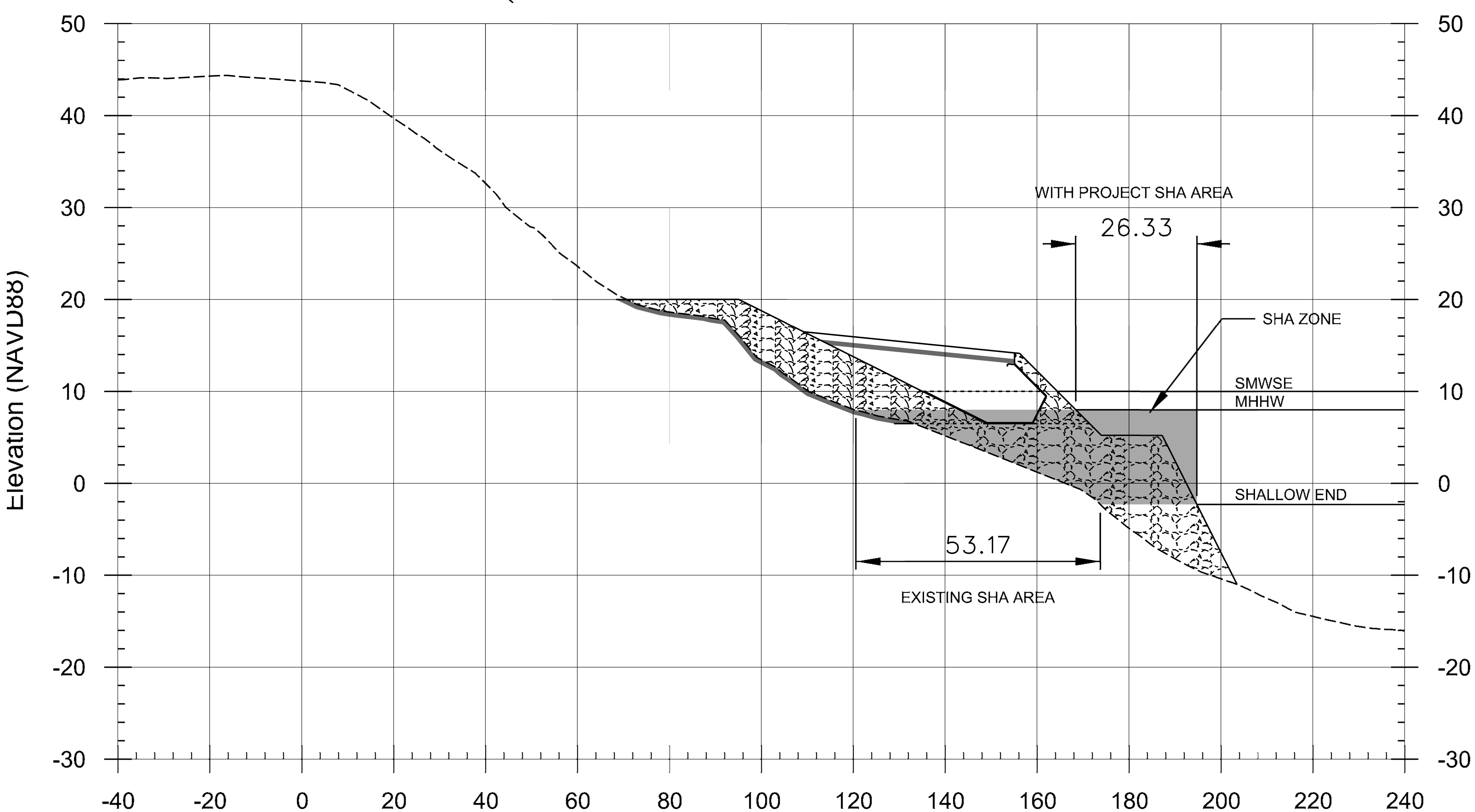


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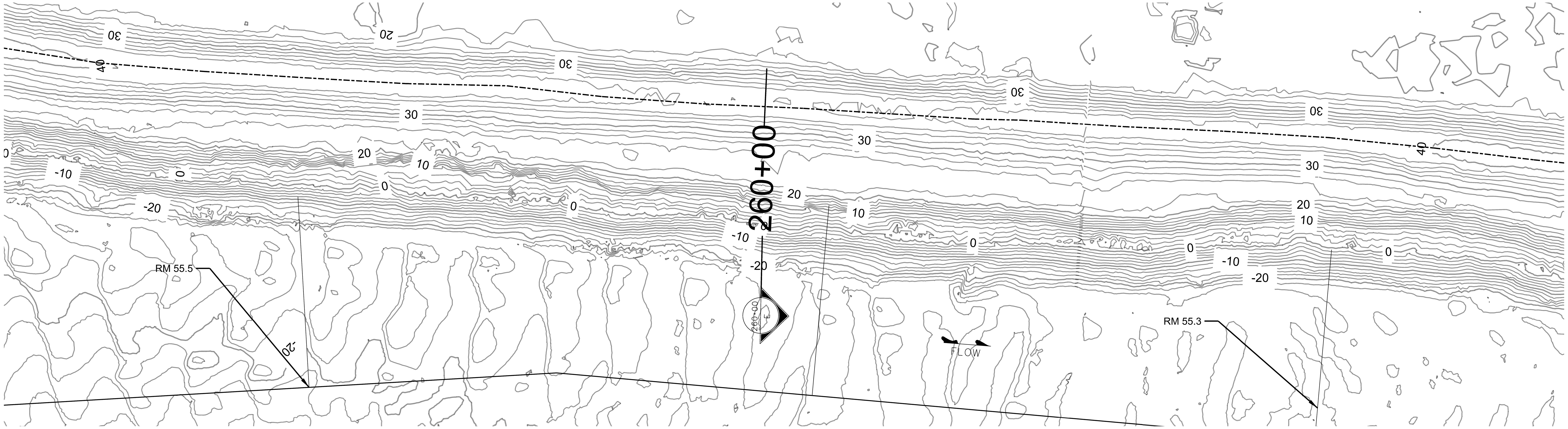


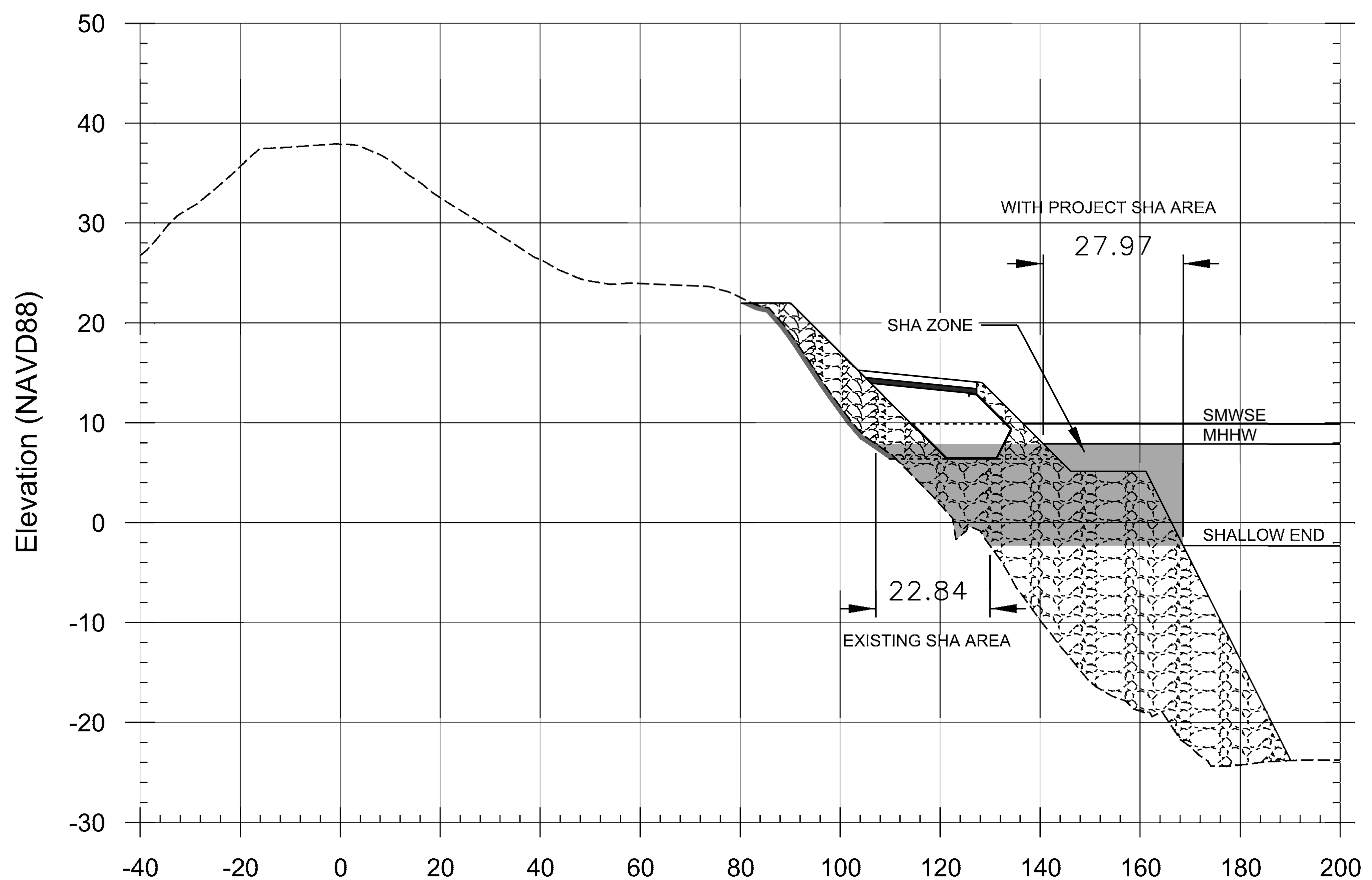


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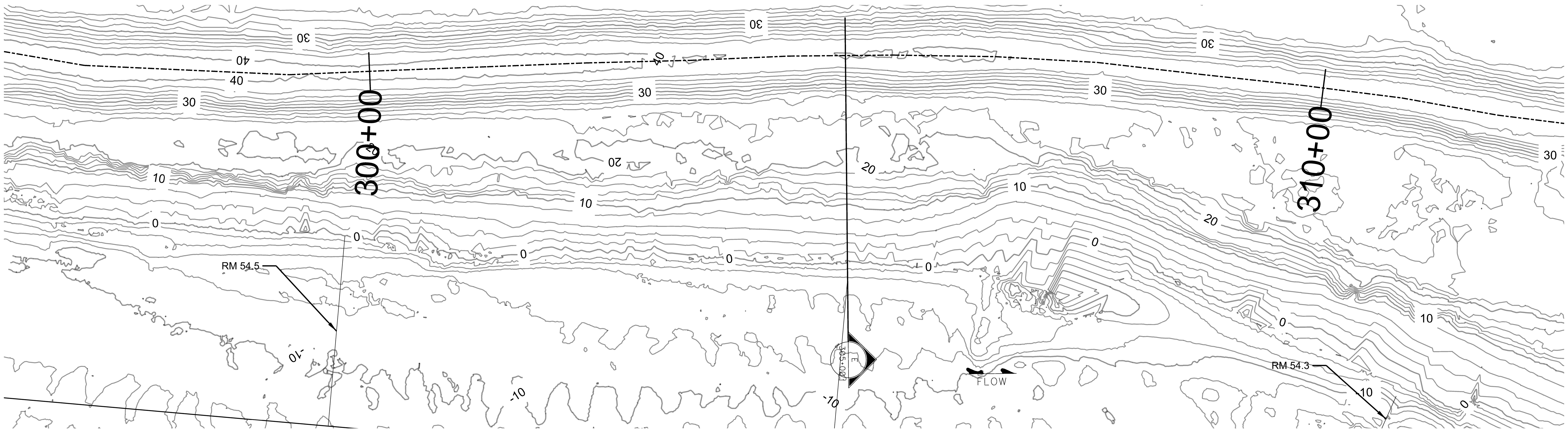


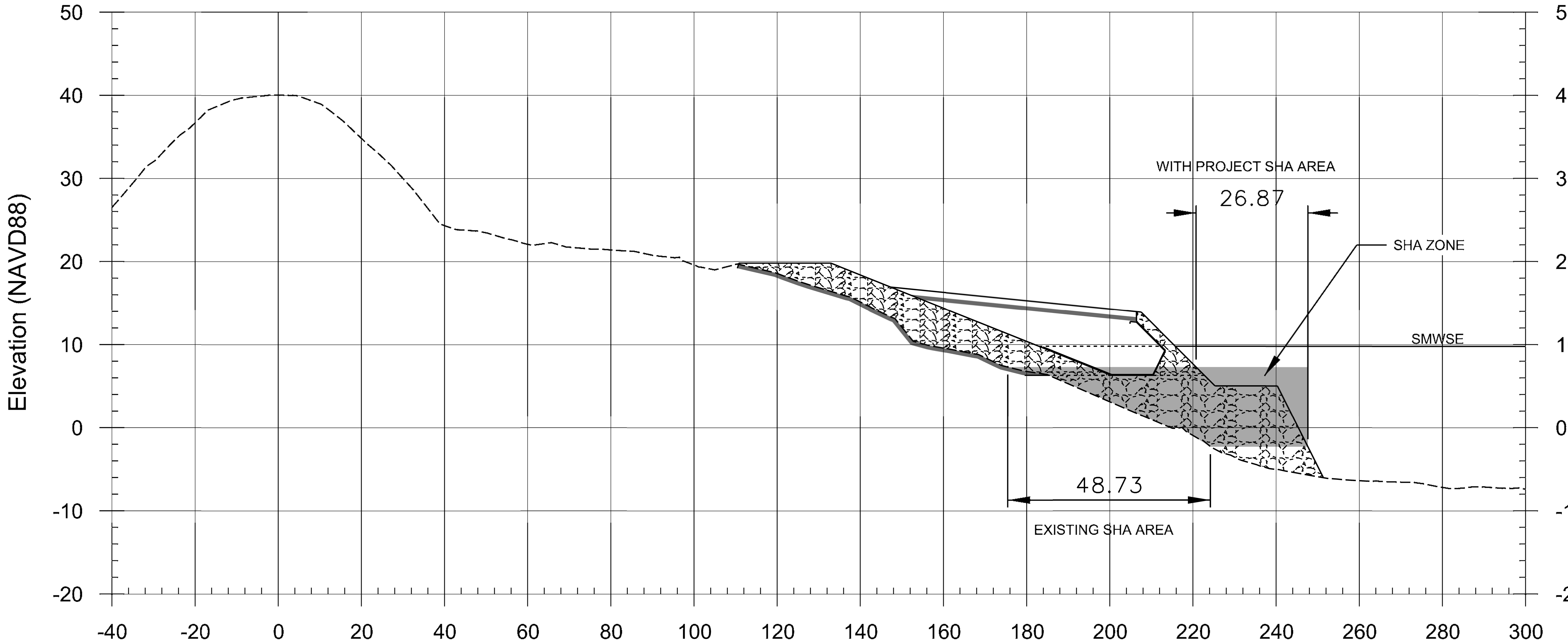


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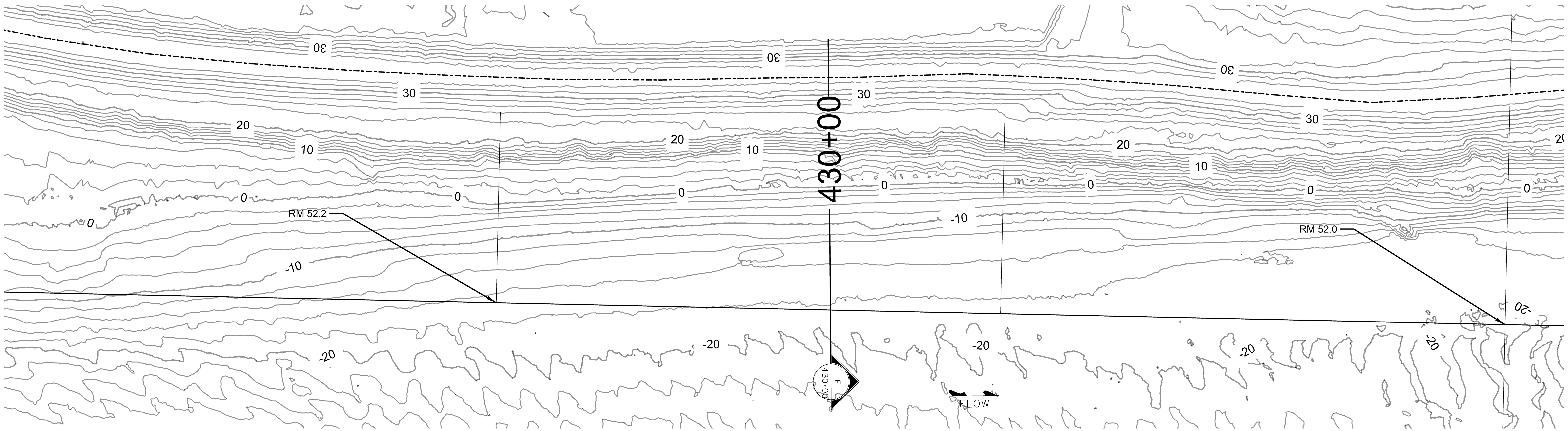


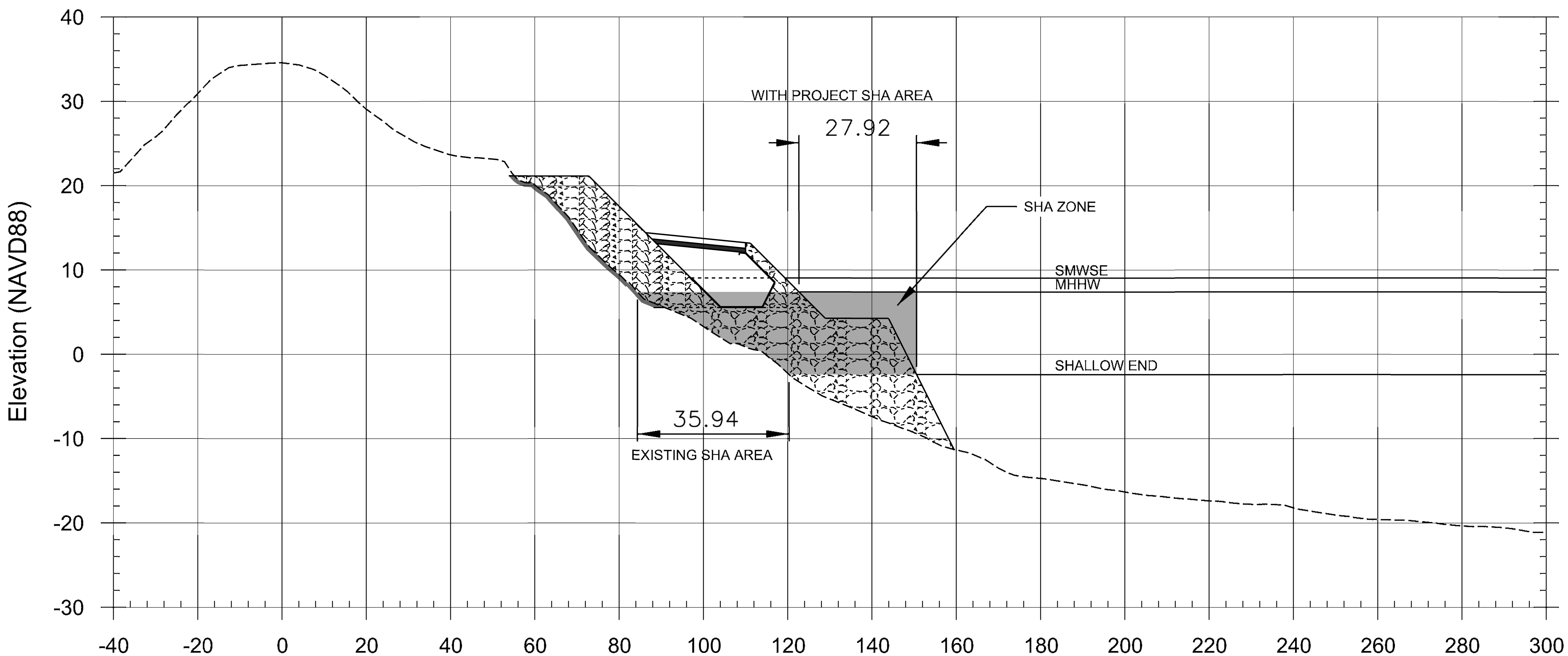


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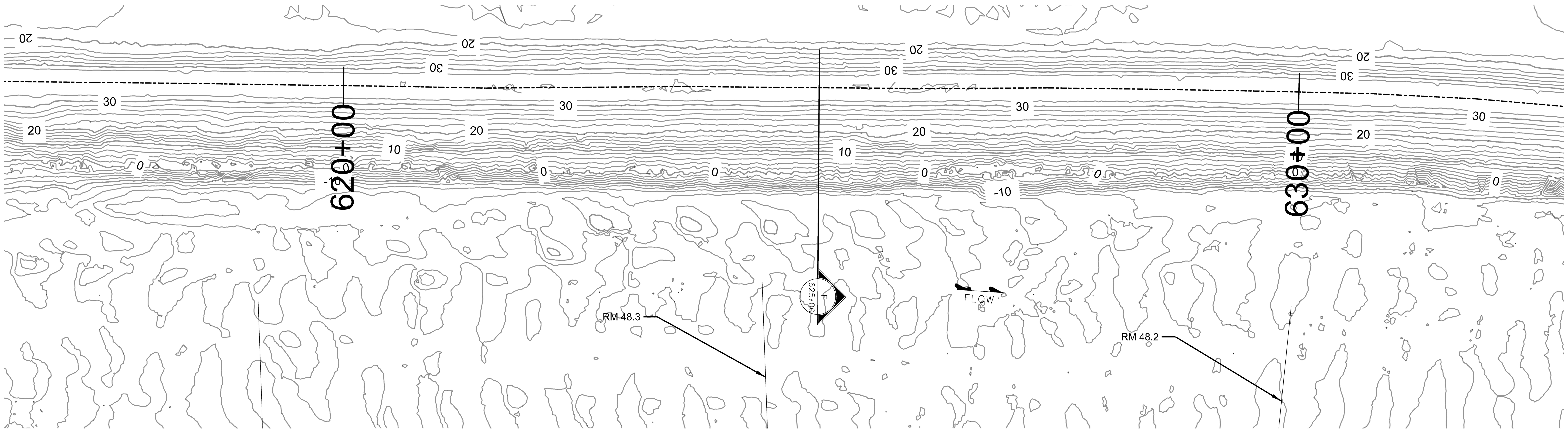


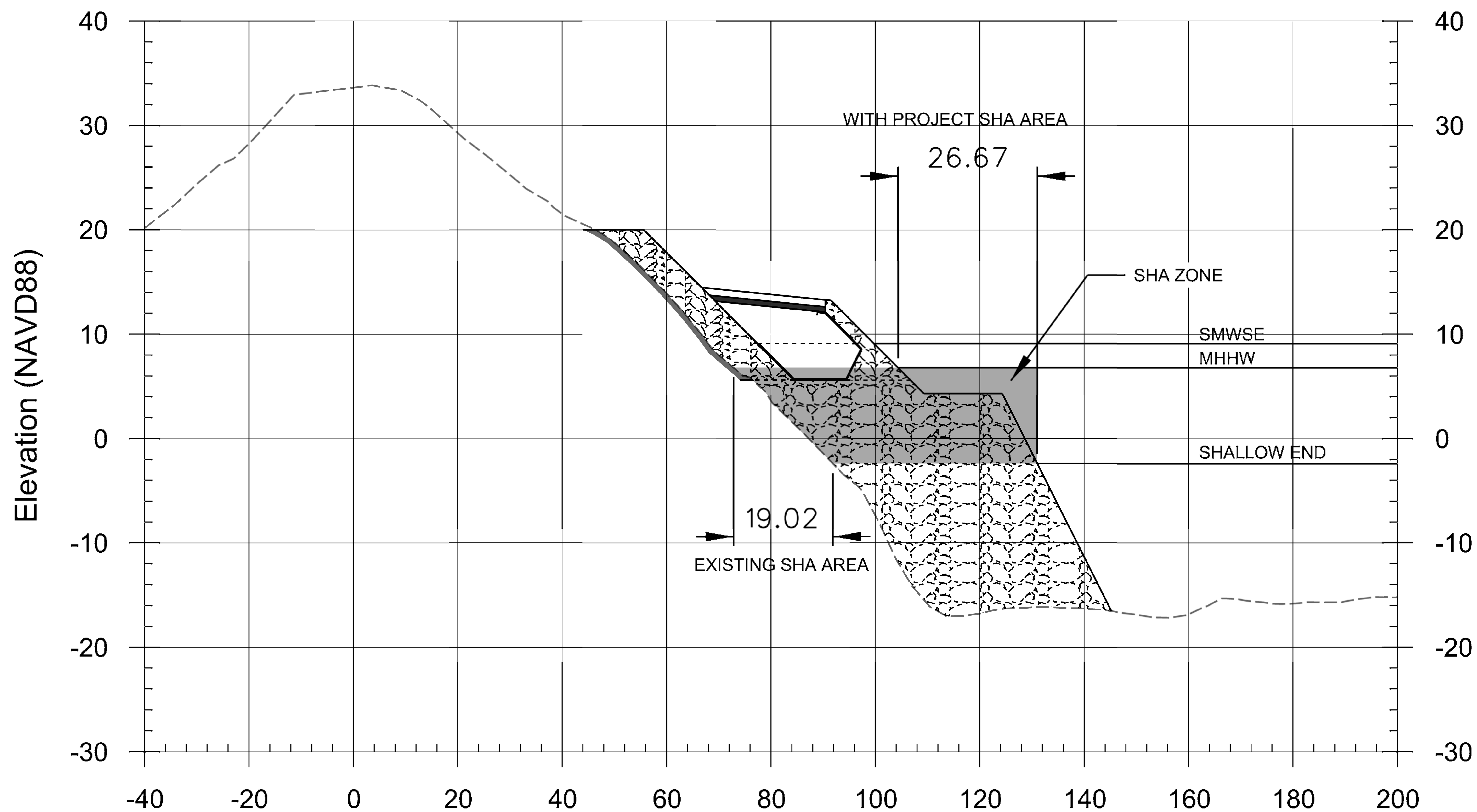


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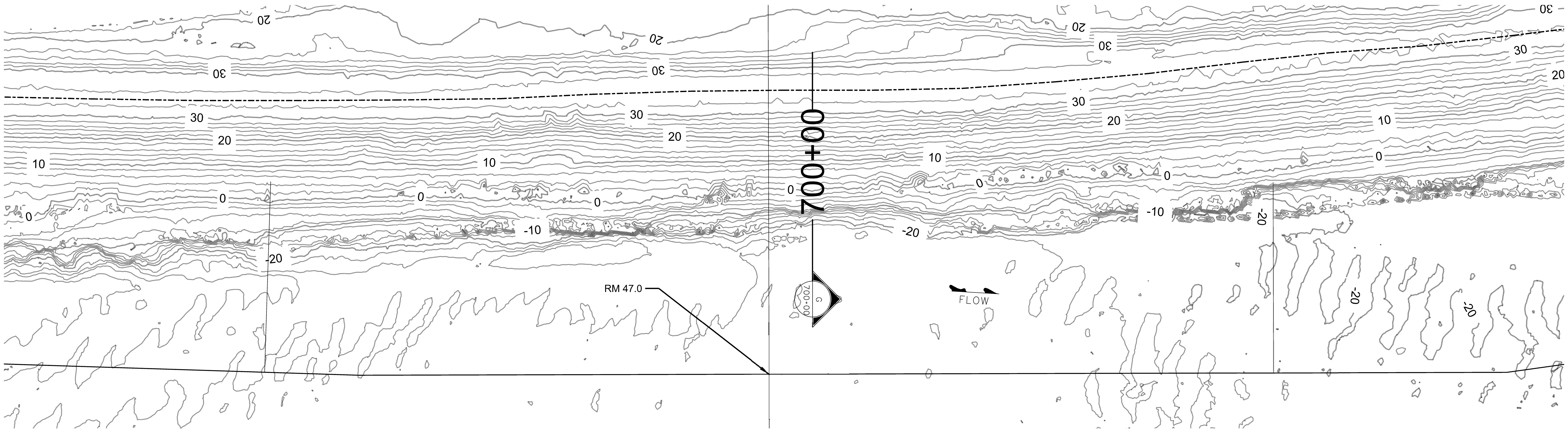


