

Yuba River

Ecosystem Restoration Feasibility Study California

Final Interim Feasibility Report & Environmental Assessment

January 2019



**US Army Corps
of Engineers®**
Sacramento District

Cover Photo courtesy of the Sacramento District:

Yuba River at the Goldfields

Photos Below:

Downy Woodpecker, Spring –run Chinook Salmon, Yellow-billed Cuckoo





DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

FINDING OF NO SIGNIFICANT IMPACT
YUBA RIVER ECOSYSTEM RESTORATION PROJECT
YUBA COUNTY, CALIFORNIA

The U.S. Army Corps of Engineers, Sacramento District, has conducted an environmental analysis in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended. I determined that implementing the proposed Yuba River Ecosystem Restoration Project would have no significant effects on the quality of the human environment.

The Proposed Action, as described in the Interim Feasibility Report/Environmental Assessment (FR/EA), incorporated herein by reference, includes 179 acres of habitat restoration along the lower Yuba River consisting of: (1) restoration of 43 acres of aquatic habitat, including side channels, backwater areas, bank scallops; and (2) restoration of 136 acres of riparian habitat, including floodplain lowering and grading and riparian vegetation plantings. The possible consequences of the work described in the FR/EA have been studied with consideration given to environmental, cultural, social, and engineering feasibility. The views of other interested agencies, organizations, and individuals have also been considered.

In evaluating the effects of the proposed action, specific attention has been given to any environmental conditions that could potentially be affected. The FR/EA evaluated in detail effects to Air Quality, Climate Change, Aesthetics, Hydrology and Hydraulics, Vegetation and Wildlife, Special Status Species, Water Quality, Transportation, Recreation, Cultural Resources, and Noise. The potential effects to these resources are summarized below. All construction would be implemented in compliance with applicable Federal laws, regulations and executive orders. Best management practices (BMPs) and avoidance and minimization measures identified within the FR/EA would be implemented. The Proposed Action would not result in significant adverse effects to the environment.

Air Quality – The Proposed Action would result in short-term construction-related emissions due to construction activities. Construction criteria pollutant emissions would be substantially less than, and would not exceed *de minimis* conformity thresholds. Potential effects to air quality would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.1.3). The Proposed Action would not result in significant adverse impacts to air quality.

Climate Change – The Proposed Action would result in short-term construction-related emissions of greenhouse gases (GHG) due to construction activities. Construction GHG emissions would be substantially less than the Federal reporting threshold. Potential effects to climate change would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.2.3). The Proposed Action would result in long term net sequestration of carbon through the planting and establishment of riparian vegetation. The Proposed Action would not result in significant adverse impacts to climate change.

Aesthetics – The Proposed Action would result in short-term and localized impacts to visual resources due to construction activities. Construction related impacts to visual resources would be restricted to periods of construction and would be consistent with typical active mining activities in the project area. Potential effects to visual resources would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.3.3). The Proposed Action would not result in significant adverse impacts to visual resources.

Hydrology and Hydraulics – The Proposed Action would result in localized changes to hydrology and hydraulics due to modification of the near bank and floodplain to create proposed habitat features. These changes would not result in changes to the macro-scale hydrologic and hydraulic processes in the project area, such as watershed level inflow of water, upstream or downstream movement of surface water, or movement of groundwater. The Proposed Action would not result in significant adverse impacts to the hydrology and hydraulics of the project area.

Vegetation and Wildlife – The Proposed Action would result in short-term impacts to vegetation and wildlife due to construction activities. Potential effects to vegetation and wildlife include the short term construction related disturbance or removal of habitat; however, project actions would result in a significant, long-term improvement to the quantity, quality, and connectivity between riverine and riparian habitats upon which the vegetation and wildlife communities in the Yuba River watershed depend. Coordination with the U.S. Fish and Wildlife Service on the proposed action was conducted under the Fish and Wildlife Coordination Act (Environmental Appendix D – Attachment 4). The Proposed Project would incorporate all recommendations in the Coordination Act Report to the greatest extent possible (Section 6.1). Potential impacts to vegetation and wildlife would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.5.3). The Proposed Action would not result in significant adverse impacts to vegetation and wildlife resources.

Special Status Species – The Proposed Action would result in short-term impacts to special status species due to construction activities. Informal coordination with the U.S. Fish and Wildlife Service was conducted under Section 7 of the Endangered Species Act evaluating the project's potential effects on the Western Yellow-billed Cuckoo, California Red-legged Frog, and Valley Elderberry Longhorn Beetle. In a letter dated 2 August 2018, the U.S. Fish and Wildlife Service concurred that implementation of the proposed action may affect, but is not likely to adversely affect, species protected under the Endangered Species Act or their critical habitat (Environmental Appendix D – Attachment 2). Coordination with the National Marine Fisheries Service (NMFS) was conducted under Section 7 of the Endangered Species Act, evaluating the project's potential effects on the Central Valley spring-run Chinook salmon, Central Valley steelhead, and southern distinct population segment green sturgeon; and under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) evaluating the project's potential effects to Essential Fish Habitat (EFH) for Pacific coast salmon. NMFS issued a Biological Opinion, dated 18 October 2018, including recommendations under the MSA, concurring that implementation of the proposed action would not jeopardize species protected under the Endangered Species Act or adversely modify their critical habitat (Environmental Appendix D – Attachment 1). Potential impacts to special status species would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.6.3). The Proposed Action would not result in significant adverse impacts to special status species.

Water Quality – The Proposed Action would result in short-term construction-related impacts to water quality due to construction activities. Construction related increases in sedimentation and turbidity would be temporary and localized. Potential effects to water quality would be reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.7.3). In a letter dated 2 October 2018, the Central Valley Regional Water Quality Control Board (CVRWQCB) indicated its support for the project and acknowledges the need for the project to obtain a Water Quality Certification 401 permit prior to construction during the preconstruction engineering and design phase of the project (Environmental Appendix D – Attachment 5). The Proposed Action would not result in significant adverse impacts to water quality.

Transportation – The Proposed Action would result in short-term impacts to transportation resources due to construction activities. Construction related increases to traffic from the Proposed Action would not exceed level of service thresholds for roadways in the project area. Potential effects to transportation resources would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.8.3). The Proposed Action would not result in significant adverse impacts to transportation resources.

Recreation – The Proposed Action would not result in short-term impacts to recreation due to construction activities. Potential effects to recreational resources would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.9.3). The Proposed Action would not result in significant adverse impacts to recreational resources.

Cultural Resources – The full extent of culturally significant and historic resources in the project area is unknown. Most of the known sites in the project area have not been assessed for eligibility for listing on the National Register of Historic Places. Potential effects to cultural and historic resources would be reduced to a less than significant level through execution of a Programmatic Agreement (Cultural Resources Appendix B). The Programmatic Agreement has been coordinated with the California State Historic Preservation Officer, the Advisory Council on Historic Preservation, tribes, and other interested parties and includes the processes for addressing potential effects to known and unknown historic properties. Through the execution of the Programmatic Agreement and adherence to processes described therein, the Proposed Action would not result in significant adverse impacts to cultural or historic resources.

Noise – The Proposed Action would result in short-term construction-related noise related primarily to the use of heavy equipment during the grading, excavation, hauling, and placement of features. However, the noise associated with the construction activities is permissible under Yuba County's Ordinance Code. Potential effects to the acoustic environment would be further reduced through implementation of BMPs and avoidance and minimization measures (Section 4.3.11.3). The Proposed Action would not result in significant adverse impacts to the acoustic environment.

Based upon my review of the FR/EA, it is my determination that the proposed project would have no significant effects on environmental, social, or cultural resources. Based on these considerations, it is my determination that the proposed project does not significantly affect the human environment. Therefore, preparation of an Environmental Impact Statement is not required.

Date

DAVID G. RAY, P.E.
COL, EN
COMMANDING

Table of Contents

Executive Summary	ES-1
ES.1 Introduction.....	ES-1
ES.2 Project Background.....	ES-1
ES.3 Study Authority.....	ES-3
ES.4 Need for Action.....	ES-4
ES.5 Consideration of Alternative Plans	ES-5
ES.6 Actions Subsequent to Public Review of the Draft FR/EA	ES-7
ES.7 Recommended Plan	ES-7
ES.8 Environmental Effects	ES-13
ES.9 Estimated Cost and Cost Sharing.....	ES-13
ES.10 Potential Future Studies	ES-14
Chapter 1 – Introduction	1
1.1 Purpose and Need for the Study	1
1.2 Study Authority	4
1.3 Study Area Location.....	4
1.4 Study Sponsor and Participants	4
1.5 Existing Projects, Studies, and Programs	7
1.5.1 Projects	7
1.5.2 Studies	12
1.5.3 Programs.....	14
1.6 Public and Agency Scoping.....	16
1.7 Report Organization	18
Chapter 2 – Need for Action	19
2.1 Purpose and Need for the Action.....	19
2.1.1 Resource Significance Overview	19
2.2 Problems and Opportunities	20
2.2.1 Problems.....	20
2.2.2 Opportunities	22
2.3 Federal and Non-Federal Objectives	22

2.4 Planning Goals and Objectives	22
2.5 Planning Constraints	23
2.6 Planning Considerations	24
Chapter 3 – Alternative Plans.....	25
3.1 Plan Formulation Process	25
3.2 Planning Criteria.....	25
3.3 Future Without-Project Conditions	26
3.4 Identification and Screening of Measures	30
3.4.1 Plan Formulation Rationale.....	30
3.4.2 Description of Initial Measures	30
3.4.3 Screening of Initial Measures.....	36
3.4.4 Screening Results	49
3.4.5 Unresolved Ecological Problem.....	51
3.5 Habitat Increment Features.....	51
3.6 Evaluation of Habitat Increments	53
3.7 Formulation of Final Array of Alternatives.....	54
3.8 Comparison of Alternatives.....	55
3.9 <i>Principles and Guidelines</i> Accounts and Evaluation Criteria	58
3.10 Recommended Plan	60
Chapter 4 – Affected Environment and Environmental Consequences	66
4.1 NEPA Alternatives	66
4.1.1 Alternatives Considered in Detail	66
4.1.2 Alternatives Not Considered in Detail	82
4.2 Resources Not Considered In Detail	83
4.2.1 Geology and Seismicity	83
4.2.2 Socioeconomics and Environmental Justice	84
4.2.3 Land Use and Agriculture	84
4.2.4 Hazardous, Toxic, and Radiological Waste	85
4.3 Resources Considered in Detail.....	85
4.3.1 Air Quality.....	85
4.3.2 Climate Change	95
4.3.3 Aesthetics.....	104

4.3.4 Hydrology and Hydraulics.....	107
4.3.5 Vegetation and Wildlife	114
4.3.6 Special Status Species	121
4.3.7 Water Quality	144
4.3.8 Transportation.....	153
4.3.9 Recreation.....	158
4.3.10 Cultural Resources.....	160
4.3.11 Noise.....	166
Chapter 5 - Cumulative Impacts	174
5.1 Methodology and Geographic Scope of the Analysis	174
5.1.1 Methodology	174
5.1.2 Geographic and Temporal Scope	174
5.2 Past, Present, and Reasonably Foreseeable Future Projects	175
5.3 Cumulative Impacts Analysis	175
5.3.1 Air Quality.....	175
5.3.2 Climate Change	175
5.3.3 Aesthetics	175
5.3.4 Hydrology and Hydraulics	178
5.3.5 Vegetation and Wildlife	178
5.3.6 Special Status Species	179
5.3.7 Water Quality	179
5.3.8 Transportation	180
5.3.9 Recreation.....	180
5.3.10 Cultural Resources	180
5.3.11 Noise.....	181
Chapter 6 – Compliance with Applicable Laws and Regulations	182
6.1 Federal Laws.....	182
6.2 Executive Orders	189
Chapter 7 – Public Agency Involvement and Review.....	191
7.1 List of Agencies and Persons Consulted	191
7.2 Public Meetings and Workshops	192
7.3 Scoping Comments.....	192

7.4 Public Review and Comments on the Draft Feasibility Report/ Environmental Assessment	193
Chapter 8 – Recommended Plan	196
8.1 Recommended Plan	196
8.1.1 Features and Accomplishments.....	196
8.1.2 Federal Interest.....	205
8.1.3 Monitoring and Adaptive Management	210
8.1.4 Operation, Maintenance, Repair, Replacement, and Rehabilitation	210
8.1.5 Real Estate.....	212
8.1.6 Plan Economics	212
8.1.7 Cost Sharing	213
8.1.8 Risk and Uncertainty	214
8.2 Plan Implementation.....	216
8.2.1 Report Completion and Approval	216
8.2.3 Project Authorization and Construction.....	216
8.2.4 Division of Responsibilities	217
8.2.5 Schedule	217
8.2.6 Further Analysis During the Design Phase	218
Chapter 9 – Recommendations.....	220
Chapter 10 – List of Preparers	224
Chapter 11 – References.....	226

FIGURES

Figure ES-1. Yuba River Watershed.	ES-2
Figure ES-2a. Recommended Plan.	ES-9
Figure ES-2b. Recommended Plan continued.	ES-10
Figure ES-2c. Recommended Plan continued.	ES-11
Figure ES-2d. Recommended Plan continued.	ES-12
Figure 1-1. Hydraulic miner operates a water cannon.	2
Figure 1-2. Malakoff Mine, Nevada County, Yuba River Watershed.	2
Figure 1-3. The Yuba River flows through the Yuba Goldfields.	3
Figure 1-4. Sacramento River Basin.	5
Figure 1-5. Yuba River Watershed.	6
Figure 1-6. Daguerre Point Dam.	8
Figure 1-7. Englebright Dam.	9
Figure 1-8. New Bullards Bar Dam.	11
Figure 3-1. Proposed levees in the Yuba Goldfields.	28
Figure 3-2. Habitat Increments eliminated from the study.	50
Figure 3-3. Incremental Costs and Outputs of Alternatives.	58
Figure 3-4a. Recommended Plan.	62
Figure 3-4b. Recommended Plan continued.	63
Figure 3-4c. Recommended Plan continued.	64
Figure 3-4d. Recommended Plan continued.	65
Figure 4-1. Habitat Increment 2.	69
Figure 4-2. Habitat Increment 3a.	71
Figure 4-3. Habitat Increment 5a.	73
Figure 4-4. Habitat Increment 5b.	75
Figure 4-5. Habitat Increment 1.	81
Figure 8-1-1. Recommended Plan.	198
Figure 8-1-2. Recommended Plan continued.	199
Figure 8-1-3. Recommended Plan continued.	200
Figure 8-1-4. Recommended Plan continued.	201
Figure 8-2. Yuba River Ecosystem Restoration RP and AFRP Measures.	203

TABLES

Table ES-1. Initial management measures and planning objectives.....	ES-5
Table ES-2. Estimated Costs of Recommended Plan.	ES-14
Table 1-1. USACE Planning and NEPA Process	17
Table 3-1. Initial Measures to Achieve Study Objectives.	31
Table 3-2. Cost Ranking.	37
Table 3-3. Quantity Ranking.....	38
Table 3-4. Quality Ranking.....	43
Table 3-5. Efficiency of Measures.....	44
Table 3-6. Risk Ranking.	47
Table 3-7. Screening Results.	48
Table 3-8. Habitat Increments.....	50
Table 3-9. Incremental Costs and Outputs of Alternatives.....	57
Table 3-10. P&G Accounts Comparison of Alternative Plans.	59
Table 3-11. P&G Evaluation Criteria Comparison of Alternative Plans.	60
Table 4-1. Summary of Project Features for Alternative 5 - Recommended Plan	67
Table 4-2. Habitat Increment 2 Details.....	69
Table 4-3. Habitat Increment 3a Details.	72
Table 4-4. Habitat Increment 5a Details.	73
Table 4-5. Habitat Increment 5b Details.....	75
Table 4-6. Riparian Planting Palette.	76
Table 4-7. Construction Sequencing.....	79
Table 4-8. Summary of Project Features for Alternative 6.....	80
Table 4-9. Habitat Increment 1 details.....	81
Table 4-10. State and Federal Ambient Air Quality Standards	87
Table 4-11. Summary of Air Quality Monitoring Data in Yuba County (2008-2015). ¹ .	88
Table 4-12. General Conformity Applicability Rates.....	92
Table 4-13. Emission Rates for Criteria Pollutants in Nonattainment Areas.	92
Table 4-14. Estimated Emissions from Alternative 5.....	94
Table 4-15. Estimated Emissions from Alternative 6.....	94
Table 4-16. Global, National, State, and Local GHG Emissions Inventories.	100

Table 4-17. Estimated GHG Emissions from Alternative 5.	103
Table 4-18. Estimated GHG Emissions from Alternative 6.	104
Table 4-20. Major dams in the Yuba River Watershed (CBEC 2010).	109
Table 4-21. Peak Discharge vs Annual Chance of Exceedance Estimates, USGS Gage Yuba River near Marysville, from USACE (2015).	111
Table 4-22. Estimates of Existing Cover of Riparian Vegetation	115
Table 4-23. Summary of Potential Impacts to Vegetation.....	119
Table 4-24. Summary of special status species with potential to occur in the study area.	123
Table 4-25. Regulatory Criteria for Roadways and Intersections.....	154
Table 4-26. Existing Conditions on Major Roadways in the Study Area.....	155
Table 4-27. Traffic Conditions – Alternative 5 and Alternative 6.....	157
Table 4-28. Cultural Resources Within the Project Area.	163
Table 4-29. Recommended Ambient Allowable Noise Level Objectives.	168
Table 4-30. Yuba County Noise Regulations.	169
Table 4-31. Population Density and Associated Ambient Noise Levels.	169
Table 4-32. Typical Noise Levels from Construction Equipment.	171
Table 5-1. Geographic Areas that Would Be Affected by the YRER Feasibility Study.	176
Table 5-2. Past, Present, and Reasonably Foreseeable Future Projects	177
Table 8-1. Estimated Costs of RP.....	212
Table 8-2. Economic Costs and Benefits of RP.....	213
Table 8-3. Summary of Cost-Sharing Responsibilities of the RP.	213
Table 10-1. List of Preparers.	224

APPENDICES

Appendix A: Plan Formulation

Appendix B: Cultural Resources

Appendix C: Engineering

Appendix D: Environmental

Appendix E: Real Estate

ACRONYMS AND ABBREVIATIONS

AAHU	Average Annual Habitat Unit
ACE	Annual Chance of Exceedance
ACHP	Advisory Council on Historic Preservation
AF	Acre Feet
AFRP	Anadromous Fish Restoration Program
APE	Area of Potential Effects
Applicability Rate	also referred to as Federal de minimis emission thresholds
ASA (CW)	Assistant Secretary of the Army (Civil Works)
ASTM	American Society for Testing and Materials
BA	Biological Assessment
BCC	Listed as Bird of Conservation Concern
BLM	United States Bureau of Land Management
BO	Biological Opinion
CA	California
CAA	Clean Air Act
CABY	Cosumnes, American, Bear, Yuba
CAP	Continuing Authorities Program
CAR	Coordination Act Report - FWCA
CARB	California Air Resources Board
CCV	California Central Valley (steelhead)
CDC	California Debris Commission
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife (formerly CDFG)
CE/ICA	Cost Effectiveness and Incremental Cost Analysis
CEC	California Energy Commission
CEQ	Council on Environmental Quality]
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	code of federal regulations

CFS	cubic feet per second
CH	Critical Habitat
CH ₄	methane
CNDDDB	California Natural Diversity Database
CNEL	community noise equivalent level
CNPS	California Native Plant Society
CNPS Ranking	
1B	rare, threatened, or endangered in California and elsewhere
2B	rare, threatened, or endangered in California only
0.1	seriously threatened in California
0.2	moderately threatened in California
0.3	not very threatened in California
4	plants of limited distribution (watch list)
CO	carbon monoxide
CO ₂	carbon dioxide
CO ₂ e	CO ₂ equivalents
CRLF	California red-legged frog
CV	Central Valley (fall run Chinook salmon)
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CY	cubic yards
dBA	A-weighted decibel scale
dbh	diameter at breast height
DOI	Department of the Interior
DPD	Daguerre Point Dam
DPS	Distinct Population Segment
DWR	California Department of Water Resources
EA	Environmental Assessment
EC	Engineering Circular
ECB	Engineering and Construction Bulletin
EFH	Essential Fish Habitat

EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	Executive Order
EP	Engineering Pamphlet
EQ	environmental quality account
ER	Engineering Regulation
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FE	Listed Endangered under the Federal Endangered Species Act
FERC	Federal Energy Regulatory Commission
FONSI	Finding of No Significant Impact
FP	Listed as Fully Protected under California Fish and Game Code Sections 3511, 4700, 5050 and 5515.
FR	Federal Register
FR/EA	Feasibility Report / Environmental Assessment
FRAQMD	Feather River Air Quality Management District
FT	Listed Threatened under the Federal Endangered Species Act
FWCA	Fish and Wildlife Coordination Act
FWOP	Future Without Project
FWP	Future With Project
GCR	General Conformity Rule
GHG	greenhouse gases
HEP	Habitat Evaluation Procedure
HFC	hydrofluorocarbons
HgT	Total mercury levels
HSI	Habitat Suitability Index
IAR	Initial Appraisal Report
IDC	Interest during construction
IPCC	Intergovernmental Panel on Climate Change
IWR	US Army Corps of Engineers Institute for Water Resources
kg	kilogram
Ldn	the day-night average noise level

Leq	the equivalent energy noise level
LERRD	lands, easements, rights-of-way, relocations, and disposal areas
Lmax	the maximum instantaneous noise level
LOS	loss of service
LWM	Large Woody Material
M&	Monitoring and Adaptive Management Plan
MAM	Monitoring and Adaptive Management
MBTA	Migratory Bird Treaty Act
mg	milligram
mmHg	methlymercury
MSA	Magnuson Steven's Fisheries Act Managed Species
MW	megawatts
N ₂ O	nitrous oxide
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAHC	Native American Heritage Commission
NED	national economic development account
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration plan
NF ₃	nitrogen trifluoride
NHPA	National Historic Preservation Act
NID	Nevada Irrigation District
NMFS	National Marine Fisheries Service
NO ₂	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOP	Notice of Preparation
NO _x	nitrogen oxide (ozone precursor)
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Properties
NSVAB	Northern Sacramento Valley Air Basin
O ₃	ozone

OHV	off highway vehicle
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance, Rehabilitation, Repair, and Replacement
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
OSE	other social effects
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
Pb	lead
PDT	Project Delivery Team
PED	Preconstruction Engineering and Design
PFC	perfluorocarbons
PG&E	Pacific Gas and Electric Company
PL	Public Law
PM	particulate matter
PM ₁₀	inhalable particulate matter
PM _{2.5}	fine particulate matter
PPA	Project Partnership Agreement
ppb	part per billion
ppm	parts per million
RCEM	Road Construction Emission Model
RED	regional economic development account
RM	River Mile
RMT	Yuba Accord River Management Team
ROG	reactive organic gas (ozone precursor)
RP	Recommended Plan
RV	recreational vehicle
RWQCB	Regional Water Quality Control Board
Sc	candidate for listing under the CESA
SE	Listed Endangered under the CESA
SF ₆	sulfur hexafluoride
SHPO	State Historic Preservation Officer
SIP	state implementation plan

SMAQMD	Sacramento Metropolitan Air Quality Management District
SO ₂	sulfur dioxide
SPCCP	Spill Prevention Control and Countermeasures Plan
SR	spring run (Chinook salmon)
ST	Listed Threatened under the CESA
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SYRCL	South Yuba River Citizens League
TAC	toxic air contaminant
TAF	thousand acre feet
TMDL	Total Maximum Daily Load
TRLIA	Three River Levee Improvement Authority
TSP	Tentatively Selected Plan
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VELB	Valley Elderberry Longhorn Beetle
WOS	Waters of the US
WRDA	Water Resources Development Act
YBCU	Western yellow-billed cuckoo
YCWA	Yuba County Water Agency (Currently Yuba Water Agency – YWA)
YRER	Yuba River Ecosystem Restoration Feasibility Study
YSF	Yuba Salmon Forum
YSPI	Yuba Salmon Partnership Initiative
YWA	Yuba Water Agency (formerly YCWA)
µg/L	micrograms/liter

This page intentionally left blank.

Executive Summary

ES.1 Introduction

In 2015, the U.S. Army Corps of Engineers (USACE) initiated the Yuba River Ecosystem Restoration Feasibility Study at the request of the Yuba County Water Agency (YCWA), the non-Federal sponsor for the study. The objective of a USACE ecosystem restoration project is to restore degraded aquatic, wetland, or riparian ecosystems to a less degraded, more natural condition. The Yuba River watershed (Figure ES-1), located on the western slope of the Sierra Nevada Mountain Range, has been extensively mined for gold and other resources. The legacy of that mining, coupled with multiple water resources development projects, resulted in a degraded ecosystem, prompting investigation into restoration opportunities.

This integrated Feasibility Report/Environmental Assessment (FR/EA) describes the planning process followed to investigate ecosystem restoration opportunities in the Yuba River watershed and serves as the environmental compliance document under the National Environmental Policy Act (NEPA). USACE is the lead agency for the feasibility study and is also the lead under NEPA. YCWA, the lead agency under the California Environmental Quality Act (CEQA), is expected to complete a CEQA compliant environmental analysis after Congressional authorization of the recommended plan. Numerous other agencies, organizations, and individuals have participated in the study including the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS).

This feasibility report is an interim response to the study authority because the recommendations herein would not address the entire scope of that authority.

ES.2 Project Background

The Yuba River watershed was the epicenter of hydraulic mining during the California Gold Rush. At its height, the hydraulic mining industry produced an estimated \$15,000,000 of gold per year (Kelly, 1954). However, hydraulic mining also produced debris flows of epic proportions. Hydraulic mining washed away entire mountainsides in the upper Yuba River watershed. Hundreds of millions of cubic yards of mining debris flowed downstream, filled river channels, caused flooding of cities and farms, and obstructed navigation on the Sacramento River and the San Francisco Bay-Delta. While some debris worked its way through the river system, vast amounts of debris settled where the grade of the river flattened, deeply aggrading the lower Yuba River and its floodplain and devastating adjacent farmland and riverine habitat.

The environmental degradation caused by hydraulic mining created significant controversy and before long the Federal government took notice. In 1893, the United States Congress established the Federal California Debris Commission (CDC) to regulate hydraulic mining and protect navigation from further damage due to mining debris. The CDC issued



Figure ES-1. Yuba River Watershed.

ES-2

permits for hydraulic mining operations under certain conditions. To prevent further injury to the navigable waters of California, the CDC built Daguerre Point Dam in 1906 to impound debris that was still working its way downslope. Later on, the CDC issued permits for dredge mining on the lower Yuba River. Dredge mining was permitted to channelize the river and mitigate flooding problems, but also to extract gold from the native river sediments. Dredgers largely turned over the bed of the Yuba River, and left behind 20,000 acres of tailings. In 1941, in an attempt to revive the hydraulic mining industry, the CDC built Englebright Dam, which quickly filled with debris, although the industry was beyond revival. Upon Congressional decommissioning of the CDC in 1986, administration of Daguerre Point Dam and Englebright Dam and Lake was assumed by USACE.

Today, the debris dams continue to hold back hydraulic mining debris, with an estimated 28 million cubic yards (yd³) impounded behind Englebright Dam and 4 million yd³ behind Daguerre Point Dam. Many sections of the lower Yuba River remain primarily composed of cobble and large gravel and the coarse substrate is unfavorable for the natural recruitment of riparian vegetation. In addition to the debris dams, construction and operation of water supply, flood control, and hydropower dams have further altered natural hydrologic and sediment transfer regimes. The altered geomorphic processes and conditions have diminished and degraded the Yuba River ecosystem and prompted the need for this feasibility study.

ES.3 Study Authority

The authority to study the Sacramento River Basin for flood control and allied purposes, including ecosystem restoration, was granted in the Rivers and Harbors Act of 1962, P.L. 87-874, Section 209, which reads:

The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements...in drainage areas of the United States and its territorial possessions, which include the following named localities...Sacramento River Basin and streams in northern California draining into the Pacific Ocean for the purposes of developing, where feasible, multi-purpose water resource projects, particularly those which would be eligible under the provisions of Title III of Public Law 85-500.

(Title III of Public Law 85-500 concerns water supply.)

On 28 April 2016, a Senate Committee Resolution clarified that ecosystem restoration is to be included in this investigation:

Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army, pursuant to the Rivers and Harbors Act of 1962, Pub. L. 87-874 § 209, is requested to investigate ecosystem restoration opportunities in the Sacramento River Basin and streams in northern California draining into the Pacific Ocean, including the Yuba River watershed.

ES-3

ES.4 Need for Action

The purpose of a USACE ecosystem restoration project is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. The Yuba River underwent major morphological changes in the late nineteenth century, including deep and broad deposition on the channel and floodplain that resulted in cutoffs of meander bends, channel avulsions, and development of distributary channels. Over time, in response to both natural processes and river engineering efforts, channel beds began to incise and abandon floodplains as terraces (James, 2009). However, the natural trajectory for incised channels to widen their floodplain by lateral migration has been arrested by extensive bank protection on the lower Yuba River (James, 2015). As a result of resource extraction and river management strategies, the present day channel and floodplain are entirely different than pre-disturbance conditions.

Drastic changes to geomorphology translate to drastic changes to river ecology too. Hydraulic mining debris flows buried aquatic and riparian habitat under millions of cubic yards of cobble. Populations of Chinook salmon and steelhead were once historically abundant on the Yuba River, but have dwindled significantly. Both species are listed as threatened under the Endangered Species Act (ESA) and the lower Yuba River has been designated as critical habitat. The western yellow-billed cuckoo, a Neotropical migratory bird, was once common throughout much of lowland California and has been observed in the Yuba River watershed, but is now listed as threatened under the ESA primarily due to riparian habitat loss. Other federally listed threatened species in the watershed that could benefit from restoration actions include green sturgeon, California red-legged frog, and Valley elderberry longhorn beetle.

As part of the USACE planning process, specific problems or undesirable conditions in the watershed were identified to provide a framework for developing project alternatives. Specifically, the impacts of hydraulic and dredge mining, and early engineering efforts to control flooding and debris problems, in conjunction with more recent water resource development projects have resulted in the following problems:

- The quality of aquatic habitat has been degraded by reduced water volume; altered depth, velocity, temperature, and substrate; and introduced heavy metals.
- Riparian habitats have been diminished in quantity, degraded in quality, and fragmented by conversion to agricultural fields and reservoirs; accumulation of mining deposits; and reduced fine sediments.
- Longitudinal river connectivity has been reduced by altered hydroperiods and sediment transport as well as blocked and impaired passage of migrating fish.
- Lateral river connectivity has been reduced by aggradation of the floodplain and channelization of the river.

ES.5 Consideration of Alternative Plans

In correlation with the problems identified in the watershed, planning objectives were developed for the Yuba River Ecosystem Restoration Feasibility Study and preliminary management measures were identified to achieve those objectives. The preliminary management measures were screened based on acceptability, effectiveness, and efficiency. The remaining measures became the array of initial measures and are listed in Table ES-1. The range of measures considered included habitat restoration on the lower Yuba River; step pools, a bypass, and dam removal at Daguerre Point Dam; a fish ladder, fish tram, bypass, and dam removal at Englebright Dam; and collection and transport of fish above Englebright and New Bullards Bar dams.

Table ES-1. Initial management measures and planning objectives.

Initial Measures	Objective: Improve the quantity, quality, complexity of aquatic habitats	Objective: Improve the quantity, quality, complexity, and connectivity of riparian habitats	Objective: Improve longitudinal river connectivity	Objective: Improve lateral connectivity of the river to its floodplain habitat
Lower Yuba River Habitat Restoration – <i>Floodplain grading</i>	X	X	X	X
Lower Yuba River Habitat Restoration – <i>Floodplain lowering</i>	X	X	X	X
Lower Yuba River Habitat Restoration – <i>Riparian vegetation planting</i>	X	X		
Lower Yuba River Habitat Restoration – <i>Side channel creation</i>	X		X	
Lower Yuba River Habitat Restoration – <i>Bank scalloping</i>	X			X
Lower Yuba River Habitat Restoration – <i>Large woody material or engineered log jams</i>	X			
Lower Yuba River Habitat Restoration – <i>Boulders</i>	X			
Lower Yuba River Habitat Restoration – <i>Backwater areas</i>	X	X		X
Daguerre Point Dam Step Pools			X	
Daguerre Point Dam 10% bypass			X	
Daguerre Point Dam Removal	X	X	X	X

Table ES-1 (cont). Initial management measures and planning objectives.

Initial Measures	Objective: Improve the quantity, quality, complexity of aquatic habitats	Objective: Improve the quantity, quality, complexity, and connectivity of riparian habitats	Objective: Improve longitudinal river connectivity	Objective: Improve lateral connectivity of the river to its floodplain habitat
Englebright Dam Fish Ladder			X	
Englebright Dam Fish Tram			X	
Englebright Dam Bypass			X	
Englebright Dam Removal	X	X	X	X
Collect and Transport Above Englebright Dam			X	
Collect and Transport Above New Bullards Bar Dam			X	

The initial measures were further evaluated to assess and rank the quantity and quality of restoration each measure would likely achieve as described in Section 3.4.3. Efficiency scores were developed to demonstrate the quantity and quality of restoration outputs relative to costs. Risks to efficiency were also evaluated based on risks associated with mercury contamination, sediment disposal, water rights, design complexity, and construction complexity. Lower Yuba River Habitat Restoration was identified as the most efficient and lowest risk restoration opportunity. Fish passage and dam modification measures were screened from consideration due to low efficiency and relatively high risks. All components of Lower Yuba River Habitat Restoration, as displayed in Table ES-1, were carried forward for more detailed evaluation.

In order to reasonably optimize the scale of the restoration plan, habitat restoration sites were divided into groups, referred to as habitat increments, based on geographic proximity. Class 4 cost estimates were prepared for each habitat increment and ecosystem benefits were quantified for each increment using habitat suitability index models and Habitat Evaluation Procedures (see Section 3.6). To formulate the final array of alternatives, USACE Institute for Water Resources (IWR) Planning Suite software v2.0.9 (certified) was used to generate all possible combinations of habitat increments. IWR Planning Suite identified 6 Best Buy Plans, including the no action alternative, based on the costs and benefits of each habitat restoration increment. The Best Buy Plans became the final array of alternatives.

Alternative 5 has been identified as the National Ecosystem Restoration (NER) plan, which is the plan that reasonably maximizes ecosystem restoration benefits relative to costs. Alternative 5 would restore about 179 acres at an estimated cost of \$97,219,000. The NER plan is also the recommended plan (Figures ES-2a through ES-2d).

ES.6 Actions Subsequent to Public Review of the Draft FR/EA

The Draft FR/EA was released for public review on January 8, 2018 through February 23, 2018. During that time, USACE received 61 comment letters, forms, and emails. Comments were reviewed, considered, and incorporated into the document as appropriate. The majority of the public and agencies indicated support for proposed habitat restoration measures but preferred that the project also address fish passage at the dams. In particular there is strong desire for removal or modification of Daguerre Point and/or Englebright Dam. However, no comments were received that required reformulation, significant changes to the recommended plan, or major changes to scope or cost.

Feasibility level analysis of the recommended plan included a refinement of the costs, risks, and feasibility of the proposed actions. The habitat restoration features of the recommended plan were analyzed to assess their effectiveness under high flow conditions. Detailed modeling results and geomorphic characterizations were used to conduct a risk assessment to ecosystem benefits and the cost-risk associated with benefit retention over time. These assessments of benefit retention and operation and maintenance costs address the risk and uncertainty associated with constructing habitat restoration measures in a dynamic riverine environment. The results of this feasibility level assessment are discussed in Section 8.1.8 and Appendix C. Additionally, the Real Estate footprint was expanded to avoid uneconomic remnants and allow for flexibility in Operation, Maintenance, Repair, Rehabilitation, and Replacement.

ES.7 Recommended Plan

The principal features of the recommended plan include restoration of approximately 43 acres of aquatic habitat including side channels, backwater areas, bank scallops, and channel stabilization. These features would provide shallow, low velocity, rearing habitat and refugia for juvenile anadromous salmonids and potentially increase benthic macroinvertebrate producing habitat. Engineered log jams (ELJs) and placement of boulders and large woody material have been incorporated in the recommended plan at actively eroding banks or sites with high velocities and shear stresses. These features would promote bank stabilization, add structural complexity, provide velocity refuge for juvenile fish, and modify local hydraulics and sediment transport.

The recommended plan also includes about 136 acres of riparian habitat restoration consisting of floodplain lowering and grading and plantings of native riparian species, which would increase the quantity and quality of riparian habitat in the river corridor. The recommended plan addresses fragmentation of habitat by targeting areas adjacent to existing vegetation that have been unable to revegetate through natural processes due to substrate composition and depth to groundwater. Floodplain lowering reconnects the river to its floodplain and makes planting feasible where it was not previously due to excessive groundwater depths. Four native species would be planted to provide species and structural diversity, including arroyo willow which is known to support neotropical bird habitat (RHJV 2004). When

the restored riparian habitat is inundated by high flows, it would also function as aquatic habitat, providing additional feeding habitat and refugia for juvenile fish.

To various degrees, the recommended plan addresses all of the objectives of the feasibility study. Longitudinal river connectivity would be increased by improving approximately five river miles of aquatic habitat, improving refuge, rearing, and food production options for migrating fish along the lower Yuba River. The recommended plan would also reduce gaps between areas of suitable aquatic habitat, such as the Hallwood Side Channel and Floodplain Restoration Project and the Hammon Bar Restoration Project.

The lower Yuba River is an ideal location for a restoration project because the river still produces one of the largest fall-run Chinook Salmon populations in the Central Valley and also supports California Central Valley steelhead and spring-run Chinook Salmon, which are federally listed as threatened. In addition, the Yuba River does not have a hatchery facility and therefore hosts one of the last remaining wild salmon runs in the Sierra Nevada Mountain range. Historically, the Yuba River has supported a substantial percentage of salmon in the Sacramento River basin. In 2009 through 2010, salmon spawning in the Yuba River made up 14 to 20 percent of all salmon spawning in Sacramento River basin (Yuba RMT 2013).

The ability of the Yuba River to support salmonids despite extensive habitat degradation is aided by the fact that New Bullards Bar Reservoir would continue to have a large cold water pool that would provide cold water for summer and early fall flows in the lower Yuba River. Climate change would affect hydrology in the watershed, particularly by an increase in the percentage of total precipitation that would come as rainfall, but the reservoir would mitigate for the projected reduction in cold water from snow melt.

The creation of functioning, diverse, and interconnected habitats on the lower Yuba River would contribute to the recovery of nationally and regionally significant resources. Endangered Chinook salmon and steelhead require riverbanks with structural complexity, side-channels, backwaters, at appropriate depths and velocities that the recommended plan would provide. The restoration of aquatic and riparian habitat would reduce the scarcity of these important habitats. Restoration of riparian habitat along the lower Yuba River would be particularly beneficial to migratory birds on the Pacific Flyway. Despite significant habitat loss throughout the Central Valley, California still supports some of the largest concentrations of wintering waterfowl and shorebirds found anywhere in the world (The Nature Conservancy, 2018). The recommended plan would add to the quilt of managed wetlands and bird-friendly agricultural lands that support migratory birds.