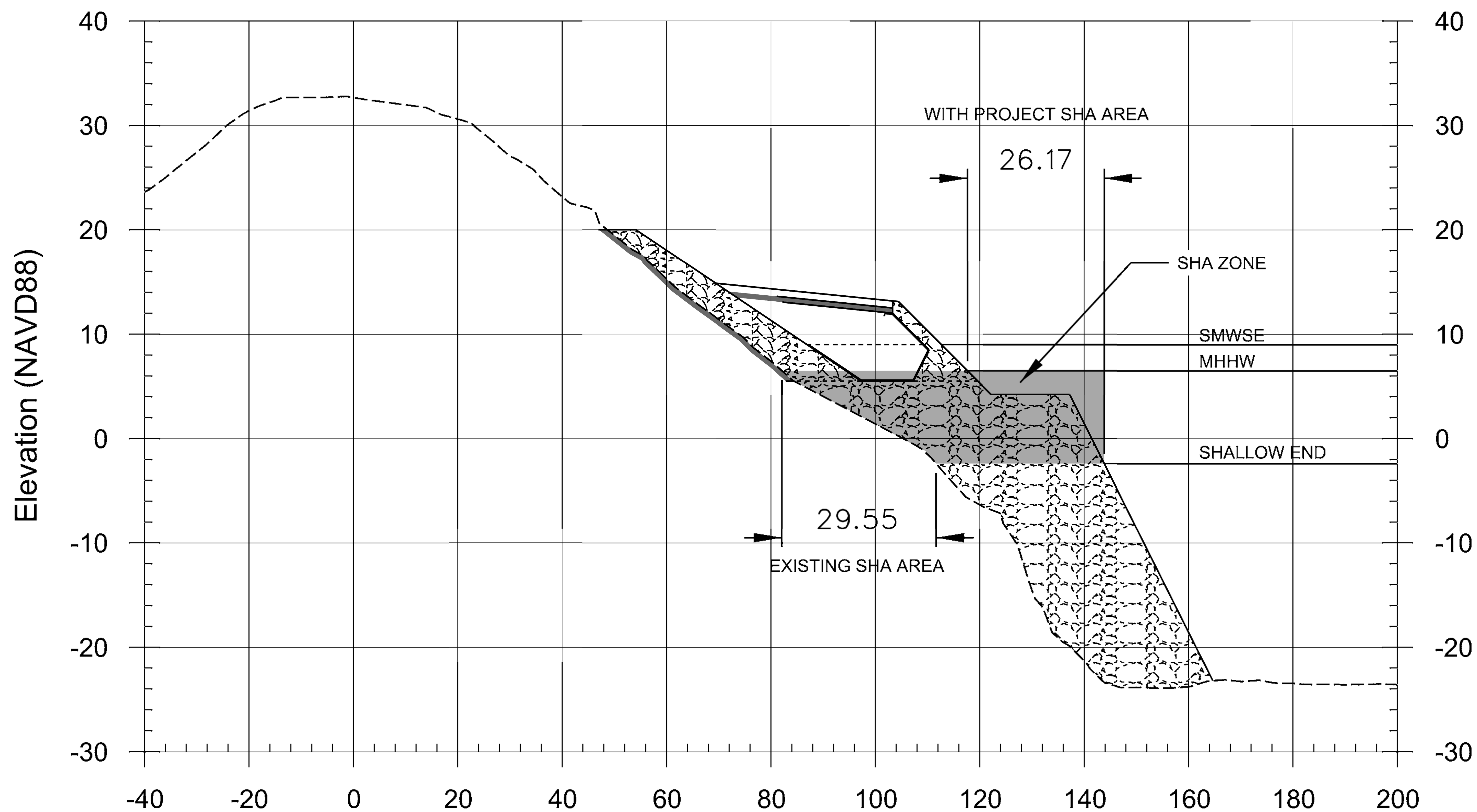


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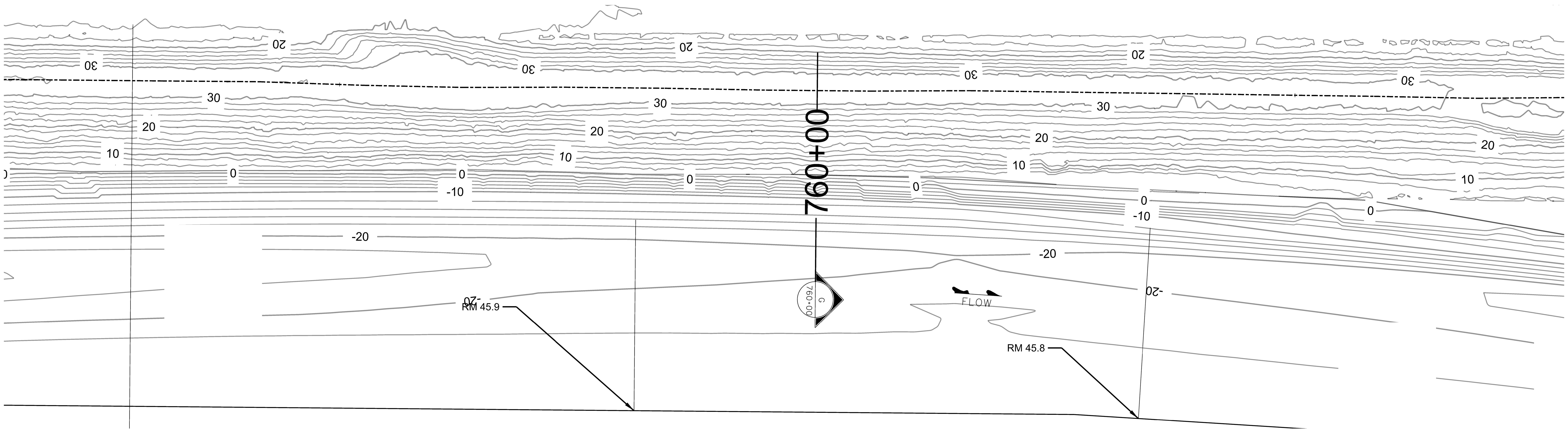


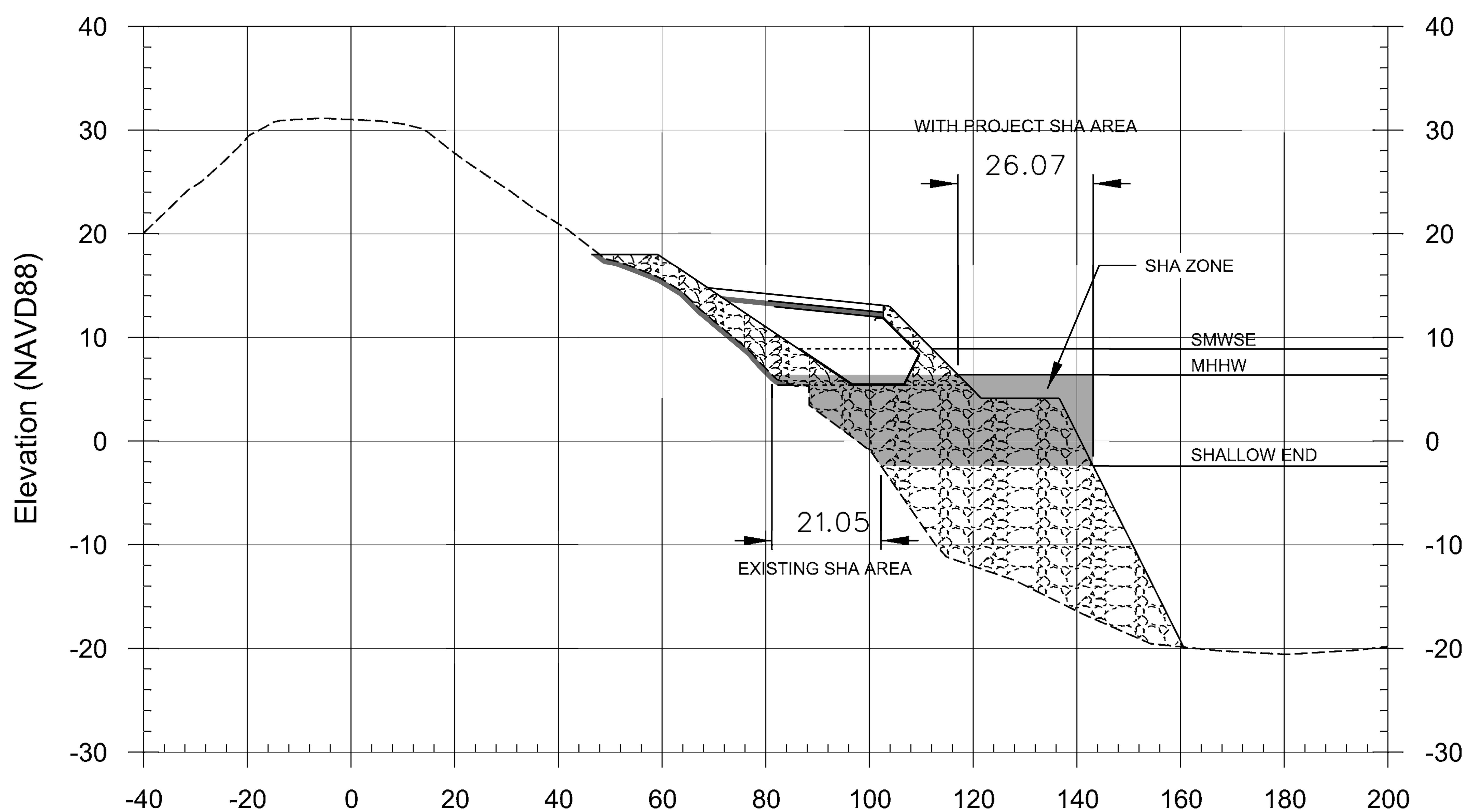


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# Appendix D

# North Sacramento Streams Levee Improvement Project

# Preliminary Biological Evaluation

Preliminary Biological Evaluation

# North Sacramento Streams Levee Improvements Project

Prepared for:

Sacramento Area Flood Control Agency

Prepared for submittal to:

U.S. Army Corps of Engineers
CESPK-PD
1325 J Street
Sacramento, CA 95814

Attn: Anne Baker

February 2015

# TABLE OF CONTENTS

**Section** **Page**

**1.0 INTRODUCTION** ..... **1**

**2.0 SPECIES CONSIDERED** ..... **2**
2.1 Species Habitat and Potential for Occurrence in the Area ..... 6
2.2 Critical Habitat ..... 7

**3.0 CONSULTATION TO DATE** ..... **8**

**4.0 DESCRIPTION OF THE PROPOSED ACTION** ..... **9**
4.1 Project Location ..... 9
4.2 Project Schedule ..... 9
4.3 Description of Proposed Project Elements ..... 9

**5.0 ACTION AREA** ..... **25**

**6.0 ENVIRONMENTAL BASELINE** ..... **27**
6.1 Vegetation and Habitat ..... 27
6.2 Wildlife ..... 28

**7.0 SPECIES ACCOUNTS** ..... **29**

**8.0 EFFECTS** ..... **30**
8.1 Direct and Indirect Effects on Species in the Action Area ..... 30

**9.0 CUMULATIVE EFFECTS** ..... **32**

**10.0 CONCLUSIONS AND DETERMINATION** ..... **33**

**11.0 ESSENTIAL FISH HABITAT ASSESSMENT** ..... **34**
The Proposed Action ..... 34
Proposed Conservation Measures ..... 34
Conclusions ..... 34

**12.0 REFERENCES** ..... **35**

## Tables

Table 1 Fish and Wildlife Species Federally Listed or Proposed for Listing that Were Considered in the Evaluation of the North Sacramento Streams Levee Improvements Project ..... 2
Table 2. Summary of Locations of Proposed Project Elements in NSS Levee Improvements Area ..... 9

## Appendix A – Exhibits

# 1.0 INTRODUCTION

The purpose of this preliminary biological evaluation is to support the preparation of a forthcoming biological assessment (BA). The BA would analyze the North Sacramento Streams (NSS) component of the Sacramento Area Flood Control Agency's (SAFCA) proposed  Levee Accreditation Project (NSS Levee Improvements Project) in sufficient detail to determine the extent to which the proposed action may affect any of the federally listed species described below under "Species Considered."

A BA is prepared in accordance with requirements set forth under Section 7 of the Federal Endangered Species Act (ESA) (16 United States Code [USC] 1536[c]). It serves to initiate consultation with the U.S. Fish and Wildlife Service (USFWS) and consultation with the National Marine Fisheries Service (NMFS) on effects of the NSS Levee Improvements Project on federally listed species. A BA also serves to initiate consultation with NMFS on essential fish habitat (EFH) conservation recommendations for Pacific salmon (*Oncorhynchus* spp.), as required by the Magnuson-Stevens Fishery Conservation and Management Act, as amended (16 USC 1801). (See the "Essential Fish Habitat Assessment" section below.)

Section 7(a)(2) of the ESA directs federal agencies to ensure that their activities are not likely to jeopardize the continued existence of any listed species, or to result in the destruction or adverse modification of designated critical habitat. This section of the ESA also requires agencies with regulatory authority over listed species to issue biological opinions evaluating the direct and indirect effects of federal actions, and actions that are interrelated or interdependent with the federal action. The biological opinions must determine whether the actions being evaluated may appreciably reduce the listed species' likelihood of surviving or recovering in the wild by reducing their productivity, numbers, or distribution.

To implement the NSS Levee Improvements Project, SAFCA would request permission from the U.S. Army Corps of Engineers (USACE) for:

- alteration of federal project levees, pursuant to Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408, referred to in this preliminary biological evaluation as "Section 408"); and

- placement of fill in jurisdictional waters of the United States, pursuant to Section 404 of the Clean Water Act (33 USC 1344, referred to in this preliminary biological evaluation as "Section 404").

These activities are described in more detail under "Description of the Proposed Action." Similar to a BA, this preliminary biological evaluation analyzes direct, indirect, interrelated/interdependent, and cumulative effects of the proposed action on federally listed species.

The proposed action described herein is also part of a larger, joint project with USACE and the State of California called the American River Common Features (ARCF) Project. The ARCF Project is currently in the planning phase and therefore detailed design information is not available. Therefore, USACE is consulting with NMFS and USFWS on the ARCF Project using a worst-case approach. Since the NSS Levee Improvements Project is a subset of the ARCF Project, and because detailed design information for SAFCA's NSS Levee Improvements Project is available, consultation for the two projects is being combined. It should be noted that because design for the NSS Levee Improvements Project has progressed further than that for the ARCF Project, some areas (e.g., borrow sites) not identified by USACE are being identified below. SAFCA also anticipates future consultation as part of the ARCF Project consultation for work along the Sacramento River, although this effort is still in the planning phase by SAFCA.

# 2.0 SPECIES CONSIDERED

This document considers species or designated critical habitat that have been termed “threatened” or “endangered” under the jurisdiction of USFWS and NMFS. On February 22, 2015, biologists consulted the online database maintained by USFWS’s Sacramento Office to conduct a query of the Rio Linda (512B) and Sacramento East (512C) 7.5-minute quadrangles (USFWS 2015). Using the California Department of Fish and Wildlife’s (CDFW’s) California Natural Diversity Database (CNDDB) (2015) and the California Native Plant Society’s database of rare and endangered plant species (CNPS 2014), biologists also conducted a query of the topographic quadrangles in which the action area occurs and the surrounding quadrangles; these database queries were conducted on February 27, 2014, and March 3, 2014, respectively. This query identified all listed species in the area surrounding the action area, which is defined here in accordance with ESA guidelines as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action” (50 Code of Federal Regulations [CFR] 402.02).

On June 18, 20, 23, 24, and 25, 2014, AECOM biologists conducted field surveys of Arcade Creek. NEMDC/Steelhead Creek was surveyed by AECOM biologists on September 3 and 8, 2014. A qualitative survey of additional areas where other proposed project elements would occur, including Robla Creek, was conducted by AECOM biologists through interpretation of aerial imagery. The purpose of these surveys was to characterize general biological resources, map vegetation and land covers within the footprints of the various project elements (i.e., levee improvements, encroachment removal, vegetation management, and Conservation Strategy), and assess the potential for the project study area to support special-status species and other sensitive biological resources. Locations of elderberry shrubs within the project study area (including a 100-foot buffer area around the various levee improvement footprints) were mapped, but no protocol-level plant or wildlife surveys were conducted. Tree survey data collected along the project study area levees by MBK Engineers (2014) was reviewed in the field. Vegetation and land cover were mapped onto aerial photographs during field surveys. The polygons were later digitized into a GIS overlay and used to create maps depicting the location and extent of each cover type present in the project study area.

Based on these database queries, field surveys, and the biologists’ familiarity with local flora and fauna, 15 plant and wildlife species that are federally listed as endangered or threatened, or are federally proposed for listing, were considered as part of this assessment (**Table 1**).

**Table 1**
**Fish and Wildlife Species Federally Listed or Proposed for Listing that Were Considered in the Evaluation of the North Sacramento Streams Levee Improvements Project**

| Species | Status | Habitat | Potential to Occur[1] in the Action Area[2] |
|---|---|---|---|
| **Plants** | | | |
| Slender Orcutt grass *Orcuttia tenuis* | Threatened | Vernal pools, often in gravelly soils; from 114 to 5,774 feet in elevation. Blooms May–October. | No potential to occur. No suitable habitat is present within the action area.[2] |
| Sacramento Orcutt grass *Orcuttia viscida* | Endangered | Vernal pools; from 98 to 328 feet in elevation. Blooms April–September. | No potential to occur. No suitable habitat is present within the action area.[2] |
| **Invertebrates** | | | |
| Valley elderberry longhorn beetle *Desmocerus californicus dimorphus* | Threatened | Closely associated with blue elderberry (*Sambucus* sp.), which is an obligate host for the beetle larvae; CNDDB (2014) occurrences along the Sacramento | Could occur; elderberry shrubs present occasionally along the Arcade Creek; however, no shrubs were observed in NSS Levee Improvements Project area. |

| Table 1<br>Fish and Wildlife Species Federally Listed or Proposed for Listing that Were Considered in the Evaluation of the North Sacramento Streams Levee Improvements Project | | | |
|---|---|---|---|
| Species | Status | Habitat | Potential to Occur[1] in the Action Area[2] |
| | | and American Rivers. | |
| Vernal pool fairy shrimp<br>*Branchinecta lynchii* | Threatened | Vernal pools and other seasonal wetlands, typically small but including a wide range of sizes; scattered CNDDB (2014) occurrences in vicinity of Dry Creek. | Could occur. Potentially suitable habitat is present within the action area.[2] |
| Vernal pool tadpole shrimp<br>*Lepidurus packardi* | Endangered | Vernal pools and other seasonal wetlands, typically medium to large but including a wide range of sizes with relatively long inundation period; scattered CNDDB (2014) occurrences in vicinity of Dry Creek. | Could occur. Potentially suitable habitat is present within the action area.[2] |
| **Fish** | | | |
| Central Valley steelhead<br>*Oncorhynchus mykiss* | Threatened | Anadromous. Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta. Adult migration to upstream spawning areas occurs July–March (Hallock 1987). Juveniles typically spend 1–3 years in fresh water before migrating to the ocean, generally in December–August (McEwan 2001). | Likely to occur. Expected to occur in the NEMDC/Steelhead Creek, either as adults migrating to their upstream spawning habitat, or as juveniles and smolts, rearing and migrating towards the ocean. High water temperatures and low flows preclude occurrence in NEMDC/Steelhead Creek in summer. Not expected to occur in Arcade or Robla Creek as these streams lack suitable water quality conditions for spawning. Designated critical habitat is in the action area[2]. |
| Central Valley fall-/late fall-run Chinook salmon<br>*Oncorhynchus tshawytscha* | Species of Concern[2] | Anadromous. Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta. Fall-run adults migrate in June–December, and juveniles migrate downstream and out to the ocean soon after emerging (December–March), rearing in fresh water for only a few months, and migrating to the ocean in March–July (Yoshiyama et al. 1998). Late fall-run adults migrate in October–April, and juveniles rear in their natal stream during summer; in some streams they remain throughout the year. Smolt outmigration can occur in November–May (Yoshiyama et al. 1998). | Likely to occur. Occurs in the Sacramento and San Joaquin Rivers, tributaries, and the Delta. Fall-run could occur in the NEMDC/Steelhead Creek, either as adults migrating upstream to their spawning habitat, spawning in the lower American River, or as juveniles and smolts, rearing and migrating towards the ocean. Not expected to occur in Arcade or Robla Creeks, as these streams regularly lack suitable water quality conditions or access for spawning. Essential fish habitat is in the action area[2]. |
| Delta smelt<br>*Hypomesus* | Threatened | Semi-anadromous. Typically restricted to the Delta and the | Unlikely to occur. Occurs in tidally influenced segments of the Sacramento and San Joaquin |

**Table 1**
**Fish and Wildlife Species Federally Listed or Proposed for Listing that Were Considered in the Evaluation of the North Sacramento Streams Levee Improvements Project**

| Species | Status | Habitat | Potential to Occur[1] in the Action Area[2] |
|---|---|---|---|
| *transpacificus* | | lower Sacramento River downstream of Isleton; juveniles move downstream with the currents (USFWS 1996; Sommer et al. 2001a; Moyle 2002). | Rivers, tributaries, and Delta. No spawning habitat is in the action area.[2] |
| Sacramento River winter-run Chinook salmon *Oncorhynchus tshawytscha* | Endangered | Anadromous. Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta. Adults migrate upstream in December–July (peak in March) (Moyle 2002), and juveniles migrate downstream soon after fry emerge, typically beginning in August and peaking in September and October (Vogel and Marine 1991). | Unlikely to occur. Occurs in the Sacramento River, tributaries, and the Delta. The Sacramento River channel is the main migration route for winter-run juveniles, and smolts (Yoshiyama et al. 1998). No spawning habitat is in the action area[2]. |
| Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha* | Threatened | Anadromous. Requires cold freshwater streams with suitable gravel for spawning; rears seasonally in inundated floodplains, rivers, tributaries, and the Delta. Adults migrate upstream in March–September, (peak May–June) (Yoshiyama et al. 1998), and juveniles and yearlings migrate downstream following the onset of the winter storm season through March (CDFG 1998; Fisher 1994; S. P. Cramer and Associates 1995; Hill and Webber 1999).<br>Adults: July–March (Hallock 1987). | Unlikely to occur. Occurs in the Sacramento River, tributaries, and the Delta. No spawning habitat is in the action area[2]. |
| Green sturgeon *Acipenser medirostris* | Threatened | Anadromous. Requires seasonally inundated floodplains, rivers, tributaries, and the Delta. Adults migrate upstream to their spawning habitat (between late February and late July), and juveniles are reared and migrate to the ocean (year-round). | Unlikely to occur. Occurs in the Sacramento and San Joaquin Rivers, tributaries, and the Delta. No spawning habitat is in the action area[2]. |
| **Amphibians and Reptiles** | | | |
| California red-legged frog *Rana draytonii (=R. aurora draytonii)* | Threatened | Prefers semi-permanent and permanent stream pools, ponds, and creeks with emergent riparian vegetation and typically without predatory fish. Requires adequate hibernacula such as small-mammal burrows and moist leaf litter. | No potential to occur. The action area is outside of the species’ extant range. |

**Table 1**
**Fish and Wildlife Species Federally Listed or Proposed for Listing that Were Considered in the Evaluation of the North Sacramento Streams Levee Improvements Project**

| Species | Status | Habitat | Potential to Occur[1] in the Action Area[2] |
|---|---|---|---|
| California tiger salamander *Ambystoma californiense* | Threatened | Vernal pools and other seasonal wetlands with adequate inundation period and adjacent uplands, primarily grasslands, with burrows and other refugia; no known occurrences in the project vicinity. | No potential to occur. No suitable habitat is present within the action area.[2] |
| Giant garter snake *Thamnophis gigas* | Threatened | Open water associated with marshes, sloughs, and irrigation/drainage ditches within the Central Valley; requires emergent herbaceous wetland vegetation for escape and foraging habitat, grassy banks and openings in waterside vegetation for basking, and higher elevation upland habitat for cover and refuge from flooding. Nearest known extant populations are located in the Natomas Basin, adjacent to and just west of NEMDC/Steelhead Creek (CDFW 2014). | Could occur. In the NSS Levee Improvements Project area, the quality of habitat for giant garter snake is better along the NEDMC/ Steelhead Creek north of Dry Creek; Arcade and Robla Creeks and the NEMDC/Steelhead Creek south of Dry Creek are less suitable for this species. Giant garter snakes are known to occur in rice fields, associated canals, and managed marshes in the Natomas Basin west of the portion of NEMDC/Steelhead Creek that is north of Dry Creek; thus, there is potential for the species to occur, at least occasionally, in this portion of NEMDC/Steelhead Creek. |
| **Birds** | | | |
| Western yellow-billed cuckoo *Coccyzus americanus occidentalis* | Threatened | Riparian forest with dense deciduous trees and shrubs; there are no recent CNDDB occurrences in the vicinity of the program area, but migrant individuals are likely to pass through the area in transit to breeding sites along the Sacramento River north of Colusa. | Unlikely to occur. Although potential dispersal and foraging habitat is in the NSS Levee Improvements Project area, the action area is outside of the species' extant range. |

Notes: CNDDB = California Natural Diversity Database; Delta = Sacramento–San Joaquin Delta; NSS = North Sacramento Streams

[1] **Potential for Occurrence Definitions:**

*No potential to occur:* Potentially suitable habitat is not present.

*Unlikely to occur:* Potentially suitable habitat present but species unlikely to be present because of very restricted distribution.

*Could occur:* Suitable habitat is available; however, there are few or no other indicators that the species may be present.

*Likely to occur:* Habitat conditions, behavior of the species, known occurrences in the vicinity, or other factors indicate a relatively high likelihood that the species would occur.

*Known to occur:* The species, or evidence of its presence, was observed during reconnaissance-level surveys or was reported by others.

[2] Action Area: The action area is defined here in accordance with ESA guidelines as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). The action area includes all areas that would be directly or indirectly affected by the components of the NSS Levee Improvements Project. Areas downstream of the NSS Levee Improvements Project area may also be indirectly affected by the flood risk management component of the project through improved water quality and flood risk management conditions.

Sources: CDFW 2014; CNPS 2014; data collected and compiled by AECOM in 2014 CNDDB 2014, CNPS 2014, USFWS 2014; data compiled by AECOM and Stillwater Sciences in 2014

The following federally proposed and federally listed species are known to occur or have the potential to occur in the NSS Levee Improvements Project area:

- vernal pool fairy shrimp *(Branchinecta lynchi),*
- vernal pool tadpole shrimp *(Lepidurus packardii),*
- valley elderberry longhorn beetle (VELB) (*Desmocerus californicus dimorphus*),
- Central Valley steelhead distinct population segment (DPS) (*Oncorhynchus mykiss*), and
- giant garter snake (*Thamnophis giga*).

Central Valley fall- /late fall-run Chinook salmon ESU (*O. tshawytscha*) is not federally listed; however, EFH is present in the action area.

The other federally listed species identified in **Table 1** were eliminated from further consideration because they are not likely to occur in the NSS Levee Improvements Project area because of a lack of suitable habitat, local range restrictions, regional extirpations, or lack of connectivity between areas of suitable or occupied habitat, or because the action area is located outside of the extant range of the species (see "Action Area" section below). The USFWS-regulated species with the potential to occur on-site are discussed in more detail in this preliminary biological evaluation.

## 2.1 SPECIES HABITAT AND POTENTIAL FOR OCCURRENCE IN THE AREA

The following is a summary of relevant habitat conditions in the action area for species that could occur, are likely to occur, or are known to occur in the NSS Levee Improvements Project area. Full species accounts for federally listed species addressed in this preliminary biological evaluation are presented in the section titled "Species Accounts."

- **Vernal pool fairy shrimp** and **vernal pool tadpole shrimp:** Seasonal wetlands, which may provide suitable habitat for vernal pool invertebrates, occur at Borrow Site 3/ Robla woodland mitigation site A. There are documented occurrences of vernal pool fairy shrimp north of Dry Creek along the landside of the NEMDC/Steelhead Creek East Levee and there are documented occurrences of vernal pool fairy shrimp and vernal pool tadpole on the former McClellan Air Force Base, northeast of Arcade Creek (CDFW 2014).

- **Valley elderberry longhorn beetle:** Elderberry shrubs were not observed along Arcade Creek or NEMDC/Steelhead Creek during field surveys. Robla Creek has not been surveyed for elderberry shrubs, the obligate host plant for the valley elderberry longhorn beetle, but shrubs may occur amongst vegetation along the creek, adjacent to Borrow Site 3 and the proposed woodland mitigation sites north of Robla Creek. While there are no documented occurrences of valley elderberry longhorn beetle in the NSS Levee Improvements Project area, this species could occur in elderberry shrubs, if present along Robla Creek.

- **Central Valley Steelhead DPS:** Adult and juvenile Central Valley steelhead could occur in the action area during migrations along the Sacramento River and its tributaries. Central Valley steelhead are expected to occur in NEMDC/Steelhead Creek as adults, migrating upstream to their spawning habitat, and as juveniles and smolts, rearing and migrating toward the ocean. Central Valley steelhead would not typically occur in Arcade Creek, as this stream regularly lacks water quality conditions for spawning. There are no known runs within Robla Creek, similar to Arcade Creek. NEMDC/Steelhead Creek includes critical habitat for Central

Valley steelhead, which uses this locations for juvenile rearing, juvenile migration, and adult migration (NMFS 2014). There is no critical fish habitat designation for Arcade and Robla Creeks.

- **Central Valley fall-/late fall-run Chinook salmon:** Adult and juvenile Central Valley fall-run Chinook salmon could occur in the action area during migrations along the Sacramento River and its tributaries. They are not expected to occur in Arcade Creek or other tributaries to NEMDC/Steelhead Creek lacking suitable water quality conditions for spawning and rearing. EFH is also present in both streams for fall-run Chinook, which use these areas for juvenile rearing, juvenile migration, and adult migration. There is no EFH for Arcade and Robla Creeks.

- **Giant garter snake:** There are numerous occurrences of giant garter snake west of NEMDC/Steelhead Creek within the Natomas Basin; these records, which are located between NEMDC/Steelhead Creek and I-5/State Route (SR) 99/70, are all located north of Elkhorn Boulevard (CDFW 2014). The channel, water primrose wetlands, and hardstem bulrush marsh in NEMDC/Steelhead Creek, particularly north of Dry Creek, provide suitable aquatic habitat for giant garter snake; suitable upland habitat for this species is present where annual (wild oats) grasslands are within 200 feet of these aquatic features. However, there are no documented occurrences of this species in NEMDC/Steelhead Creek or in any of its eastside tributaries (CDFW 2014). The historic habitat conditions of NEMDC/Steelhead Creek and particularly its eastside tributaries were likely never suitable for this species (e.g., steeper elevational slope, rapid water runoff, lack of historical marsh [E. Hansen, pers. comm., 2015; B. Halstead, pers. comm., 2015]); a recent analysis suggests that this species' distribution is limited by dispersal distances associated with historic marsh habitats (Halstead et al. 2014). However, the quality of habitat for giant garter snake is better along the NEDMC/Steelhead Creek north of Dry Creek and giant garter snakes are known to occur in rice fields, associated canals, and managed marshes in the Natomas Basin west of this portion of NEMDC/Steelhead Creek; thus, there is potential for the species to occur, at least occasionally, in this portion of NEMDC/Steelhead Creek.

## 2.2 CRITICAL HABITAT

"Critical habitat" is defined in Section 3(5)A of the ESA as the specific areas in the geographical area occupied by the species where physical or biological features are found that are essential to the conservation of the species and that may require special management considerations or protection. Specific areas outside of the geographical area occupied by the species may also be included in critical-habitat designations, based on a determination that such areas are essential for the conservation of the species.

The proposed action addressed in this preliminary biological evaluation falls within designated critical habitat for Central Valley steelhead DPS. Critical habitat for the Central Valley steelhead DPS was designated on August 12, 2005; a final designation was published on September 2, 2005 (70 FR 52604), with an effective date of January 2, 2006 (70 FR 52487). Critical habitat is designated to include select waters in the Sacramento and San Joaquin River basins, including the segment of the NEMDC/Steelhead Creek in the action area (see "Action Area" section below).

The action area is not within designated critical habitat for the remaining species listed in **Table 1** for which such a designation has been made: Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, VELB, Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, and California red-legged frog. Critical habitat has not been designated for Central Valley fall-/late fall–run Chinook salmon ESU, giant garter snake, or western yellow-billed cuckoo.

# 3.0 CONSULTATION TO DATE

*[No information to input yet.]*

# 4.0 DESCRIPTION OF THE PROPOSED ACTION

## 4.1 PROJECT LOCATION

The proposed project includes Levee Accreditation improvements that would be implemented in the North Sacramento Streams area. Approximately 4 miles of levee along the Natomas East Main Drainage Canal (NEMDC)/Steelhead Creek East Levee and Arcade Creek North and South Levees would be improved (**Exhibit 1**). These levee reaches require substantial work to mitigate seepage, meet embankment and foundation stability requirements, and remove high-hazard encroachments and vegetation. This work requires use of proposed borrow sites (located along either side of NEMDC/Steelhead Creek, just north of Dry Creek and along the north side of Robla Creek) and staging areas (located along the levee improvement areas).

## 4.2 PROJECT SCHEDULE

SAFCA's NSS Levee Improvements Project would start construction in 2016. The proposed project is anticipated to take 1 to 2 years to complete.

## 4.3 DESCRIPTION OF PROPOSED PROJECT ELEMENTS

The NSS Levee Improvements Project consists of four project elements: levee improvements, high-hazard levee encroachment and vegetation removal, and conservation strategy. These four project elements are summarized in **Table 2** below.

**Table 2. Summary of Locations of Proposed Project Elements in NSS Levee Improvements Area**

| Portion of Project Study Area | Levee Improvements | Encroachment Removal | Vegetation Management | Conservation Strategy[1] |
|---|---|---|---|---|
| Arcade Creek Levees | X | X | X | X |
| NEMDC/Steelhead Creek East Levee | X | – | – | X |
| Robla Creek South Levee | – | X | – | X |
| Borrow Sites | X | – | – | X |
| Robla Creek Tree Mitigation Sites (A and B) | – | – | – | X |

Notes: NEMDC = Natomas East Main Drainage Canal

[1] In addition to providing mitigation for levee improvements, the Conservation Strategy includes an extensive list of avoidance and minimization measures that would be implemented throughout the project study area, where applicable

Source: Data compiled by AECOM in 2014

### 4.3.1 NORTH SACRAMENTO STREAMS LEVEE IMPROVEMENTS

#### DESCRIPTION OF THE NORTH SACRAMENTO STREAMS LEVEE IMPROVEMENTS AREA

This section discusses specific levee improvements proposed for each reach along NEMDC/Steelhead Creek and Arcade Creek in the NSS Levee Improvements area. To identify and describe the levee improvements proposed for the NSS Levee Improvements area, the area has been divided into eight levee reaches (**Exhibit 1**): two along the east side of NEMDC/Steelhead Creek and three along each side of Arcade Creek. These levee reaches and associated improvements are described below.

### NEMDC A

Reach A of the NEMDC/Steelhead Creek East Levee is about 1,700 feet long and extends from Station 3028+00 to Station 3051+00. The levee height ranges from 22.7–25.7 feet, with a crown width ranging from 14–26 feet. This reach is located along the eastern boundary of the Natomas Basin, just south of the confluence with Arcade Creek. A railroad embankment that pre-dates the construction of the NEMDC/Steelhead Creek East Levee is present along the entirety of the landside embankment slope of this reach and is integral with the NEMDC/Steelhead Creek levee.

The levee embankment consists of clay materials with a fine-grained blanket layer of clay and silt, and occasional instances of clayey sand at the ground surface. This reach contains riparian habitat, ruderal land, and stream channels within the construction footprint of the proposed improvements. Preliminary analysis indicates that this reach does not meet 100-year water surface elevation (WSE) criteria or Urban Levee Design Criteria (ULDC) for potential underseepage. The underseepage may be due to high hydraulic head in the stormwater collector channel along the landside levee toe that leads to a pump station within the reach.

Construction of a cement-bentonite (CB) slurry cutoff wall at the waterside toe of the levee was selected as the preferred levee improvement.

### ACS A

Reach A of the Arcade Creek South (ACS) Levee is about 1,300 feet long and extends from Station 4000+00 to Station 4013+00. This reach was originally constructed in the 1930s, but specific construction details and documentation are unavailable. The levee crest was widened and the waterside slope liner was constructed in the 1950s by USACE. The levee ranges between 19.4 and 22.0 feet high, with a crown width ranging from 10–26 feet. A railroad crossing occurs at the downstream boundary of the levee, with a stoplog structure across the rail used to block this crossing during high-water events.

The levee embankment consists of clay, silt, and sand materials, and contains a fine-grained blanket layer comprised of clay and silt. The reach contains riparian habitat, creek, and ruderal land within the construction footprint of proposed levee improvements. Preliminary analysis indicates that this reach does not meet 100-year WSE criteria or ULDC for potential underseepage and stability.

Construction of a soil-bentonite (SB) cutoff wall at the centerline of the levee was selected as the preferred levee improvement.

### ACS B

Reach B of the Arcade Creek South Levee is about 3,727 feet long and extends from Station 4031+18 to Station 4068+45. This reach was originally constructed in the 1930s, but specific construction details and documentation are unavailable. The levee crest was widened and the waterside slope liner was constructed in the 1950s by USACE. The levee ranges between 11 and 17 feet high, with a crown width ranging from 17–28 feet.

The levee embankment consists of clay, silt, and sand materials, and contains a fine-grained blanket layer comprised of clay and silt. This reach contains riparian habitat, creek, and ruderal land within the construction footprint of the proposed levee improvements. Preliminary analysis indicates that this reach does not meet 100-year WSE criteria or ULDC for potential underseepage and stability.

Construction of an SB cutoff wall at the centerline of the levee was selected as the preferred levee improvement.

### ACS C

Reach C of the Arcade Creek South Levee is about 4,155 feet long and extends from Station 4068+45 to Station 4110+34. The levee was constructed in the 1930s, but the original construction documentation is unavailable. Subsequent improvements to the levee (i.e., crest raise and floodwall) were completed by SAFCA in the 1990s. The downstream (western) boundary of this reach occurs at the intersection of the levee reach with Rio Linda Boulevard. The upstream (eastern) boundary is located at the intersection of the levee and Marysville Boulevard. The levee ranges between 19.4 and 22.0 feet high, with a crown width ranging from 10–26 feet. A low concrete flood wall curb extends along the waterside of the levee crest from Rio Linda Boulevard to Marysville Boulevard.

The levee embankment consists of clayey and silty sand materials, with a foundation layer comprised of silty and clayey sand over silt. The reach contains riparian habitat, creek, and ruderal land within the construction footprint of proposed levee improvements. Preliminary analysis indicates that this reach does not meet 100-year WSE underseepage and stability criteria, as well as ULDC for underseepage, through-seepage or stability.

Construction of a CB slurry cutoff wall at the waterside toe combined with waterside slope replacement was selected as the preferred levee improvement.

### ACN A

Reach A of the Arcade Creek North Levee is about 1,050 feet long and extends from Station 5023+00 to Station 5033+50. This levee reach was originally constructed in the 1950s by USACE. Subsequent improvements to the levee’s landside and waterside slopes, in conjunction with a levee raise, were completed in the 1990s by SAFCA. A concrete-lined ditch owned by the City of Sacramento at Drainage Pumping Plant No. 158 is located approximately 30 feet from the landside toe up to Station 5031+00. From there, this concrete-lined toe ditch descend into the pump station sump. This reach includes the lined channel and the concrete paved pump station sump area. The levee ranges between 15 and 28 feet high, with a crown width ranging from 8–16 feet.

The levee embankment consists of silty and clayey sand materials. Preliminary analysis indicates that this reach does not meet 100-year WSE underseepage and stability criteria, as well as ULDC for underseepage, through-seepage, or stability.

Installation of pressure relief wells along the landside of the levee was selected as the preferred levee improvement.

### ACN B

Reach B of the Arcade Creek North Levee is about 3,700 feet long and extends from Station 5038+00 to Station 5075+00. The upstream (eastern) boundary of this reach occurs at the beginning of the concrete floodwall that runs along the levee crest between Stations 5068+10 and Marysville Boulevard. The levee ranges between 10 and 18 feet high, with a crown width ranging from 8–23 feet. This levee reach was originally constructed in the 1950s by USACE. Subsequent improvements to the levee’s landside and waterside slopes, in conjunction with a levee raise, were completed in the 1990s by SAFCA.

The levee embankment consists of silty and clayey sand materials. The downstream blanket layer is comprised of silty and clayey sand, while the upstream blanket layer is comprised of clay and silt. This reach contains riparian habitat, creek, and ruderal land within the construction footprint of proposed levee improvements. Preliminary analysis indicates that this reach does not meet 100-year WSE criteria or ULDC for underseepage and stability.

Construction of an SB cutoff wall at the centerline of the levee was selected as the preferred levee improvement.

### ACN C

Reach C of the Arcade Creek South Levee is about 3,743 feet long and extends from Station 5075+00 to Station 5112+3. This levee reach was originally constructed in the 1950s by USACE. The floodwall that runs along the waterside of the levee crest was constructed in the 1990s by SAFCA. The downstream (western) boundary of this reach is located at the beginning of the concrete floodwall that runs along the levee crest between Stations 5075+00 and Marysville Boulevard. The upstream (eastern) boundary of this reach is located at the intersection of the levee and Marysville Boulevard. The levee ranges between 1 and 9 feet high, with a crown width ranging from 5–17 feet.

The levee embankment consists of silty and clayey sand materials, with a coarse-grained blanket layer comprised of silty and clayey sand. This reach contains riparian habitat, creek, and ruderal land within the construction footprint of proposed levee improvements. Preliminary analysis indicates that this reach does not meet 100-year WSE criteria or ULDC for underseepage and stability.

Construction of a CB cutoff wall at the waterside toe combined with waterside slope replacement from Station 5075+00 to Station 5100+00, and construction of a sheet pile cutoff wall at the centerline of the levee from Station 5100+00 to Marysville Boulevard was selected as the preferred levee improvement.

### BORROW AREAS AND HAUL ROUTES

Based on proximity to the improvement areas, SAFCA has identified three preferred borrow sites to provide suitable material for levee improvements for the NSS Levee Improvements area. The preferred borrow sources are illustrated in **Exhibit 2** and their locations are briefly described below.

- **Site 1 -** Three soil stockpiles located on the grounds of a new high school, near Sorento Road and East Levee Road.
- **Site 2 -** Site 2K **-** Up to 35,000 cubic yards (cy) available above the water table.
- **Site 3 -** Area north of Robla Creek and the Dry Creek South Levee, east of Rio Linda Boulevard.

The most likely sources for borrow currently under consideration are Sites 1 and 2. While Site 3 is a possible source, the suitability and available quantities of borrow material from each source must be investigated further and confirmed as part of project design.

The goal in selecting haul routes is to use existing levee crowns for hauling wherever possible (**Exhibit 3**). However, there are locations where hauling on paved public roads is the best available option because the levee crown is already paved for public use or because there is inadequate room on the waterside of the levee to develop a temporary toe road without affecting standing water or low flow channels. Final haul routes would be selected based on constraints, the construction schedule, and in coordination with the City.

Borrow site strippings would either be reused as part of post-borrow reclamation or hauled off-site. Borrow sites would be returned to pre-project conditions following construction activities.

### POTENTIAL STAGING AREAS

Four potential staging areas have been identified for potential use to support construction of  of the NSS Levee Improvements Project (see **Exhibit 3 4**). Several of these areas have been used previously to support levee improvements along Arcade Creek. The areas would require little preparation other than surface stripping, and temporary connection roads and ramps to the levee crown.

The primary use for the staging areas would be for temporary trailers, parking, and material staging and for stockpiling and blending of excavated soils with imported borrow to make the excavated soils suitable for use in levee reconstruction. This would involve stockpiles of material to be processed, a processing area where excavated soils and imported soils would be spread out and processed to mix and moisture condition the material, and stockpiles of processed material. Importing, processing, and exporting material for levee reconstruction would all be continuous activities once the work flow is established during the start of the construction season. Other disturbed areas would be also be stabilized. Staging areas would be returned to pre-project conditions following construction activities unless the owner agrees to some grade raising to help dispose of excess construction soils.

## ADDITIONAL LEVEE IMPROVEMENTS COMPONENTS

### Erosion Protection

The only erosion protection currently envisioned includes placement of rip rap on waterside benches where waterside toe slurry walls are constructed. Following construction, levee slopes and other areas disturbed by construction would be revegetated and brought back to pre-project conditions.

Locations where erosion is identified along the waterside levee slope and riverbank have been evaluated to determine whether levee integrity or stability may be affected. Insufficient embankment protection may cause a levee to be undermined by erosive forces due to wave action and/or high flow velocities along the levee bank. In many cases, the placement of embankment protection material, such as engineered armoring (rip-rap), would dissipate wave and velocity forces and reduce the potential for erosion to occur. Other factors to be considered prior to installing embankment protection material include grading the levee waterside slope to address stability issues, and environmental impacts within the vicinity of the embankment repair site.

### Utility Relocation

SAFCA prepared an inventory and assessment of existing encroachments and penetrations within the NSS Levee Improvements Project area. Known utilities that cross or are adjacent to the levee include gas pipelines; storm drainage and pump station discharge pipes; and numerous water supply mains, culverts, electrical conduits, and sanitary sewers. The construction contractor can work around many of these utilities. However, some utilities may need to be temporarily removed or relocated prior to construction. Temporary bypass pumping may be required for sanitary sewers. SAFCA and the construction contractor would coordinate closely with utility owners to manage the utilities in advance of construction. Disturbed utilities would be restored after construction consistent with CVFPB requirements. Coordination between SAFCA and the utility owner would be required for those utilities that do not currently have CVFPB encroachment permits.

### Stormwater Pollution Prevention

Temporary erosion/runoff best management control measures would be implemented during construction to minimize stormwater pollution resulting from erosion and sediment migration from the construction, borrow, and staging areas. These temporary control measures may include implementing construction staging in a manner that minimizes the amount of area disturbed at any one time; secondary containment for storage of fuel and oil; and the management of stockpiles and disturbed areas by means of earth berms, diversion ditches, straw wattles, straw bales, silt fences, gravel filters, mulching, revegetation, and temporary covers as appropriate. Erosion and stormwater pollution control measures would be consistent with National Pollutant Discharge Elimination System (NPDES) permit requirements and would be included in a Stormwater Pollution Prevention Plan (SWPPP).

After completion of construction activities, the temporary facilities (construction trailers and batch plants) would be removed and the site would be restored to pre-project conditions. Site restoration activities for areas disturbed by construction activities, including borrow areas and staging areas, will include a combination of regrading, reseeding, constructing permanent diversion ditches, using straw wattles and bales, and applying straw mulch and other measures deemed appropriate.

### PROPOSED SEQUENCE OF PROJECT CONSTRUCTION

It is anticipated that the North Sacramento Streams levee improvements would be implemented in one construction season (2016). The construction season would take place from April 15 to November 1. An approximate construction sequence includes the following:

- **Mobilization:** Mobilization would include setting up construction offices and the slurry batch plant and transporting heavy earthmoving equipment to the site. These activities may take up to 1 month.
- **Vegetation and encroachment removal:** Trees and other encroachments that impact remedial measures would be removed consistent with established SAFCA policies regarding vegetation and encroachments. These activities may take 1–4 weeks depending upon the reach being remediated.
- **Levee degradation for cutoff wall installation:** Beginning of levee degradation would follow vegetation and encroachment removal and precede cutoff wall installation. Degradation would take a total of about 4 months but it would not likely be conducted in one simultaneous operation. Rather, levee reaches would be degraded for specific lengths of cutoff wall to minimize the total length of degraded levee at any one time. Construction would take approximately 3 months.
- **Cutoff wall installation:** This activity would begin with construction of the work pad once a sufficient length of levee was degraded and was available for construction. Assuming four headings, construction would take approximately 4 months.
- **Drainage blanket construction:** Drainage blanket would be constructed prior to placing overlying slope reconstruction fill. Portions of drainage blanket extending up levee cut slopes would be placed as the adjacent slope reconstruction material is placed. Construction would take approximately 1 month since such construction is a small part of the proposed project.
- **Toe cutoff wall erosion protection:** Toe cutoff wall rip rap erosion protection would be placed after the toe cutoff wall bench has been completed to final lines and grades. Construction would take approximately 2 months.
- **Utility relocation:** Any required utility relocation would be conducted concurrent with the levee degradation, toe cutoff wall bench construction, and reconstruction operations. Construction would take approximately 4 months.
- **Levee reconstruction:** Levee reconstruction would begin once there was sufficient length completed cutoff wall to efficiently begin reconstructing the levee embankment. Total time estimated for levee reconstruction is about 6 months.
- **Seepage Wells:** Seepage wells can be installed at any time during the construction season. Installation and development of relief wells and reconstruction of paved channel and basin inverts would likely take about 2 month.

- **Site restoration and demobilization:** Upon completion of the main construction activities, the levee patrol road would be resurfaced, disturbed areas would be revegetated, staging and borrow areas would be restored, and the contractor would demobilize the site(s). These activities are expected to take about 2 months.

Construction would be staged and sequenced with the appropriate stakeholders: the City, County, Reclamation District, utility and service providers, biological resource construction work windows, and other environmental and land use/real estate constraints, to the greatest extent practical to minimize impacts and effects on the community.

### 4.3.2 HIGH HAZARD LEVEE ENCROACHMENT AND VEGETATION REMOVAL

#### ENCROACHMENT MANAGEMENT

The National Flood Insurance Program (NFIP) standards for levee accreditation and the State's ULDC both require removal or modification of encroachments that pose an unacceptably high risk to the performance and safety of a levee either by undermining its structural integrity or by interfering with necessary inspection, operation, and maintenance activities. To address this requirement, SAFCA has identified and evaluated all of the encroachments in the NSS Levee Improvements area. Each of these encroachments has been evaluated to determine whether it constitutes an unacceptably high risk to the performance of the levee either by undermining the stability of the levee or by interfering with necessary patrolling, operation, and maintenance activities. Based on this evaluation, the encroachments have been classified as either:

- High-risk – poses a threat to levee integrity, removable prior to the levee being accredited;
- High-risk – impedes operation, maintenance, and inspection, removable within 3 years after the levee is accredited; or
- Low-risk – not identified as high hazard.

In the NSS Levee Improvements area, high-risk encroachments to be removed are limited to residential landscaping located at approximately 10 locations along the landside of the south and north levees of Arcade Creek (mainly between Marysville Boulevard and Rio Linda Boulevard) and along the Robla Creek South Levee, east of Rio Linda Boulevard.

#### VEGETATION MANAGEMENT

The levee accreditation element of the proposed project also includes a vegetation management component. Although the NFIP does not identify specific standards for managing vegetation on levees, ULDC provides criteria that reflect the underlying risk management objectives of the NFIP. Under these criteria, vegetation on levees must be modified or removed if it presents an unacceptable risk to the structural integrity or impedes operation and maintenance of the levee.

In the NSS Levee Improvements area, approximately 8 high-risk trees along Arcade Creek have been identified for removal. All of the trees are either nonnative (7) or snags (3). Five are located on the waterside of the levees. These trees are in addition to any trees that would be removed as a result of implementation of levee improvements in the NSS Levee Improvements area.

### 4.3.3 CONSERVATION STRATEGY

Implementation of the NSS Levee Improvements Project would result in impacts on sensitive biological resources such as riparian woodland, near-shore aquatic, and special-status species habitat on the NEMDC/Steelhead Creek and Arcade Creek. The measures outlined in the Conservation Strategy would avoid and reduce some of these impacts. However, even with implementation of avoidance and minimization measures and with self-mitigating projects, impacts on sensitive biological resources would require compensatory mitigation to reduce impacts to less-than-significant levels, and to comply with permit conditions. These compensatory mitigation actions and potential mitigation sites are described below. Mitigation sites would be planned, designed and constructed to avoid impacts to sensitive biological and cultural resources, and if further analysis indicates potential impacts would be unavoidable, the site would be removed from further consideration.

### AVOIDANCE AND MINIMIZATION MEASURES

A key element of the Conservation Strategy is to avoid and/or minimize impacts on sensitive habitats and special-status species during implementation of the NSS Levee Improvements Project. The following general and resource-specific conservation measures will be incorporated by SAFCA during construction (which also includes demolition), operation, and maintenance.

### General Conservation Measures

- **CM-1: Limit Ground Disturbance to Construction Areas and Avoid and Limit Disturbance to River and Creek Banks and Habitats when Feasible.** Ground disturbance shall be limited to construction areas, including necessary access routes and staging areas. The number of access routes, size of staging areas, and total area of the project activity shall be limited to the minimum necessary. When possible, existing access routes and points shall be used. All roads, staging areas, and other facilities shall be placed to avoid and limit disturbance to river and creek banks and habitat when feasible.

- **CM-2: Clearly Mark Project Construction Limits.** To minimize ground and vegetation disturbance during project construction, project limits shall be clearly marked, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

- **CM-3: Observe 20-Mile-Per-Hour Speed Limits within Construction Areas on City, Private, and Levee Roads.** Project-related vehicles shall observe a 20-mile-per-hour speed limit within construction areas, except on County roads and on State and Federal highways.

- **CM-4: Avoid Disturbing or Exceeding the Minimum Vegetation Removal Necessary.** Disturbance or removal of vegetation by machinery shall not exceed the minimum necessary to complete project construction and operations.

- **CM-5: Replant or Reseed with Native Species and Monitor and Maintain Growth to Ensure Success for Areas Requiring Vegetation Removal.** When vegetation removal is required, the disturbed areas shall be replanted or reseeded with native species and monitored and maintained to ensure the revegetation effort is successful. If erosion control fabrics are used in revegetated areas, they shall be slit in appropriate locations as necessary to allow for plant root growth.

- **CM-6: Limit Rock Riprap for Erosion Protection.** The amount of rock riprap and other materials used for bank protection shall be limited to the minimum needed for erosion protection and establishment of planting benches.

- **CM-7: Destroy and Dispose of Invasive Species using Approved Protocols and Disposal Sites.** Invasive species that are removed shall be destroyed using approved protocols and disposed of in an appropriate disposal area out of the stream channel.

- **CM-8: Use All Pesticides in Accordance with Laws and Regulations.** All pesticides/herbicides (pesticides) used to control nonnative vegetation shall be used in accordance with label directions. Methods and materials used for herbicide application shall be in accordance with DWR's most current guidelines on herbicide use and with laws and regulations administered by the California Department of Pesticide Regulation.

- **CM-9: Store All Construction Materials at Designated Construction Staging Areas.** Construction materials such as portable equipment, vehicles, and supplies, including chemicals, shall be stored at designated construction staging areas.

- **CM-10: Prepare and Implement a Storm Water Pollution Prevention Plan.** A SWPPP that identifies specific best management practices to avoid and minimize impacts on water quality during construction activities shall be prepared and implemented.

- **CM-11: Install, Monitor, and Maintain Erosion Control Measures that Minimize Soil or Sediment from Entering Waterways or Wetlands.** Erosion control measures that minimize soil or sediment from entering waterways and wetlands shall be installed, monitored for effectiveness, and maintained throughout construction operations.

- **CM-12: Use Acceptable Erosion Control Materials to Minimize Potential for Small Animals to Become Entangled.** If use of erosion control fabrics is necessary, tightly-woven fiber netting (mesh size less than 0.25-inch) or similar material shall be used to minimize potential for small animals to become entangled. Coconut coir matting is an acceptable erosion control material, but no plastic mono-filament matting shall be used. The edge of the material shall be buried in the ground to prevent animals from crawling underneath the material.

- **CM-13: Avoid Use of Materials in Locations Where it can Erode from Normal or Expected High Flows.** No material shall be placed in a manner or location where it can be eroded by normal or expected high flows. Jute netting or another non-monofilament erosion control fabric shall be used to cover soil that is placed over or mixed into riprap or other revetment materials.

- **CM-14: Implement Precautionary Measures to Minimize Turbidity/Siltation during Construction.** Precautions to minimize turbidity/siltation shall be implemented during construction. This may require placing barriers (e.g., silt curtains) to prevent silt and/or other deleterious materials from entering downstream reaches.

- **CM-15: Inspect Sediment and Turbidity Control Barriers Daily during Construction for Proper Function and Replace Immediately if Not Functioning Effectively.** Performance of sediment and turbidity control barriers shall be inspected at least once each day during construction to check that they are functioning properly. Should a control barrier not function effectively, it shall be immediately repaired or replaced. Additional controls shall be installed as necessary.

- **CM-16: Remove Sediment from Sediment Controls and Dispose of Properly.** Sediment shall be removed from sediment controls once the sediment has reached 1/3 of the exposed height of the control. Sediment collected in these devices shall be disposed of away from the collection site at designated upland disposal sites.