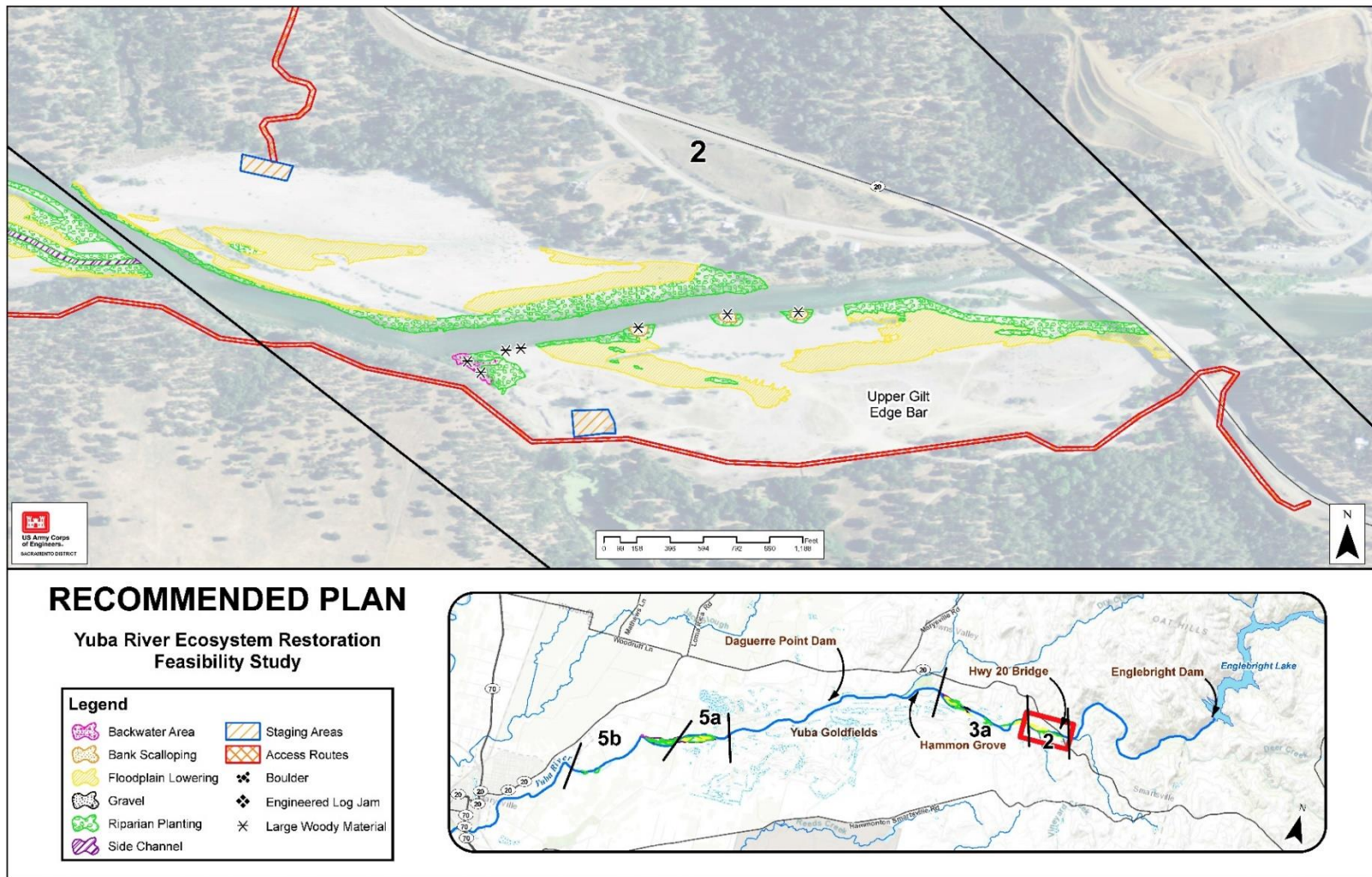


Figure ES-2a. Recommended Plan.

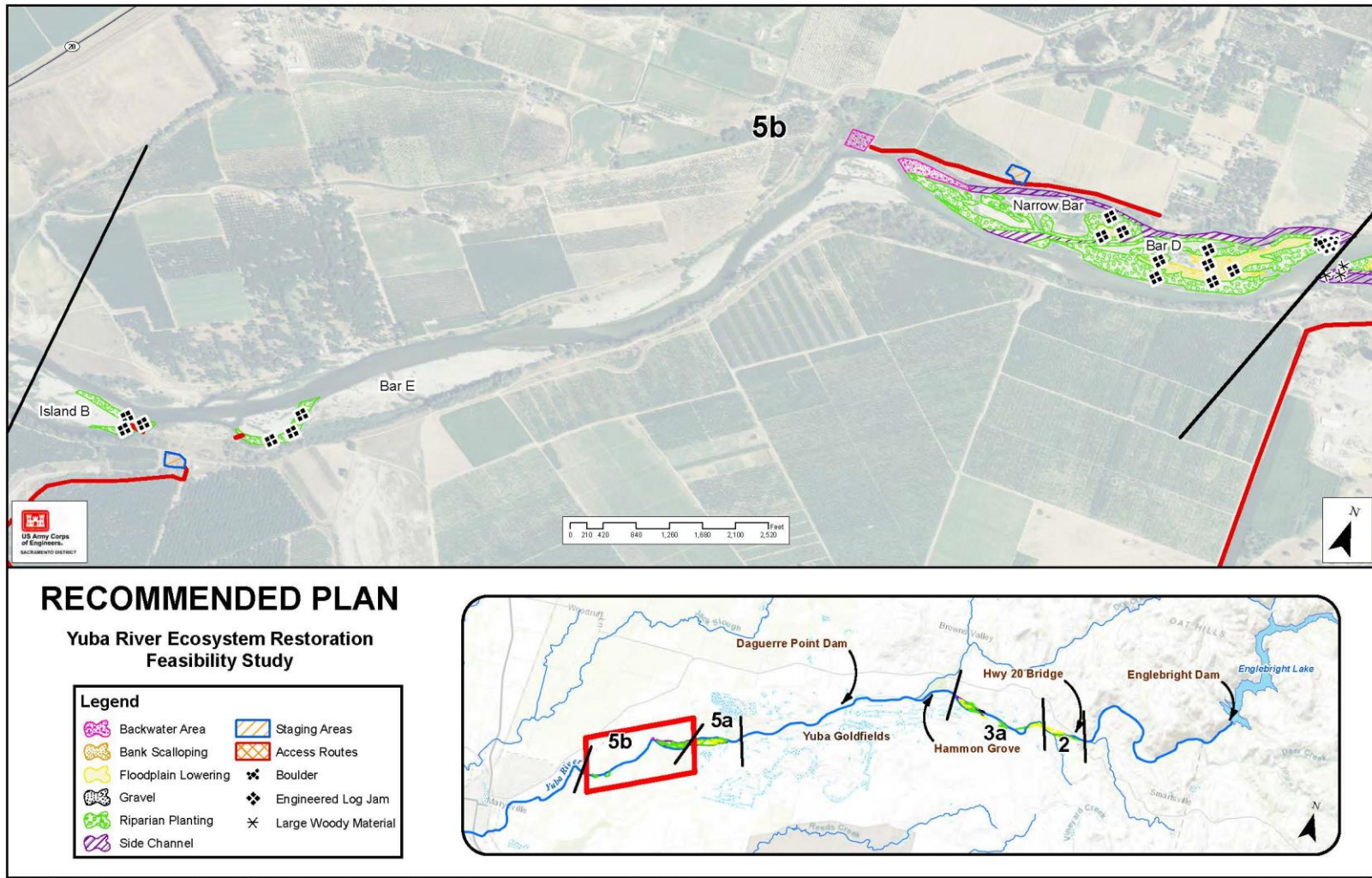


Figure ES-2d. Recommended Plan continued.

ES.8 Environmental Effects

The possible consequences of the proposed actions described in the FR/EA have been studied with consideration given to the natural, cultural, and social environment, and opportunities have been evaluated to provide ecosystem restoration, as described above. The proposed alternatives, while providing long-term benefits to the Yuba River watershed, would also have short-term effects on some resources. The FR/EA evaluated in detail, potential effects to Air Quality, Climate Change, Aesthetics, Hydrology and Hydraulics, Vegetation and Wildlife, Special Status Species, Water Quality, Transportation, Recreation, Cultural Resources, and Noise.

In all cases, the potential adverse environmental effects would be reduced to a less-than-significant level through project design, construction practices, preconstruction surveys and analysis, regulatory requirements, and best management practices. All construction would be implemented in compliance with applicable Federal laws, regulations and executive orders. Best management practices and avoidance and minimization measures as summarized within the FR/EA would be implemented. No compensatory mitigation would be required. A geotechnical analysis of underlying substrates and water quality analysis of construction activities and methods would be conducted during the preconstruction engineering and design phase to further refine potential impact analysis. A National Pollutant Discharge Elimination System general construction permit would be required. A Storm Water Pollution Prevention Plan and Spill Prevention Control and Countermeasures Plan would be developed by the contractor prior to construction.

The likelihood of encountering Hazardous, Toxic, and Radiological Waste during the construction of this project is minimal. Elemental mercury and methylmercury are known contaminants of concern in the lower Yuba River; however, no concentrations of any material are anticipated at levels that would be classified as Hazardous or acutely Toxic. The potential for release of contaminants would be addressed through characterization, monitoring, and adaptive controls.

ES.9 Estimated Cost and Cost Sharing

Construction cost accounts from the certified cost estimate for the recommended plan are displayed in Table ES-1 below.

Table ES-2. Estimated Costs of Recommended Plan.¹

Item	Cost (\$1,000s)
Lands and Damages	9,060
Relocations ²	0
Construction (Fish and Wildlife Facilities) ³	58,491
Planning, Engineering, Design	14,489
Construction Management	3,396
Monitoring	2,384
Adaptive Management	9,400
Total First Cost	97,219

¹Based on October 2018 price levels

²No relocations required for the Recommended Plan.

³Fish and Wildlife Facilities account includes ecosystem restoration activities (excavation, grading, planting, etc.).

The recommended plan is a cost-effective and implementable alternative, is in the Federal interest, and would be fully compliant with all environmental laws prior to construction. This report recommends Alternative 5, the NER plan, for authorization as a Federal project. The estimated first cost of the recommended plan is \$97,219,000. The estimated annual OMRR&R cost is \$15,000. The Federal portion of the estimated first cost, based on October 2018 price levels, is \$63,192,000. The non-Federal portion of the estimated first cost is \$34,027,000.

ES.10 Potential Future Studies

A significant ecosystem problem that was considered in this study would not be resolved by the recommended plan. While the plan reasonably maximizes ecosystem restoration benefits compared to costs, it would not resolve the problem of blocked and impaired fish passage and altered hydrologic and sediment transport regimes caused by existing dams. Additional investigation of this unresolved problem could be addressed in a future study under the same authority.

Chapter 1 – Introduction

Planning for Federal water resources projects constructed by the U.S. Army Corps of Engineers (USACE), along with those of the U.S. Bureau of Reclamation, Natural Resource Conservation Service, and the Tennessee Valley Authority, is based on the economic and environmental *Principles and Guidelines* promulgated in 1983 by the U.S. Water Resources Council. This report documents the planning process for ecosystem restoration in the Yuba River watershed, California, to demonstrate consistency with USACE planning policy and to meet the regulations that implement the National Environmental Policy Act (NEPA) of 1969, as amended. The following sections provide background information regarding the basis for this study.

1.1 Purpose and Need for the Study

The Yuba River ecosystem has been degraded by hydraulic mining and water resources development in the watershed, prompting an investigation into restoration opportunities. The purpose of the Yuba River Ecosystem Restoration Feasibility Study is to identify problems and opportunities associated with ecosystem degradation in the Yuba River watershed; to formulate, evaluate, and screen potential solutions to these problems; and to recommend a project in the Federal interest¹ that is supported by a local entity willing to provide the necessary items of local cooperation. This report presents the analysis and findings of the Feasibility Study and integrates documentation of the plan formulation process with documentation of environmental effects.

The current state of riparian and aquatic ecosystems in the Yuba River watershed was largely shaped by extensive hydraulic mining that occurred from 1853 to 1884. Early descriptions of the Yuba River before the onset of hydraulic mining are limited. However, available field, documentary, and cartographic evidence suggests that the Yuba channel near Marysville was characterized by a distinct riparian zone along the stream banks. This zone was vegetated by tall trees, brush, and vines (James, 2013). The floodplain along the lower Yuba River was described as an extended strip of bottom-lands with rich, black alluvial soil, on average a mile and a half wide on each side of the river (Sawyer, 1884). The upper watershed was free of dams and an estimated 300,000 fish returned to the Yuba River each year (Yoshiyama et al. 2001; CDFG 1993).

The California Gold Rush of 1849 enticed settlement in the watershed and ingenious methods for resource extraction. Modern hydraulic mining techniques, which includes the use of high pressure water cannons to dislodge rock material or move sediment (Figure 1-1), were developed in mining camps of the northern Sierra Nevada. Miners directed the water-sediment

¹ A project is said to be in the Federal interest if it is consistent with the mission of the Corps of Engineers and the project benefits are in excess of the project costs.

slurry through sluice boxes to separate gold or other desirable minerals. Entire mountainsides were washed away as hydraulic technology evolved and the industry boomed (Figure 1-2).



Figure 1-1. Hydraulic miner operates a water cannon.



Figure 1-2. Malakoff Mine, Nevada County, Yuba River Watershed.

Hydraulic mining resulted in torrents of sediment transported downslope, causing rapid aggradation and exacerbating flooding along the lower Yuba River (James and Singer 2008). The sediment deposited in the channel raised the channel bed to the point that in 1868 it was higher than the streets in Marysville. It is estimated that 684 million cubic yards of gravel and debris from hydraulic mining washed into the Yuba River from 1849 -1909 (Yoshiyama et al. 2001). This is more than triple the sediment volume of the Panama Canal excavations (Yoshiyama et al. 2001).

Much of the sediment dislodged by hydraulic mining settled where the grade of the river flattened, suffocating stretches of riverbank under millions of cubic yards of cobble, but also creating another opportunity for extraction. Gold dredging operations re-mined the vast hydraulic mining sediment deposits along the lower Yuba River. Dredging began in 1902, and by 1910, 15 dredges were operating in the lower Yuba River. In coordination with the Federal California Debris Commission (CDC), dredge operators created enormous “training walls” to contain the river in a single channel and mitigate sediment problems. Gravel berms 20 to 75 feet high were constructed between 1910 and 1935 to promote scouring and formation of a permanent, stable river channel (Adler 1980). This section of the river, known as the Yuba Goldfields, is currently dominated by 20,000 acres of dredger tailings (Figure 1-3). The altered landscape is discernible from orbital space even today.

In addition to training walls in the Yuba Goldfields, several structures were built on the Yuba River to control flooding and sedimentation. Specifically, two major debris dams were constructed by the CDC (i.e., Daguerre Point Dam in 1906 and Englebright Dam in 1941) to prevent further movement of finer sediment into the Feather and Sacramento Rivers, and ultimately the Sacramento and San Joaquin River Delta and San Francisco Bay. The dams sequestered sediment and also trapped the chemicals that were used in hydraulic mining processes. Mercury was used to separate gold from sand and gravel in the sluice box. In the

Sierra Nevada Mountains, up to 9 million pounds of mercury were added to the environment (Churchill 2000). Mercury and other heavy metals remain as contaminants in the sediment loads

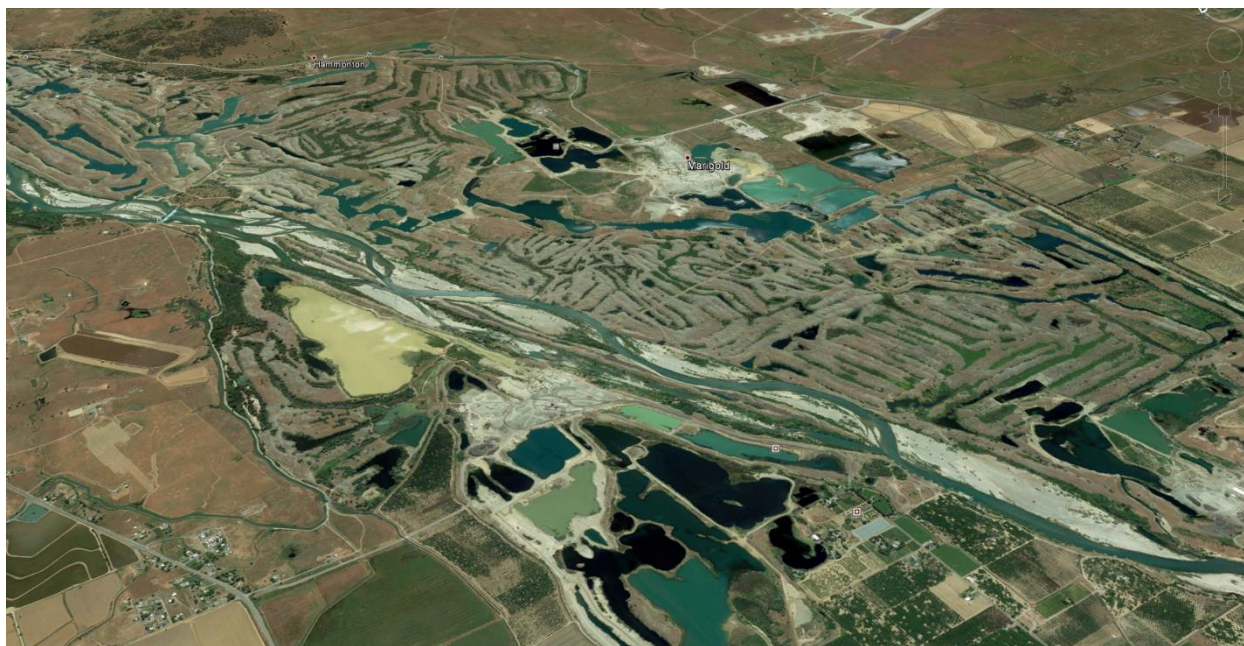


Figure 1-3. The Yuba River flows through the Yuba Goldfields.

behind Daguerre Point and Englebright Dams causing present day safe-eating advisories from the California Office of Environmental Health Hazard Assessment. Guidelines advise women ages 18-45 and children ages 1-17 to avoid eating largemouth, smallmouth, or spotted bass from Englebright reservoir.

The upper Yuba River watershed was also developed for hydropower and water supply during the early 20th century. Most of the dams and diversions that were used primarily for gold mining were in place during this period, but they were replaced or removed as developmental emphasis in the watershed shifted from gold mining to flood management, water supply, and hydropower generation.

The purpose of this study is to address the degradation of this ecosystem, as described above, and to determine the National Ecosystem Restoration (NER) plan. This report analyzes potential NER benefits associated with restoring natural structure, function, and processes of the Yuba River and concludes with identification of a Recommended Plan for Congressional authorization. Although this report identifies and recommends ecosystem restoration actions within the study area, due to the considerable degradation of the ecosystem and the broad scope of the study authorization, the plan recommended by this report could not reasonably, fully address the need for ecosystem restoration in the Yuba River Watershed. Consequently, recommendations in this report would serve as an interim response to the study authority.

1.2 Study Authority

The authority to study the Sacramento River Basin for flood control and allied purposes, including ecosystem restoration, was granted in the Rivers and Harbors Act of 1962, Public Law (P.L.) 87-874, Section 209, which reads:

The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements...in drainage areas of the United States and its territorial possessions, which include the following named localities...Sacramento River Basin and streams in northern California draining into the Pacific Ocean for the purposes of developing, where feasible, multi-purpose water resource projects, particularly those which would be eligible under the provisions of Title III of Public Law 85-500.

(Title III of Public Law 85-500 concerns water supply.)

On 28 April 2016, a Senate Committee Resolution clarified that ecosystem restoration is to be included in the investigation:

Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army, pursuant to the Rivers and Harbors Act of 1962, Pub. L. 87-874 § 209, is requested to investigate ecosystem restoration opportunities in the Sacramento River Basin and streams in northern California draining into the Pacific Ocean, including the Yuba River watershed.

1.3 Study Area Location

Located within the Sacramento River Basin (Figure 1-4), the Yuba River watershed (Figure 1-5) encompasses 1,340 square miles on the western slopes of the Sierra Nevada Mountain Range. The river flows east to west through forest, foothill chaparral, and agricultural lands to the confluence of the Feather River.

The watershed is located in portions of Sierra, Placer, Yuba, and Nevada counties. There are a total of 32 dams and 11 powerhouses in the watershed. For most of its course, levees are absent from the river, except for near the confluence with the Feather River. At that point, the Yuba River is confined by setback levees for six miles.

1.4 Study Sponsor and Participants

USACE and the Yuba County Water Agency (YCWA) are the lead agencies in the Feasibility Study and share the cost of the study equally, pursuant to the Feasibility Cost Sharing Agreement executed by the parties on June 2, 2015 and amended July 31, 2017.



Figure 1-4. Sacramento River Basin.