- **CM-17: Treat Water with Silt or Mud from Construction Activities to Prevent it from Entering Live Waterways.** Water containing mud or silt from construction activities shall be treated by filtration, or retention in a settling pond, adequate to prevent muddy water from entering live waterways.

- **CM-18: Treat All Disturbed Soils with Appropriate Erosion Control.** All disturbed soils shall undergo appropriate erosion control treatment (e.g., sterile straw mulching, seeding, planting) prior to the end of the construction season, or prior to November 1, whichever comes first.

- **CM-19: Dispose of All Construction Materials at an Approved Disposal Site.** All debris, sediment, rubbish, vegetation, or other material removed from the construction areas shall be disposed of at an approved disposal site.

- **CM-20: Dispose Daily all Construction-related Materials and Equipment that Cannot be Secured at an Appropriate Disposal/Storage Site.** All litter, debris, unused materials, equipment, and supplies that cannot reasonably be secured shall be removed daily from the project work area and deposited at an appropriate disposal or storage site.

- **CM-21: Remove Immediately All Construction-Related Pads/Debris from Work Sites Upon Completion.** All work pads and construction debris shall be removed from work sites immediately when work is completed at each site.

- **CM-22: Use Safer Alternative Products to Protect Streams and Other Waters.** Every reasonable precaution shall be exercised to protect streams and other waters from pollution with fuels, oils, and other harmful materials. Safer alternative products (such as biodegradable hydraulic fluids) shall be used where feasible.

- **CM-23: Prevent Any Contaminated Construction By-Products from Entering Flowing Waters; Collect and Transport Such By-Products to An Authorized Disposal Area.** Petroleum products, chemicals, fresh cement, and construction by-products containing, or water contaminated by, any such materials shall not be allowed to enter flowing waters and shall be collected and transported to an authorized upland disposal area.

- **CM-24: Prevent Hazardous Petroleum or Other Hazardous Substances to Aquatic Life from Contaminating the Soil or Entering Waters of the State or U.S.** Gas, oil, other petroleum products, or any other substances that could be hazardous to aquatic life and resulting from project-related activities, shall be prevented from contaminating the soil and/or entering waters of the State and/or waters of the U.S.

- **CM-25: Prepare and Implement a Spill Prevention and Control Plan.** A written spill prevention and control plan (SPCP) shall be prepared and implemented. The SPCP and all material necessary for its implementation shall be accessible on-site prior to initiation of project construction and throughout the construction period. The SPCP shall include a plan for the emergency cleanup of any spills of fuel or other material. Employees/construction workers shall be provided the necessary information from the SPCP to prevent or reduce the discharge of pollutants from construction activities to waters and to use the appropriate measures should a spill occur. In the event of a spill, work shall stop immediately and the California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Central Valley Regional Water Quality Control Board (RWQCB), and USACE shall be notified within 24 hours.

- **CM-26: Properly Maintain All Construction Vehicles and Equipment and Inspect Daily for Leaks; Remove and Repair Equipment/Vehicles with Leaks.** Construction vehicles and equipment shall be properly maintained to prevent contamination of soil or water from external grease and oil or from leaking hydraulic fluid, fuel, oil, and grease. Vehicles and equipment shall be checked daily for leaks. If leaks are found, the equipment shall be removed from the site and shall not be used until the leaks are repaired.

- **CM-27: Refuel and Service Equipment at Designated Refueling and Staging Areas.** Equipment shall be refueled and serviced at designated refueling and staging sites located on the crown or landside of the levee and at least 50 feet from active stream channels or other water bodies. All refueling, maintenance, and staging of equipment and vehicles shall be conducted in a location where a spill shall not drain directly toward aquatic habitat. Appropriate containment materials shall be installed to collect any discharge, and adequate materials for spill cleanup shall be maintained on-site throughout the construction period.

- **CM-28: Store Heavy Equipment, Vehicles, and Supplies at Designated Staging Areas.** All heavy equipment, vehicles, and supplies shall be stored at the designated staging areas at the end of each work period.

- **CM-29: Install an Impermeable Membrane Between the Ground and Any Hazardous Material in Construction Storage Areas.** Storage areas for construction material that contains hazardous or potentially toxic materials shall have an impermeable membrane between the ground and the hazardous material and shall be bermed as necessary to prevent the discharge of pollutants to groundwater and runoff water.

- **CM-30: Use Water Trucks to Control Fugitive Dust during Construction.** Water (e.g., trucks, portable pumps with hoses) shall be used to control fugitive dust during temporary access road construction.

- **CM-31: Use Only Nontoxic Materials and Materials Placed in Any Waters with No Coatings or Treatments Deleterious to Aquatic Organisms.** All materials placed in streams, rivers, or other waters shall be nontoxic and shall not contain coatings or treatments or consist of substances deleterious to aquatic organisms that may leach into the surrounding environment in amounts harmful to aquatic organisms.

- **CM-32: Clean Construction Vehicles and Equipment Used Within the Stream Channel Before Arrival at the Project Construction Areas, and Inspect Vehicles/Equipment to Ensure They Are Free of Soil, Debris, and Nonnative Aquatic Species.** Construction vehicles and equipment operated within the channel margins (high water line) shall be cleaned of mud and other debris with a scrub brush and dry, or pressure-washed with hot (>140°F) water, before arrival at the project construction areas and prior to transporting the equipment to another stream or watershed. All equipment operated within the channel margins shall be carefully inspected for signs of aquatic invasive species (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=4958&inline), including mussels and plant materials, with special attention paid to shaded, sheltered, and protected areas which might contain standing water and areas that form ‘edges’ or ‘right angles,’ such as tracks, feet, and/or tires. If vehicles or equipment are found to be contaminated with non-native invasive species, vehicles and equipment shall be stored in a dry location for at least one week prior to transport to a different stream or watershed, or alternatively, will be pressure-washed with hot (>140°F) water after each use. All water shall be drained from watercraft, including motor cooling system and bilge, and allow to dry as thoroughly as possible prior to entering a new stream or watershed. Large vessels and barges transported via the stream channel shall be contracted from nearby locations or shall undergo similar hull-cleaning prior to use for the project. Watercraft transported from distant areas, including barges, shall not release bilge water into the project area, unless screened to prohibit fish, plant, or other animal transport.

### Resource-Specific Conservation Measures

#### *Sensitive Biological Resources*

- **SBR-1: Conduct Environmental Awareness Training.** A qualified biologist shall provide environmental awareness training to workers before project construction activities begin, and as needed when new personnel begin work on the project. The environmental awareness training shall inform all construction personnel about the relevant species and habitats that are known to occur in the project study area and vicinity, the need to avoid damaging these resources and causing mortality, measures to avoid and minimize impacts on the sensitive biological resources, the conditions of relevant regulatory permits, and the possible penalties for not complying with these requirements.

- **SBR-2: Erect High-Visibility Fencing to Protect Sensitive Biological Resource Areas, Inspect Fencing Daily, and Incorporate Sensitive Habitat Information into Bid Specifications.** Before the commencement of construction activities, high-visibility fencing shall be erected to protect areas of sensitive biological resources that are located adjacent to construction areas, but can be avoided, from encroachment of personnel and equipment. The fencing shall be inspected before the start of each work day and shall be removed only when the construction within a given area is completed. Sensitive habitat information shall be incorporated into project bid specifications, along with a requirement for contractors to avoid these areas.

- **SBR-3: Monitor Construction Activities in Sensitive Biological Resource Areas and Stop Work if Unauthorized Project Impacts Occur.** A qualified biologist shall monitor all construction activities in sensitive biological resource areas to ensure that avoidance and minimization measures are being properly implemented and no unauthorized activities occur. The biological monitor shall be empowered to stop construction activities that threaten to cause unanticipated and/or unauthorized project impacts. Project activity shall not resume until the conflict has been resolved.

- **SBR-4: Conduct Vegetation Removal Between September 16 and January 31 to the Extent Feasible.** Vegetation removal, particularly tree removal, shall be conducted between September 16 and January 31, to the extent feasible, to minimize potential loss of active bird nests and bat maternity roosts.

#### *Vernal Pool Crustaceans*

- **VPC-1: Provide Suitable Vernal Pool Crustacean Habitat with Protective Buffers, to the Extent Feasible, and Temporarily Fence and Designate the Buffers as Environmental Sensitive Areas.** Suitable habitat for vernal pool crustaceans shall be provided with protective buffers, to the extent feasible. The size and shape of the buffers shall depend on the local topography and potential for project activities to affect hydrology of the habitat. All buffers shall be temporarily fenced and designated as environmentally sensitive areas. These areas shall be avoided by all construction personnel.

- **VPC-2: Monitor All Construction Activities in Sensitive Biological Resources to Ensure that Avoidance and Minimization Measures Are Being Properly Implemented and Stop Construction Activities that Threaten Unauthorized Project Impacts.** A qualified biologist shall monitor all construction activities in sensitive biological resource areas to ensure that avoidance and minimization measures are being properly implemented and no unauthorized activities occur. The biological monitor shall be empowered to stop construction activities that threaten to cause unanticipated and/or unauthorized project impacts. Project activity shall not resume until the conflict has been resolved.

### *Valley Elderberry Longhorn Beetle*

- **VELB-1: Temporarily Fence All Elderberry Shrubs Adjacent to Construction Areas and Designate the Area as Environmentally Sensitive.** All elderberry shrubs that are located adjacent to construction areas, but can be avoided, shall be temporarily fenced and designated as environmentally sensitive areas. These areas shall be avoided by all construction personnel. Fencing shall be placed at least 20 feet from the dripline of each shrub, unless otherwise approved by USFWS.

- **VELB-2: Prohibit Use of Pesticides or Chemicals within 100 Feet of Elderberry Shrubs.** No insecticides, herbicides, or other chemicals that might harm the beetle or its host plant shall be used within 100 feet of the elderberry shrubs.

- **VELB-3: Transplant Elderberry Shrubs Requiring Removal to Riparian Habitat Creation Areas, or Alternative Transplant Areas.** Elderberry shrubs that require removal shall be transplanted to the riparian habitat creation areas. If none of the areas of suitable habitat to be created as part of the proposed project would be available before the impact would occur, alternative transplant locations shall be identified. Transplant activities shall be conducted in accordance with USFWS guidelines.

### *Special-Status Fish*

- **SSF-1: Conduct In-Water Construction Work Within In-Water Work Windows (June-October).** In-water construction activities shall be conducted within in-water work windows to avoid impacts to critical salmonid life stages (juvenile rearing, and juvenile and adult passage), typically from June through October.

- **SSF-2: Avoid SRA Habitat to the Maximum Extent Practicable and Temporarily Fence and Designate SRA Habitat as Environmentally Sensitive.** Natural woody riparian and/or SRA habitat shall be avoided to the maximum extent practicable. Habitat to be avoided shall be temporarily fenced and designated as environmentally sensitive areas. These areas shall be avoided by all construction personnel.

- **SSF-3: Install Screens on Any Construction-Related Water Pump Intakes Located on Waterways with Salmonids.** Screens shall be installed on any construction-related water pump intakes located on waterways with salmonids in accordance with current salmonid screening specifications of NMFS and CDFW.

### *Giant Garter Snake*

- **GGS-1: Avoid Construction Activities within 200 Feet from the Banks of Suitable Giant Garter Snake Habitat and Confine Movement of Heavy Equipment to Existing Roadways, Where Feasible in These Areas.** To the extent possible, construction activities shall be avoided within 200 feet from the banks of suitable giant garter snake habitat. Movement of heavy equipment in these areas shall be confined to existing roadways, where feasible, to minimize habitat disturbance.

- **GGS-2: Temporarily Fence and Designate Suitable Giant Garter Snake Habitat to be Avoided as an Environmentally Sensitive Area.** Suitable giant garter snake habitat to be avoided within or adjacent to construction areas shall be temporarily fenced and designated as environmentally sensitive areas. These areas shall be avoided by all construction personnel.

- **GGS-3: Limit Ground Disturbance within 200 Feet of Suitable Giant Garter Snake Habitat and Conduct Activities Between May 1 and October 1, Unless Authorized by USFWS.** Unless authorized by USFWS, construction and other ground-disturbing activities within 200 feet of suitable aquatic habitat for the giant garter snake shall not commence before May 1, with initial ground disturbance expected to correspond with the snake's active season (as feasible in combination with minimizing disturbance of nesting Swainson's hawks). Initial ground disturbance shall be completed by October 1.

- **GGS-4: Ensure that Suitable Giant Garter Snake Aquatic Habitat that is Dewatered Remains Dry for 15 Consecutive Days after April 15 and if Not Possible, Potential Snake Prey is Removed.** Any suitable giant garter snake aquatic habitat that is dewatered shall remain dry for at least 15 consecutive days after April 15 and before excavating or filling of the dewatered habitat. If complete dewatering is not possible, potential snake prey (e.g., fish and tadpoles) shall be removed so that snakes and other wildlife are not attracted to the construction area.

- **GGS-5: Conduct a Preconstruction Survey within 200 Feet of Suitable Giant Garter Snake Habitat Within 24 Hours Before Commencement of Ground-Disturbing Activities.** Within 24 hours before the commencement of ground-disturbing activities, areas within 200 feet of suitable giant garter snake habitat shall be surveyed for giant garter snakes by a qualified biologist. The biologist shall provide USFWS with written documentation of the monitoring efforts within 48 hours after the survey is completed. The project area shall be reinspected by a qualified biologist whenever a lapse in construction activity of 2 weeks or greater has occurred.

- **GGS-6: Allow Snakes to Leave the Construction Area on Their Own and Notify USFWS and CDFW Immediately if a Giant Garter Snake is Found On Site.** No snakes shall be harassed, harmed, or killed, and they shall be allowed to leave the construction area on their own volition. If any snake is observed retreating into an underground burrow within the project limits, a 50-foot radius nondisturbance buffer zone shall be established until a qualified biologist determines that the snake is not a giant garter snake or the snake has left the area. The biologist shall notify USFWS and CDFW immediately if a giant garter snake is found on-site, and shall submit a report, including date(s), location(s), habitat description, and any corrective measures taken to protect the snake.

- **GGS-7: Restore All Suitable Giant Garter Snake Habitat Subject to Temporary Ground Disturbance to Preproject Conditions.** After construction activities are complete, all suitable giant garter snake habitat subject to temporary ground disturbances, including storage and staging areas and temporary roads, shall be restored to preproject conditions. These areas shall be recontoured, if appropriate, and revegetated with appropriate native plant species to promote restoration of the area to preproject conditions. Appropriate methods and plant species used to revegetate such areas shall be determined on a site-specific basis in consultation with USFWS and CDFW.

- **GGS-8: Maintain and Monitor Temporarily-Disturbed Areas of Suitable Giant Garter Snake Habitat Following Completion of Construction and Restoration Activities.** Temporarily-disturbed areas of suitable giant garter snake habitat shall be maintained and monitored for 1 year following the completion of construction and restoration activities. Monitoring reports documenting restoration of these areas shall be submitted to USFWS and CDFW upon the completion of the restoration implementation and 1 year after the restoration implementation.

### COMPENSATION MEASURES

To mitigate for impacts to riparian habitat caused by levee improvements along Arcade Creek, and for removal of high-hazard trees that may affect the performance and reliability of existing levees on the Arcade Creek, SAFCA has identified some locations where native riparian vegetation could be established. Planting locations were selected to increase the patch size, improve habitat connectivity, and expand age class and species diversity of woodland habitat. These improvements would enhance nesting opportunities for native bird species, and, if necessary, could provide opportunities to satisfy VELB compensation.

- **Arcade Creek Habitat Improvements:** Impacts caused by levee improvements and high-hazard tree removal along Arcade Creek would be mitigated on-site to the extent feasible by improving and expanding native wetland and riparian habitat adjacent to the low-flow channel within the reach between Rio Linda Boulevard and Marysville Boulevard, which is currently dominated by nonnative annual grasses and broadleaf weeds. Following construction, native wetland vegetation (e.g., Santa Barbara sedge, Baltic rush) would be planted along the banks of Arcade Creek, and one row of large riparian tree species (e.g., valley oak) would be planted along each bank of the low-flow channel. The tree spacing would be determined by the capacity of the floodplain to accommodate vegetation without impacting the desired flood performance. The dense, high overhead canopy of the trees as they mature would provide important shade to the low-flow channel and bank, cover for small mammals and a connected migration corridor for flying and gliding animals (both vertebrates and invertebrates). The SRA habitat along the active channel would benefit water quality by keeping temperatures lower (cooler water retains higher levels of dissolved oxygen needed to sustain native fish and aquatic invertebrates), and provide leaf drop and other organic material to support aquatic food webs. In addition, shade from streamside trees would help suppress some growth of dense red sesbania and willows in the understory, and prevent new colonization of invasive species.

- **Robla Creek Habitat Improvements:** Replacement riparian woodlands are proposed either on Robla Creek Mitigation Site A (which is also Borrow Site 3, approximately 6 acres north of Rio Linda Boulevard) or on Robla Creek Mitigation Site B (approximately 7.1 acres south of Rio Linda Boulevard). Both sites are adjacent to and west of Robla Creek, (see **Exhibit 5**). Site A is a previous borrow site and is at a lower elevation making this area better suited for wetland mitigation. Site B is connected to the Robla Creek floodplain and is the site of a future multi-use recreational trail. SAFCA would provide right-of-way for future construction of the trail.

# 5.0 ACTION AREA

The action area is defined here in accordance with ESA guidelines as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 Code of Federal Regulations [CFR] 402.02). The action area includes all areas that would be directly or indirectly affected by the components of the NSS Levee Improvements Project. Areas downstream of the NSS Levee Improvements Project area might also be indirectly affected by the flood risk management component of the project through improved water quality and flood risk management conditions. The extent of this potential effect is difficult to quantify.

For the purpose of the proposed project, project activities would occur in the following areas, which collectively comprise the action area:

- The section of NEMDC/Steelhead Creek that extends approximately 0.5-mile south from the confluence of Arcade Creek.
- The section of Arcade Creek between NEMDC/Steelhead Creek and Marysville Boulevard.
- A small section along the Robla Creek south levee, east of Rio Linda Boulevard near Dry Creek Road.
- The 3 borrow sites.
- The 4 potential staging areas.
- The one woodland mitigation site along Robla Creek.

# 6.0 ENVIRONMENTAL BASELINE

The NSS Levee Improvements Area includes NEMDC/Steelhead Creek and two of its tributaries: Arcade and Robla Creeks, as well as the borrow sites, potential staging areas, and tree mitigation site.

## 6.1 VEGETATION AND HABITAT

### 6.1.1 NEMDC/STEELHEAD CREEK

NEMDC/Steelhead Creek 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. The NEMDC/Steelhead Creek forms a portion of the eastern boundary of the Natomas Basin and under high flows connects to the Pleasant Grove Creek Canal which drains into the Natomas Cross Canal and carries flows to the Sacramento River. For the purpose of the proposed project, levee improvements would occur on a portion of the NEMDC/Steelhead Creek levee that extends approximately 0.5-mile south from the confluence of Arcade Creek. The East Levee Road extends along the crown of the west levee, and a levee road and railroad tracks extend along the crown of the east levee.

South of the confluence with Arcade Creek, the east and west levees of NEMDC/Steelhead Creek are dominated by wild oats grasslands, while the channel of NEMDC/Steelhead Creek is characterized by Fremont cottonwood forest, with smaller amounts of valley oak woodland, smart-weed cocklebur patches, and perennial rye grass fields.

### 6.1.2 ARCADE CREEK

The approximately 16.2-mile-long channel of Arcade Creek extends east-to-west from Orangevale to the American River, via NEMDC/Steelhead Creek. Levee improvements, as well as components of the Conservation Strategy, would occur on the section of Arcade Creek between NEMDC/Steelhead Creek and Marysville Boulevard, and encroachment removal and vegetation management would occur mainly in the section between Rio Linda and Marysville Boulevards.

The north and south levees are dominated by wild oats grasslands, with a paved or gravel road along the levee crowns and the landside levee toe. Developed areas along Arcade Creek include the four bridges that cross the channel; from east to west, these are: Norwood Avenue, the Sacramento Northern Bike Trail, Rio Linda Boulevard, and Marysville Boulevard. Residential developments and Gateway Park, located north of Arcade Creek and respectively east and west of Norwood Avenue, and Hagginwood Park, located north Arcade Creek east of Marysville Boulevard, include landscaped areas. 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/Steelhead Creek. 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/Steelhead Creek to Norwood Avenue. East of Norwood Avenue, the creek channel becomes narrower, and dominated by a shaded canopy of valley oak woodland.

### 6.1.3 ROBLA CREEK

Robla Creek is a perennial stream located just south of Dry Creek, extending east-to-west from near McClellan Air Force Base to the American River (via NEMDC/Steelhead Creek). In the 1970s, a reach of Robla Creek between Dry Creek Road and the Sacramento Northern Bike Trail was relocated to facilitate the construction of a housing development and recreational lakes. This channelized section of Robla Creek was restricted to a very narrow corridor that contained low-quality habitat and did not provide adequate room for flood flows (SAFCA 2014). In 1993, SAFCA constructed a new Rio Linda Creek channel west of Dry Creek Road. A section of the Robla Creek channel west of Dry Creek Road was filled in 2002 to accommodate the Robla Creek north levee, and a new channel was built to replace it. This new creek section provides a sinuous, meandering channel with improved flood flow capabilities and increased habitat values (SAFCA 2014). The area adjacent to NEMDC/ Steelhead Creek is characterized as seasonal wetlands, while further east, the creek channel is surrounded by, invasive red sesbania, wild oats grasslands with some clusters of valley oak woodland. For the purposes of the proposed project, a limited amount of encroachment removal would occur in a small footprint along the Robla Creek south levee, east of Rio Linda Boulevard near Dry Creek Road.

### 6.1.4 BORROW AND STAGING AREAS

Three potential borrow sites have been identified to support levee improvements in the North Sacramento Streams Levee Improvements area. The environmental effects that would result from use of borrow materials from Borrow Site 1 were evaluated in the Phase 3 FEIS/FEIR (USACE and SAFCA 2009).

Borrow Site 2 is a narrow site dominated by yellow star thistle and nonnative grasslands, located between the NEMDC/Steelhead Creek levees (East Levee Road and Sorrento Road), immediately east of the channel. Just east of the southern portion of this borrow site is the approximately 60-acre Wolf Ranch Wildlife Sanctuary, on which SAFCA created mitigation wetland and upland habitats after using the site as a borrow source for a previous levee improvement project (SAFCA 2014).

Borrow Site 3 is located north of Robla Creek and the Robla Creek South Levee, east of Rio Linda Boulevard on a site that is comprised of ruderal fields. This site would also serve as a potential tree mitigation site for the North Sacramento Streams Levee Improvements.

Four potential staging areas have been identified to support the levee improvements in the North Sacramento Streams Levee Improvements area. As depicted in **Exhibit 4.6-1**, three of these occur adjacent to, but not within the levee improvement footprint; thus, these areas are considered additional impacts. Staging Area 1 is considered developed. Staging Areas 2 and 4 are primarily wild oats grassland with some developed.  Staging Area 3 is primarily developed with some wild oats grasslands. Staging within these areas would be located to avoid the removal of sensitive vegetation and trees. Wild oats grasslands are found in the levee maintenance easements.

### 6.1.5 WOODLAND MITIGATION SITES

Two areas have been identified where riparian woodlands could replaced as off-site mitigation for tree removal associated with levee improvements along Arcade Creek and NEMDC/Steelhead Creek. These two sites are located north of and immediately adjacent to Robla Creek, distributed along both sides of Rio Linda Boulevard. Both sites are owned by SAFCA and are currently ruderal grassland. The approximately 6-acre Site A is also the potential Borrow Site 3. Site B is an approximately 7.1-acre area.

## 6.2 WILDLIFE

The NSS Levee Improvements area provides a variety of wildlife habitats associated with the various creeks that are present. The NEMDC/Steelhead Creek habitat corridor and downstream portion of the Arcade Creek corridor generally provide higher-quality wildlife habitat than the upper portions of Arcade Creek, because they are wider and support more diversity of habitat types. A variety of common wildlife species are anticipated to be resident in the North Sacramento Streams Levee Improvements area, and additional species are likely to use the channels on a seasonal or other irregular basis as movement corridors between upstream and downstream areas.

# 7.0 SPECIES ACCOUNTS

*[Refer to the USACE GRR BA.]*

# 8.0 EFFECTS

## 8.1 DIRECT AND INDIRECT EFFECTS ON SPECIES IN THE ACTION AREA

Under the ESA, direct effects are those that are caused by the project and that occur at the same time as the action (see, e.g., construction-related effects). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur (e.g., operational effects). Avoidance and minimization measures for both direct and indirect effects are presented in the "Conservation Strategy" section above.

### 8.1.1 VERNAL POOL INVERTEBRATES

Seasonal wetland habitat is present in annual grassland north of Robla Creek, including in the eastern portion of Borrow Site 3/Robla woodland mitigation site A. Although borrow extraction and riparian planting activities associated with levee improvements and the Conservation Strategy in the NSS Levee Improvements area would not directly affect the seasonal wetland habitat, these activities could indirectly affect potentially suitable habitat for vernal pool invertebrates in this area by altering hydrology and/or degrading water quality. These effects could result in temporary loss of individuals, but the population could persist if the habitat is restored to its prior condition.

However, implementation of the Conservation Strategy avoidance and minimization measures, and specifically VPC-1, "Provide Suitable Vernal Pool Crustacean Habitat with Protective Buffers, to the Extent Feasible, and Temporarily Fence and Designate the Buffers as Environmental Sensitive Areas," and VPC-2, "Monitor All Construction Activities in Sensitive Biological Resources to Ensure that Avoidance and Minimization Measures Are Being Properly Implemented and Stop Construction Activities that Threaten Unauthorized Project Impacts," would avoid and minimize the potential for indirect effects on suitable habitat for vernal pool invertebrates through the establishment of appropriate buffers.

### 8.1.2 VALLEY ELDERBERRY LONGHORN BEETLE

Blue elderberry shrubs (Sambucas mexicana), the host plant for valley elderberry longhorn beetle larvae, are sparsely scattered throughout the action area. There are no known documented occurrences of VELB in the NSS Levee Improvements Project area, but the species could use elderberry shrubs in the action area.

Elderberry shrubs were not observed along Arcade Creek or NEMDC/Steelhead Creek during field surveys and are not expected to occur at Borrow Sites 2 and 3. Encroachment removal along Robla Creek would be limited to trimming back residential landscaping from a fence line and would have no potential for adverse impact to any elderberry shrubs, if present nearby. Elderberry shrubs could be present adjacent to potential woodland mitigation sites, including along Robla Creek. However, the Conservation Strategy would focus tree mitigation efforts on open grassland areas and avoid disturbance of elderberry shrubs that may be nearby. Further, implementation of the Conservation Strategy avoidance and minimization measures, and specifically VELB-1 "Temporarily Fence All Elderberry Shrubs Adjacent to Construction Areas and Designate the Area as Environmentally Sensitive," would avoid the potential for direct and indirect effects on elderberry shrubs through the establishment of appropriate buffers. Other Conservation Strategy avoidance and minimization measures, such as VELB-2, "Prohibit Use of Pesticides or Chemicals within 100 Feet of Elderberry Shrubs,"

## 8.1.3 SPECIAL-STATUS FISH SPECIES [PLACEHOLDER]

## 8.1.4 GIANT GARTER SNAKE

Giant garter snakes have not been documented in NEMDC/Steelhead Creek or its eastside tributaries (CDFW 2014), and historical habitat conditions are thought to have limited dispersal of the species east of NEMDC/ Steelhead Creek (Halstead et al. 2014; B. Halstead, pers. comm., 2015; E. Hansen, pers. comm., 2015). Based on these factors and current habitat conditions, such as close proximity to urban development, high levels of human disturbance, scarcity of upland habitat, and riparian vegetation along the banks of most channel reaches, giant garter snakes are unlikely to occur in the eastside tributaries and the southern portion of NEMDC/Steelhead Creek. Therefore, all proposed project elements that would occur in these areas, including encroachment removal and levee improvements along Arcade Creek and levee improvements along the adjacent portion of the NEMDC/ Steelhead Creek east levee, are unlikely to directly or indirectly impact giant garter snakes or adversely affect habitat occupied by the species.

The quality of habitat for giant garter snake improves along NEDMC/Steelhead Creek north of Dry Creek, where aquatic habitat is more extensive, very little riparian vegetation is present, urban development is less extensive, and large areas of open grasslands are present landside of the levees. Giant garter snakes are known to occur in rice fields, associated canals, and managed marshes in the Natomas Basin. An occurrence was documented along Elkhorn Boulevard, approximately 0.7 mile northwest of Borrow Site 2, and the species occurs at the complex of TNBC reserves immediately west of NEMDC/Steelhead Creek, approximately 3.5 miles farther north (CDFW 2014). Based on habitat conditions and known occurrences of giant garter snake, there is potential for the species to occur, at least occasionally, in nearby portions of NEMDC/Steelhead Creek. Borrow Site 2 is located immediately east of NEMDC/Steelhead Creek and may support potentially suitable upland habitat for the species. If giant garter snakes are present during borrow activities, these activities would result in direct and indirect effects to this species.

Ground disturbing activities at Borrow Site 2, where uplands adjacent to suitable aquatic habitat would be disturbed, could result in direct displacement, injury, or death of snakes if the habitat is used for basking, hibernating, or aestivating. Indirect effects could occur if snakes are displaced from occupied habitat or disturbed by nearby construction activities. Displacement and disturbance resulting from human activity, construction noise, and equipment vibrations could affect the ability of snakes to conduct essential life history functions, such as dispersal, movement, or foraging, and could result in increased competition for food and space and vulnerability to predation. Construction activities could temporarily degrade aquatic habitat, but the overall result of implementing the Conservation Strategy would be an enhancement of habitat quality.

All project-related impacts at Borrow Site 2 would occur within one active season and, therefore, are considered temporary. Borrow Site 2 would be restored /enhanced and re-graded to a condition that exceeds the pre-project condition by lowering the land surface closer to the low flow channel elevation and through establishment of a more diverse mosaic of aquatic and wetland habitat components.

# 9.0 CUMULATIVE EFFECTS

*[Refer to the USACE GRR BA.]*

# 10.0 CONCLUSIONS AND DETERMINATION

In conclusion, based on the biology and ecology of the federally listed species that have the potential to occur in the NSS Levee Improvements Project area, the environmental baseline for the action area, and the effects of the proposed action and its cumulative effects, implementing the NSS Levee Improvements Project may affect and is likely to adversely affect giant garter snake and would result in no effect on listed vernal pool invertebrates, valley elderberry longhorn beetle, and Central Valley steelhead. Designated critical habitat in the action area has been designated for Central Valley steelhead; however, none would be adversely modified or destroyed.

- **Vernal pool invertebrates:** The NSS Levee Improvements Project would result in no effect on federally listed vernal pool invertebrates considered in this preliminary biological evaluation. Effects are not expected to occur because of the avoidance and minimization measures incorporated into the NSS Levee Improvements Project. The NSS Levee Improvements Project includes several measures that would avoid potential direct and indirect environmental effects during project construction. The potential indirect effects impacts of altered hydrology or degraded water quality, would be avoided and minimized through the use of best management practices (e.g., establishment and maintenance of appropriate buffers, erosion control, and revegetation).

- **Valley elderberry longhorn beetle:** The NSS Levee Improvements Project would result in no effect to VELB. Any elderberry shrubs located in the NSS Levee Improvements Project area would be avoided (see VELB-1 “Temporarily Fence All Elderberry Shrubs Adjacent to Construction Areas and Designate the Area as Environmentally Sensitive”), thereby avoiding direct effects to VELB. Additional conservation measures (VELB-2, “Prohibit Use of Pesticides or Chemicals within 100 Feet of Elderberry Shrubs.”.

- **Federally listed fish species:** [Placeholder]

- **Giant garter snake:** The NSS Levee Improvements Project may affect and is likely to adversely affect giant garter snake through the implementation of activities at Borrow Site 2. Ground disturbing activities at Borrow Site 2 could result in direct displacement, injury, or death of snakes and indirect displacement of snakes. These direct and indirect effects, which could affect the ability of snakes to conduct essential life history functions, such as dispersal, movement, or foraging, would be temporary (occurring during one active season). Construction activities could temporarily degrade aquatic habitat, but the overall result of implementing the Conservation Strategy would be an enhancement of habitat quality.

# 11.0 ESSENTIAL FISH HABITAT ASSESSMENT

The Magnuson-Stevens Fishery Conservation and Management Act, as amended (16 USC 1801), requires that EFH be identified and described in federal fishery management plans. Federal agencies must consult with NMFS on any activity that they fund, permit, or carry out that may adversely affect EFH. The EFH regulations require that federal agencies obligated to consult on EFH also provide NMFS with a written assessment of the effects of any action on EFH (50 CFR 600.920). NMFS is required to provide EFH conservation and enhancement recommendations to federal agencies. The statute also requires federal agencies receiving NMFS EFH conservation recommendations to provide a detailed written response to NMFS within 30 days of receipt, detailing how they intend to avoid, mitigate, or offset the impact of activity on EFH (Section 305[b][4][B]).

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purposes of interpreting the definition of EFH, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle.

The Pacific Fishery Management Council has identified and described EFH, adverse impacts, and recommended conservation measures for salmon in Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 2003). Freshwater EFH for Pacific salmon in the Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem, as described in Myers et al. (1998), and includes the segment of the NEMDC/Steelhead Creek in the action area. Central Valley fall-/late fall–run Chinook salmon is a species managed under the *Pacific Coast Salmon Plan* that occur in the NEMDC/Steelhead Creek.

## THE PROPOSED ACTION

The proposed action is described in detail in the "Description of the Proposed Action" section of this preliminary biological evaluation. The action area, environmental baseline, and species accounts, respectively, are described in the "Action Area," "Environmental Baseline," and "Species Accounts" sections of this preliminary biological evaluation.

### ESSENTIAL FISH HABITAT DESIGNATION IN THE ACTION AREA [PLACEHOLDER]

### EFFECTS OF THE PROPOSED ACTION [PLACEHOLDER]

## PROPOSED CONSERVATION MEASURES [PLACEHOLDER]

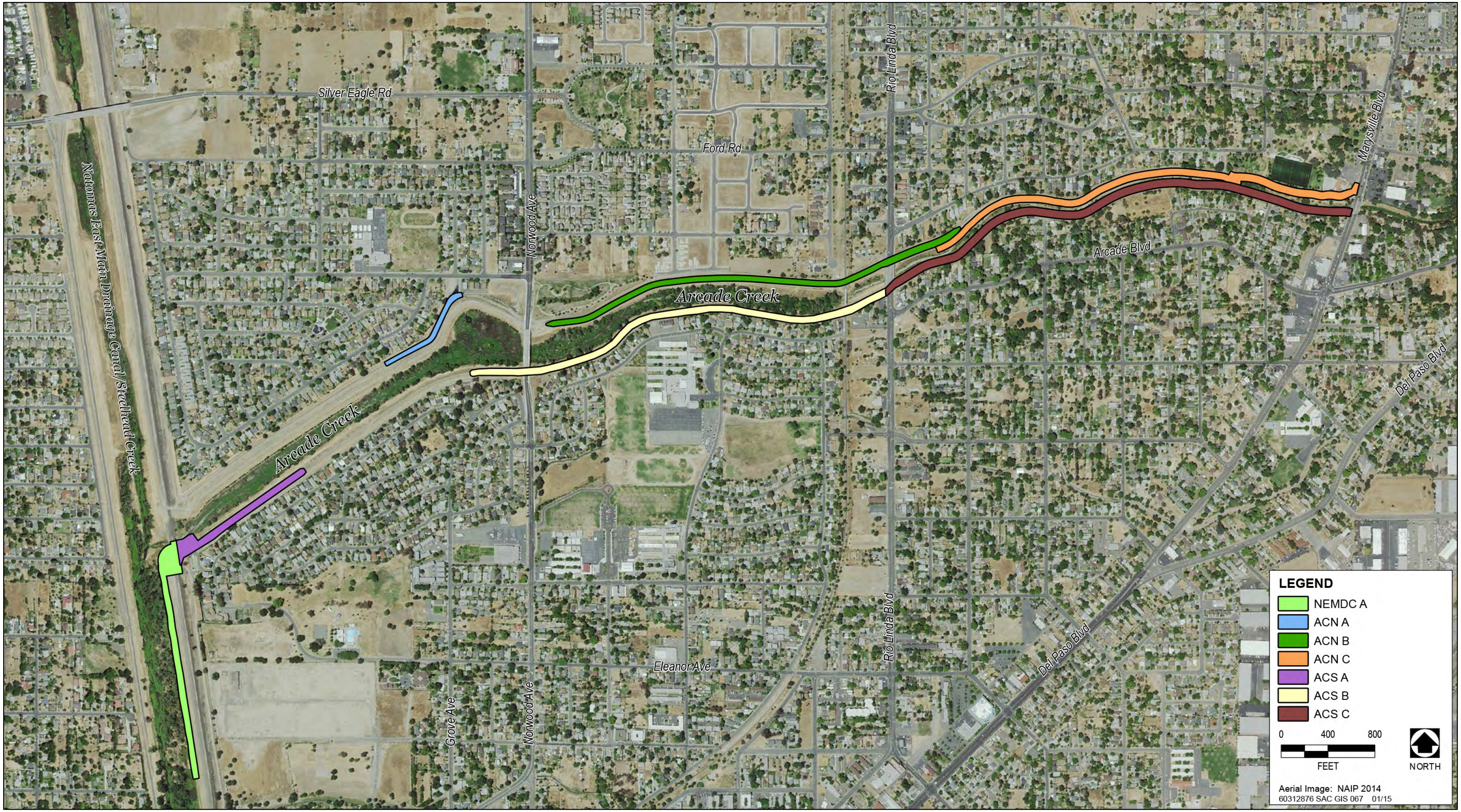
## CONCLUSIONS [PLACEHOLDER]

# 12.0 REFERENCES

*[To be provided]*.

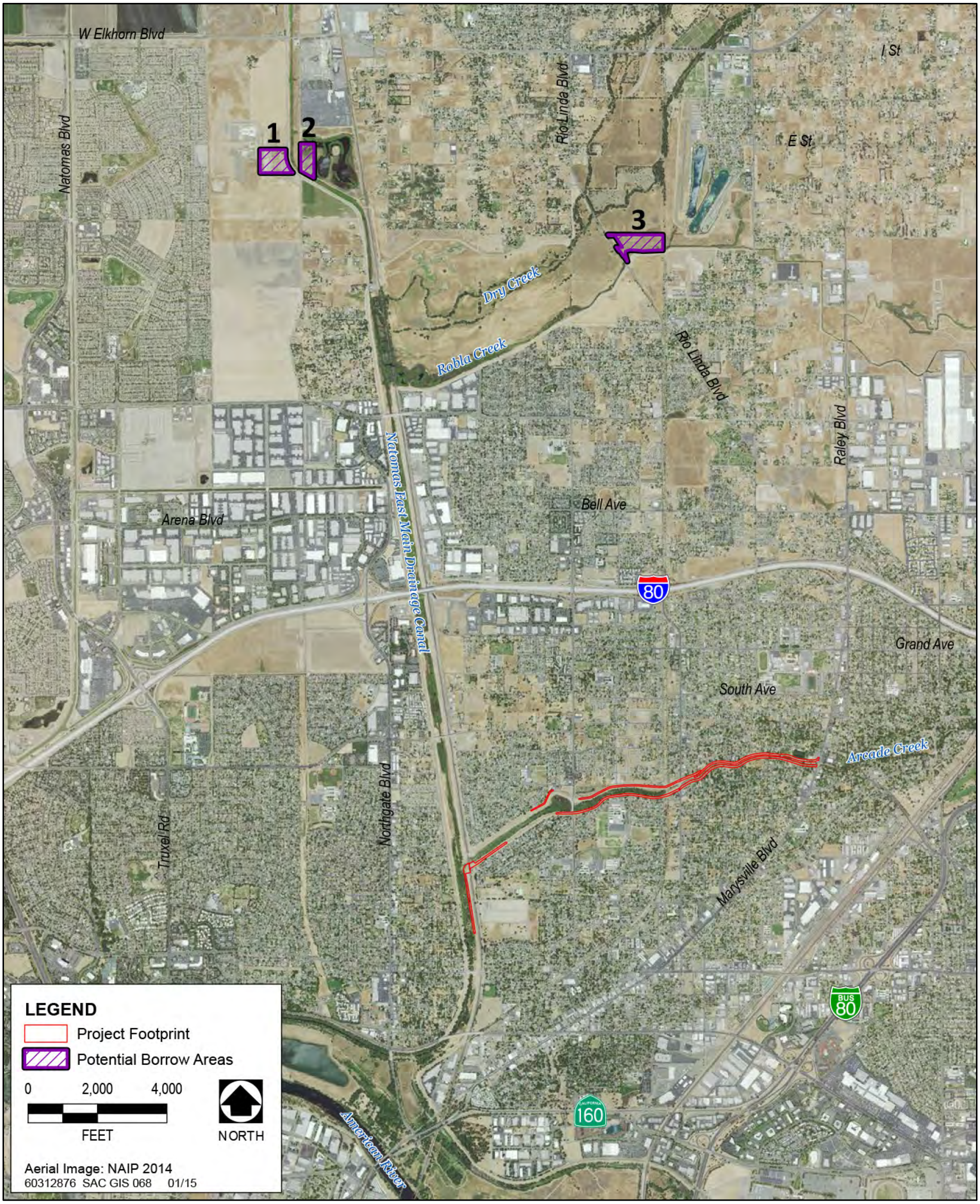
# APPENDIX A

Exhibits




Source: MBK Engineers 2014, adapted by AECOM in 2014

**Exhibit 1.** **North Sacramento Streams Levee Improvements Area Reaches**

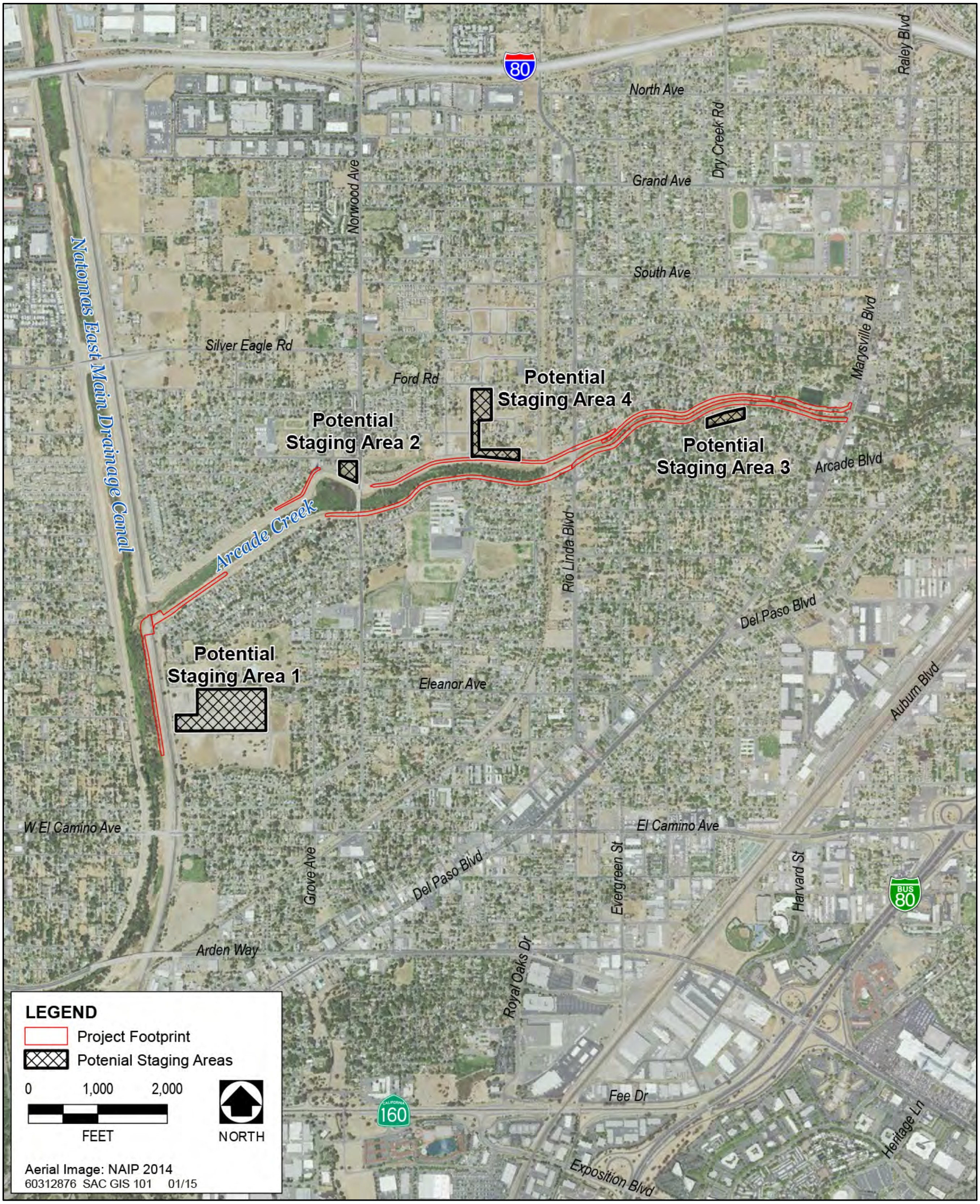



Source: SAFCA 2014, adapted by AECOM in 2014

**Exhibit 2.** **North Sacramento Streams Borrow Areas**


Source: URS Corporation 2014, adapted by AECOM in 2014

**Exhibit 3. North Sacramento Streams Haul Routes**




Source: URS Corporation 2014, adapted by AECOM in 2014

**Exhibit 4.** **North Sacramento Streams Staging Areas**


Source: AECOM 2014

**Exhibit 5. Potential Mitigation Sites – Robla Creek**

# Appendix E

# Magpie Creek Flood Control Project

# Biological Opinion

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
**Sacramento Fish and Wildlife Office**
**2800 Cottage Way, Room W-2605**
**Sacramento, California 95825-1846**

In reply refer to:
1-1-04-F-0132

**SEP 15 2004**

Mr. Mark Charlton
Department of the Army
U.S. Army Engineer District, Sacramento
Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: Review of the Proposed Magpie Creek Flood Control Project, Sacramento County, California, for Inclusion with the Vernal Pool Crustaceans Programmatic Consultation (File Number 1-1-96-F-0001) and a Separate Formal Consultation for the Giant Garter Snake

Dear Mr. Charlton:

This letter responds to your March 25, 2004, letter requesting formal consultation with the U. S. Fish and Wildlife Service (Service) and concurrence to append the U. S. Army Corps of Engineers' (Corps) proposed Magpie Creek Flood Control Project (project) in Sacramento, California, to the programmatic formal consultations for the threatened giant garter snake (*Thamnophis gigas*), and the endangered vernal pool tadpole shrimp (*Lepidurus packardi*) and the threatened vernal pool fairy shrimp (*Branchinecta lynchi*) (File Numbers 1-1-F-97-149 and 1-1-96-F-1, respectively).

As explained below, we determined during our review of your request that the proposed project qualifies for inclusion under the programmatic consultation for vernal pool crustaceans only. Accordingly, a separate consultation for giant garter snake was deemed necessary and is provided in this letter. The findings in this consultation are based on information provided in your March 25, 2004, letter and attached *Draft Environmental Assessment* (DEA), dated January 2004; your *Draft Detailed Project Report/Environmental Assessment* dated January 14, 2004; a *Second Revised Draft Fish and Wildlife Coordination Act* (FWCA) *Report*, dated May 8, 2003, prepared by the Service; site visits on April 27 and May 20, 2004, with the Corps and Sacramento Area Flood Control Agency (SAFCA), the project local sponsor; electronic mail (e-mail) communications to the Service from the Corps dated May 17 and June 9, 2004, providing project description language pertaining to preservation of purchased land; and our review of earlier FWCA Reports, numerous other file documents, and meeting and site visit notes during the 1993-2004 period of Service coordination and consultation activity on this project.

## CONSULTATION HISTORY

In the early 1990s, the Corps investigated flood protection needs in the Magpie Creek area, compared detention basin and channel widening (channel plan) alternatives that included the former McClellan Air Force Base (currently known as McClellan Business Park), and recommended the channel plan. The Service's biological opinion dated September 20, 1995 (File Number 1-1-95-F-30) determined that the channel plan would have direct and indirect effects on vernal pools and other wetlands that would involve significant compensation for impacts. The opinion did not address effects on giant garter snake. The Service met with the local sponsor on November 20, 1997, regarding the potential for use of habitat within the lower Dry Creek corridor for mitigation of project impacts, but did not reach agreement. In late 1999 to early 2000, the channel plan was redesigned with an upstream terminus just east of Raley Boulevard. This plan provided for reduced effects to seasonal wetlands and increased vegetation allowance (with reduced maintenance) within the widened Magpie Creek Diversion Channel (MCDC), with raising of Raley Boulevard and relocation of a portion of Don Julio Creek. On February 27, 2001, Service and Corps staff met and discussed effects of the project on floodplain development. Beginning June 2001, the project was again redesigned based on additional hydraulic analysis and preliminary alternatives developed by David Ford Consulting Engineers (Magpie Creek Floodplain Analysis, dated November 19, 2001). The selected alternative which is described in more detail below, would accomplish flood protection using modest levee and culvert improvements together with purchase of land primarily east of Raley Boulevard for the purpose of peak flood detention, and would not involve widening or other modification of the existing MCDC channel.

Recent consultation activities directly related to this proposed project are as follows:

*March 26, 2004*: Service received letter from the Corps (Mark Charlton) dated March 25, 2004, and draft Environmental Assessment dated January 2004, requesting appendage of the proposed project to the programmatic biological opinions for giant garter snake and vernal pool crustaceans.

*April 29, 2004*: Service, Corps, and SAFCA staff met in the field to review proposed project features and confirm type of disturbance associated with Robla Creek bikeway trail culvert.

*May 7, 2004*: Service staff (Steve Schoenberg) submitted an e-mail request to Corps staff (Ed Stewart) to clarify protective mechanism by which purchased lands would be preserved in perpetuity.

*May 17, 2004*: Service received an e-mail response from Corps staff (Ed Stewart), forwarding language from SAFCA (Grant Kreinberg) that it would place a flood control easement on the land in addition to purchase and would request purchased land be re-zoned as open space.

*May 18, 2004*: Service informed Corps by an e-mail of the need for a second site visit to verify vernal pool indirect effects near Kelly-Moore Paint Store, and assess status of vernal pools south of MCDC between Vinci Avenue and Dry Creek Road previously mapped in 1993.

*May 19, 2004*: Service faxed the Corps additional information on locations of vernal pool crustacean habitat which required confirmation.

*May 20, 2004*: Service and Corps staff met in field, concluded that pool impacts near the Kelly-Moore Paint Store were at most no greater in size than indicated in the March 25, 2004, biological assessment, and the pool areas between Vinci Avenue and Dry Creek Road were no longer present, possibly due to recent grading from an unrelated project.

*May 22, 2004*: Service requested via an e-mail to the Corps, clarification as to whether unrelated grading/construction activity between Vinci Avenue and Dry Creek Road would require modification of the proposed flood control project, specifically, the location of the maintenance road.

*June 8, 2004*: Corps (Charles Rairdan) replied via an e-mail that the Corps had contacted the developer who had conducted subject unrelated grading, and confirmed that the maintenance road element of the proposed flood control project would be constructed in the location as originally planned.

*June 9, 2004*: Corps (Charles Rairdan) e-mailed Service revisions to proposed project description language.

*July 30, 2004*: Service requested via an e-mail to the Corps to confirm areas of habitat disturbance and loss.

*August 3, 2004*: Corps (Ed Stewart) replied via an e-mail to the Service confirming habitat disturbance and loss areas.

## PROJECT DESCRIPTION

The proposed project would be located in Sacramento County north of Interstate 80 and west of McClellan Business Park, and would provide for improved flood protection within the historic Magpie Creek floodplain between Raley Boulevard and the Natomas East Main Drainage Canal. Currently, drainage is provided by the MCDC, an existing artificial channel which spans between

Raley Boulevard and the confluence of Robla Creek with the MCDC. The MCDC includes existing sections of levees between Raley Boulevard and Vinci Avenue, and between Dry Creek Road and the Robla Creek confluence. Proposed project features include:

- raising the MCDC levee between Raley Boulevard and Vinci Avenue;
- constructing maintenance roads - for the 2,100 feet between Raley Boulevard and Vinci Avenue, the existing road on top of the levee would be reconstructed and a second new road would be built land side of the levee base; for the 2,700 feet between Vinci Avenue and Dry Creek Road, a new maintenance road would be constructed immediately adjacent to the top of slope of the MCDC;
- constructing a new 1,000-foot-long levee along the west side of Raley Boulevard between the existing MCDC crossing and Santa Ana Avenue to prevent outflanking flows (with floodgates at the entrance to the Kelly-Moore Paint Store);
- excavating a new overflow channel and installing culverts under the bike trail bridge near the Robla Creek confluence with the MCDC;
- relocating and replacing the existing slide gate outlet between the MCDC and historic Magpie Creek;
- disposing of abandoned tanks between the MCDC and Raley Boulevard, and;
- acquiring and preserving in perpetuity 79 acres (76.5 acres excluding roadways and channels) between Raley Boulevard, McClellan Business Park, and Magpie and Don Julio Creeks.

The MCDC levee raise and new Raley Boulevard levee segment are designed to detain the 250 year flood within the 79-acre area which would be acquired (hereafter termed "preservation area"). The raise would range from about five feet at Raley Boulevard and taper to existing ground a short distance south of Vinci Street. The Raley Boulevard levee would be about five feet high where it meets the MCDC levee, tapering to existing ground near Santa Ana Avenue. The bike trail culvert is sized to result in no change in peak flood stage on the MCDC upstream of Dry Creek Road. The maintenance roads allows the full length of proposed project features (both levee and channel) to be maintained. The 20-foot-wide overflow channel near the bike bridge would be above the invert of the MCDC and configured to avoid existing oak trees. The new slide gate outlet to historic Magpie Creek would retain the flexibility to release flows into the historic channel.

Construction will take one season. Two staging areas have been designated, an existing borrow storage and disposal location near Dry Creek Road and Ascot Avenue, and a section of Vinci Avenue just west of the MCDC. The bike trail culvert and overflow channel would be constructed first, and suitable material stockpiled for use in subsequent construction of the new Raley Boulevard levee or MCDC levee raise work described above. Remaining material would be obtained from the existing borrow storage area. After the levee work is completed, the maintenance roads would be built with an aggregate base. All soils exposed by grading would be revegetated by seeding and mulching.

The action area includes the MCDC and adjacent lands where levee, channel, culvert, or road construction would occur, a small area along Raley Boulevard where levee construction would occur, the preservation area, and the historic Magpie Creek floodplain. These areas are dominated by uplands, primarily herbaceous, non-native grasslands, with scattered houses and a few light industries near Raley Boulevard. Most areas are relatively undisturbed, but other areas near residences are more frequently disturbed by tilling, and ongoing activities such as grazing, storage of a variety of items, and off-road vehicle travel. Magpie and Don Julio Creeks, and the MCDC, have both wetland and primarily young woody vegetation within the channel banks. Larger and more dense woody vegetation is present around some sections of Don Julio Creek, and several mature oaks are in the vicinity of the bike trail culvert element. The preservation area as well as portions of the historic Magpie Creek floodplain have a variety of seasonal and permanent wetlands. The MCDC currently is subject to occasional maintenance of vegetation. The proposed work would occur outside of the channels and no change in channel maintenance is proposed. Approximately 0.25 acres of wetland that is potential vernal pool crustacean habitat near the MCDC would be indirectly affected by elimination of outflanking flows. About 6.1 acres of lands adjacent to the MCDC that are potential giant garter snake habitat, would be disturbed by the proposed project (upland plus the existing maintenance road), of which 1.4 acres would be a permanent conversion of upland to additional maintenance road surface.

The Corps has recommended fee title acquisition of the preservation area and SAFCA has indicated it will purchase the property in fee and also place a flood control easement on the title. The intention of these actions is to prohibit construction of any structures on the properties and to permanently prevent the properties from being developed. Although conservation areas in accordance with programmatic formal consultations are typically protected by a conservation easement, the Corps can only require a flowage easement to fulfill the proposed project's flood control purpose. However, the restrictiveness and compensation for such an easement has been determined by the Corps to be tantamount to fee title. Following purchase, SAFCA will request the City of Sacramento to change the land use and zoning designation on the property to reflect the permanent preservation of the properties as open space. SAFCA has further indicated it will develop, separate from the proposed flood control project, a habitat management plan for the properties with a view toward enhancing the habitat, such as by native tree planting adjacent to Magpie and Don Julio Creeks, and has stated its intention to coordinate such enhancement activity with appropriate regulatory agencies, which would include the Service.