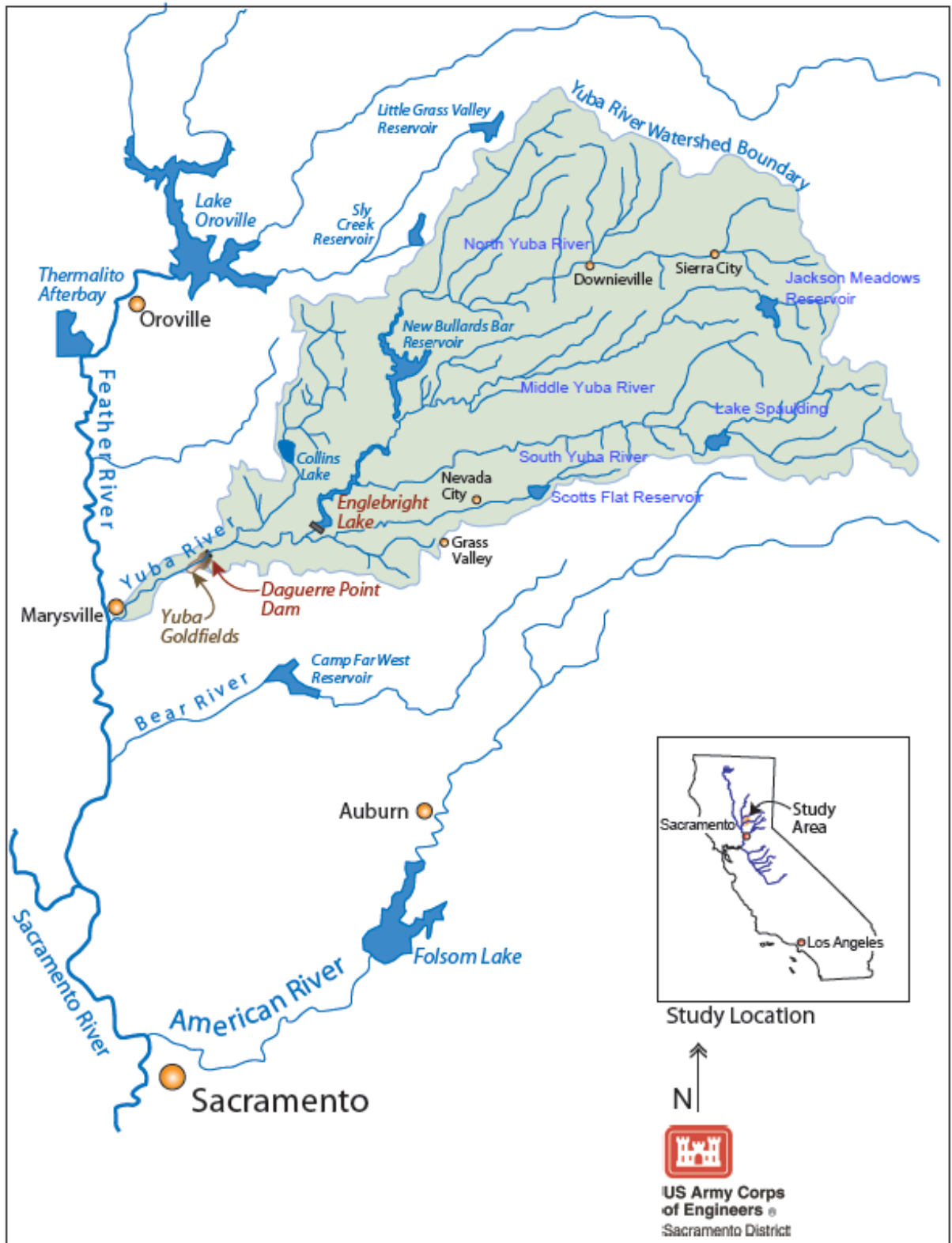


Figure 1-5. Yuba River Watershed.

Affected agencies and stakeholders include but are not limited to: the National Marine and Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), California Department of Fish & Wildlife (CDFW), Tahoe National Forest, public recreation groups, mining companies, irrigation districts, South Yuba River Citizen's League (SYRCL), and Trout Unlimited. USACE has also consulted with the Native American Tribes in the area (Section 7.1).

1.5 Existing Projects, Studies, and Programs

There are several ongoing water resources related projects, studies, and programs that could affect ecosystem conditions in the study area. Those efforts that pertain directly to this feasibility study are summarized below.

1.5.1 Projects

There are many water resources development projects on the Yuba River from sediment retention structures, hydropower generation, water supply for irrigation, municipal, and industrial purposes, to fish and wildlife mitigation and restoration projects. The following list is not exhaustive, but highlights the projects most relevant to this study, such as the dams that are the first barriers to fish passage, hydropower projects with controlled water releases, and other habitat restoration efforts.

Yuba River Restraining Barriers. The Rivers and Harbors Acts of 1893 and 1896 authorized the construction of restraining barriers to control movement of hydraulic mining debris as recommended by the California Debris Commission (CDC). The Yuba River Restraining Barriers project consists of Daguerre Point Dam, which forms a storage basin for debris, and about 15 miles of large berms or training walls. The berms confine flows to narrow channels to prevent stream meander and downstream movement of old debris deposits from floodplain areas.

Congress established the CDC in 1893 to provide for: resumption of hydraulic mining without injury to navigation or damage to overflow; to restore, as nearly as practicable, navigation conditions as of 1860; and to afford relief in flood time and to provide sufficient water to maintain scouring force in summer to restore channel capacities. Members of the CDC were USACE officers appointed by the President of the United States. The CDC did not discover a satisfactory method to allow resumption of hydraulic mining, but was effective in debris management.

Daguerre Point Dam. Daguerre Point Dam (Figure 1-6) is located on the Yuba River approximately 11.5 miles upstream of Marysville. The CDC recommended the dam to prevent hydraulic mining debris from washing into navigable waters of the Sacramento and Feather Rivers. Congress authorized the dam's construction in the 1902 Rivers and Harbors Act (P.L. 57-154). Although the dam was completed in May of 1906, the river was not diverted over the dam until 1910. The dam rapidly filled to capacity with sediment and debris that moved downstream during flooding in 1911. Daguerre Point Dam was damaged and breached by floods in 1963 and 1964, then rebuilt in 1965. The area behind the dam is almost entirely filled with up to 4 million cubic yards of sediment that has accumulated since it was rebuilt.

The Water Resources Development Act of 1986 (P.L. 99-662) eliminated the CDC and transferred Daguerre Point Dam to USACE. USACE is responsible for operation and maintenance of the dam.

As documented in the 2013 Biological Assessment (BA) on Daguerre Point Dam, USACE implemented protective and voluntary conservation measures for listed species under its obligation to Section 7(a)(1) of the Endangered Species Act and several voluntary conservation measures in accordance with USACE's Environmental Stewardship and Maintenance Guidance and Procedures, respectively. USACE is in compliance with the Endangered Species Act for the operation and maintenance of Daguerre Point Dam.

Daguerre Point Dam's key details include the following:

- Overflow concrete ogee ("s-shaped") spillway with concrete apron and abutments.
- Ogee spillway section is 575 feet wide and 25 feet tall.
- Originally designed to retain hydraulic mining debris.
- Currently used to facilitate water diversion for irrigation purposes.
- Not operated for flood control or recreation.
- No storage capacity – reservoir filled with hydraulic mining debris and sediments.

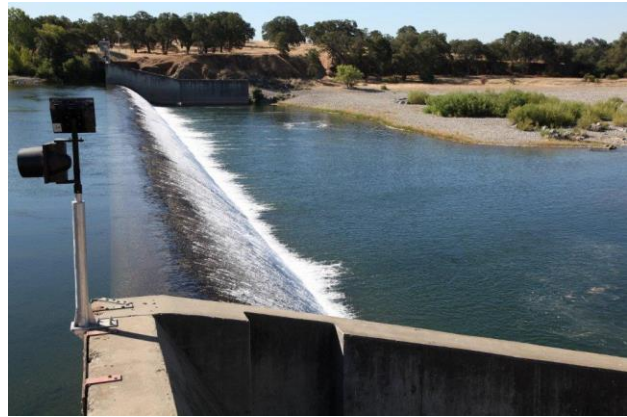


Figure 1-6. Daguerre Point Dam.

There are three water diversions associated with Daguerre Point Dam which utilize the elevated head², or pressure, created by the dam, or the influence of the dam in the prevention of additional river channel incision, to gravity-feed their canals. The three diversions are the Hallwood-Cordua diversion, the South Yuba/Brophy diversion, and the Browns Valley Irrigation District diversion, which have a combined capacity of 1,085 cubic feet per second (cfs).

In addition to the dam structure, there are two fish ladders, each with a control gate. The purpose of these two fish ladders is to permit salmon and steelhead access upriver to the seasonal spawning areas. Other native species, including pike minnow and suckers, have also been observed using the ladders. However, the ladders do not meet modern fish passage design standards, and are not effective in passing all species over a full range of flows (NMFS 2014a).

Englebright Dam. Originally known as Upper Narrows Reservoir, the Harry L. Englebright Dam and Lake is on the main stem of the Yuba River (RM 23.9) approximately 20

² The "elevated head" at Daguerre Point Dam is created by the hydraulic conditions associated with water being impounded behind (i.e., upstream) of the dam. USACE has no control over the in-river flows, and has no discretionary control over the "head" for local water users in the vicinity of Daguerre Point Dam.

miles northeast of Marysville. The concrete arch dam and reservoir was authorized by the Rivers and Harbors Act of 1935 (P.L. 74-409) as part of the Sacramento River and Tributaries Project. Completed by the CDC in 1941, the project was authorized primarily to contain hydraulic mining sediments originating in upstream areas (USACE 2013).

Englebright Dam (Figure 1-7) is 260 feet high, and the storage capacity of the reservoir was 69,700 AF at the time of construction (Childs et al. 2003). However, due to sediment buildup, the gross storage capacity was more recently estimated at 50,000 AF (USGS 2003). The volume of sediment in Englebright Lake is significant and was estimated at approximately 28 million cubic yards in 2003 by the U.S. Geological Survey (USGS). Additional details regarding Englebright Dam and Lake are provided below.

- Englebright Dam is a concrete constant angle arch structure.
- Dam crest length of 1,142 feet and the dam top crest width is 21 feet.
- Dam spillway crest elevation is 527 feet mean sea level (msl).
- Maximum spillway design capacity is 108,000 cfs.
- Dam is not operated for flood control.
- Englebright Lake is approximately 9 miles long.
- Reservoir water surface elevation generally fluctuates between 517 feet to 525 feet msl on a daily and weekly basis.
- Englebright Reservoir is used as an afterbay for releases from New Bullards Bar Reservoir through the New Colgate Powerhouse. Water releases from Englebright Reservoir are managed by PG&E and YCWA to maintain Yuba Accord instream flows for fisheries, while also generating hydroelectric power, providing surface water for irrigation, maintaining Englebright Reservoir water surface elevations within a range suitable for recreation, and other beneficial uses.
- Englebright Dam provides the hydraulic head for approximately 67 megawatts (MW) of electric generation at the Narrows 1 and 2 powerhouses.



Figure 1-7. Englebright Dam.

Water in the reservoir provides for recreational opportunities as well as hydroelectric power generation. The reservoir does not have any dedicated flood storage space and only provides incidental flood control benefits. Since the reservoir was constructed for mining debris retention and not for flood control purposes, it does not have a low-level outlet. In fact, the design of the dam allows unregulated flood flows to spill over the top of the dam during flood events. Since around 1941, controlled releases into the lower Yuba River have been

made from the Pacific Gas and Electric (PG&E) Narrows 1 Power Plant, and since 1970 from the YCWA Narrows 2 Power Plant, both Federal Energy Regulatory Commission (FERC) licensed facilities. These power plants are just downstream of the dam.

Englebright Dam typically represents the delineation between the upper and lower Yuba River. Englebright Dam is impassable to fish moving upstream and is the upstream limit of anadromous fish migration in the Yuba River.

Yuba River Development Project. The Yuba River Development Project serves multiple uses, including hydropower, flood control, water supply, and environmental resources. The project as described in YCWA's June 2, 2017 Amended Final License Application to FERC consists of: 1) New Bullards Bar Dam and Reservoir; 2) Our House Diversion Dam; 3) Log Cabin Diversion Dam; 4) Lohman Ridge Diversion Tunnel; 5) Camptonville Diversion Tunnel; 6) New Colgate Powerhouse; 7) Narrows 2 Powerhouse; and 8) several recreational facilities centered around New Bullards Bar Reservoir. The project's original FERC license was issued May 16, 1963 and amended May 6, 1966. Since May 2016, the Project has operated under annual FERC licenses, which have the same terms as the previous FERC license. The project has an energy generation capacity of 361 megawatts.

The Yuba River Development Project releases water into the lower Yuba River in order to meet flow requirements specified in their water rights, as described in Revised Water Right Decision 1644 and Corrected Water Right Order 2008-0014. Corrected Water Right Order 2008-0014 allows implementation of the lower Yuba River Accord (Yuba Accord). Portions of the Project are on Federal lands managed by the U.S. Forest Service and USACE.

New Bullards Bar Dam. The largest structure on the river, New Bullards Bar Dam is on the North Yuba River, 18 miles upstream from Englebright Dam. Construction was completed in 1970 by YCWA as part of FERC Project No. 2246 to provide water for power generation, irrigation, water supply, flood control, and recreation. USACE contributed \$12 million to the construction of the dam in exchange for flood control space the reservoir would provide. The reservoir is used heavily for recreation, and it powers two hydroelectric plants.

The USACE Flood Control Manual for New Bullards Bar Reservoir (1972) specifies flood releases in a major flood event. Releases from New Bullards Bar Reservoir are made through the New Colgate Powerhouse, through the dam's low-level outlet, or through the gated spillway. Figure 1-8 displays New Bullards Bar Dam.

Additional details about New Bullards Bar Dam and Reservoir are (YCWA 2010):

- 1,110-foot long radius, double curvature, concrete arch dam.
- Dam height is 645 feet.
- Overflow-type spillway with a width of 106 feet.
- Spillway crest elevation of 1,902 feet msl.
- Three 30-foot wide and 54-foot tall tainter gates on the spillway.
- Maximum spillway design capacity of 160,000 cfs.
- Provides hydraulic head for 340 MW of hydroelectric peaking power at the Colgate powerhouse.
- The reservoir extends approximately 8.5 miles upstream at the normal maximum water surface elevation (1,956 feet).
- Estimated reservoir storage capacity is 966,103 acre-feet.
- Reservoir maximum depth is 645 feet.
- Normal water level fluctuations of 150 feet.



Figure 1-8. New Bullards Bar Dam.

1.5.1.1 Other Existing Water Projects

Other dams have been constructed in the Yuba River watershed for irrigation and drinking water supplies. Many of the earlier dams have been retrofitted to supply hydropower in addition to newer dams constructed with hydropower as a purpose. Other hydroelectric projects within the Yuba River watershed are the Yuba-Bear Project managed by the Nevada Irrigation District (a water agency based in Grass Valley, California), and the Drum-Spaulding Project overseen by PG&E.

Marysville and Yuba City, the communities at the downstream end of the Yuba River, receive flood risk reduction benefits from a system of levees, bypasses, and reservoirs, including USACE's Sacramento River Flood Control Project authorized in 1917, Yuba River Basin Project authorized in 1999, and Sutter Basin Project authorized in 2014. The Three Rivers Levee Improvement Authority (TRLIA) and Sutter Butte Flood Control Agency have constructed projects, including portions of the two recently authorized USACE projects, to address critical flood risk issues. USACE is currently constructing the Marysville Ring Levee element of the Yuba River Basin Project and is initiating design of the unconstructed portion of the Sutter Basin Project.

Hammon Bar Riparian Restoration Project. In 2011 and 2012 SYRCL planted 6,800 riparian cuttings on five acres of Hammon Bar on the lower Yuba River. Hammon Bar, like

other sections of the lower Yuba River, is primarily composed of cobble and large gravel with small and varying composition of small gravel or sand. The course substrate, a result of the altered sediment regime, may be unfavorable for natural recruitment of riparian trees. This project demonstrates the feasibility of establishing riparian hardwood forests on open bar surfaces of the lower Yuba River by targeting areas with appropriate groundwater depths and utilizing specific planting techniques. Plantings can influence conditions for natural riparian recruitment, increase biomass and structural complexity, encourage additional hydraulic interactions, and benefits to habitat (SYRCL 2013). Storm events over the winter of 2016-2017 realigned the Yuba River, testing the sustainability of the restoration project. In July 2017, U.S. Fish and Wildlife Service biologists reported that nearly 2,000 trees survived.

1.5.2 Studies

The Yuba River downstream of Englebright Dam is one of the more thoroughly studied rivers in the Central Valley of California. Much of the research is connected to the FERC relicensing process of YCWA's Yuba River Development Project. Additional key prior studies and reports are described below.

Applicant-Prepared Draft Biological Assessment for Central Valley Spring-Run Chinook Salmon, Central Valley Steelhead and North American Green Sturgeon. YCWA, June 2017.

Identified and evaluated potential effects on threatened and endangered species from YCWA's power generating activities. The assessment in Volume IV of YCWA's Amended Final License Application to FERC was required as part of the FERC relicensing process.

Biological Opinion (BO) for Operation and Maintenance of Daguerre Point Dam and Fish Ladders. National Marine Fisheries Service (NMFS), May 2014.

Responded to the 2013 Daguerre Point Dam BA and concluded that implementation of the proposed action is not likely to jeopardize the threatened and endangered species, or adversely modify their designated critical habitat. NMFS included Reasonable and Prudent Measures and discretionary terms and conditions that are intended to minimize incidental take associated with the proposed action. The BO superseded the February 2012 BO for Operation and Maintenance of Englebright and Daguerre Point Dams.

Letter of Concurrence for Operation and Maintenance for Englebright Reservoir on the Yuba River. NMFS, May 2014.

Response to the 2013 USACE BA for Operation and Maintenance for Englebright Reservoir. In the letter, NMFS concurs with USACE's determination that the project proposed is not likely to adversely affect Central Valley spring-run Chinook salmon and steelhead or green sturgeon or the species' designated critical habitats.

Yuba Salmon Forum Summary Habitat Analysis, Prepared by Cardno ENTRIX for the Yuba Salmon Forum. September 2013.

This report provides a summary assessment of potential anadromous spring-run Chinook salmon and steelhead habitat in the Yuba River watershed. The summary assessment was designed to provide habitat information that can be used to review potential actions that warrant further investigation regarding introduction of Central Valley spring-run Chinook salmon and Central Valley steelhead into the North, Middle, and/or South Yuba Rivers and/or portions of the Yuba River. The summary assessment includes a synthesis of data from various sources that includes hydrology, water temperature, upstream migration barriers, and a quantification of migration, holding, spawning, incubation, rearing, and smolt emigration habitat.

Interim Monitoring & Evaluation Report Draft, Lower Yuba River Accord, River Management Team. April 2013.

Served as both a ‘report card’ on the lower Yuba River Accord’s River Management Team’s monitoring and evaluation program results regarding the implementation of the Yuba Accord for regulators, stakeholders and the broader scientific community, and to help inform the FERC relicensing process.

Assessment of Infrastructure and Related Items to Support Anadromous Fish Passage to the Yuba River Watershed, Prepared by MWH for the Yuba Salmon Forum. March 2013.

Provides an assessment of infrastructure to support anadromous fish passage to the Yuba River watershed, including an engineering assessment of the facilities, appurtenances, costs, permitting, and changes to the infrastructure and operations of existing facilities required for the implementation and operations and maintenance of an Anadromous Fish Passage Program to locations in the upper Yuba River watershed, including the North, Middle, and South Yuba Rivers.

Yuba River Basin Post Authorization Documentation Report, USACE. December 2012.

Reaffirmed that there is Federal interest in project improvements within the Linda/Olivehurst area of the authorized Yuba River Basin Project. The project, as authorized, includes improvements to strengthen existing levees to reduce flood risk to the City of Marysville and to Reclamation District 784.

Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment. DWR, 2007.

The California Department of Water Resources (DWR) Upper Yuba River Studies Program conducted this study to determine whether the re- introduction of wild Chinook salmon and steelhead to the upper Yuba River Watershed is biologically feasible. The study concluded that the Middle Yuba River could support a small salmon run.

Yuba River, California, Daguerre Point Dam Initial Appraisal Report. USACE, August 2005.

Under Section 216 authority, the USACE prepared an Initial Appraisal Report (IAR) in 2005. The report recommended a cost-shared feasibility study to determine the Federal interest

in fish passage improvement, restoration of fisheries, restoration of aquatic habitat, and flood damage reduction associated with Daguerre Point Dam. A Continuing Authorities Program (CAP) Section 1135 study was not recommended because alternative costs to address aquatic ecosystem problems along the Yuba River were expected to exceed the CAP funding limit.

Daguerre Point Dam Fish Passage Improvement Project Alternative Concepts Evaluation, Wood Rodgers, Inc., Sacramento, CA. September 2003.

This evaluation described the potential solutions (and limitations of each) for fish passage improvements at Daguerre Point Dam as recommended by the California Department of Fish and Game (now the Department of Fish and Wildlife). It provided costs for each solution and compared the impacts to fish passage, water supply interests, and downstream flood protection relative to the cost for implementation.

Preliminary Fish Passage Improvement Study. USACE, August 2001.

Identified potential alternatives for fish passage improvement at Daguerre Point Dam on the Yuba River. It included preliminary plans to reduce fisheries resource problems in the study area. It provided the project status and planned future efforts needed to conduct a feasibility study.

1.5.3 Programs

Sacramento River Basin Habitat Expansion Agreement

The Habitat Expansion Agreement provides a framework for DWR and PG&E to jointly identify, evaluate, and select the most promising and cost-effective action(s) to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon and steelhead in the Sacramento River Basin. Habitat expansion is intended to mitigate for any presently unmitigated impacts due to the blockage of passage of all fish species caused by Feather River Hydroelectric Projects.

Because the Yuba River was historically a major contributor of spring-run Chinook salmon to the Sacramento River System, DWR and PG&E, in consultation with resource agencies, identified actions to expand spawning habitat on the lower Yuba River, specifically the *Yuba River Canyon Salmon Restoration Project*. An additional, optional action to support segregation of spring-run and fall-run Chinook salmon using a seasonally operated segregation weir was also identified.

Anadromous Fish Restoration Program

Under the authority of the Central Valley Project Improvement Act, the USFWS Anadromous Fish Restoration Program (AFRP) has the broad goal of doubling natural production of anadromous fish in the rivers and streams of the Central Valley of California. One of the high priority actions of the AFRP is to evaluate the benefits of restoring stream channel and riparian habitats of the Yuba River, including the creation of side channels for spawning and rearing habitat for salmonids. In keeping with AFRP goals, USFWS and partner agencies have proposed and funded the *Hallwood Side Channel and Floodplain Restoration Project* (construction start 2018), *Yuba River Canyon Salmon Habitat Restoration Project* (construction anticipated 2018) and the *Hammon Bar Restoration Project* (completed 2011-2012).

Lower Yuba River Accord

The Yuba Accord is a consensus-based, comprehensive program designed to protect and enhance 24 miles of the lower Yuba River extending from Englebright Dam downstream to Yuba River's confluence with the Feather River. The Yuba Accord addresses water management in the lower Yuba River until a new FERC license is issued for the Yuba River Development Project. The State Water Resources Control Board's Corrected Water Right Order 2008-0014 adopted in 2008, amended YCWA's water-right permits to add the Yuba Accord instream flow schedules, which YCWA had been implementing under pilot programs since 2006. The Yuba Accord is composed of three interrelated agreements: 1) the Lower Yuba River Fisheries Agreement, which specifies lower Yuba River minimum stream flows and creates a detailed fisheries monitoring and evaluation program; 2) the Water Purchase Agreement, under which YCWA provides annual water supplies for fish and wildlife purposes in the Bay-Delta, CALFED's Environmental Water Account, the State Water Project, and the Central Valley Project; and 3) the Conjunctive Use Agreements which specify the terms of the Yuba Accord's conjunctive use program.

Yuba Salmon Forum

The Yuba Salmon Forum is a collaborative process that began in 2011. The forum is comprised of a diverse group of stakeholders including State and Federal agencies, municipalities, and environmental groups. The purpose of the Forum is to identify, evaluate, recommend, and seek to achieve implementation of effective near-term and long-term actions that achieve viable salmonid populations in the Yuba River Watershed to contribute to recovery goals.

Yuba Salmon Partnership Initiative

The Yuba Salmon Partnership Initiative (YSPI) is a collaborative, science-based initiative to contribute to the recovery of Central Valley spring-run Chinook salmon and Central Valley steelhead by enhancing habitat in the Yuba River downstream of Englebright Dam and reintroducing salmon (and possibly steelhead) into their historic habitat in the North Yuba River upstream of New Bullards Bar Dam.

1.6 Public and Agency Scoping

Scoping began on October 9, 2015, when USACE published a Notice of Intent in the Federal Register (Vol. 80, No. 196) to prepare an Environmental Impact Statement. Following publication of the notice, input was solicited from Federal, State, and local agencies, non-governmental organizations, and the general public. USACE and YCWA hosted four public meetings throughout the watershed. The meetings were held to educate the public about the study efforts and to garner input on the proposed scope, in accordance with the National Environmental Policy Act (NEPA). Table 1-1 displays the USACE planning and NEPA processes. YCWA, the lead agency under the California Environmental Quality Act (CEQA), is expected to complete a CEQA compliant environmental analysis after Congressional authorization of a Federal project and would ensure full compliance with all applicable state environmental laws.

Over 150 comments were received through email, mail, and at public scoping meetings (written and verbal). Comments ranged from general support of or opposition to the study, to requests for specific measures. The key comments included:

- General support for study.
- General support for reintroduction of salmonids into upper watershed.
- Interest in volitional or voluntary fish passage past Daguerre Point Dam and Englebright Dam.
- Support for a watershed scope of study.
- An interest in preserving existing and developing new recreation opportunities, including: fishing, boating, hiking, wildlife, and gold panning.
- Interest in communication and transparency throughout the study process – make information available to public including public scoping information, public comments, and screening criteria.
- Concern regarding the sponsor, YCWA, and USACE partnership.
- Concern for impacts to existing water resources.

The health of the native salmon and steelhead fisheries has been at the center of extensive study and debate. The overall awareness of and interest in issues in the Yuba River watershed is high. Participation in public meetings and submission of comments reflects an engaged public. There is a general expectation for this feasibility study to recommend a plan that achieves progress in the ongoing debate over natural resource management in the watershed.

During the plan formulation process, certain measures were screened from further consideration as more information was gathered and more analyses completed. This led to identification of a final array of reasonable alternatives that, following an analysis of environmental effects, were determined to have no significant impacts on environmental resources with the implementation of appropriate BMPs and avoidance and minimization

measures. Due to these findings, it was decided that the appropriate NEPA documentation to be made available for public review was a draft environmental assessment (EA) with an associated draft finding of no significant impact (FONSI).

For more detail on comments received during public review of the draft Feasibility Report/Environmental Assessment, information available at meetings, and a summary of key issues that were raised, see Chapter 7, Public Agency Involvement and Review.

Table 1-1. USACE Planning and NEPA Process

USACE Planning Process	Yuba River Ecosystem Restoration Feasibility Study	NEPA Process
Step 1. Identify Problems and Opportunities	Scoping Charrette: Federal Interest Decision	Publish Notice of Intent (NOI)
Step 2. Inventory and Forecast		Conduct scoping process
		Prepare Statement of Purpose and Need/Project Objectives Describe existing conditions and affected environment
Step 3. Formulate Alternatives	Milestone 1: Alternatives	Identify reasonable alternatives
Step 4. Evaluate Alternatives		Evaluate impacts and potential mitigation
Step 5. Compare Alternatives		Compare alternatives
Step 6. Select Alternative	Milestone 2: Tentatively Selected Plan	Draft EA: public notice and 30-day public review ¹
	Milestone 3: Agency Decision	Final EA: respond to public comments
	Milestone 4: Senior Leader Briefing State and Agency Review	
		Milestone 5: USACE Chief’s Report ASA(CW) Transmits Chief’s Report to OMB ASA(CW) Transmits Chief’s Report to Congress Congressional Authorization

¹Although only a 30 day period is public review required for public review, the study elected to open the review period on the draft FR/EA for 45 days.

ASA (CW) = Assistant Secretary of the Army (Civil Works).

OMB = Office of Management and Budget.

1.7 Report Organization

The planning process consists of six major steps: (1) Specification of water and related land resources problems and opportunities; (2) Inventory, forecast and analysis of water and related land resources conditions within the study area; (3) Formulation of alternative plans; (4) Evaluation of the effects of the alternative plans; (5) Comparison of the alternative plans; and (6) Selection of the recommended plan based upon the comparison of the alternative plans.

This report documents the study process. It also serves as the EA for compliance with NEPA. The chapter headings and analysis presented in this report generally follow the outline of an EA. The report chapters relate to the six steps of the planning process as follows:

- The second chapter of this report, Need for Action, covers the first step in the planning process (specification of water and related land resources problems and opportunities).
- The third chapter of this report, Alternative Plans, is the heart of the report and is therefore placed before the more detailed discussions of resources and effects. It covers the third step in the planning process (formulation of alternative plans), the fifth step in the planning process (comparison of alternative plans), and the sixth step of the planning process (selection of the recommended plan based upon the comparison of the alternative plans). In addition, at the end of the chapter, a project description is provided for the purposes of the NEPA analysis.
- The fourth chapter of this report, Affected Environment and Environmental Consequences, covers the second and fourth step of the planning process (Inventory, forecast and analysis of water and related land resources in the study area and evaluation of the effects of the alternative plans). This chapter is the majority of the NEPA analysis for the study.
- The remaining chapters of the report discuss: cumulative effects (Chapter 5); compliance with Federal laws and regulations (Chapter 6); public and agency involvement and review (Chapter 7); the tentatively selected plan (Chapter 8); recommendations (Chapter 9); the list of preparers (Chapter 10); and references (Chapter 11).

Chapter 2 – Need for Action

This chapter presents results of the first step of the planning process, the specification of water and related land resources problems and opportunities in the study area, and establishes the purpose and need for action within the NEPA framework. The chapter also establishes the planning objectives and planning constraints, which are the basis for formulation of alternative plans.

2.1 Purpose and Need for the Action

The purpose of the project is to improve degraded ecosystem structure, function, and dynamic processes in the Yuba River watershed to a less degraded, more natural condition. The need for ecosystem restoration in the Yuba River watershed is to reduce stressors to nationally significant resources including the critical riparian and aquatic habitats that support them. Numerous Federal, State, and local agencies have also recognized the need for restoration and are working within their authorities to implement restoration projects throughout the watershed. However USACE has the capability to undertake restoration projects that would require major hydrologic and geomorphic modifications beyond the capability of other entities.

2.1.1 Resource Significance Overview

The Yuba River watershed contains a diverse array of environments and conditions, from the snow-covered crest of the Sierra Nevada Mountain Range to the agricultural fields of the Sacramento Valley below. The variety of ecological communities support a multitude of significant resources which are legally protected under the Federal Endangered Species Act (ESA), California Endangered Species Act, Migratory Bird Treaty Act, and other regulations, including rare plant species listed by the California Native Plant Society, demonstrating institutional significance. There are 13 species with the potential to occur in the study area that are listed as Threatened or Endangered under the ESA, and the lower Yuba River is designated critical habitat for Federally listed threatened Chinook salmon, steelhead trout, and green sturgeon. The lower Yuba River is among the last Central Valley floor tributaries supporting populations of naturally-spawning spring-run Chinook salmon and steelhead (NMFS 2014).

The Central Valley of California, including the Sacramento River Basin and the Yuba River watershed, was once one of the richest regions in the world for Chinook salmon production (Yoshiyama et al. 1998). This once abundant natural resource has been in long term decline since the Euro-American settlement of the region. Massive amounts of sediment discharged by hydraulic mining covered spawning beds and filled the channels of major tributaries such as the Yuba, Feather, Bear, and American rivers, obliterating salmon runs. Additionally, dredge mining, construction of dams, and water diversion projects contributed to further loss of habitat. It is estimated that 72% of the historical Chinook salmon spawning and holding habitat in the Central Valley is no longer available (Yoshiyama et al. 2001). The amount of habitat loss for steelhead is likely much higher than that for salmon because steelhead were more extensively

distributed. On the Yuba River, most of the historical habitat was impeded by the construction of Daguerre Point Dam and completely blocked by construction of Englebright Dam.

Riparian habitat in the Central Valley of California has also been significantly reduced from historic levels. It is estimated that less than 5% of historic riparian forests remain in the Central Valley (Hunter et al. 1999) and at least 80% of historic riparian habitat has been lost in the western United States (NMFS). Degraded and diminished riparian habitat affects the quality and quantity of aquatic habitat. The lack of riparian vegetation translates to scarce shade, shelter, nutrients, and food for aquatic species. Loss, degradation, and fragmentation of riparian habitat has been identified as potentially the largest individual threat to migratory birds. Parallel to regional and national trends, riparian and aquatic habitat along the Yuba River has been drastically degraded by human activities, limiting the productiveness of the ecosystem.

Additional information on resource significance can be found in section 8.1.2.

2.2 Problems and Opportunities

Identification and specification of the problems and opportunities to be addressed is an important step in the planning process. A problem is an existing undesirable condition to be changed. An opportunity is a chance to create a future condition that is desirable. Within the context of solving the problems, opportunities contribute to the overall beneficial outcome of the project. The difference between problems and opportunities is often indistinct, but in both cases a changed future condition is preferred. The purpose of this feasibility study is to develop an implementable and acceptable plan to change the future condition and address specific water and related land resources problems and opportunities in the Yuba River watershed.

2.2.1 Problems

Modifications along the Yuba, North Yuba, Middle Yuba, and South Yuba rivers for resource extraction (hydraulic mining, dredging), initial mitigation of resource extraction effects (sediment dams, training walls), and water resource development (hydropower, water supply, flood control dams, irrigation diversions) have resulted in the following problems:

- The quality of aquatic habitat has been degraded by reduced water volume; altered depth, velocity, temperature, and substrate; and introduced heavy metals.
- Riparian habitats have been diminished in quantity, degraded in quality, and fragmented by conversion to agricultural fields and reservoirs; accumulation of mining deposits; and reduced fine sediments.
- Longitudinal river connectivity has been reduced by altered hydroperiods and sediment transport as well as blocked and impaired passage of migrating fish.
- Lateral river connectivity has been reduced by aggradation of the floodplain and channelization of the river.

The size and design of the dams on the Yuba River block and impair fish passage to different degrees. Daguerre Point Dam is 25 feet tall and has two fish ladders to permit adult

salmon and steelhead access upriver. Salmon and steelhead, as well as other species successfully use these ladders to pass over the dam, as demonstrated by an infrared fish counter and video monitoring system. However, the design of the ladders could delay or impede passage under certain conditions. At present, there is no data to quantify the degree to which the ladders delay or impede passage over the dam. Additionally, juvenile salmon and steelhead emigrating downstream over the dam may be impeded by low flows or injured or killed if passing over the spillway. Piscivorous fish that prey on juvenile salmonids have been observed in pools immediately upstream and downstream of the dam. At present, there is no data to quantify the percentage of fish that are impacted on the downstream migration. The fish ladders at Daguerre Point Dam were not designed for green sturgeon, therefore the dam is a complete barrier to upstream passage for green sturgeon. Englebright Dam is 260 feet tall and has no fish ladders. Englebright Dam is a complete barrier to upstream migration of salmonids and all other fish.

Climate change is further exacerbating habitat degradation, fragmentation, and subsequent impacts to wildlife. For example, the Western yellow-billed cuckoo breeds in low- to moderate-elevation native forests lining the rivers and streams of the western United States. They require relatively large, contiguous patches of multilayered riparian habitat for nesting. The loss and degradation of native riparian habitat throughout their range have played a major role in the bird's decline. Climate change has the potential to be an additional stressor to the cuckoo. The warmer temperatures already occurring in the southwestern United States may alter the plant species composition of riparian forests over time (NPS 2015). In the Central Valley, low species richness, poor vital rates, and low abundance of songbirds reflect the loss of riparian habitat integrity (CVJV 2006). In fact, riparian habitat loss may be the most important cause of population declines among songbird species in western North America (DeSante and George 1994), and climate change scenarios predict further changes in vegetation.

Another example of risk from climate change is to the cold-water fish species. The Yuba River watershed is historical habitat for threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, and threatened North American green sturgeon. These anadromous fish species rely on appropriate habitat and cold, clean water to survive. Climate change is likely to reduce availability and access to cold water habitat through increasing average air and water temperatures and change in precipitation patterns (NMFS 2016). Reduced snow packs would cause prolonged periods of low streamflows during summer and early fall in many California rivers. A May 2017 report from biologists at the University of California, Davis, Center for Watershed Sciences and California Trout states that nearly 75 percent of California's salmon, trout, and steelhead would be extinct in 100 years unless critical habitat is protected and restored. If present trends continue, 45 percent of species are likely to be extinct in the next 50 years (Moyle et al, 2017). While hydrology in the Yuba River also would be affected by climate change, particularly by an increase in the percentage of total precipitation that would come as rainfall, New Bullards Bar Reservoir would continue to have a large coldwater pool that would provide cold water for summer and early fall flows in the lower Yuba River.

2.2.2 Opportunities

In addition to the problems identified above, the following opportunities that could potentially be addressed in the feasibility study were also identified:

- Provide compatible recreation in conjunction with ecosystem restoration features.
- Conserve Evolutionary Significant Units of Chinook Salmon in the Yuba River watershed, including genetic isolation of seasonal runs.

Unlike many other Sierra Nevada rivers, there are no fish hatcheries on the Yuba River. In fact, the Yuba supports one of the last remaining wild salmon runs in California, providing a unique opportunity to preserve genetic integrity of independent salmonid populations. Improving opportunities for reproductive isolation would reduce interbreeding between Chinook salmon fall and spring runs and result in increased species productivity, resiliency to changing conditions, and survival.

2.3 Federal and Non-Federal Objectives

The Federal (USACE) objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to national ecosystem restoration (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units).

YCWA's primary mission is flood protection, water supply, fisheries protection and enhancement, hydroelectric generation, and recreation. The YCWA objective for the study is to identify opportunities for construction of sustainable ecological habitat improvements to the Yuba River watershed to restore the Yuba River ecosystem degraded by hydraulic mining and other anthropogenic impacts.

2.4 Planning Goals and Objectives

The overall goal of the study is to restore degraded ecosystem structure, function, and dynamic processes of the Yuba River watershed to a less degraded, more natural condition. The planning objectives, which are developed specifically for this study, are statements of the intended steps toward achieving the goals. An objective is developed to address each of the identified problems and opportunities. Planning objectives represent desired positive changes in the future without-project conditions.

Each planning objective is applicable to the entire Yuba River watershed study area over a 50-year period of analysis. Based upon the problems and opportunity identified in the study area, planning objectives include the following.

- **Improve the quantity, quality, and complexity of aquatic habitats.** This objective addresses the improvement of aquatic habitats and the functions those habitats provide

for all life stages of anadromous fish, water birds, amphibians, and other wildlife within the watershed.

- **Improve the quantity, quality, complexity, and connectivity of riparian habitats.** This objective addresses the improvement of riparian habitats and migratory corridors and the functions those habitats provide for waterfowl, water birds, riparian songbirds, amphibians, and other wildlife within the watershed.
- **Improve longitudinal river connectivity.** This objective addresses the improvement of hydrologic and aquatic habitat connectivity. Critical components of longitudinal connectivity include the downstream movement of anadromous fish, water and sediment, and the upstream movement of anadromous fish and the oceanic nutrients they provide. Connectivity is improved when areas of suitable habitat are joined or gaps between areas of suitable habitat are reduced.
- **Improve lateral connectivity of the river to its floodplain.** This objective addresses the improvement of hydrologic connectivity within and between aquatic and floodplain habitats. Critical components of connectivity include the lateral, or horizontal movement of water within the channel and onto the floodplain, and the vertical, or downward movement of water into the ground.

The feasibility study presents a range of alternative plans that balance objectives and avoid conflicts or, where necessary, demonstrate the tradeoffs between conflicting objectives, enabling decisions to be made. The Federal objective is to maximize net benefits. Because of this, it is not appropriate to identify targets within objectives. For example, no target of minimum acreage of restored habitat was identified for the project. Rather, the planning process includes formulation of alternative plans to maximize NER benefits relative to cost.

2.5 Planning Constraints

A constraint is a restriction that limits the extent of the planning process. It is a statement of aspects of the study area the alternative plans should avoid. In the development of alternatives, the following constraints were identified:

- The recommended plan would not recommend any action that is legally required of another entity or is included as O&M of an existing USACE project, *e.g.*, mitigation requirements of FERC licenses or NMFS May 2014 Biological Opinion.
- Removal of any Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulated wastes would be a responsibility of the non-Federal sponsor, *e.g.*, contaminated sediment.

An example situation in which the constraint would apply is pollution abatement. According to the ER 1105-2-100, paragraph E-30.g., USACE would not propose any restoration projects or features that would result in treating or otherwise abating pollution problems caused by other parties where the other parties have, or are likely to have, a legal responsibility for remediation or other compliance responsibility. Any such actions would become part of the

future without-project condition. Also, a USACE restoration project cannot implement fish and wildlife mitigation that is required for another project or be used as a mitigation credit.

2.6 Planning Considerations

In addition to the planning constraints, the following key planning considerations were recognized. Key considerations are based on identified study or implementation risks. The feasibility study will seek to identify measures and alternatives that address these considerations to the extent practicable.