Proposed Minimization and Compensation Measures: The Corps has proposed to acquire 0.5 mitigation credits from a Service-approved mitigation bank for preservation of vernal pool habitat. As it concerns measures to protect the giant garter snake, the Corps states that it will limit such construction to between May 1 and October 1, instruct personnel in awareness training by a Service-approved biologist, confine construction equipment to existing roads and levee surfaces, conduct pre-construction surveys and re-surveys between construction lapses, report any giant garter snake sitings and, upon any siting, halt construction until such time avoidance measures are developed in consultation with the Service. These are consistent with the standard avoidance and minimization measures 1-7 of the Service's *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties* (Snake Programmatic Consultation) (Appendix C, attached).

**APPENDMENT TO VERNAL POOL FAIRY SHRIMP PROGRAMMATIC OPINION**

With respect to listed vernal pool crustaceans, indirect effects of the proposed project could result from elimination of outflanking storm flows to pools within 250 feet of proposed project elements. Two wetlands totaling about 0.25 acre are present west of the Kelly Moore Paint Store. The Corps has proposed to acquire 0.5 mitigation credits from a Service-approved mitigation bank for preservation of vernal pool habitat to offset this impact. The proposed project will also have slight effects on flood depth and duration in the area proposed for purchase and preservation. Increasing the levee height of the MCDC levee would increase the depth of flooding of the area between Magpie and Don Julio Creeks by less than 1 foot for several hours during a 250-year flood event, and by much less (0.01-0.05 feet) during the average annual (2-year) flood event. The hydraulic changes in this area caused by the proposed project are determined by the Service to be of insufficient magnitude, frequency, and duration to cause an adverse effect to listed vernal pool crustaceans or their habitat.

The Service has determined that, based on the effects on listed vernal pool crustaceans described in your March 25, 2004, letter, it is appropriate to append the proposed Magpie Creek Flood Control Project to the Service's *Programmatic Formal Endangered Species Act Consultation on Issuance of 404 Permits for Projects with Relatively Small Effects on Listed Vernal Pool Crustaceans within the Jurisdiction of the Sacramento Field Office, California* (Vernal Pool Programmatic Consultation).

The Service is tracking losses of habitat permitted under the Vernal Pool Programmatic Consultation. We reevaluate the effectiveness of the Vernal Pool Programmatic Consultation at least every six (6) months to ensure that continued implementation will not result in unacceptable effects to the listed species.

The conservation measures identified in the Vernal Pool Programmatic Consultation include the following:

1. Preservation component: For every acre of habitat directly or indirectly affected, at least two vernal pool credits will be dedicated within a Service-approved ecosystem preservation bank or, based on Service evaluation of site-specific conservation values, three acres of vernal pool habitat may be preserved on the project site or another non-bank site as approved by the Service.

2. Creation component: For every acre of habitat directly affected, at least one vernal pool creation credit will be dedicated within a Service-approved habitat creation bank or, based on Service evaluation of site-specific conservation values, two acres of vernal pool habitat will be created and monitored on the project site or another non-bank site as approved by the Service.

3. Listed vernal pool crustacean habitat and associated uplands utilized as on-site compensation will be protected from adverse effects and managed in perpetuity or until the Corps, the applicant, and the Service agree on a process to exchange such areas for credits within a Service-approved conservation banking system. Off-site conservation at a Service-approved non-bank location will be protected and managed in perpetuity through a Service-approved conservation easement, Service-approved management plan, and a sufficient endowment fund to manage the site in perpetuity in accordance with the management plan

4. If habitat is avoided (preserved) on site, then a Service-approved biologist (monitor) will inspect any construction-related activities at the proposed project site to ensure that no unnecessary take of listed species or destruction of their habitat occurs. The biologist will have the authority to stop all activities that may result in such take or destruction until appropriate corrective measures have been completed. The biologist also will be required to immediately report any unauthorized impacts to the Service and the California Department of Fish and Game.

5. Adequate fencing will be placed and maintained around any avoided (preserved) vernal pool habitat to prevent impacts from vehicles.

6. All on-site construction personnel will receive instruction regarding the presence of listed species and the importance of avoiding impacts to these species and their habitat.

7. The applicant will ensure that activities that are inconsistent with the maintenance of the suitability of remaining habitat and associated on-site watershed are prohibited. This includes, but is not limited to: (i) alteration of existing topography or any other alteration or uses for any purposes, including the exploration for or development of mineral extraction; (ii) placement of any new structures on these parcels; (iii) dumping, burning, and/or burying of rubbish, garbage, or any other wastes or fill materials; (iv) building of any new roads or trails; (v) killing, removal, alteration, or replacement of any existing

native vegetation; (vi) placement of storm water drains; (vii) fire protection activities not required to protect existing structures at the project site; and (viii) use of pesticides or other toxic chemicals.

The proposed project will result in 0.25 acre of indirect effects to vernal pools/swales of potentially suitable vernal pool shrimp and vernal pool tadpole shrimp habitat. The applicant has identified and agreed to purchase 0.5 vernal pool preservation credits at a Service-approved conservation bank or Service-approved fund. Credits will be purchased prior to the effect on any vernal pool habitat.

The agreed upon conservation responsibilities of the applicant are as follows:

1. Prior to any earth-moving activities at the proposed project site, the applicant shall purchase at least 0.5 vernal pool preservation credits within a Service-approved ecosystem preservation bank or fund account.

## SEPARATE BIOLOGICAL OPINION ON GIANT GARTER SNAKE

With respect to the giant garter snake, certain sections of Magpie and Don Julio Creeks and the MCDC contain suitable habitat for the giant garter snake. The DEA references a professional consultant's opinion that potential presence of giant garter snake cannot be discounted in these sections, and notes the connection between and proximity of the proposed project watercourses to the Natomas drainage system as well as a nearby siting of giant garter snake within McClellan Business Park at Robla Creek. Accordingly, the presence of giant garter snake in the proposed project area is assumed. Although no construction would occur in aquatic habitat, your March 25, 2004, letter which requested formal consultation incorrectly states that there would be no removal of upland habitat during channel modifications. In fact, the DEA states that construction would take place in uplands within 200 feet and/or adjacent to aquatic habitat, in the forms of: (1) 4,800 feet of a new 10-foot-wide maintenance road (and an additional one foot of shoulder on each side); and (2) approximately 200 feet of new 20-foot-wide channel excavation near the bicycle bridge in the vicinity of the Robla Creek Confluence. The total area of upland that would be adversely affected would be 6.1 acres, of which 1.4 acres of impact related to the construction of the new maintenance road would be permanent, as this road would be surfaced with aggregate stone and maintained free of vegetation (areas provided by an e-mail communication from the Corps (Ed Stewart) dated August 3, 2004). Snakes would be able to move across this surface but it would lack the vegetation of typical uplands that provide essential habitat functions. The construction of a culvert and associated channel near the bicycle bridge would be considered a temporary effect, as it would be earth-surfaced, and assumed to be lightly maintained by mowing and debris removal similar to what is currently done on the MCDC. The adjacent upland habitat at the proposed project site represents giant garter snake habitat because snakes prefer upland habitat that consists of grassy banks and openings in waterside vegetation such as occurs in the project site.

Under the Service's Snake Programmatic Consultation, "permanent impacts" are defined as those proposed project activities which result in a loss of essential habitat components, and upland habitat within a 200-foot radius is recognized within that definition of essential habitat and the determination of potential take. Regardless of whether the impact is upland or aquatic in nature, the compensation for all such permanent impact under the guidelines for the Snake Programmatic Consultation is replacement at a 3:1 ratio, with a 2:1 replacement ratio of upland to aquatic area. Applying this guidance to the subject proposed project, 1.40 acres of impact would require 4.20 acres of replacement habitat, which must meet all Terms and Conditions, guidelines, and criteria in Appendices A and C of the Snake Programmatic Consultation (attached).

We have reviewed the Corps' proposed purchase and preservation in perpetuity of 76.5 acres of upland-wetland habitat near the proposed project site. This type of preservation and purchase proposed is not in accordance with Appendix A (replacement guideline #1) and Appendix C (avoidance and minimization measure #8), and is atypical of the protective covenant description in Term and Condition 2D of the Snake Programmatic Consultation. Therefore, the Service has determined that appending this proposed project to the Snake Programmatic Consultation is not appropriate, and a separate biological opinion is required for consultation for this species and consideration of the merits of the proposed preservation area. Despite the inconsistencies with the Snake Programmatic Consultation, the 76.5 acres of habitat that would be protected as part of the proposed project description far exceed the 4.20 acres which would be required if compensation were deemed necessary.

## STATUS OF THE SPECIES

The Service published a proposal to list the giant garter snake as an endangered species on December 27, 1991 (56 **FR** 67046). The Service re-evaluated the status of the snake before adopting the final rule. The snake was listed as a threatened species on October 20, 1993 (58 **FR** 54053).

Description. The giant garter snake is one of the largest garter snakes and may reach a total length of at least 64 inches. Females tend to be slightly longer and proportionately heavier than males. The weight of adult female snakes is typically 500-700 grams (1.1-1.5 pounds). Dorsal background coloration varies from brownish to olive with a checkered pattern of black spots, separated by a yellow dorsal stripe and two light-colored lateral stripes. Background coloration and prominence of a black-checkered pattern and the three yellow stripes are geographically and individually variable (Hansen 1980). The ventral surface is cream to olive or brown and sometimes infused with orange, especially in northern populations.

Historical and Current Range. This species formerly occurred throughout the wetlands that were extensive and widely distributed in the Central Valley. Fitch (1941) described the historical range of the snake as extending from the vicinity of Sacramento and Contra Costa Counties southward to Buena Vista Lake, near Bakersfield, in Kern County. Prior to 1970, the snake was recorded historically from 17 localities (Hansen and Brode 1980). Five of these localities were clustered in and around Los Banos, Merced County. The paucity of information makes it difficult to determine precisely the species' former range. Nonetheless, these records coincide with the historical distribution of large flood basins, fresh water marshes, and tributary streams. Destruction of wetlands for agriculture and other purposes apparently extirpated the species from the southern one-third of its range by the 1940s -1950s, including the former Buena Vista Lake and Kern Lake in Kern County, and the historic Tulare Lake and other wetlands in Kings and Tulare Counties (Hansen and Brode 1980, Hansen 1980).

Surveys over the last two decades have found the snake as far north as the Butte Basin in the Sacramento Valley. As recently as the 1970s, the range of the snake extended from near Burrell, Fresno County (Hansen and Brode 1980), northward to the vicinity of Chico, Butte County (Rossman and Stewart 1987). California Department of Fish and Game (CDFG) studies (Hansen 1988) indicate that snake populations currently are distributed in portions of the rice production zones of Sacramento, Sutter, Butte, Colusa, and Glenn Counties; along the western border of the Yolo Bypass in Yolo County; and along the eastern fringes of the Sacramento-San Joaquin River Delta from the Laguna Creek-Elk Grove region of central Sacramento County southward to the Stockton area of San Joaquin County.

Essential Habitat Components. Endemic to wetlands in the Sacramento and San Joaquin valleys, the snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways and agricultural wetlands, such as irrigation and drainage canals and rice fields, and the adjacent uplands. The snake feeds on small fishes, tadpoles, and frogs (Fitch 1941, Hansen 1980, Hansen 1988). Essential habitat components consist of: (1) wetlands with adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) upland habitat with grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for escape cover (vegetation, burrows) and underground refugia (crevices and small mammal burrows) (Hansen 1980).

Reproductive Ecology. The breeding season extends through March and April, and females give birth to live young from late July through early September (Hansen and Hansen 1990). Brood size is variable, ranging from 10 to 46 young, with a mean of 23 individuals (Hansen and Hansen 1990). At birth young average about 20.6 cm snout-vent length and 3-5 grams. Young immediately scatter into dense cover and absorb their yolk sacs, after which they begin feeding on their own. Although growth rates are variable, young typically more than double in size by one year of age, and sexual maturity averages three years in males and five years for females (58 **FR** 54053).

Movements and Habitat Use. The giant garter snake typically inhabits small mammal burrows and other soil crevices throughout its winter dormancy period (November to mid-March). Although these areas are generally thought to be above prevailing flood elevations, snakes may not always utilize high ground during their winter dormancy period. The Biological Resources Division (BRD) has documented giant garter snakes at the Colusa National Wildlife Refuge overwintering in areas with few high ground retreat sites (Wylie *et al.* 1997). Snakes in another study population at Gilsizer Slough overwintered in a low elevation wetland area, even though higher ground was present nearby. Both of these populations survived flooding and were not displaced from the area. The snake also uses burrows as refuge from extreme heat during their active period. While the snakes usually remain in close proximity to wetland habitats, the BRD has documented snakes using burrows as much as 165 feet away from the marsh edge to escape extreme heat (Wylie *et al.* 1997). Overwintering snakes have been documented to use burrows as far as 820 feet from the edge of marsh habitat. Snakes typically select south- and west-facing burrows as hibernacula (58 **FR** 54053).

In studies of marked snakes in the Natomas Basin, snakes moved about 0.25 to 0.5 mile per day (Brode and Hansen 1992). However, total activity varies widely between individuals, and individual snakes have been documented moving up to 5 miles over the period of a few days in response to dewatering of habitat (Wylie *et al.* 1997). In agricultural areas, snakes were documented using rice fields in 19-20 percent of the observations, marsh habitat in 20-23 percent of observations, and canal and agricultural waterway habitats in 50-56 percent of the observations (Wylie 1999). Telemetry studies have also shown that active snakes use uplands extensively–more than 31 percent of observations were in uplands (Wylie 1999). Almost all snakes observed in uplands during the active season were near vegetative cover, where cover exceeded 50 percent in the area within 1.6 feet of the snake; less than 1 percent of observations were of snakes in uplands with less than 50 percent cover nearby (Wylie 1999).

Reasons for Decline and Threats to Survival. The current distribution and abundance of the snake is much reduced from former times. Loss of habitat due to agricultural activities and flood control have extirpated the snake from the southern one third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds. These lakebeds once supported vast expanses of ideal snake habitat, consisting of cattail and bulrush dominated marshes. Vast expanses of bulrush and cattail floodplain habitat also typified much of the Sacramento Valley historically (Hinds 1952). Prior to reclamation activities beginning in the mid to late 1800s, about 60 percent of the Sacramento Valley was subject to seasonal overflow flooding in broad, shallow flood basins that provided expansive areas of snake habitat (Hinds 1952). Valley floor wetlands are subject to the cumulative effects of upstream watershed modifications, water storage and diversion projects, as well as urban and agricultural development; all natural habitats have been lost and an unquantifiable but small percentage of semi-natural wetlands remain extant. Only a small percentage of extant wetlands currently provide habitat suitable for the snake.

Ongoing maintenance of aquatic habitats for flood control and agricultural purposes eliminate or prevent the establishment of habitat characteristics required by snakes and can fragment and isolate available habitat, prevent dispersal of snakes among habitat units, and adversely affect the availability of the garter snake's food items (Hansen 1988, Brode and Hansen 1992). In many areas, the restriction of suitable habitat to water canals bordered by roadways and levee tops renders snakes vulnerable to vehicular mortality. Fluctuation in rice and agricultural production affects stability and availability of habitat. Recreational activities, such as fishing, may disturb snakes and disrupt basking and foraging activities. Nonnative predators, including introduced predatory gamefish, bullfrogs (*Rana catesbiana*), and domestic cats also threaten snake populations. While large areas of seemingly suitable snake habitat exist in the form of duck clubs and waterfowl management areas, water management of these areas typically does not provide the summer water needed by snakes. Although snakes on national wildlife refuges are relatively protected from many of the threats to the species, degraded water quality continues to be a threat to the species both on and off refuges. A number of land use practices and other human activities currently threaten the survival of the snake throughout the remainder of its range. Although some snake populations have persisted at low levels in artificial wetlands associated with agricultural and flood control activities, many of these altered wetlands are now threatened with urban development. Rapidly expanding cities within the current range of the snake include Chico, Yuba City, Sacramento, Galt, Stockton, Gustine, and Los Banos.

<u>Status with Respect to Recovery</u>. Currently, the Service recognizes 13 separate populations of the snake, with each population representing a cluster of discrete locality records (USFWS 1993). The 13 extant population clusters largely coincide with historical riverine flood basins and tributary streams throughout the Central Valley (Hansen 1980; Brode and Hansen 1992): (1) Butte Basin, (2) Colusa Basin, (3) Sutter Basin, (4) American Basin, (5) Yolo Basin-Willow Slough, (6) Yolo Basin-Liberty Farms, (7) Sacramento Basin, (8) Badger Creek-Willow Creek, (9) Caldoni Marsh, (10) East Stockton-Diverting Canal and Duck Creek, (11) North and South Grasslands, (12) Mendota, and (13) Burrell-Lanare. These populations span the Central Valley from just southwest of Fresno (Burrell-Lanare) north to Chico (Hamilton Slough).

The draft recovery plan for the snake subdivided its historic range into four recovery units (Service 1999). These are: (1) the Sacramento Valley unit, extending from the vicinity of Red Bluff south to the confluence of the Sacramento and Feather Rivers; (2) the Mid-Valley unit, extending from the American and Yolo Basins south to Duck Creek near the City of Stockton; (3) the San Joaquin Valley unit, extending south from Duck Creek to the Kings River; and (4) the South Valley unit, extending south of the Kings River to the Kern River Basin. Portions of the Mid-Valley recovery unit are within the action area.

The Sacramento Valley Recovery Unit at the northern end of the species' range is known to support relatively large, stable populations of the snake. This unit contains three populations (Butte Basin, Colusa Basin, and Sutter Basin) and a large amount of suitable habitat, in protected areas on state refuges and refuges of the Sacramento NWR Complex in the Colusa and Sutter Basins, and along waterways associated with rice farming (Service 1999). While populations within this unit have some protection on refuge and other public lands within National Wildlife Refuges, snakes are subjec to flooding and mortality from predatory fish and birds, vehicular traffic agricultural practices, aand maitenance of water channels. The populations within this unit are widely distributed and mostly restricted to unnatural agricultural water delivery and drainage facilities associated with rice fields, and habitat corridors connecting populations and subpopulations are not present and/or protected.

The Mid-Valley Recovery Unit, directly to the south of the Sacramento Valley Recovery Unit, includes seven populations: American Basin, Yolo Basin–Willow Slough, Yolo Basin–Liberty Farms, Sacramento Area, Badger Creek/Willow Creek, Caldoni Marsh, and East Stockton. The status of the seven snake populations in the Mid-Valley Recovery Unit is very uncertain. The East Stockton population may be extirpated, and is not considered recoverable as a result of urban encroachment into habitat (Service 1999). Five of the remaining six populations within the recovery unit are very small, highly fragmented and isolated, and, except for the Badger Creek/Willow Slough population, are also threatened by urbanization. This latter population is within a small isolated area. Within the Mid-Valley unit, only the American Basin population supports a sizeable snake population which is dependent largely upon rice lands. The American Basin population, although threatened by urban development, will receive protection from the approved Metro Air Park Habitat Conservation Plan (HCP) and Natomas Basin HCP (NBHCP), which share a regional strategy to maintain a viable snake population in the basin.

The remaining two recovery units are located to the south in the San Joaquin Valley, where the best available data indicate that the snake's status is precarious. The San Joaquin Valley Recovery Unit contains three historic snake populations: North and South Grasslands; Mendota Area; and Burrell/Lanare Area (Service 1999). This recovery unit formerly supported large snake populations, but numbers have declined severely in recent decades, and recent survey efforts indicate numbers are very low compared to Sacramento Valley populations.

No surviving snake populations are known from the fourth recovery unit, the South Valley Recovery Unit, at the southern end of the snake's historic range; this unit includes only extirpated populations, including the historic but lost Tulare and Buena Visa lakes.

Current Research Related to Recovery Efforts. Since April of 1995, the BRD has further documented occurrences of snakes within some of the known populations. The BRD has studied snake subpopulations at the Sacramento and Colusa NWRs within the Colusa Basin, at Gilsizer Slough within the Sutter Basin, the Badger Creek area of the Cosumnes River Preserve within the Badger Creek-Willow Creek area, and the Natomas area within the American Basin (Wylie *et al.* 1997, Wylie 1999). These subpopulations represent the largest known extant subpopulations. With the exception of the American Basin, these subpopulations are largely protected from many of the threats to the species. Outside of these protected areas, snakes in these populations are still subject to all the threats identified in the final listing rule. The remaining nine populations identified in the final rule are distributed discontinuously in small isolated patches and are vulnerable to extirpation by stochastic environmental, demographic, and genetic processes. The 13 extant populations are largely isolated from each other, with any dispersal corridors between them limited and not protected. When small populations are extirpated, the recolonization is unlikely in most cases, given the isolation from larger populations and the lack of dispersal corridors between them.

## ENVIRONMENTAL BASELINE

The action area for the proposed project is included in the American Basin snake population. The American Basin population is within the Mid-Valley Recovery Unit (Service 1999). A description of the recovery unit along with the status of the population is outlined below.

The Mid-Valley Recovery Unit includes seven giant garter snake populations: American Basin, Yolo Basin–Willow Slough, Yolo Basin–Liberty Farms, Sacramento Area, Badger Creek/Willow Creek, Caldoni Marsh, and East Stockton. The status of the seven snake populations in the Mid-Valley Recovery Unit is very uncertain. The East Stockton population may be extirpated, and is not considered recoverable as a result of urban encroachment into habitat (Service 1999). Five of the remaining six populations within the recovery unit are very small, highly fragmented and isolated, and, except for the Badger Creek/Willow Slough population, are also threatened by urbanization. This latter population is within a small isolated area. Within the Mid-Valley unit, only the American Basin population supports a sizeable snake population which is dependent largely upon rice lands. The American Basin population, although threatened by urban development, receives some protection on lands managed by the Natomas Basin Conservancy, which has a goal of maintaining a viable snake population in the basin.

The American Basin has one of the largest and better protected snake poulations, but the unit is subject to the effects of a number of projects. Many development projects have been constructed in or near snake habitat in this rapidly urbanizing area, and snakes are subject to secondary effects of urbanization such as predation by house cats and increased vehicular mortality. Most documented localities have also been adversely impacted by freeway construction, flood control projects, and commercial development. Several former localities are known to have been lost or depleted to the extent that continued viability is in question (Brode and Hansen 1992). The scarcity of remaining suitable habitat, flooding, stochastic processes, and continued threats of habitat loss pose a severe threat to this population.

Factors Affecting the Snake within the Action Area. A number of State, local, private, and unrelated Federal actions have occurred within the action area and adjacent region affecting the environmental baseline of the species. Some of these projects have been subject to prior section 7 consultation. These actions have resulted in both direct and indirect impacts to snake habitat within the region. In addition to projects already discussed, projects affecting the environment in the action area include communication projects (e.g., installation of cable systems) and transportation projects with Federal, county or local involvement. The Corps has consulted the Service on the issuance of wetland fill permits for several bridge replacement projects within the Sacramento Basin that affected snake habitats. The direct effect of these projects is often small and localized, but transportation projects which improve access can indirectly affect snakes by facilitating development of habitat, and by increasing traffic mortality, and these effects are not quantifiable.

Ongoing agricultural activities also affect the environmental baseline for the snake, and are largely not subject to section 7 consultation. Some agriculture, such as rice farming, can provide valuable seasonal foraging and upland habitat for the snake. Although rice fields and agricultural waterways can provide habitat for the snake, agricultural activities such as waterway maintenance, weed abatement, rodent control, and discharge of contaminants into wetlands and waterways can degrade snake habitat and increase the risk of snake mortality (Service 1999). Ongoing maintenance of agricultural waterways can also eliminate or prevent establishment of snake habitat, eliminate food resources for the snake, and can fragment existing habitat and prevent dispersal of snakes (Service 1999). Flood control and maintenance activities which can result in snake mortality and degradation of habitat include levee construction, stream channelization, and the riprapping of streams and canals (Service 1999).

Several flood control programs administered by the Corps are completed or ongoing within the action area. Large completed projects include the Sacramento River Flood Control Project, which constructed and/or improved levees and other flood control features which make up the Federal Sacramento River Flood Control System; this system includes the levee which would receive bank protection under the Corps' proposed action. Subsequent to the 1986 flood events, the Corps initiated the ongoing Sacramento River Flood Control System Evaluation (SRFCSE) to examine the existing flood control system and to develop remedial repair plans to restore the designed level of protection. The Natomas Area Flood Control Project allowed urban development in the Natomas Basin to move forward. The American River Watershed Investigation administered by the Corps will affect snakes in the Natomas and American Basins. A separate recent flood control action in the immediate vicinity of the proposed project area in this consultation is the Lower Dry Creek and Robla Creek Levee Improvement Project (Public Notice 200000541; Service File Number 1-1-01-F-01340), conducted by SAFCA under permit from the Corps. That work involved reconfiguring a section of Robla Creek, and included grading and planting to enhance habitat for the giant garter snake. Other on-going or planned activities include levee raising along the Natomas Cross Canal, modification of the NEMDC Levee, and relocation of canals and stability berms along the various levees. Although the Corps has consulted on previous projects and is expected to continue to do so on future projects, the ongoing nature of these activities and the administration under various programs makes it difficult to determine the continuing and accumulative impacts of these activities.

<u>The Snake in the Proposed Project Area</u>. Numerous California Natural Diversity Database (CNDDB) (CDFG 2001) locality records are known from the Natomas Basin portion of the American Basin and are distributed throughout most of the basin. Robla Creek, Dry Creek, and Magpie Creek all converge with the Natomas East Main Drain Canal east of the Natomas Basin. Recent research efforts by BRD to collect demographic and habitat use data during 1998 and 1999, have further documented occurrences of giant garter snakes within the Natomas Basin (Wylie and Casazza 2000, Wylie *et al.* 2000). BRD surveys have provided significant recent information on the distribution of giant garter snakes within the Basin, and supplements previous research on the snake within Natomas Basin (e.g. Brode and Hansen 1992, Hansen and Brode 1993). BRD capture data and CNDDB records indicate giant garter snakes are distributed

throughout the Basin, but relative abundance varies widely across the Basin. Wylie and Cassaza (2000) concluded that habitat within the Natomas Basin has apparently degraded over time, as compared to previous accounts of habitat in the Basin. They also concluded that the quality of habitat within the Natomas Basin is less than that at other geographic locations where giant garter snakes are found. The other localities studied by BRD included more extensive areas of native or restored and/or protected habitat as compared with the Natomas Basin.

## EFFECTS OF THE ACTION

The proposed work would affect giant garter snake upland habitat, adjacent to the MCDC. No snake aquatic habitat would be affected. The disturbance would be temporary and occur within the footprint of existing flood control structures, with the exception of a new maintenance road spanning between Raley Boulevard and Dry Creek Road on the outboard side of the levee or adjacent to the existing channel. The Service acknowledges that the levee raise approach obviates the need to disturb giant garter snake habitat in the MCDC, as would have been required by the channel widening approach considered in our previous biological opinion of September 20, 1995 (File Number 1-1-95-F-30). However, construction activities on upland near aquatic habitat may remove vegetative cover and basking sites used for thermoregulation and fill, or crush burrows/crevices needed for hibernation. Construction or maintenance vehicles may harm or crush snakes, or cause snakes to move to other areas at risk. The risk of take of the snake is reduced by restricted road access (i.e, gates) and limitation on road use for the purpose of channel maintenance. The area of uplands in which the maintenance road would be constructed is currently subject to infrequent disturbance by discing or mowing, and infrequent channel maintenance activity with heavy equipment. Due to the presence of uplands on the levee or uplands on the side of the MCDC opposite the maintenance road, uplands would not be entirely eliminated by the proposed action, and snakes would not be required to cross this maintenance road to access essential habitat elements due to the presence of uplands on the opposite side. Although the Service agrees that the protection measures proposed by the Corps would reduce construction-related effects, these measures do not compensate for the loss of upland in association with aquatic habitat.

Although not specifically identified as a compensation measure, the Service evaluated the potential for the preservation area - which functions as an area to detain peak flood flows - to provide for improved habitat and offset impacts to the giant garter snake not identified in the DEA. The habitat which would be acquired and preserved as part of the proposed project is in the vicinity of portions of Magpie and Don Julio Creeks both of which appear to have more consistent, perennial flow than does the MCDC, and possess essential habitat elements for giant garter snake. The preservation area is also adjacent to and serves as an upland buffer to other undeveloped habitat areas in McClellan Business Park with known vernal pool crustacean populations as well as potential suitability for giant garter snake. Due to its proximity to Raley Boulevard and Interstate 80, and current land use designation for light industry, the preservation area would otherwise be considered at a modest risk of development loss over the long- term. However, due to its lower topography and position between two creeks, portions would require either extensive pad construction or additional, upstream flood control measures to avoid flood damage. The acquisition and preservation as provided in the project description allow for future opportunity for habitat enhancement actions as discussed in the Service's December 2003, FWCA report, even though specific enhancements are not proposed as part of the flood control project.

The Service also considered whether the proposed flood control project could have an indirect effect in terms of affecting the rate of development and consequential loss of habitat within the floodplain along portions of historic Magpie Creek that may support giant garter snake or other listed species. In evaluating this influence, we note the floodplain is currently designated FEMA Zone X, a classification which does not require flood insurance for loans, but which may still experience damage during some flood conditions. If the proposed project were not built, earth pads could still be feasibly constructed for individual development actions within the floodplain to reduce flood damage risk to the desired level. Thus, development within the floodplain could occur with or without the project, but at a potentially faster rate (and lower cost) with the project. Loss of habitat due to development near the historic Magpie Creek channel may be limited due to provisions of the *North Sacramento Community Plan Amendment: Magpie Creek Goals and Policies* (approved by City Council July 27, 1993) to establish and enhance a creek right of way, but this policy could be modified over the long-term and would not apply to wetlands outside the right-of-way provision. The largest component of seasonal wetlands is outside the right of way near Sunset Lawn Cemetary, and is currently zoned as agriculture. As reviewed in our May 2003 FWCA report, several recent development actions have already occurred in the floodplain in the absence of the flood control project and, to our knowledge, nearly all have been properly considered and compensated under the Service's Programmatic Consultations. Taken together, the flood zoning, protective local policies, and history of permit actions indicate that the effect of the project in terms of accelerated development is modest if at all, and that any related loss of habitat would likely be detected and compensated under the Corps' 404 permit administration.

We note, however, that this same risk of harm to habitat from development is substantially eliminated from the 76.5 acres of habitat in the preservation area. This preservation area includes a mosaic of two creeks, seasonal and permanent wetland types, and associated upland, and includes numerous vernal pools of which four occurrences of the listed vernal pool fairy shrimp have been documented. It is also adjacent to similar habitat within McClellan Business Park. In the Service's opinion, the preservation element of the proposed project offsets the particular net effect of inducing development growth in the floodplain, and the modest loss of upland near the MCDC. The Service expressly limits this finding to any growth-inducing effect of the flood control project only - not the actual loss of habitat or indirect effect near habitat due to future development action(s). Accordingly, consultation is required for any subsequent action, separate from the proposed project, involving take of a listed species in the historic Magpie Creek floodplain.

## CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed project are not considered in this section because they require separate consultation pursuant to section 7 of the Act, and, therefore, are not considered cumulative to the proposed project.

An undetermined number of future land use conversions and routine agricultural practices that are not subject to Federal authorization or funding may alter the habitat or increase incidental take of giant garter snake, vernal pool fairy shrimp, and vernal pool tadpole shrimp and are, therefore, cumulative to the proposed project.

Cumulative effects that apply to giant garter snake include: (1) unpredictable fluctuations in aquatic habitat due to water management; (2) dredging and clearing vegetation from irrigation canals; (3) discing, mowing, ornamental cultivation, and routine grounds maintenance of upland habitat; (4) increased vehicular traffic on access roads adjacent to aquatic habitat; (5) use of burrow fumigants on levees and other potential upland refugia; (6) contaminated runoff from agriculture and urbanization; (7) predation by feral animals and pets; (8) human intrusion into habitat; (9) diversion of water; and (10) rip-rapping or lining of canals and stream banks.

## CONCLUSION

After reviewing the current status of the giant garter snake, the environmental baseline, the effects of the proposed action, and any cumulative effects, it is the Service's biological opinion that the proposed project as described, with the proposed protection measures and habitat preservation/acquisition components, is not likely to jeopardize the continued existence of the giant garter snake. No critical habitat has been designated for this species, therefore, none will be affected.

## INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary for listed species in this opinion and must be implemented by the Corps so they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

## AMOUNT OR EXTENT OF INCIDENTAL TAKE

The Service anticipates incidental take of the snake will be difficult to detect or quantify for the following reasons: snakes are cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, and other cover. Individual snakes are difficult to detect unless they are observed, undisturbed at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that would be harassed, harmed, or killed during construction activities, including in staging areas, canal banks, soil burrow areas and roads carrying vehicular traffic to borrow areas. In instances where take is difficult to detect, the Service may estimate take in the form of numbers of a species per acre of habitat affected as a result of the action. The Service expects that all snakes in the 6.1 acres of upland habitat on the proposed project site may be harassed, harmed, or killed by loss and disturbance of habitat as a result of the proposed project. The proposed project may result in the death of one snake.

The Service authorizes the following forms of incidental take:

1. The number of giant garter snakes found in 4.7 acres of upland habitat will be disturbed, harassed, harmed, or killed by project activities resulting from temporary impacts due to use of heavy equipment and earthmoving activity near aquatic habitat. No more than one snake will be killed.

2. 1.4 acres of giant garter snake habitat would be permanently lost due to construction of new maintenance road on upland near aquatic habitat.

Upon implementation of the following reasonable and prudent measures, incidental take associated with the proposed project on the snake, in the form of harm, harassment, or death from habitat loss or direct mortality will become exempt from the prohibitions described under section 9 of the Endangered Species Act for direct and indirect effects.

## EFFECT OF THE TAKE

In the accompanying biological opinion, the Service has determined that the anticipated take is not likely to jeopardize the giant garter snake or destroy or adversely modify its critical habitat.

## REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of giant garter snakes.

1. The potential effects of the proposed project on the giant garter snake shall be minimized.

## TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. The terms and conditions are non-discretionary.

The following terms and conditions implement the reasonable and prudent measure:

1. Best Management Practices (BMPs) shall be implemented to prevent sediment from entering areas containing giant garter snake habitat including, but not limited to, silt fencing, temporary berms, no cleaning equipment in or near snake habitat, installation of vegetative strips, and temporary sediment disposal.

2. Project-related vehicles shall observe a 20-mph speed limit within construction areas, except on County rods, and State and Federal highways; this is particularly important during periods when the giant garter snake may be sunning or moving on roadways.

3. To eliminate attraction of predators of the snake, all food-related trash items such as wrappers, cans, bottles, and food scraps must be disposed of in closed containers and removed at least every other day from the entire project site.

4. Plastic monofilament netting (erosion control matting) or similar material shall not be used at the project because giant garter snakes may become entangled and trapped in it. Acceptable substitutes include conconut coir matting or takified hydroseeding.

5. After completion of construction activities, any temporary fill and construction debris shall be removed and the 4.7 acres of disturbed areas shall be restored to pre-project conditions. Project proponents will monitor the project site for one year following completion of construction and restoration of habitat. Monitoring

reports documenting the restoration effort shall be submitted to the Service upon completion of the restoration activity, and after one year. The monitoring reports shall include photo-documention when restoration was completed, what materials were used, specified plantings, and justification of any substitution to the Service-recommended guidelines (refer to Appendix A, Snake Programmatic Consultation, Mitigation Criteria for Restoration and/or Replacement of Giant Garter Snake Habitat, attached).

6. The Corps shall ensure compliance with the Reporting Requirements below.

## REPORTING REQUIREMENTS

The Service-approved biologist shall notify the Service immediately if giant garter snakes are found on site, and will submit a report including date(s), location(s), habitat description, and any corrective measures taken to protect the snake(s) found. The Service-approved biologist shall submit locality information to the California Department of Fish & Game (CDFG), using completed California Native Species Field Survey Forms or their equivalent, no more than 90 calendar days after completing the last field visit of the project site. Each form shall have an accompanying scale map of the site such as a photocopy of a portion of the appropriate 7.5 minute U.S. Geological Survey map and shall provide at least the following information: township, range, and quarter section; name of the 7.5' or 15' quadrangle; dates (day, month, year) of field work; number of individuals and life stage (where appropriate) encountered; and a description of the habitat by community-vegetation type.

A post-construction compliance report prepared by the Service-approved monitoring biologist shall be forwarded to the Chief, Endangered Species Division, at the Sacramento Fish and Wildlife Office within 60 calendar days of the completion of the project. This report shall detail: (i) dates that construction occurred; (ii) pertinent information concerning the applicant's success in meeting project mitigation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on federally listed species, if any; (v) occurrences of incidental take of federally listed species, if any; and (vi) other pertinent information.

The Corps shall also monitor specific execution of the proposed measures for protection in perpetuity of the preservation area provided in the project description, and obtain and submit documentation of property purchase, placement of flood easement, request of zoning change, and the decision pertaining to that request, to the Chief, Endangered Species Division, at the Sacramento Fish and Wildlife Office within 60 calendar days of the completion of the project.

The Sacramento Fish and Wildlife Office is to be notified within three working days of the finding of any dead listed species or any unanticipated harm to the species addressed in this biological opinion. The Service contact person for this is the Chief, Endangered Species Division at (916) 414-6600.

## CONSERVATION RECOMMENDATIONS

Section 7 (a) (1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's 7(a)(1) responsibilities for these species.

1. As a Recovery Plan for the giant garter snake is developed, the Corps should assist the Service in its implementation.

2. The Corps should incorporate into bidding documents the "Standard Avoidance and Minimization Measures for Construction Activities in Giant Garter Snake Habitat" provided in the Snake Programmatic Opinion, Appendix C, when appropriate.

3. The Corps, in partnership with the Service, should develop maintenance guidelines for the project that will reduce adverse effects of routine maintenance on giant garter snakes and their habitat. Such actions may contribute to the delisting and recovery of the giant garter snake by preventing degradation of existing habitat and increasing the amount and stability of suitable habitat.

4. The Corps should support and assist SAFCA with development of a habitat management plan for the preservation area element of this project with the goal of maximally protecting and enhancing habitat values for listed species, and overall habitat value of the two creeks, associated riparian, seasonal wetland, and upland habitats. Example actions of this type outlined in our May 2003 FWCA report include: a) modest replanting of native trees and shrubs at the top of creek banks, such as oak and elderberry, willow, cottonwood, or box elder; b) management of star thistle in conjunction with reseeding with native grasses and forbs; c) monitoring and management of beaver activity and damage to riparian trees; and d) potential realignment of Don Julio Creek west of Raley Boulevard to a more westerly alignment away from Raley (and with a reconstructed confluence with the MCDC), and revegetation of this reconstructed creek segment. Density and distribution of tree plantings should be such that they would establish with minimal or no irrigation, require no long term irrigation, and would not adversely affect listed vernal pool crustacean habitat.

5. The Corps should support and assist SAFCA with restoration of the historic section of Magpie Creek west of Raley Boulevard including: a) re-establishing flows through the reconstructed low-flow outlet from the MCDC to the historic creek (an element proposed as part of the flood control project action); and b) reconstructing the channel for sections that are now leveled or filled. These actions should be consistent with the North

Sacramento Community Plan Amendment: Magpie Creek Goals and Policies, reference number M92-071, but are recommended to be implemented in advance of that which would be required by the amendment. We especially encourage re-establishing oaks and elderberry, which are largely absent from this drainage, together with more common natives like cottonwood, willow or box elder, and reseeding with native grasses and forbs.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

This concludes formal consultation on the proposed Magpie Creek Flood Control Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. If you have any questions regarding this biological opinion for the Magpie Creek Flood Control Project, please contact Steven Schoenberg of my staff, at (916) 414-6564.

Sincerely,

Cliff Wagner

fn Kenneth D. Sanchez
Acting Field Supervisor

cc:
AES, Portland, OR
American River Flood Control District, Sacramento, CA (Attn: Paul Devereux)
CDFG, Rancho Cordova, CA
COE, Sacramento, CA (Attn: Ed Stewart)
EDAW, Sacramento, CA (Attn: Debra Bishop)
SAFCA, Sacramento, CA (Attn: Grant Kreinberg)

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APPENDIX A

## Guidelines for Restoration and/or Replacement of Giant Garter Snake Habitat

Replacement and Restoration Guidelines are provided together, as the two conservation measures may not be mutually exclusive. Replacement of habitat may also require restoration of some areas. Preserved habitat may additionally be improved for giant garter snake by using some of the restoration guidelines.

### Reference sites

A nearby reference site should be chosen both for restoration of giant garter snake habitat and for creation of replacement habitat. The reference site will be used to determine the success of conservation efforts. For restoration of habitat, the pre-project condition may be used as a reference site if adequate documentation exists. For creation of replacement habitat or for restoration where pre-project conditions are not documented, the reference site should be nearby or adjacent and should represent high quality giant garter snake habitat.

### Restoration of giant garter snake habitat

Restoration may include incorporating some of the Replacement guidelines to enhance habitat value for giant garter snake. Restoration should follow the guidelines outlined below:

1. Restoring giant garter snake habitat includes minimizing impacts of project activities to the existing habitat, including using silt fencing, designating environmentally sensitive areas, using protective mats, preventing runoff, and providing worker awareness training. Measures to minimize impacts include:

   a. Avoid construction activities within 200 feet from the banks of giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.

   b. Construction activity within habitat should be conducted between May 1 and October 1. This is the active period for giant garter snakes and direct mortality is lessened, because snakes are expected to actively move and avoid danger. Between October 2 and April 30 contact the Service's Sacramento Fish and Wildlife Office to determine if additional measures are necessary to minimize and avoid take.

   c. Confine clearing to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the project area as Environmentally Sensitive Areas. This area should be avoided by all construction personnel.

d. Construction personnel should receive Service-approved worker environmental awareness training. This training instructs workers to recognize giant garter snakes and its habitat(s).

e. 24-hours prior to construction activities, the project area should be surveyed for giant garter snakes. Survey of the project area should be repeated if a lapse in construction activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Report any sightings and any incidental take to the Service immediately by telephone at (916) 414-6600.

f. Any dewatered habitat should remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.

2. Remove all construction debris and stockpiled materials.

3. Regrade area to preexisting contour, or a contour that would improve restoration potential of the site.

4. Replant and hydroseed the restoration area. Recommended plantings consist of a) wetland emergents, b) low-growing cover on or adjacent to banks, and c) upland plantings/hydroseeding mix to encourage use by other wildlife. Riparian plantings are not appropriate because shading may result in lack of basking sites. Native plantings are encouraged except where non-natives will provide additional values to wildlife habitat and will not become invasive in native communities. The applicant should obtain cuttings, plantings, plugs, or seeds, from local sources wherever possible. The applicant should attempt to restore conditions similar to that of adjacent or nearby habitats.

a. Emergent wetland plants recommended for giant garter snake habitat are California bulrush (*Scirpus californicus*), cattail (*Typha* spp.), and water primrose (*Ludwigia peploides*). Additional wetland plantings may include common tule (*Scirpus acutus*), Baltic rush (*Juncus balticus*), or duckweed (*Lemna* spp.).

b. Cover species on or adjacent to the bank may include California blackberry (*Rubus vitifolius*) or wild grape (*Vitis californica*), along with the hydroseeding mix recommended below.

c. Upland plantings/hydroseeding mix: Disturbed soil surfaces such as levee slopes should be hydroseeded to prevent erosion. The Service recommends a mix of at least 20-40 percent native grass seeds [such as annual fescue (*Vulpia* spp.), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and needle grass (*Nassella* spp.)], 2-10 percent native forb seeds, five percent rose clover (*Trifolium hirtum*), and five percent alfalfa (*Medicago sativa*). Approximately 40-68 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. The Corps will not include endophyte-infected grasses in the mix. Mixes of one-hundred percent native grasses and forbs may also be used, and are encouraged.

**Replacement of giant garter snake habitat**

Location

Replacement location should be within the same population cluster boundaries (population clusters are defined in 58 **FR** 54053) as the habitat lost. For example: The boundaries of the Sacramento Basin population cluster are approximately, Highway 16 to the north, Sacramento River to the west, Twin Cities Road to the south, and the Folsom Aqueduct to the east. Habitat lost within this area must also be replaced within this area.

Habitat components

*Giant Garter Snake 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. For the purposes of this programmatic opinion, a basic giant garter snake habitat unit will incorporate 2.00 acres (0.81 hectares) of surrounding upland for every 1.00 acre (0.40 hectare) of aquatic habitat. The 2.00 acres (0.81 hectares) of upland also may be defined as 218 linear feet (66 meters) of bankside habitat which incorporates adjacent uplands to a width of 200 feet (61 meters) from the edge of the bank.

Replacement habitat must provide the above mentioned essential habitat components and include the following:

1. All replacement habitat must include both upland and aquatic habitat components. Upland and aquatic habitat components must be included in the replacement habitat at a ratio of 2:1 upland acres to aquatic acres

2. A semi-permanent or permanent aquatic habitat which provides water during the active period for giant garter snakes (April through October) with suitable vegetative cover present. Linear or meandering channels with slow flowing water over mud or silt substrate are preferred.

3. Upland basking and retreat sites with low growing vegetation cover adjacent to aquatic habitat, and upland retreats and flood refugia with partially buried broken concrete or animal burrows.

4. Small fish and amphibian larvae for foraging, but predatory "gamefish" (bass, *Micropterus* spp.; sunfish, *Lepomis* spp.; catfish, *Ictalurus* spp. and *Ameiurus* spp.) absent or controlled.

5. An adequate buffer (at least 200 feet) from roadways to reduce vehicular mortality.

6. Follow planting recommendation provided above under restoration guidelines.

**Monitoring**

Habitat restoration

Restoration of habitat should be monitored for one year following implementation. Monitoring reports documenting the restoration effort should be submitted to the Service: (1) upon completion of the restoration implementation; and (2) one year from restoration implementation. Monitoring reports should include photo documentation, when restoration was completed, what materials were used, plantings (if specified) and justification of any substitutions to the Service recommended guidelines. Monitoring reports should also include recommendations for remedial actions and approval from the Service, if necessary, and justification from release of any further monitoring, if requested.

Creation of replacement habitat

Replacement habitat should be monitored for 5 years following implementation. Hydrology should be monitored for the first two years after creation of wetlands. The monitoring effort should continue for three additional years to ensure success criteria are met. Monitoring reports documenting implementation of conservation measures should be submitted to the Service: (1) upon completion of wetland creation; (2) yearly for the first two years of monitoring; and (3) 5 years from implementation. Monitoring reports should include photo documentation, when restoration was completed, what materials were used, plantings (if specified) and justification of any substitutions to the Service recommended guidelines. Monitoring reports should also include recommendations for remedial actions and approval from the Service, if necessary, and justification from release of any further monitoring, if requested.

APPENDIX A

Success criteria for replacement habitat:

1. At completion of monitoring, the cover measured on the habitat area should be 90 percent of cover measured on the reference site.

2. At completion of monitoring, the species composition measured on the habitat area should be 90 percent of that measured on the reference site.

3. At completion of monitoring, wetlands created on the site should meet Corps jurisdictional criteria.

**Maintenance and management of replacement giant garter snake habitat**

1. A final management plan of replacement habitat must be approved by the Service.

2. All maintenance activities should follow Standard Avoidance and Minimization Measures During Construction Activities in Giant Garter Snake Habitat.

3. Additional guidance includes:

  a. Canal Maintenance - Hand clearing of canals is preferred for removal of excessive vegetation or debris. Any equipment should be operated from the bank top. Excavate from only one side of the canal during a given year. Avoid excavating the banks above the high water level. Preferably, one side of the canal should be left undisturbed indefinitely (the preferred side would be the west or north side) so that emergent vegetation and bank side cover is left in place.

  b. Place the spoils from canal clearing in a designated location, rather than along bank tops. This will prevent burying or crushing snakes basking on the banks, or trapping snakes taking cover in burrows or bank-top soil crevices.

  c. Vegetation control - Uplands should not be disced. Leave vegetation on levees and canal sides wherever possible. Mowing to control vegetation should take place July through September and mower blades should be raised at least six inches to avoid injuring snakes and to leave some grassy cover.

  d. Traffic - Control vehicle access to avoid vehicular mortality of giant garter snakes.

4. Use a water maintenance regime that will maintain some open water to provide vegetated edge for giant garter snake to forage along.

5. Eradicate/control non-natives and invasive exotics.

APPENDIX A

Compatible uses of giant garter snake replacement habitat:

Rice farming is a compatible land use for adjacent properties.

Uses of giant garter snake replacement habitat that are incompatible with the habitat of giant garter snake, or represent threats to giant garter snakes include row cropping on uplands, orchards on uplands, OHV (off-highway vehicle) use, and combining with riparian habitat creation which requires dense cover or SRA (shaded riverine aquatic) habitat.

APPENDIX C

## Standard Avoidance and Minimization Measures During Construction Activities in Giant Garter Snake (*Thamnophis gigas*) Habitat

HABITAT TYPE:

Marshes, sloughs, ponds, small lakes, low gradient streams, irrigation and drainage canals, and rice fields. Permanent aquatic habitat, or seasonally flooded during the snake's active season (early-spring through mid-fall), with herbaceous wetland vegetation, such as cattails and bulrushes, grassy banks (often salt grass), and uplands for cover and retreat sites during the snake's active season and for refuge from flood waters during the dormant season (winter). Giant garter snakes are typically absent from larger rivers because of lack of suitable habitat, and from wetlands with sand, gravel, or rock substrates. Some riparian woodlands may not provide suitable habitat because of excessive shade, lack of basking sites, and absence of giant garter snake prey.

AVOIDANCE AND MINIMIZATION MEASURES:

1. Avoid construction activities within 200 feet from the banks of giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.

2. Construction activity within habitat should be conducted between May 1 and October 1. This is the active period for giant garter snakes and direct mortality is lessened, because snakes are expected to actively move and avoid danger. Between October 2 and April 30 contact the Service's Sacramento Fish and Wildlife Office to determine if additional measures are necessary to minimize and avoid take.

3. Confine clearing to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the project area as Environmentally Sensitive Areas. This area should be avoided by all construction personnel.

4. Construction personnel should receive Service-approved worker environmental awareness training. This training instructs workers to recognize giant garter snakes and their habitat(s).

5. 24-hours prior to construction activities, the project area should be surveyed for giant garter snakes. Survey of the project area should be repeated if a lapse in construction activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been

completed or it has been determined that the snake will not be harmed. Report any sightings and any incidental take to the Service immediately by telephone at (916) 414-6600.

6. Any dewatered habitat should remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.

7. After completion of construction activities, remove any temporary fill and construction debris and, wherever feasible, restore disturbed areas to pre-project conditions. Restoration work may include such activities as replanting species removed from banks or replanting emergent vegetation in the active channel.

8. Follow the conservation measures in Table 1 to minimize the effects of loss and disturbance of habitat on giant garter snakes. Replacement ratios are based on the acreage and on the duration of disturbance.

**TABLE 1 - SUMMARY OF GIANT GARTER SNAKE CONSERVATION MEASURES**

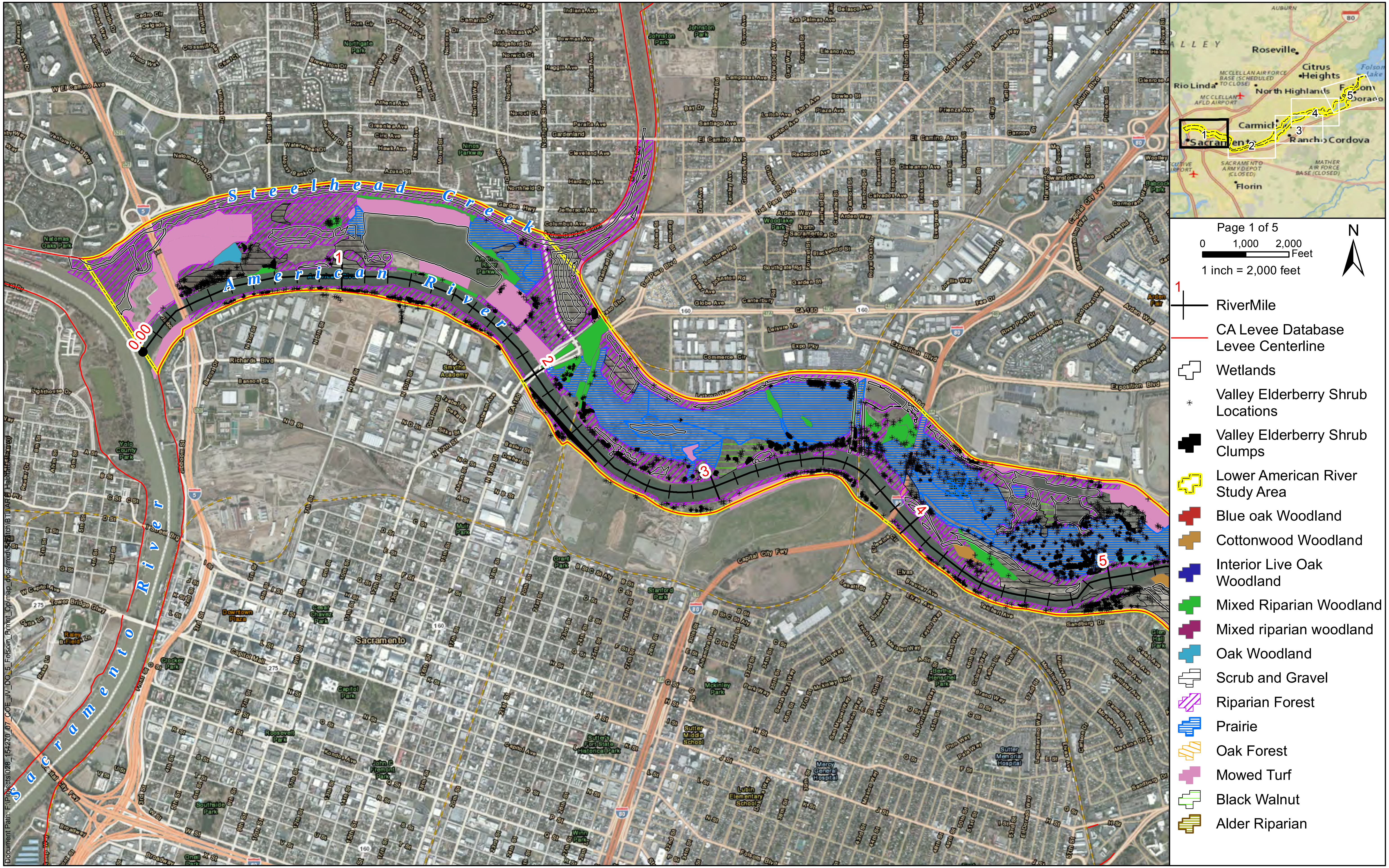
| | **IMPACTS:** DURATION | **IMPACTS:** ACRES | **CONSERVATION MEASURE:** COMPENSATION |
|---|---|---|---|
| **LEVEL 1** | 1 season | Less than 20 and temporary | Restoration |
| **LEVEL 2** | 2 seasons | Less than 20 and temporary | Restoration plus 1:1 replacement |
| **LEVEL 3** | More than 2 seasons and temporary | Less than 20 and temporary | 3:1 Replacement (or restoration plus 2:1 replacement) |
| | Permanent loss | Less than 3 acres total giant garter snake habitat AND Less than 1 acre aquatic habitat; OR Less than 218 linear feet bank habitat | 3:1 Replacement |

Giant garter snake habitat includes 2.0 acres of surrounding upland habitat for every 1.0 acre of aquatic habitat. The 2.0 acres of upland habitat also may be defined as 218 linear feet of bankside habitat which incorporates adjacent uplands to a width of 200 feet from the edge of each bank. Each acre of created aquatic habitat should be supported by two acres of surrounding upland habitat. Compensation may include creating upland refuges and hibernacula for the giant garter snake that are above the 100-year flood plain.

A season is defined as the calendar year period between May 1 and October 1, the active period for giant garter snake when mortality is less likely to occur.