- Do not increase flood risk or reduce flood management capabilities.
- Do not have a significant negative effect on Federal ESA-listed species or impair existing habitat for listed species in the future.
- Avoid or minimize, where practicable, providing upstream passage for non-native fish.
- Avoid or minimize adverse effects on the downstream water users' diversions at Daguerre Point Dam.
- Avoid or minimize, where practicable, adverse effects to groundwater recharge.
- Avoid or minimize, where practicable, impeding green sturgeon recovery efforts.
- Avoid or minimize, where practicable, impeding public access or recreational opportunities as currently allowed.

An outstanding challenge is, and would remain, the presence of toxic sediments behind Englebright and Daguerre Point dams (including mercury, arsenic, chromium, copper, and nickel) deposited from past mining activities (USGS, 2004 and 2006). Responsibilities for any remedial action would be determined in accordance with applicable laws, regulations, and policies.

Chapter 3 – Alternative Plans

3.1 Plan Formulation Process

The formulation, evaluation, and comparison of alternative plans comprise the third, fourth, and fifth steps of the USACE planning process. These steps are often referred to collectively as plan formulation. Plan formulation is an iterative process that involves cycling through the formulation, evaluation, and comparison steps several times to develop a reasonable range of alternative plans and then narrow those plans down to a final array of feasible plans from which a single plan can be identified for implementation.

In this study, preliminary measures were first tested against planning criteria as described in Section 3.2. Next, the measures that passed tests of the planning criteria were scored based on cost, quantity, and quality of habitat restored. Scores from this evaluation exercise were plugged into an efficiency formula ((quantity factor x quality factor) / cost factor) and ranked accordingly as described in Section 3.4.3. To capture uncertainty and the potential for unforeseen outcomes in the cost, quantity, and quality scores, the measures were also assigned risk scores and ranked accordingly. After analyzing the results of this evaluation process, the measures with the best efficiency and risk scores were carried through to form the final array of alternatives. At this stage of the planning process, cost estimates and average annual habitat units were developed and used in a cost effectiveness and incremental cost analysis. This analysis, as described in Sections 3.6 through 3.8, allowed for a comparison of the final array of alternatives and ultimately identification of a single plan for implementation.

3.2 Planning Criteria

Planning criteria are used to formulate, screen, evaluate, and compare measures and alternative plans. Four specific formulation criteria are required in USACE water resource studies, as described in ER 1105-2-100, paragraph 2-3.c: completeness, effectiveness, efficiency, and acceptability. These criteria are generally subjective and are useful in narrowing down the array of possible alternative plans. With the exception of completeness, these criteria are also useful in screening potential measures. The four planning criteria are:

- **Completeness.** Completeness is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities. It is an indication of the degree to which the planned outputs are dependent upon the actions of others. All alternative plans were formulated to be complete.
- **Effectiveness.** Effectiveness is the extent to which a measure or alternative plan contributes to achieving the planning objectives. Measures that clearly make little or no contribution to the planning objectives were dropped from consideration.
- **Efficiency.** Efficiency is the extent to which a measure or alternative plan is the most cost effective means of achieving the planning objectives. In a USACE ecosystem

restoration study, benefits are non-monetary. Measures that provide little benefit relative to cost were dropped from consideration.

- **Acceptability.** Acceptability is the extent to which a measure or alternative plan is acceptable in terms of applicable laws, regulations and public policies. Unpopular plans are not necessarily unacceptable, just unpopular. Measures that were clearly not acceptable were dropped from consideration.

Measures and plans that pass the screening criteria are evaluated and compared against more specific evaluation criteria, which are described later in this chapter. Evaluation criteria can include costs, outputs, or effects and reflect the planning objectives or constraints. Some or all of the evaluation criteria may be used at various stages in the plan formulation process to compare alternative plans. Effective evaluation criteria must be measurable and reveal differences or trade-offs between alternative plans.

3.3 Future Without-Project Conditions

Alternative plans are formulated and evaluated based on the future without-project condition. The future without-project condition is forecasted from the base year (the year when the proposed project is expected to be operational) to the end of the 50-year period of analysis. For this study, the assumed base year is 2025. Forecasts should consider all other actions, plans, and programs that are most likely to be implemented in the future to address the problems and opportunities in the study area in absence of a USACE project. For the purpose of this study, a project was considered likely to be implemented if it was funded for construction; projects in planning were not included in the future without-project conditions because of the inherent uncertainty associated with future funding.

If no Federal action is taken, the Yuba River ecosystem-related problems existing today are expected to continue, and stressors would persist and potentially become exacerbated. Populations of Chinook salmon, steelhead, and waterbirds would continue to be significantly reduced from historic conditions. Connectivity of the riverine aquatic habitat would continue to be curtailed by the presence of large dams in the watershed. Regeneration of riparian habitat would continue to be impeded by coarse substrate conditions on the lower Yuba River. Incremental improvements to currently accessible habitat may be made by other entities. However, the cost of large scale excavation is likely a barrier to other entities and the sites requiring minimal excavation have already been addressed, leaving the most problematic and expensive sites in the current state of degradation.

Under the Englebright Dam project authority, USACE is responsible for various discretionary and non-discretionary functions. The discretionary functions include activities related to the manner and frequency of maintaining the recreational facilities on the reservoir. Non-discretionary functions include the inspection and maintenance of the dam structure to ensure it remains in good repair. USACE does not conduct any water control operations or releases for the dam.

Under the Daguerre Point Dam project authority, USACE is responsible for various discretionary and non-discretionary functions. The discretionary functions include, but are not

limited to, the timing and frequency of monitoring and clearing debris from the existing fish passage facilities, and managing sediment buildup across the upstream face of the dam. Future gravel injections and the Large Woody Material Management Plan are anticipated as components of USACE's voluntary conservation measures associated with the recent ESA consultation. USACE's Gravel Augmentation Implementation Plan contains guidance for a long-term gravel injection program to provide spring-run Chinook salmon spawning habitat in the bedrock canyon downstream of Englebright Dam. Non-discretionary functions include the inspection and maintenance of the dam structure and fishways to ensure they remain in good repair.

Mining would continue in the Yuba Goldfields, and the tailings would remain. Restoration opportunities may be present in the Yuba Goldfields, however, due to the tremendous volume of gravel tailings and the inability of those tailings to support much vegetation, the future without-project condition does not include any restoration projects in the Yuba Goldfields.

Flood Risk Management structures would continue to be constructed and maintained in the lowest portion of the watershed. Three River Levee Improvement Authority (TRLIA) plans to construct a levee within the Yuba Goldfields and along the southern edge, about three miles southwest of Daguerre Point Dam and one mile south of the river (Figure 3-1).

Implementation of lower Yuba River restoration actions by other entities is expected to continue. The USFWS Anadromous Fish Restoration Program (AFRP) has completed one project, with two more projects scheduled for implementation in 2018. 1) Implemented in 2011-2012, the Hammon Bar Restoration Project was the first habitat restoration project to occur on the lower Yuba River. Over 6,000 willow and cottonwood species were planted with the goal of creating diverse riparian vegetation that would enhance fish habitat. The project was designed to test the methods and resulting habitat benefits of planting large cuttings of cottonwood and willow trees. 2) The Hallwood Side Channel and Floodplain Restoration Project has the potential to enhance or create up to 170 acres of seasonally-inundated riparian floodplain habitats, more than 3 miles of perennial side channels and alcoves, and more than 4 miles of seasonal side channels. 3) The Yuba River Canyon Salmon Habitat Restoration Project would restore up to 0.5 miles of in-channel spawning habitat by restoring and replenishing gravel and removing shot rock debris from the Narrows Reach, which is below Englebright Dam. Figure 8-2 displays how the habitat increments proposed in this study build upon completed and proposed AFRP projects.

Over the next 50 years, climate change is expected to be a stressor for anadromous salmonids in the Yuba River, and climate change in general poses an additional risk to the survival of salmonids in the Central Valley (NMFS 2014). According to National Oceanic and Atmospheric Administration (NOAA) research, under the expected warming of around 5°C, substantial habitat in the Central Valley would be lost, although significant amounts of habitat could remain, primarily in the Feather and Yuba Rivers (Lindley et al. 2007). Literature suggests

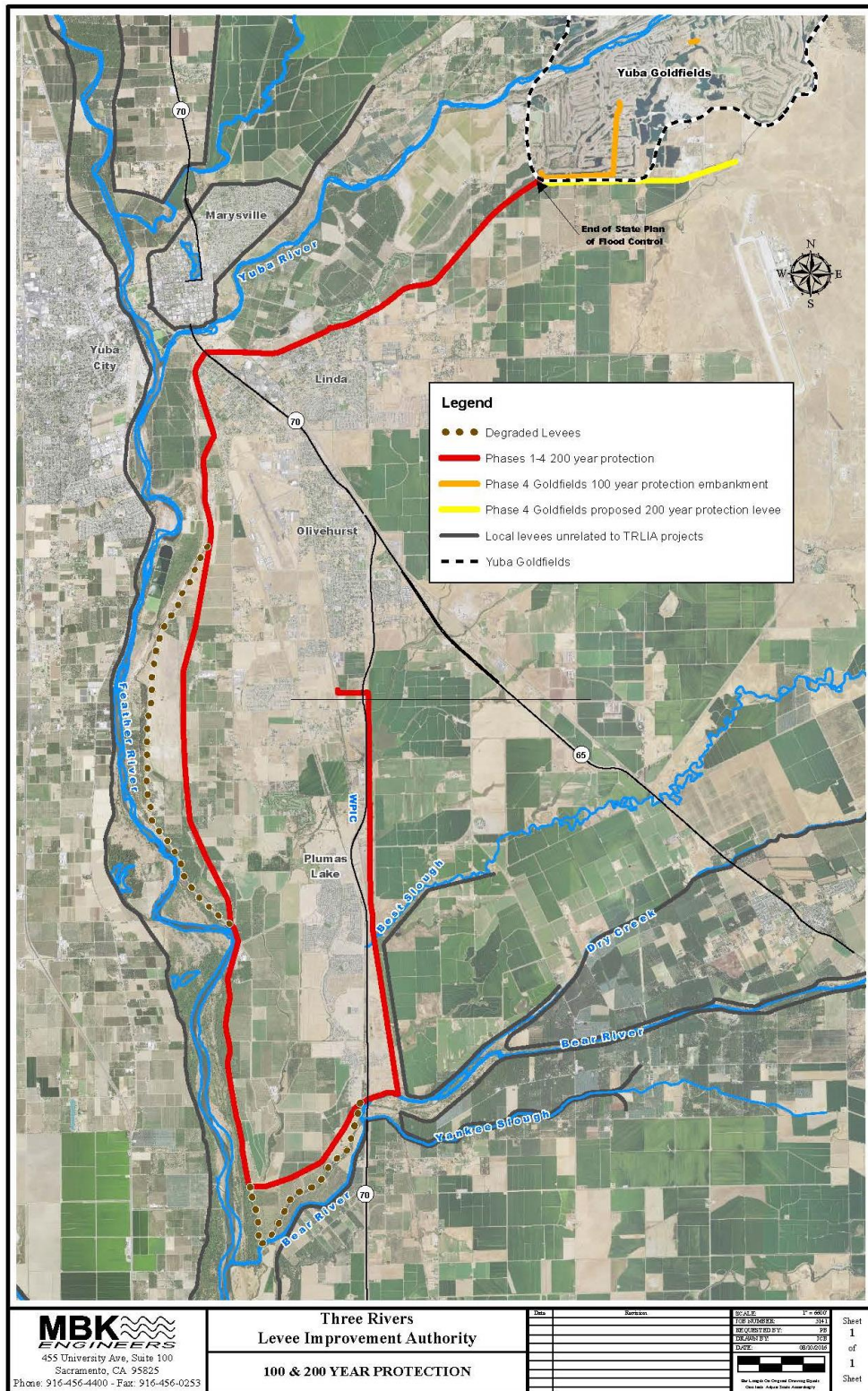


Figure 3-1. Proposed levees in the Yuba Goldfields.

that by the year 2100, mean summer temperatures in the Central Valley may increase by 2 to 8°C. Precipitation would likely shift to more rain and less snow, with significant declines in total precipitation possible. Hydrographs would likely change, and Chinook salmon and steelhead would be more thermally stressed by stream warming at the southern ends of their ranges (NMFS 2014).

NMFS (2014) has prioritized the upper Yuba River (upstream of Englebright Dam) as a primary area to re-establish viable populations of spring-run Chinook salmon and steelhead. Recent studies conducted by Yuba Salmon Forum (YSF) (2013) demonstrate that of all rivers/reaches in the Yuba River watershed, the North Yuba River upstream of New Bullards Bar Reservoir and the lower Yuba River downstream of Englebright Dam provide the most thermally suitable amounts of habitat in the watershed. The North Yuba River, because of the lack of storage reservoirs and water management infrastructure, most closely approximates unimpaired conditions. According to YCWA (2010), because of specific physical factors, hydrologic factors, and flows negotiated under the Yuba Accord, the lower Yuba River is expected to continue to provide the most suitable water temperature conditions for anadromous salmonids of all Central Valley floor rivers, even if there are long-term climate changes. This is because New Bullards Bar Reservoir is a deep, steep-sloped reservoir with ample cold water pool reserves that would continue to be available to provide sustained, relatively cold flows of water into the lower Yuba River during the late spring, summer, and fall of each year (YCWA 2010).

Public lands along the South Yuba River would continue to be managed under the South Yuba River Comprehensive Management Plan. The plan is the result of a multi-agency effort to develop a shared vision for lands along the river.

Urban development along the Yuba River would be negligible. Most of the upper watershed is National Forest land. The towns along the upper portions of the Yuba River are over an hour's drive from job centers, so they are not expected to grow significantly. Areas along the lower Yuba River are expected to remain rural; indeed, Yuba County's current general plan, from 2011, states that, "Rural residential areas would be preserved, recognizing the need to provide for a variety of lifestyles. On the valley floor, lands that are the least productive for agricultural purposes would be committed to development while higher value agricultural land would be protected from encroachment and preserved for future generations of farmers."

The Water Resources Council's Principles and Guidelines specify that formulation and evaluation of alternatives should be based on the most likely conditions expected to exist in the future. Other programs currently in early planning phases could also potentially influence the study area in the future, but are not assumed to be part of the future without-project conditions. They include the Yuba Salmon Partnership Initiative, which is investigating collection and transport of spring-run chinook to the North Yuba River and the Yuba County Integrated Regional Water Management Plan. They are not assumed to be part of the future without-project conditions because they are not funded and approved. Also, FERC relicensing of some existing facilities would be required in the future, but no specific changes associated with relicensing are assumed as part of the future without-project-conditions. Any assumptions regarding specific future changes would be highly speculative and therefore inappropriate for inclusion in the future without-project-conditions because no specific changes have been required by FERC.

3.4 Identification and Screening of Measures

Preliminary measures were compiled from several source documents including the Central Valley Recovery Plan (NMFS 2014), Yuba River Ecosystem Restoration Section 905(b) Analysis (USACE 2014), Habitat Expansion Plan (DWR and PG&E 2010), Habitat Expansion for Spring-run Chinook Salmon and Steelhead (RMT 2009), Daguerre Alley Habitat Enhancement Measures (cbec 2014), Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach (cbec et al. 2010), and Rehabilitation Planning from Parks Bar to Marysville (cbec 2013). Additional preliminary measures were suggested at the YRER Planning Charette held in Marysville, California from September 22 – 25, 2015. The compiled preliminary measures were screened and, in some cases, combined to form initial measures with identifiable ecosystem outputs that would address the planning objectives.

3.4.1 Plan Formulation Rationale

Initial measures were developed to address study objectives, as shown below in Table 3-1. The four general types of initial measures that were developed were riverine habitat restoration, connectivity at Daguerre Point Dam, connectivity at Englebright Dam, and connectivity at New Bullards Bar Dam. Riverine habitat restoration is considered nonstructural and all other measures are considered structural.

3.4.2 Description of Initial Measures

- Lower Yuba Habitat Restoration. This measure represents approximately 40 habitat restoration site concepts along the lower Yuba River which include channel, floodplain, and riparian habitat improvements, such as floodplain grading, side-channel and backwater creation, riparian vegetation planting, and installation of woody material. After the screening process described below, the site concepts were divided into multiple geographic increments for further evaluation.
- Daguerre Point Dam Step Pools. This measure involves constructing a series of low-head weirs, also known as step pools, across the river downstream of the dam. This measure addresses upstream and downstream fish passage. Existing irrigation diversions would not be affected.
- Daguerre Point Dam 10% Bypass. This measure includes a fishway/bypass around Daguerre Point Dam, which would redirect up to 10% of the flows around the dam in order to facilitate fish passage. NMFS and CDFW generally accept a fishway design flow of 10% of the fish passage flow (related to flows during the upstream migration period). Flow for fish passage releases would be controlled by a headworks structure by regulating flow in the bypass channel in proportion to flow in the Yuba River. A concrete floodwall or levee along the proposed channel boundary would be required to protect the bypass channel from high river flows. Additionally, this measure could affect at least one irrigation diversion.

Table 3-1. Initial Measures to Achieve Study Objectives.

Initial Measures	Objective: Improve the quantity, quality, complexity of aquatic habitats	Objective: Improve the quantity, quality, complexity, and connectivity of riparian habitats	Objective: Improve longitudinal river connectivity	Objective: Improve lateral connectivity of the river to its floodplain habitat
Lower Yuba River Habitat Restoration – <i>Floodplain grading</i>	X	X	X	X
Lower Yuba River Habitat Restoration – <i>Floodplain lowering</i>	X	X	X	X
Lower Yuba River Habitat Restoration – <i>Riparian vegetation planting</i>	X	X		
Lower Yuba River Habitat Restoration – <i>Side channel creation</i>	X		X	
Lower Yuba River Habitat Restoration – <i>Bank scalloping</i>	X			X
Lower Yuba River Habitat Restoration – <i>Large woody material or engineered log jams</i>	X			
Lower Yuba River Habitat Restoration – <i>Boulders</i>	X			
Lower Yuba River Habitat Restoration – <i>Backwater areas</i>	X	X		X
Daguerre Point Dam Step Pools			X	
Daguerre Point Dam 10% bypass			X	
Daguerre Point Dam Removal	X	X	X	X
Englebright Dam Fish Ladder			X	
Englebright Dam Fish Tram			X	
Englebright Dam Bypass			X	
Englebright Dam Removal	X	X	X	X
Collect and Transport Above Englebright Dam			X	
Collect and Transport Above New Bullards Bar Dam			X	

- Daguerre Point Dam Removal. This measure includes blasting and demolishing the existing 575-foot-wide by 25-foot-high by 50-foot-thick ogee-type concrete debris control dam, the 575-foot-wide by 65-foot-long concrete apron, retaining walls, abutments, and the two existing fish ladders. Potentially over four million cubic yards of stored sediment would need to be addressed, as well as effects to the existing irrigation diversions.
- Englebright Dam Fish Ladder. This measure includes the installation of a fish ladder at Englebright Dam. The ladder would likely be constructed along the northern side of the Yuba River, with its entrance near the existing Narrows 2 Powerhouse. A juvenile collection facility consisting of a floating surface collector or screen system would be required within Englebright Reservoir to collect juvenile salmon, and juvenile and adult steelhead. Juveniles would be returned to the lower Yuba River via truck, piping, or tramway.
- Englebright Dam Fish Tram. This measure involves the construction of a mechanical tramway or elevator to transport adult fish (upstream) and juvenile fish (downstream) over the existing Englebright Dam. The tramway would be constructed along the northern side of the Yuba River, with its entrance near the existing Narrows 2 Powerhouse. The tramway system would include an attraction and crowding system for adult fish, large bins to carry fish, and a rail or cable system to hoist the live fish boxes up and over the dam. The same hoist and box system could be used to return juveniles to the lower Yuba River. A juvenile collection facility consisting of a floating surface collector or screen system would be required within Englebright Reservoir to collect juvenile salmon, and juvenile and adult steelhead. Juveniles would be returned to the lower Yuba River via tramway.
- Englebright Dam Bypass. This measure uses Deer Creek and a newly constructed canal to provide a low-gradient, rock-bedded channel for adult migration. Modifications to the existing Deer Creek channel would need to be undertaken, such as re-contouring and removal of natural barriers, to ensure the potential for successful fish passage at a range of flows. The new canal would be several miles long. A headworks structure and short fish ladder would be required to control flows into the canal, since reservoir elevations vary by 10 to 15 feet. A juvenile collection facility, consisting of a floating surface collector or screen system, would be required within Englebright Reservoir to collect juvenile salmon, and juvenile and adult steelhead. Juveniles would be returned to the lower Yuba River via truck, piping, tramway, or through the bypass.
- Englebright Dam Removal. This measure includes the complete removal of Englebright Dam. The large volume of sediment deposited behind Englebright Dam cannot be released due to water quality concerns. The sediment would either need to be completely or partially removed or secured in place in such a manner that the sediment would not be mobilized and released downstream. Due to upstream fish passage concerns, this measure also includes a fish ladder and juvenile return bypass on the Middle Yuba River, and improvements to the New Bullards Bar Dam outlet, tailrace, and habitat downstream of New Bullards Bar Dam.

- Collect and Transport above Englebright Dam and Reservoir. This measure includes the upstream collection and transport of adult spring-run Chinook salmon from the lower Yuba River at Daguerre Point Dam to above Englebright Reservoir (to the Middle and/or South Yuba Rivers) and the downstream collection and transport of juvenile spring-run Chinook salmon from Englebright Reservoir to the lower Yuba River. Fish would be transported via tanker truck to historic spawning habitat in the upper watershed.
- Collect and Transport above New Bullards Bar Dam and Reservoir. This measure includes the upstream collection and transport of adult spring-run Chinook salmon from the lower Yuba River at Daguerre Point Dam to above New Bullards Bar Reservoir and the downstream collection and transport of juvenile spring-run Chinook salmon from the North Yuba River to the lower Yuba River. Fish would be transported via tanker truck to historic spawning habitat in the upper watershed.

3.4.2.1 Preliminary Measures Not Considered in Detail

- Daguerre Point Dam Fish Ladder. This measure consists of two new fish ladders to replace existing fish ladders. This would primarily serve to improve upstream migration but fails to improve downstream fish passage. Based on currently available information, it is not possible to demonstrate that new fish ladders would be a cost-effective method providing quantifiable ecosystem restoration benefits compared to the other measures considered. Available data indicate that most fish attempting to migrate upstream are currently able to do so successfully. Although the effectiveness of the fish ladders might be improved based on current design criteria, it is not possible to accurately quantify that improvement in terms of ecosystem outputs because (1) there is insufficient quantitative information on the degree to which upstream migration remains impeded despite the existing fish ladders, (2) the degree to which a new ladder would improve upstream migration is not known, and (3) there is no existing USACE-approved ecosystem model that would quantify ecosystem outputs from improved fish migration for direct comparison to ecosystem outputs from the other restoration measures considered, including aquatic and riparian habitat restoration. This measure was not carried forward for further consideration because it cannot be shown to be effective or efficient based on information that can be obtained within the scope of this study.
- Lower or Notch Englebright Dam and Install a Fish Ladder. The normal water surface elevation immediately downstream of Englebright Dam is approximately 287 feet and the existing dam crest elevation is 527 feet, for a height difference of approximately 240 feet. According to research and anecdotal information, it is not clear that a fish ladder has been successfully implemented over a dam of this height. This measure includes lowering Englebright Dam by about 100 feet so that it could accommodate a fish ladder within both the length and height of previously constructed successful fish ladders. Construction of a juvenile collection and transport system near Englebright Dam would be necessary to collect and concentrate juveniles, and convey the juveniles safely downstream through use of a bypass pipe or other arrangement. Similar to a complete removal of Englebright Dam, a modification of this nature would require at least a partial

removal of sediment behind Englebright Dam because it is deposited at a relatively high elevation in the upper reservoir. This measure retains high technical complexity, high operations and maintenance costs, and high technical and cost uncertainty with minimal additional habitat restored; therefore, it is not carried forward for further consideration because it would not be efficient.

- Construct a second dam as a step to Englebright Dam. This measure would generally include construction of a second dam and reservoir downstream of Englebright Dam, and construction of two fish ladders, one from the river to the top of the first dam, the second from the first reservoir to the top of Englebright Dam. There are currently no conceptual evaluations of this concept. Construction of a second dam would result in additional impacts compared to other measures, including impacts to existing power facilities and the inundation of existing riverine habitat. This measure would not result in additional benefits and therefore is not carried forward for further consideration because it would be less efficient than other measures.
- Construct a segregation weir downstream of Englebright Dam. This measure would include establishing a barrier across the width of the river, potentially comprised of a fixed sill or base, with weir pickets installed seasonally to provide positive distinction between Chinook salmon runs. The design would need to accommodate a range of flow levels, as well as consider recreational and safety issues. This measure would require annual operation and maintenance. This measure is limited to single species management, which would not be consistent with policy regarding USACE participation in ecosystem restoration.
- Habitat restoration in the Yuba Goldfields. Because the Yuba Goldfields are covered by extensive deposits of large cobbles from previous mining, and continue to be actively mined, this measure would be less efficient than other potential restoration measures.

Additional measures were suggested during the study scoping process, but were not considered in detail because they would not be consistent with USACE ecosystem restoration policy and, therefore, would not be acceptable. Under USACE policy, the objective of ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition, rather than to manage particular species (ER 1105-2-100 and EP 1165-2-502). Generally, restoration lands must be acquired in fee title by the non-Federal sponsor; however, restoration cannot consist primarily of land acquisition. Clean up of hazardous or toxic materials is not an ecosystem restoration purpose. Regulation of land use is a non-Federal responsibility. Operation of existing water supply and hydropower facilities is the responsibility of the operating and regulating agencies. The use of USACE funds to mitigate the effects of a non-federal USACE licensed water diversion would not be consistent with USACE Policy. The following preliminary measures were not considered in detail because they would not be consistent with these general policies regarding USACE participation in ecosystem restoration. These measures could be implemented by other agencies or organizations in addition to the plan recommended by this study.

- Rice field rearing of fish.
- Build a hatchery.
- Conduct mining to remove mercury.
- Mine remediation.
- Mercury clean-up.
- Zoning restrictions and other government planning processes to curtail further development in active floodplains of the Yuba River.
- Permanently protect riparian and floodplain habitat through easements and/or land acquisition.
- Implement programs and measures to minimize predation by non-native fish.
- Monitor and evaluate sport fishing regulations to ensure they are consistent with recovery of listed salmonids.
- Evaluate whether adult anadromous salmonids straying between the Feather and Yuba Rivers can be minimized through flow management.
- Implement flow fluctuation and ramping rates found to be protective of anadromous salmonid embryos and juveniles.
- Modify the Hallwood-Cordua diversion facility to decrease mortality of out-migrating juvenile anadromous salmonids.
- Modify the South Yuba/Brophy diversion facility to decrease mortality of out-migrating juvenile anadromous salmonids.
- Install new security features or reconstruct existing barriers to limit public access at Daguerre Point Dam to reduce poaching of indicator fish species.
- Removal or realignment of Hammonton Road between Lower Gilt Edge Bar and First Island.
- Relocate the riverside motocross recreation area, located in the Marysville Reach, outside of the active floodplain.

3.4.3 Screening of Initial Measures

In order to ensure that only implementable measures with a reasonable chance of achieving a significant increase in habitat value at a reasonable cost (i.e., efficient measures) were included in the final array of alternatives, criteria were established to further screen measures. The criteria used to screen measures are efficiency (cost, habitat quantity, and habitat quality) and risk to efficiency. Use of efficiency and risk to efficiency as screening criteria is consistent with the NER objective, which is to reasonably maximize ecosystem benefits compared to costs. These criteria are further described below:

3.4.3.1 Efficiency.

For the purposes of screening measures, relative efficiency was calculated for each measure based on estimated cost, quantity of habitat restored, and quality of habitat restored, as described below:

Estimated Cost.

In order to compare the relative costs of measures, cost categories were established to rank measures as Low-Medium-High cost. Cost categories with \$200 million ranges were used because of the high degree of uncertainty in the rough order of magnitude cost estimates used in the screening process. For efficiency calculations, associated ranking factors were also assigned. Cost ranking categories and associated ranking factors shown in Table 3-2 are as follows:

- Low (Ranking Factor 1) = \$0 to \$200 million
- Low-Medium (Ranking Factor 2) = \$200 to \$400 million
- Medium (Ranking Factor 3) = \$400 to \$600 million
- Medium-High (Ranking Factor 4) = \$600 to \$800 million
- High (Ranking Factor 5) = \$800 to \$1,000 million
- Very High (Ranking Factor 6) = \$1,000 to \$1,200 million
- Very High (Ranking Factor 7) = \$1,200 to \$1,400 million
- Very High (Ranking Factor 8) = \$1,400 to \$1,600 million
- Very High (Ranking Factor 9) = \$1,600 to \$1,800 million
- Very High (Ranking Factor 10) = over \$1,800 million

Table 3-2. Cost Ranking.

Measure	Cost	Ranking Factor
Lower Yuba Habitat Restoration	Low	1
Daguerre Point Dam Step Pools	Low	1
Daguerre Point Dam 10% Bypass	Low	1
Daguerre Point Dam Removal	Med	3
Englebright Dam Fish Ladder	High	5
Englebright Dam Fish Tram	Very High	6
Englebright Dam Bypass	Very High	6
Englebright Dam Removal	Very High	10
Collect and Transport above New Bullards Bar Dam and Reservoir	Low-Med	2
Collect and Transport above Englebright Dam and Reservoir	Med	3

Quantity of Habitat Restored.

- The quantity of habitat restoration by the various measures was compared in terms of both (1) the size of the area within which habitat quality would be improved and (2) the degree to which unrestricted ecological connectivity between existing areas of habitat would be restored. Translating these two factors into a single common unit of measure for the comparison of diverse measures is a difficult problem for which there is no generally accepted solution. After considering various potential approaches, USACE decided to use the conversion method presented in the USACE Fiscal Year 2016 Budget Development Guidance, Engineer Circular 11-2-206, Appendix C, 31 Mar 2014 (EC 11-2-206). Although the EC method was intended only for prioritizing projects for budget purposes, the EC provides an unbiased and logical approach to converting area and connectivity factors into a single metric. The EC method is an excellent fit because it was developed to compare aquatic habitat improvements, dam removals, and fish passage improvements, which are the same categories as the types of measures being considered in this study. The EC method measures the quantity of ecological outputs from fish passage improvements in terms of equivalence to acres of habitat restored.
 - Formulas described in EC 11-2-206 were applied as follows:
 - Direct alterations of habitat in a channel = bank to bank stream width multiplied by the length of the reach within which the restoration measures are located.

- Dam removal = [length of the impoundment created by the dam under normal flow conditions multiplied by the width of the river immediately upstream of the impoundment] plus [length of the mainstem river up to the next fish passage impediment multiplied by the width of the river immediately upstream of the impoundment multiplied by a factor of 0.25] Per EC 11-2-206, the 0.25 multiplier represents the fact that fish are restored to the reach, but that fish only represent one component of the habitat.
- Fish passage project other than complete dam removal = length of the mainstem river up to the next fish passage impediment multiplied by the width of the river immediately upstream of the impoundment multiplied by a factor of 0.25, as described above. Additionally, this product is then multiplied by an efficiency factor of 0.9 for nature-like bypass channels, 0.8 for rock ramp, and 0.6 for fish ladders. An efficiency factor of 0.6 was also applied for collect and transport measures because of the limited degree of ecological connectivity that would be provided by those measures.
- Based on the formulas described above, quantity ranking categories shown in Table 3-3 are as follows:
 - Low (Ranking Factor 1) = 0 to 100 acres
 - Low-Medium (Ranking Factor 2) = 101 to 200 acres
 - Medium (Ranking Factor 3) = 201 to 300 acres
 - Medium-High (Ranking Factor 4) = 301 to 400 acres
- High (Ranking Factor 5) = 401 to 500 acres

Table 3-3. Quantity Ranking.

Measure	Quantity of Habitat Restored	Ranking Factor
Lower Yuba Habitat Restoration	Med	3
Daguerre Point Dam Step Pools	Low	1
Daguerre Point Dam 10% Bypass	Low	1
Daguerre Point Dam Removal	Med	3
Englebright Dam Fish Ladder	Low-Med	2
Englebright Dam Fish Tram	Low-Med	2
Englebright Dam Bypass	Low-Med	2
Englebright Dam Removal	Med-High	4
Collect and Transport above New Bullards Bar Dam and Reservoir	Low	1
Collect and Transport above Englebright Dam and Reservoir	Low-Med	2

Quality and Significance of Habitat Restored.

- In order to compare the quality of habitat restored, the following significance criteria derived from ER 1105-2-100, Appendix E, paragraph E-37 and ranking criteria from EC 11-2-206 were applied to the measures, as shown in Table 3-4:
 - *Habitat Scarcity.* This ranking represents the scarcity of the type of habitat from a national and regional context:
 - High (Ranking Factor 5) indicates the measures would restore nationally scarce habitat;
 - Medium-High (Ranking Factor 4) indicates the measure would restore regionally scarce habitat;
 - Medium (Ranking Factor 3) indicates the measure would restore a broad type of habitat (e.g., wetlands) that is recognized nationally as declining;
 - Low-Medium (Ranking Factor 2) indicates the measure would restore other declining habitat types; and
 - Low (Ranking Factor 1) indicates the measure would restore a habitat type that is abundant, stable at natural levels, or improving beyond natural levels.

All measures were assigned to Ranking Factor 4 based on the regional scarcity of anadromous fish habitat and riparian forest and shrub-scrub habitats.

- *Connectivity.* This ranking represents the extent to which the measure facilitates the movements of native species. For Daguerre Point Dam, the future without-project condition assumes the existing fish ladders remain in place; therefore, scores for measures at Daguerre Point Dam were reduced in order to represent the net improvement from the future without-project conditions. (Example: dam removal is in Ranking Factor 5, but the future without-project condition is the existing fish ladder, which is in Ranking Factor 3, so the improvement resulting from dam removal was assigned to Ranking Factor 2, to represent the net improvement from Ranking Factor 3 to Ranking Factor 5.) Rankings are as follows:
 - High (Ranking Factor 5) indicates the measure would fully restore a critical direct physical connection between existing habitat areas within a corridor (e.g., removing a dam);
 - Medium-High (Ranking Factor 4) indicates the measure would create a nodal connection between existing habitat areas within a corridor (e.g., ramps or by-pass channels);
 - Medium (Ranking Factor 3) indicates the measure would restore suitability of an existing connection or corridor (e.g., fish ladders [existing condition at Daguerre Point Dam]); Englebright Dam fish tram and bypass, and collect and transport

were also assigned to this category because they would similarly be unnatural measures focused solely on salmonid passage;

- Low-Medium (Ranking Factor 2) indicates the measure would provide a large expansion to an existing habitat; and
 - Low (Ranking Factor 1) indicates the measure is an isolated unit.
- *Special Status Species.* This ranking represents the extent to which a significant contribution would be made to some key life requisite within the potential range of a special status species. Rankings are as follows:
- High (Ranking Factor 5) indicates the measures restore habitat for Federally listed or candidate threatened or endangered species;
 - Medium (Ranking Factor 3) indicates the measures restore habitat for species covered by international treaty, such as International Migratory Birds; and
 - Low (Ranking Factor 1) indicates the measures restore habitat for State listed or candidate species.

All measures were assigned to Ranking Factor 5 because they would restore habitat for Federally-listed species.

- *Hydrologic Character.* This ranking represents the degree to which appropriate hydrology is restored in order to maintain the ecological functions of aquatic, wetland, and/or riparian systems. Rankings are as follows:
- High (Ranking Factor 5) indicates the measures fully restore the natural hydrology to the system or site;
 - Medium-High (Ranking Factor 4) indicates the measures partially restore the natural hydrology to the system or site;
 - Medium (Ranking Factor 3) indicates hydrologic impairment does not exist at the site or the hydrology is restored to the best attainable condition, but remains a limiting factor in ecosystem health;
 - Low-Medium (Ranking Factor 2) indicates some elements of the system or site hydrology are restored but most conditions necessary for a more natural hydrology are not attained; and
 - Low (Ranking Factor 1) indicates the measures do not address hydrologic restoration, although hydrologic impairments exist on the system or critical goals are not attained.

Dam removal measures were assigned to Ranking Factor 4 because they would restore natural hydrology at the dam sites to a significant degree, but would not fully restore the natural hydrology. Other measures were assigned to Ranking Factor 1 because they would not restore natural hydrology to a significant degree.

- *Geomorphic Character.* This ranking relates to the establishment of suitable structure and physical processes for successful restoration. Rankings are as follows:
 - High (Ranking Factor 5) indicates the measures fully restore the natural or attainable geomorphic processes and form to the system or site;
 - Medium-High (Ranking Factor 4) indicates the measures restore the key geomorphic processes to the system or site, and the system is expected to recover full ecological function within an appropriate timeframe;
 - Medium (Ranking Factor 3) indicates geomorphic impairment does not exist at the site or the geomorphology is restored to the best attainable condition, but remains a limiting factor in ecosystem health;
 - Low-Medium (Ranking Factor 2) indicates the form of the site or system is restored, but some key system processes remain degraded or non-functional (e.g., restoration of an oxbow on a stream that is not allowed to meander naturally); and
 - Low (Ranking Factor 1) indicates the measures do not address geomorphic restoration, although impairments exist on the system or critical goals are not met.

Dam removals were assigned to Ranking Factor 5 because they would fully restore the attainable geomorphic processes and form at the dam sites. Lower Yuba Habitat Restoration was assigned to Ranking Factor 4 because key geomorphic processes would be restored to the aquatic restoration sites, which are expected to recover full ecological function within several years. Other measures were assigned to Ranking Factor 1 because they would not address geomorphic processes to a significant degree.

- *Self-Sustaining.* This ranking represents the extent to which the measures restore a self-sustaining ecosystem consisting of natural processes. Rankings, based on relative operations and maintenance costs, are as follows:
 - High (Ranking Factor 5) indicates low relative operations and maintenance costs;
 - Medium (Ranking Factor 3) indicates medium relative operations and maintenance costs; and
 - Low (Ranking Factor 1) indicates high relative operations and maintenance costs.

Lower Yuba Habitat Restoration and dam removals were assigned to Ranking Factor 5 because they would have relatively low long-term routine operation and maintenance costs. All fish passage measures except step pools were assigned to Ranking Factor 1 because they would have relatively high long-term routine operation and maintenance costs. Step pools were assigned to Ranking Factor 3 because they are expected to have intermediate operation and maintenance costs. For screening purposes, it was assumed that all measures would be designed to minimize total costs, including costs for construction, operation, maintenance, repair, replacement and rehabilitation, over the period of analysis.

3.4.3.2 Efficiency Ranking

In order to compare the overall efficiency of each measure, the following formula was used:

Efficiency Ranking Factor = (Quality Factor X Quantity Factor) / Cost Factor

Overall efficiency ranking factors range from 1 (least efficient) through 12 (most efficient) and are shown below in Table 3-5 in order of efficiency. Efficiency ranking categories are as follows:

- Very High = Ranking Factor above 10
- High = Ranking Factor of 9 to 10
- Medium-High = Ranking Factor of 7 to 8
- Medium = Ranking Factor of 5 to 6
- Low-Medium = Ranking Factor of 3 to 4
- Low = Ranking Factor of 1 to 2

Table 3-4. Quality Ranking.

Measure	Habitat Scarcity		Connectivity		Special Status Species		Hydrologic Character		Geomorphic Condition		Self-Sustaining		Quality Score (Total)	Average Quality Ranking	
Lower Yuba Habitat Restoration	Med-High	4	Low-Med	2	High	5	Low	1	Med-High	4	High	5	21	Med-High	4
Daguerre Point Dam Step Pools	Med-High	4	Low	1	High	5	Low	1	Low	1	Med	3	15	Med	3
Daguerre Point Dam 10% Bypass	Med-High	4	Low	1	High	5	Low	1	Low	1	Low	1	13	Low-Med	2
Daguerre Point Dam Removal	Med-High	4	Low-Med	2	High	5	Med-High	4	High	5	High	5	25	Med-High	4
Englebright Dam Fish Ladder	Med-High	4	Med	3	High	5	Low	1	Low	1	Low	1	15	Med	3
Englebright Dam Fish Tram	Med-High	4	Med	3	High	5	Low	1	Low	1	Low	1	15	Med	3
Englebright Dam Bypass	Med-High	4	Med	3	High	5	Low	1	Low	1	Low	1	15	Med	3
Englebright Dam Removal	Med-High	4	High	5	High	5	Med-High	4	High	5	High	5	28	High	5
Collect and Transport above New Bullards Bar Dam and Reservoir	Med-High	4	Med	3	High	5	Low	1	Low	1	Low	1	15	Med	3
Collect and Transport above Englebright Dam and Reservoir	Med-High	4	Med	3	High	5	Low	1	Low	1	Low	1	15	Med	3

Table 3-5. Efficiency of Measures

Measure	Quantity Factor		Quality Factor		Cost Factor		Efficiency Ranking Factor = (Quantity × Quality) ÷ Cost	Efficiency Ranking
Lower Yuba Habitat Restoration	3	×	4	÷	1	=	12	Very High
Daguerre Point Dam Removal	3	×	4	÷	3	=	4	Low-Med
Daguerre Point Dam Step Pools	1	×	3	÷	1	=	3	Low-Med
Englebright Dam Removal	4	×	5	÷	10	=	2	Low
Daguerre Point Dam 10% Bypass	1	×	2	÷	1	=	2	Low
Collect and Transport above Englebright Dam and Reservoir	2	×	3	÷	3	=	2	Low
Collect and Transport above New Bullards Bar Dam and Reservoir	1	×	3	÷	2	=	2	Low
Englebright Dam Fish Ladder	2	×	3	÷	5	=	1	Low
Englebright Dam Fish Tram	2	×	3	÷	6	=	1	Low
Englebright Dam Bypass	2	×	3	÷	6	=	1	Low

Risk and Uncertainty Regarding Efficiency Ranking

Certain critical drivers exist that could affect the efficiency ranking described above. These risk factors, described below, each include uncertainty and were qualitatively ranked as Low, Low-Medium, Medium, Medium-High, or High based on professional judgment. Risk rankings are shown below in Table 3-6.