# Appendix F

# American River Parkway Habitat Maps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Mixed Riparian Woodland
Mixed riparian woodland
Oak Woodland
Scrub and Gravel
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Prairie
Oak Forest
Mowed Turf
Black Walnut
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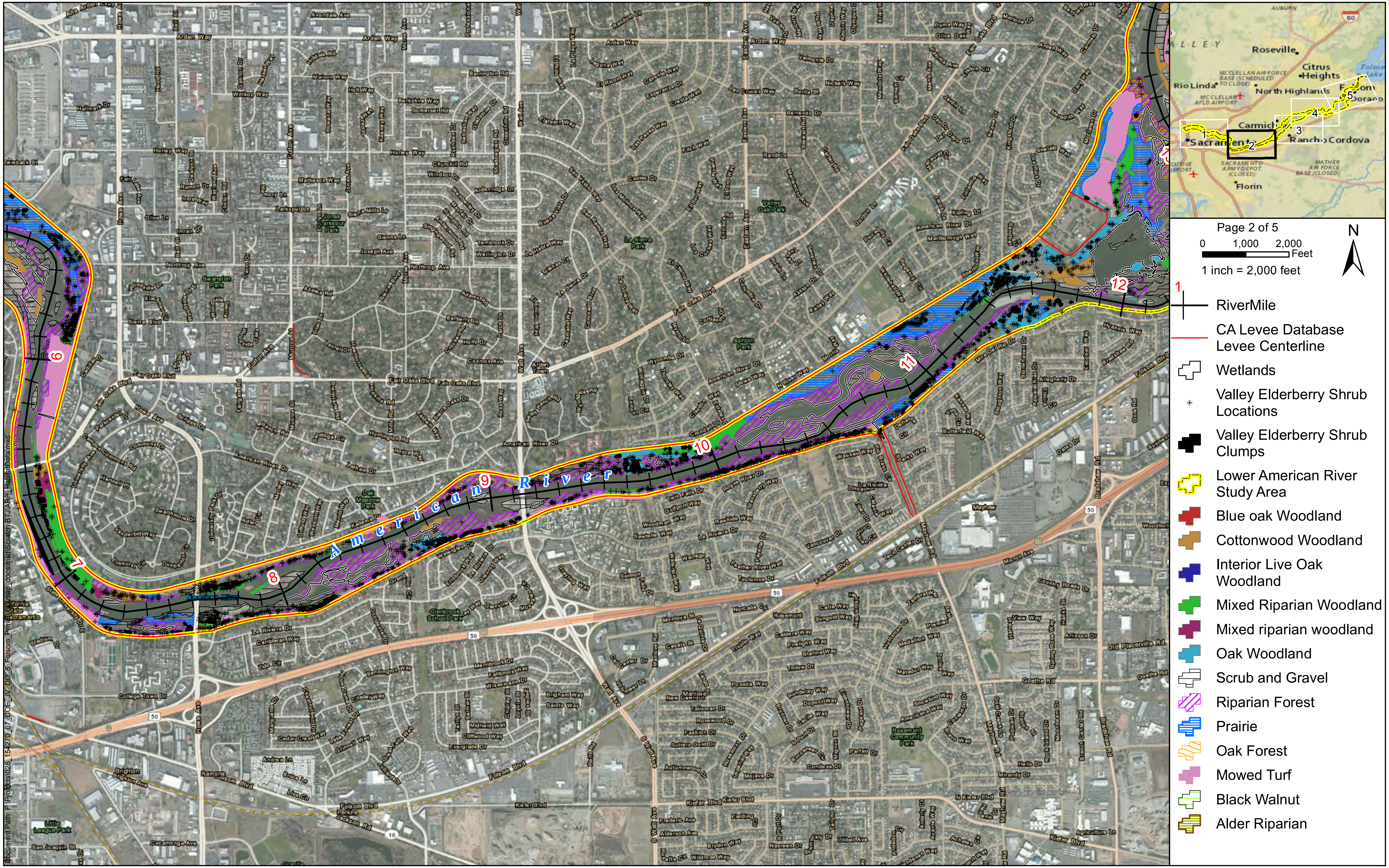
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Interior Live Oak Woodland
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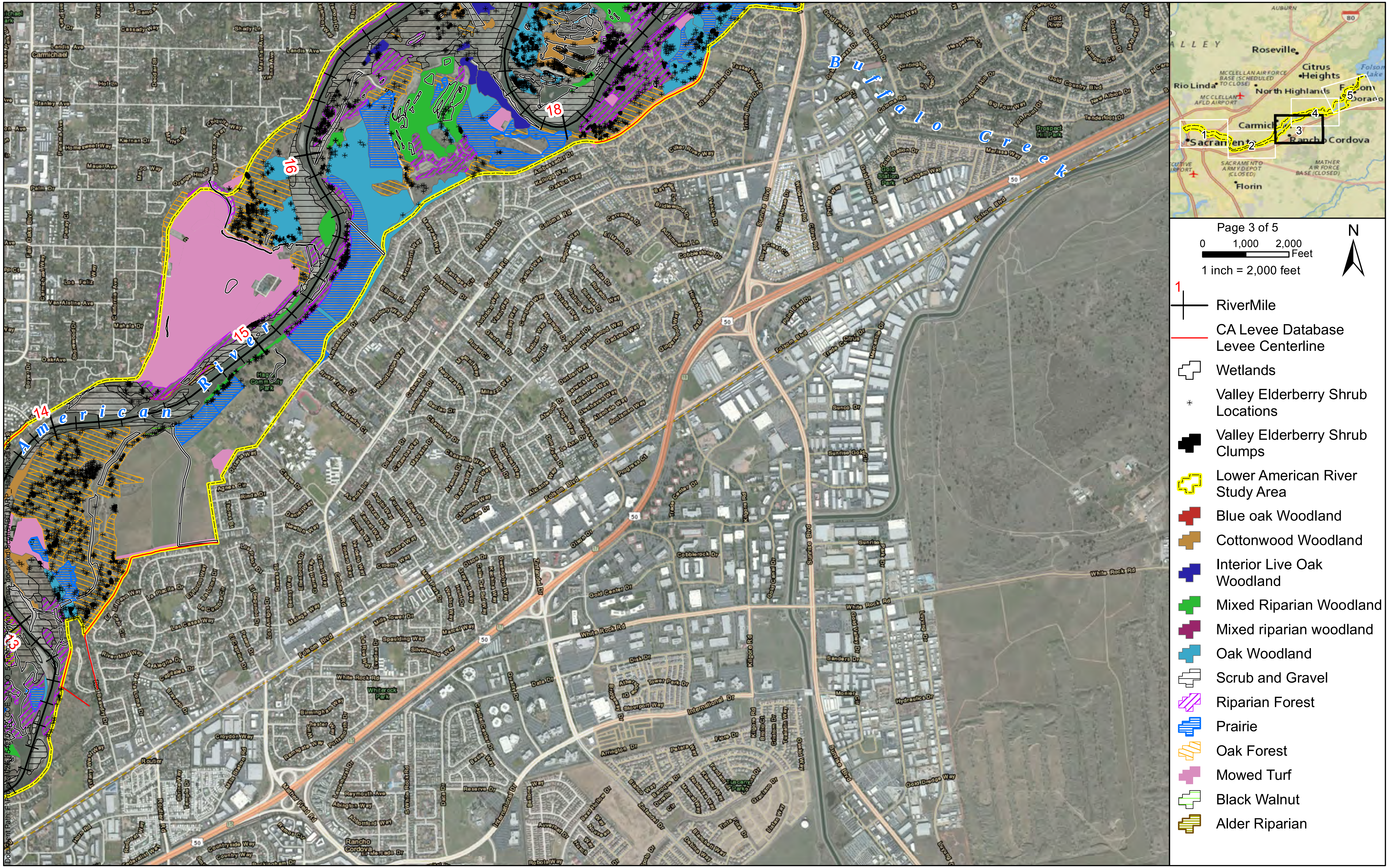
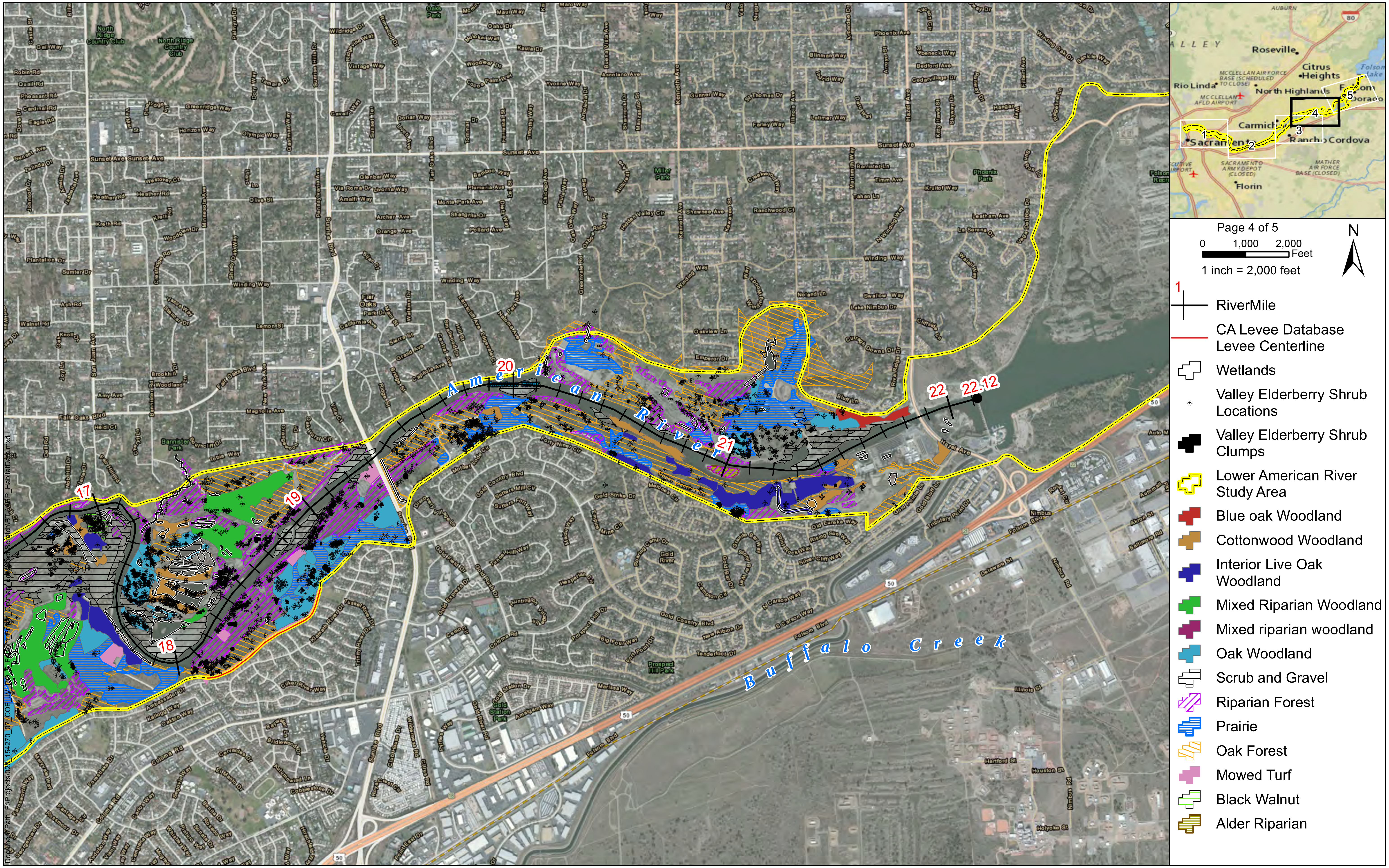
Scrub and Gravel
Riparian Forest
Prairie
Oak Forest
Mowed Turf
Black Walnut
Alder Riparian



American River
Buffalo Creek
14
15
16
18
Page 3 of 5
0 1,000 2,000 Feet
1 inch = 2,000 feet
N
RiverMile
CA Levee Database Levee Centerline
Wetlands
Valley Elderberry Shrub Locations
Valley Elderberry Shrub Clumps
Lower American River Study Area
Blue oak Woodland
Cottonwood Woodland
Interior Live Oak Woodland
Mixed Riparian Woodland
Mixed riparian woodland
Oak Woodland
Scrub and Gravel
Riparian Forest
Prairie
Oak Forest
Mowed Turf
Black Walnut
Alder Riparian
Roseville
Citrus Heights
Rio Linda
North Highlands
Sacramento
Rancho Cordova
Florin


American River
Buffalo Creek
17
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Page 4 of 5
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Feet
1 inch = 2,000 feet
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CA Levee Database Levee Centerline
Wetlands
Valley Elderberry Shrub Locations
Valley Elderberry Shrub Clumps
Lower American River Study Area
Blue oak Woodland
Cottonwood Woodland
Interior Live Oak Woodland
Mixed Riparian Woodland
Mixed riparian woodland
Oak Woodland
Scrub and Gravel
Riparian Forest
Prairie
Oak Forest
Mowed Turf
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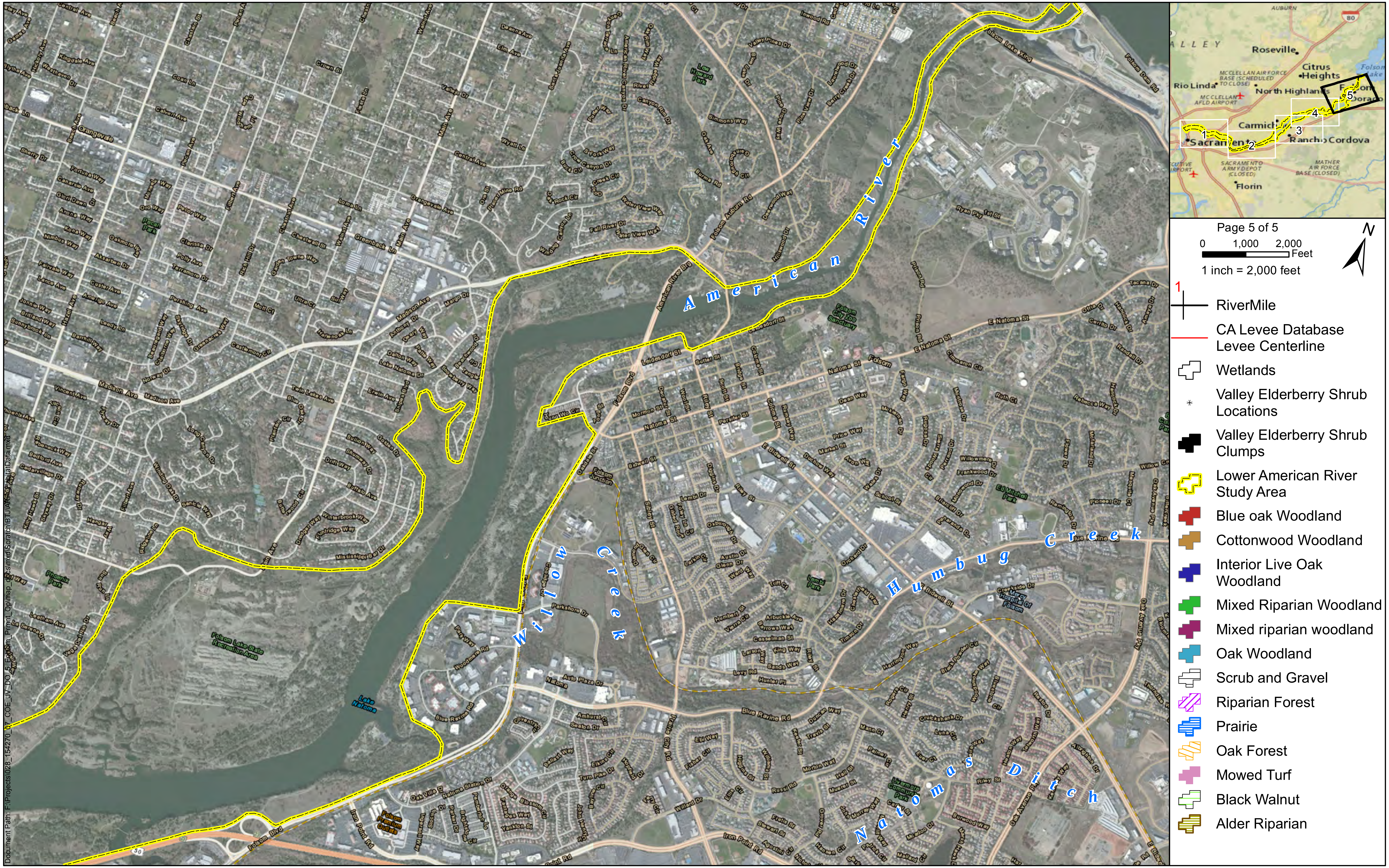
Alder Riparian
Roseville
Citrus Heights
Rio Linda
North Highlands
Carmichael
Rancho Cordova
Florin


American River
Willow Creek
Humbug Creek
Natomas Ditch
Roseville
Citrus Heights
Rio Linda
North Highlands
Carmichael
Sacramento
Rancho Cordova
Florin
Page 5 of 5
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1 inch = 2,000 feet
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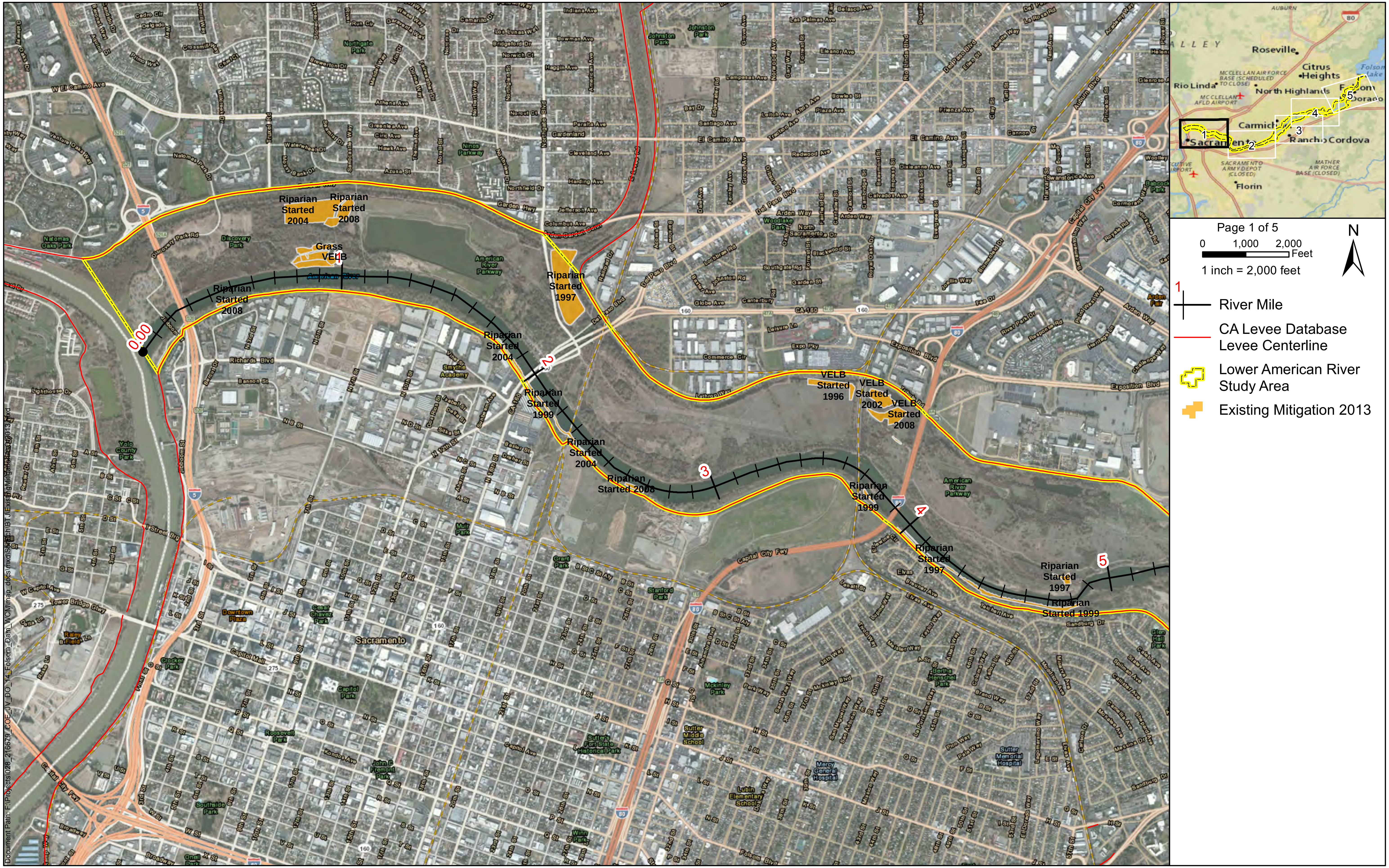
RiverMile
CA Levee Database Levee Centerline
Wetlands
Valley Elderberry Shrub Locations
Valley Elderberry Shrub Clumps
Lower American River Study Area
Blue oak Woodland
Cottonwood Woodland
Interior Live Oak Woodland
Mixed Riparian Woodland
Mixed riparian woodland
Oak Woodland
Scrub and Gravel
Riparian Forest
Prairie
Oak Forest
Mowed Turf
Black Walnut
Alder Riparian

# Appendix G

# Existing VELB Mitigation Sites in the American River Parkway



Page 1 of 5
0 1,000 2,000 Feet
1 inch = 2,000 feet
N
River Mile
CA Levee Database Levee Centerline
Lower American River Study Area
Existing Mitigation 2013
Riparian Started 2004
Riparian Started 2008
Grass VELB
Riparian Started 2008
Riparian Started 1997
Riparian Started 2004
Riparian Started 1999
Riparian Started 2004
Riparian Started 2008
VELB Started 1996
VELB Started 2002
VELB Started 2008
Riparian Started 1999
Riparian Started 1997
Riparian Started 1997
Riparian Started 1999
0.00
1
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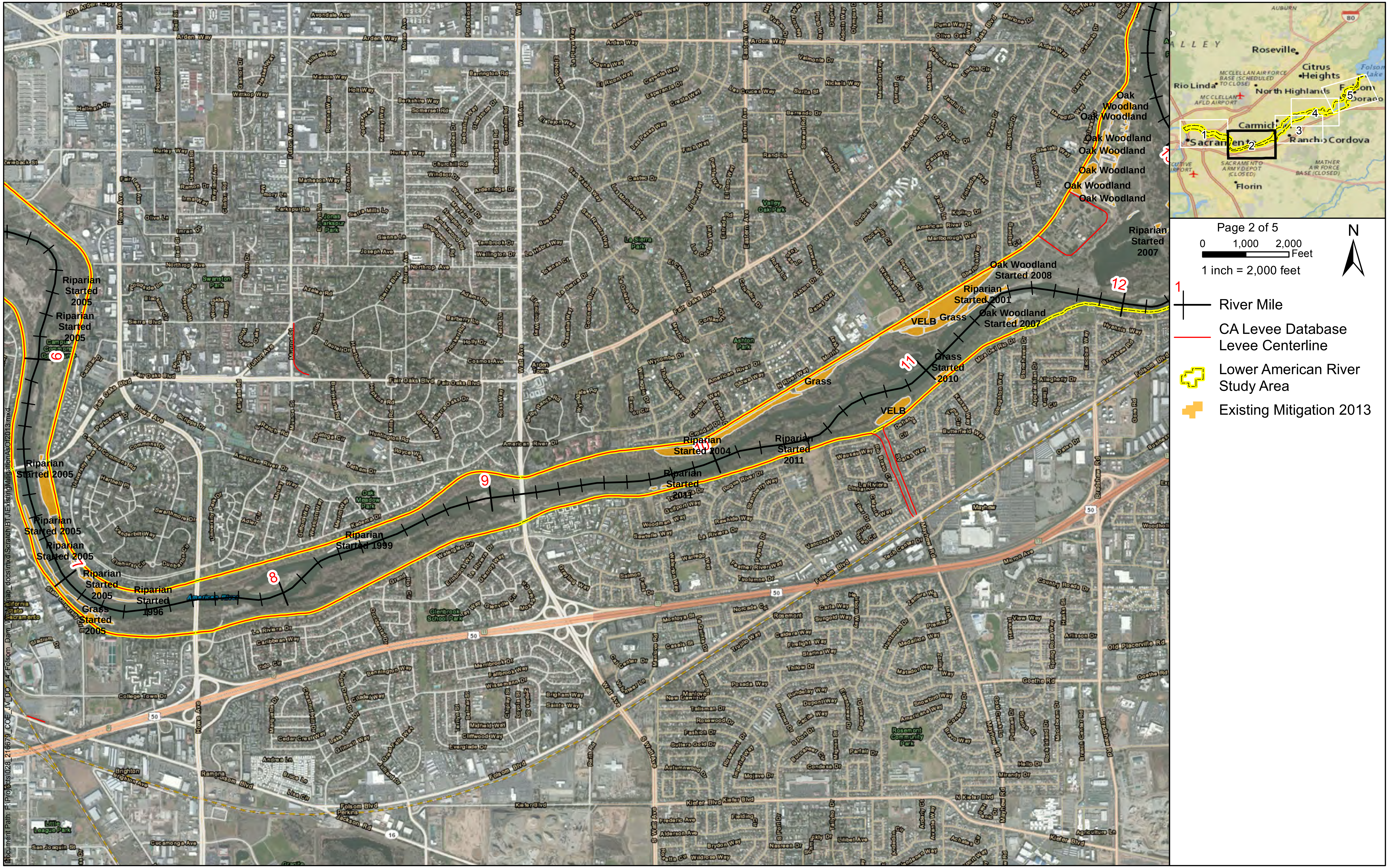
5
Sacramento
Roseville
Citrus Heights
Rio Linda
North Highlands
Carmichael
Rancho Cordova
Florin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0 1,000 2,000 Feet
1 inch = 2,000 feet
N
River Mile
CA Levee Database Levee Centerline
Lower American River Study Area
Existing Mitigation 2013
Roseville
Citrus Heights
Rio Linda
North Highlands
Folsom
Carmichael
Sacramento
Rancho Cordova
Florin
Oak Woodland
Oak Woodland Started 2008
Riparian Started 2001
VELB
Grass
Oak Woodland Started 2007
Riparian Started 2007
Grass Started 2010
VELB
Grass
Riparian Started 2004
Riparian Started 2011
Riparian Started 2011
Riparian Started 1999
Riparian Started 1996
Riparian Started 2005
Grass Started 2005
Riparian Started 2005
8
9
10
11
12
6
7
American River Dr
Fair Oaks Blvd
Watt Ave
Arden Way
Folsom Blvd


Riparian
Started 2007
Oak Woodland
Riparian
Started
2007
Riparian
Started
2007
VELB
Started
1988
Oak
Woodland
Oak Woodland
Started 1999
Oak Woodland
Started 2009
18
Oak
Woodland
Oak Woodland
Started 1988
16
Oak Woodland
Started 2009
Riparian
Started
2007
Oak Woodland
Started 2009
Oak Woodland
Started 2009
15
Riparian
Started 2007
14
VELB
Oak
Woodland
VELB
Started
2007
VELB
Oak
Woodland
VELB
Oak
Woodland
13
Riparian
Started 2007
Riparian
Started
2007
Roseville
Citrus
Heights
Rio Linda
North Highlands
Folsom
Carmichael
Sacramento
Rancho Cordova
Florin
Page 3 of 5
0 1,000 2,000
Feet
1 inch = 2,000 feet
N
River Mile
CA Levee Database
Levee Centerline
Lower American River
Study Area
Existing Mitigation 2013


Page 4 of 5
0 1,000 2,000 Feet
1 inch = 2,000 feet
N
River Mile
CA Levee Database Levee Centerline
Lower American River Study Area
Existing Mitigation 2013
Roseville
Citrus Heights
Rio Linda
North Highlands
Carmichael
Rancho Cordova
Sacramento
Florin
17
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21
22
22.12
Riparian Started 2007
Riparian Started 2007
Riparian Started 2007
Oak Woodland Started 1999
Oak Woodland Started 2009
Oak Woodland Started 1988
Oak Woodland
VELB Started 1988
Oak Woodland
VELB Started 1988
Oak Woodland
Oak Woodland
Oak Woodland
Riparian Started 2009
VELB Started 1988
VELB Started 2007
VELB Started 2007
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Oak Woodland
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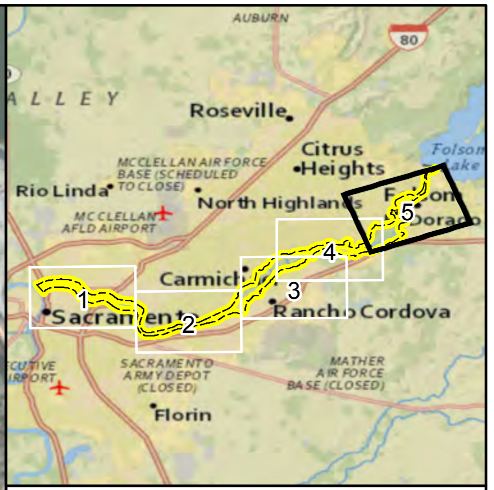
Riparian Started 1988
Sunset Ave
Fair Oaks Blvd
Folsom Blvd
50






0 1,000 2,000 Feet

1 inch = 2,000 feet

N

1 River Mile

CA Levee Database Levee Centerline

Lower American River Study Area

Existing Mitigation 2013