- **Cost Risk/Uncertainty Due to Potential for Mercury Contamination.** As a result of historic hydraulic gold mining in the region, sediments throughout the watershed are highly contaminated with mercury. Due to uncertainty regarding concentration and location of mercury contamination, as well as uncertainty regarding regulatory requirements that could result, a risk ranking was applied for potential impacts to cost estimates due to mercury contamination. Lower Yuba River Habitat Restoration, DPD step pools, and dam removal measures involve excavation of material potentially contaminated with mercury. However, cost risks of dealing with potential mercury are low for restoration measures and high for dam removal measures. This is because the principal risk from mercury contamination is the potential for methylation, which is the process that makes mercury bio-available in the environment. Sediments sequestered behind dams are more likely prone to both anaerobic conditions and a greater fine sediment fraction (less than 74 microns) than in-river sediments. Anaerobic conditions increase the likelihood of methylated mercury, and fine grain sediments more favorably partition methylated mercury for transport and deposition downstream, if disturbed. Materials that would be excavated for Lower Yuba River Habitat Restoration are coarser, thus trapping less mercury, and permeable, thus likely already stripped of mercury contaminants. DPD step pools were given a low-medium ranking because the foundation construction would require deep excavation into potentially anaerobic and finer sediments. Excavated material would need to be tested during the design and construction phases, although the level of contamination is expected to be below CERCLA thresholds. Mercury contamination could be significant enough to warrant disposal as hazardous waste or low enough that material could be placed on adjacent lands.
- **Cost Risk/Uncertainty Due to Distance to Sediment Disposal.** In addition to general uncertainty regarding mercury, a specific cost driver could be uncertainty regarding distance to disposal of excavated material. Due to this uncertainty, a relative risk ranking was applied to each measure based on the relative quantity of material to be excavated: “high” for the dam removal measures, “medium” for the bypass measures, and “low” for the other fish passage and habitat restoration measures.
- **Potential Effects to Water Diversions and/or Water Rights.** There are many water diversions and associated water rights throughout the watershed. Some measures have the potential to alter hydrology in a manner that could impact current diversions, which would require further analysis and could potentially increase costs beyond current estimates. For this reason, a risk ranking was assigned to each measure based on the potential for that measure to affect water diversions and/or water rights. Dam removal

measures received a “high” risk ranking and all other measures received a “low” risk ranking.

- **Risk of Design Complexity.** Some measures under consideration are extremely complex from a design perspective. In order to capture this complexity, which could increase costs, a risk ranking was applied as follows: “low” indicates that no unique design is required (common action with documented success); “medium” indicates that some unique design is required, but not for the majority of the action; and “high” indicates that unique or unproven design features are needed for the majority of the action (experimental). Conventional habitat restoration was ranked “low” and DPD step pools, 10% bypass, and removal were ranked “medium” relative to the other measures. Englebright Dam removal, bypass, fish passage, and fish collection and transport measures were ranked “high” because of the majority of the design features for those actions would be unique or unproven.
- **Risk of Construction Complexity.** Some measures under consideration are extremely complex from a construction perspective. In order to capture this complexity, which could increase costs, a risk ranking was applied as follows: “low” indicates that the measures requires standard techniques and locally available equipment and skills; “medium” indicates that the measure requires proven techniques and regionally available equipment and skills; and “high” indicates that the measure requires unique or unproven techniques and specialized equipment and skills. Lower Yuba Habitat Restoration was ranked “low” because it would use conventional construction methods that are available locally. Englebright Dam removal, bypass, fish passage, and fish collection and transport measures were ranked “high” because those measures would use site-specific and uncommon techniques requiring specialized equipment and skills. The DPD 10% bypass would use proven construction methods that are available regionally; therefore, it was ranked as “medium.” DPD step pools and dam removal were ranked as “low-medium” and “medium-high,” respectively, because those measures fell between categories, based on professional judgment.

Table 3-6. Risk Ranking.

Measure	Cost Risks of Mercury Contamination		Cost Risk of Distance to Sediment Disposal		Potential Effects to Water Rights		Risk of Design Complexity		Risk of Construction Complexity		Risk Ranking (Total)
Lower Yuba Habitat Restoration	Low	1	Low	1	Low	1	Low	1	Low	1	5
Daguerre Point Dam Step Pools	Low-Med	2	Low	1	Low	1	Med	3	Low-Med	2	9
Daguerre Point Dam 10% Bypass	Low	1	Med	3	Low	1	Med	3	Med	3	11
Daguerre Point Dam Removal	High	5	High	5	High	5	Med	3	Med-High	4	22
Englebright Dam Fish Ladder	Low	1	Low	1	Low	1	High	5	High	5	13
Englebright Dam Fish Tram	Low	1	Low	1	Low	1	High	5	High	5	13
Englebright Dam Bypass	Low	1	Med	3	Low	1	High	5	High	5	15
Englebright Dam Removal	High	5	High	5	High	5	High	5	High	5	25
Collect and Transport above New Bullards Bar Dam and Reservoir	Low	1	Low	1	Low	1	High	5	High	5	13
Collect and Transport above Englebright Dam and Reservoir	Low	1	Low	1	Low	1	High	5	High	5	13

Table 3-7. Screening Results.

Measure	Efficiency		Cost Risks of Mercury Contamination		Cost Risk of Distance to Sediment Disposal		Potential Effects to Water Rights		Risk of Design Complexity		Risk of Construction Complexity	
Lower Yuba Habitat Restoration	Very High	12	Low	1	Low	1	Low	1	Low	1	Low	1
<-----Screening Break----->												
Daguerre Point Dam Removal	Low-Med	4	High	5	High	5	High	5	Med	3	Med-High	4
Daguerre Point Dam Step Pools	Low-Med	3	Low-Med	2	Low	1	Low	1	Med	3	Low-Med	2
Englebright Dam Removal	Low	2	High	5	High	5	High	5	High	5	High	5
Daguerre Point Dam 10% Bypass	Low	2	Low	1	Med	3	Low	1	Med	3	Med	3
Collect and Transport above Englebright Dam and Reservoir	Low	2	Low	1	Low	1	Low	1	High	5	High	5
Collect and Transport above New Bullards Bar Dam and Reservoir	Low	2	Low	1	Low	1	Low	1	High	5	High	5
Englebright Dam Fish Ladder	Low	1	Low	1	Low	1	Low	1	High	5	High	5
Englebright Dam Fish Tram	Low	1	Low	1	Low	1	Low	1	High	5	High	5
Englebright Dam Bypass	Low	1	Low	1	Med	3	Low	1	High	5	High	5

3.4.4 Screening Results

Upon applying screening criteria and ranking measures based on how well they achieved those criteria, measures were screened based on these results. A definitive breakpoint exists in the overall efficiency ranking. As shown in Table 3-7, Lower Yuba River Habitat Restoration was the most efficient measure by a significant margin: the Lower Yuba Habitat Restoration ranking factor was 12, while the next most efficient measure (Daguerre Point Dam Removal) ranking factor was 4. The Lower Yuba Habitat Restoration measure was also the only measure to rank as low risk in all risk categories. For these reasons, the Lower Yuba Habitat Restoration measure was retained for further evaluation and all other measures were screened from further consideration under this study. The Lower Yuba Habitat Restoration measure, as defined for screening purposes, contains dozens of site concepts throughout the lower Yuba River which are further defined and refined in subsequent chapters.

For more detailed evaluation, the initial Lower Yuba Habitat Restoration measure was divided into eight Habitat Increments to provide a range of restoration scales for consideration. The Habitat Increments are based on geographic locations that take advantage of cost-efficiencies of scale, including shared access routes for construction. The Habitat Increments are large enough to have substantial restoration benefits and also allow for flexibility in Operation, Maintenance, Repair, Rehabilitation, and Replacement to ensure the continuation of restoration benefits on project lands despite changes in channel alignment. Habitat restoration sites that are likely to be completed by other organizations (as described in the FWOP conditions; Section 3.3) were excluded from Habitat Increments and eliminated from the study.

As shown below in Figure 3-2 and Table 3-8, two Habitat Increments (3b and 4) that would be impacted by potential future actions at Daguerre Point Dam were eliminated because there is significant interest from the public and the sponsor for future action to improve fish passage at Daguerre Point Dam (DPD). Due to the proximity of increments 3b and 4 to DPD, future removal of DPD or construction of fish passage improvements (such as step pools) at DPD could damage or destroy restored habitat in those increments. To avoid creating an impediment to potential future dam removal or construction of step pools, increments 3b and 4 were eliminated from further consideration. Increment 3b was located within the estimated extent of the backwater/sediment impoundment of DPD (1.9 miles). Increment 4, immediately downstream of DPD, would be directly affected by dam removal as well as construction of step pools.

Habitat Increment 5c was also eliminated due to substantial geomorphic changes during the winter of 2016-2017. The preliminary restoration concept for increment 5c proposed the creation of an anabranching channel based on geomorphic analysis. High flows during the winter of 2016-2017 created a similar channel configuration. Consequently, it was apparent that further restoration of increment 5c would provide limited benefits compared to the other increments being evaluated since many of the benefits had been realized as a result of the high flows. For that reason, increment 5c was eliminated from further consideration, leaving five Habitat Increments to further refine.

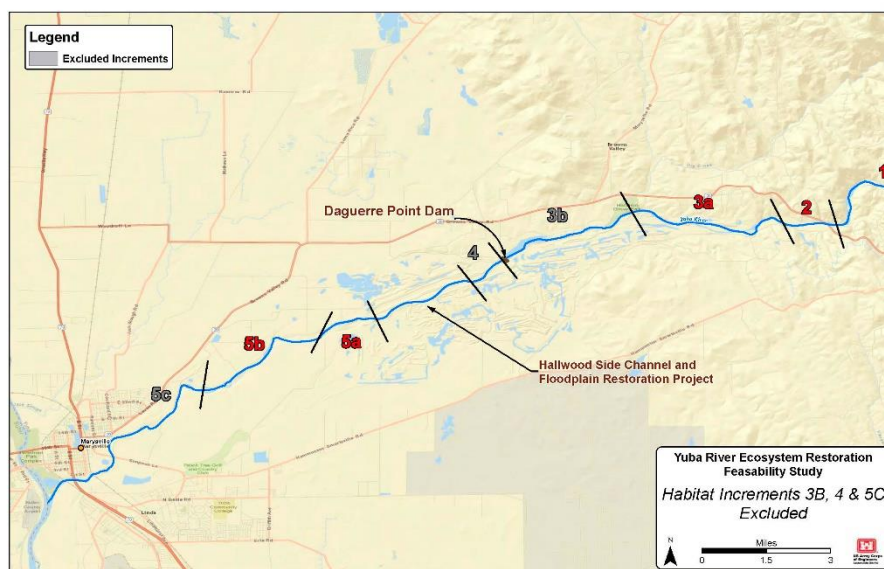


Figure 3-2. Habitat Increments eliminated from the study.

Table 3-8. Habitat Increments.

Increments	Description	Notes
Habitat Increment 1	19.2 acres - Restoration measures upstream of Highway 20	No anticipated effects from potential future action at Daguerre Point Dam
Habitat Increment 2	23.3 acres - Restoration measures between Highway 20 and Lower Gilt Edge Bar	No anticipated effects from potential future action at Daguerre Point Dam
Habitat Increment 3a	56.4 acres - Restoration measures between Lower Gilt Edge Bar and Hammon Bar	Split from increment 3 based on proximity to Daguerre Point Dam; no anticipated effects from potential future action at Daguerre Point Dam
Habitat Increment 3b	58.1 acres - Restoration measures between Hammon Bar and Daguerre Point Dam	Screened from analysis due to proximity to Daguerre Point Dam and relative uncertainty regarding future conditions
Habitat Increment 4	17.0 acres - Restoration measures between Daguerre Point Dam and Hallwood	Screened from analysis due to proximity to Daguerre Point Dam and relative uncertainty regarding future conditions
Habitat Increment 5a	49.3 acres - Restoration measures downstream of Hallwood at Bar C	No anticipated effects from potential future action at Daguerre Point Dam
Habitat Increment 5b	49.5 acres - Restoration measures at Narrow Bar downstream to Island B	No anticipated effects from potential future action at Daguerre Point Dam
Habitat Increment 5c	18.0 acres – Restoration measures downstream of Island B	Screened from analysis due to changed conditions during winter floods of 2016

Alternative plans will be composed of an increment or any combination of the increments. The increments are on the lower Yuba River downstream of Englebright Dam and are composed of various features that are described below. The design details are planning assumptions that are subject to refinement during feasibility-level design and pre-construction design.

3.4.5 Unresolved Ecological Problem

An ecosystem related problem was identified through this study which is not being fully addressed through measures included in the final array of alternatives. Specifically, longitudinal river connectivity has been reduced by altered hydroperiods and sediment transport as well as blocked and impaired passage of migrating fish.

While some measures in the final array of alternatives would address this problem on a small scale (i.e., restoration areas which could create a habitat corridor), the overarching connectivity problem caused by the presence of dams across the river remains unresolved.

At Daguerre Point Dam, the extent to which the presence of the dam creates ecological problems is at present poorly defined. While there are perceived problems with fish passage at Daguerre Point Dam, existing fish ladders at the dam currently facilitate upstream passage of salmonids. Downstream passage of juvenile salmonids appears to be potentially impacted to some extent, based on limited screw trap data. Green sturgeon have been observed immediately downstream of the dam but are unable to pass via the fish ladder. In order to quantify ecological outputs that could result from any action at Daguerre Point Dam (i.e., fish bypass, step pools, rock riffle, dam removal, etc.), existing conditions must first be better defined and quantified. Additional study would be required to:

- Better define and quantify specific ecological problems associated with longitudinal river connectivity within the study area;
- Better define specific measures to address these specific ecological problems; and
- Develop a methodology to quantify ecological outputs of specific measures.

3.5 Habitat Increment Features

Habitat restoration features and locations are based on the morphological analysis and expert judgment found in three primary references.

1. Habitat Expansion for Spring-Run Chinook Salmon and Steelhead in the Lower Yuba River Prepared for the Habitat Expansion Agreement Steering Committee by Members of the Yuba Accord River Management Team (RMT 2009) identified side channel restoration locations based upon morphological analyses utilizing historical aerial photography for channel alignments, site visits, and expert judgment.
2. Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach of the Lower Yuba River (cbec et al. 2010) utilized flow frequency analyses for the flow regime (1970-2009) and morphologic analyses based on aerial photography from 1952-2009 to site proposed

bank scalloping, backwater creation, riparian planting, floodplain enhancement (including boulder and woody debris).

3. In Landforms of the Lower Yuba River (2012), authors Wyrick and Pasternack conducted a thorough geomorphic assessment of the Lower Yuba River using digital elevation models and detailed 2D hydrodynamic modeling that was extensively referenced in Hydrologic and Geomorphic Analysis to Support Rehabilitation Planning for the Lower Yuba River from Parks Bar to Marysville, (cbec 2013). This report built upon cbec et al. (2010) through use of detailed 2D modeling results and the geomorphic characteristics of the Lower Yuba River to recommend habitat measure sites.

HDR (2016) reviewed several references that recommended restoration activities for the Lower Yuba River including RMT (2009), cbec et al. (2010) and cbec 2013 to generate a list of potential restoration activities and recommend further activities on previously analyzed perennial landforms for USACE and YCWA as part of the USACE Planning Process.

Restoration features are fully described in Section 4.1.1, Alternatives Considered in Detail. Access and staging, disposal assumptions, and construction sequencing are also described in Section 4.1.1. The main features of the habitat increments are:

- Riparian Planting
- Backwater Area
- Floodplain Lowering
- Floodplain Grading
- Side Channel
- Bank Scalloping
- Large Woody Material
- Boulders

Habitat Increment 1

Habitat Increment 1 includes 7.4 acres of riparian planting, 5.8 acres of side channel creation, and 6.1 acres of restored backwater area. Restoration sites are located upstream of the Highway 20 Bridge. A high ratio of material excavated to acreage restored makes Increment 1 the most expensive increment per unit of ecosystem output.

Habitat Increment 2

Habitat Increment 2 includes 8.7 acres of riparian planting, 14 acres of floodplain lowering, 0.3 acres of restored backwater area, and 0.3 acres of bank scalloping. Restoration sites are downstream of the Highway 20 Bridge on Upper Gilt Edge Bar and an Unnamed Bar on the north side of the river near River Mile (RM) 17.

Habitat Increment 3a

Habitat Increment 3a includes 28.7 acres of riparian planting, 13 acres of floodplain lowering, 11.3 acres of side channel creation, and 3.5 acres of channel stabilization. Restoration sites are located on Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and Bar A. Increment 3a would increase habitat connectivity between Habitat Increment 2 and SYRCL's Long Bar Restoration Project and Hammon Bar Restoration Project.

The measures proposed for Bar A overlap with the Long Bar Restoration Project, a similar USFWS AFRP project at this site. As of February of 2018, the Long Bar project was at 65% designs. For this study, the criteria set for assuming a project is part of the Future Without Project Condition is complete funding for design and construction, and environmental permitting and compliance activities that are substantially achieved. Should the Long Bar project meet these requirements, USACE would drop Bar A from the recommended plan and consider other locations for similar measures.

Habitat Increment 5a

Habitat Increment 5a would connect riparian and aquatic habitat corridors to the Hallwood Side Channel and Floodplain Restoration Project. Increment 5a includes 21.3 acres of riparian planting, 13 acres of floodplain lowering, and 15.1 acres of side channel creation. Restoration sites are downstream of the Hallwood Side Channel and Floodplain Restoration Project on Bar C.

Habitat Increment 5b

Habitat Increment 5b includes 29.7 acres of riparian planting, 7.7 acres of floodplain lowering, 9.2 acres of side channel creation, and 2.9 acres of restored backwater area. Restoration sites are on Narrow Bar, the right bank of the river at RM 6.5, Bar E, and Island B.

3.6 Evaluation of Habitat Increments

USACE guidance requires that the ecosystem benefits of potential measures, alternatives, or in this case, habitat increments be evaluated through a detailed Cost Effectiveness and Incremental Cost Analysis (CE/ICA). The analysis must allow for an explicit comparison of the costs and benefits associated with each habitat increment. To prepare for this analysis, Class 4 cost estimates were developed based on early concept technical information. Class 4 estimates include major estimate assumptions in technical information and quantities, heavy reliance on cost engineering judgment, and a great deal of uncertainty relative to major construction components (ER 1110-2-1302). Ecosystem benefits were developed using established habitat assessment methodologies. For this study, a standard Habitat Evaluation Procedure (HEP) was performed to quantify the ecosystem benefits of potential restoration features (Environmental Appendix D – Attachment 8).

The HEP methodology was developed by the U.S. Fish and Wildlife Service and other state and federal agencies to evaluate habitat losses and gains. HEP is a species-habitat approach

that measures the capacity of a given habitat to support a selected species. HEP does not attempt to quantify all ecosystem benefits, but instead uses selected evaluation species to provide an indicator of the relative magnitude of ecological outputs that is used to compare the cost-efficiency of different measures or alternatives. For this study, evaluation species were selected based on several criteria: (1) species known to be sensitive to specific land and water use actions; (2) species that play a key role in nutrient cycling or energy flow; (3) species that utilize a common environmental resource; or (4) species that are associated with important resource problems, such as anadromous fish and migratory birds. The species identified to evaluate habitat were steelhead, yellow warbler, and downy woodpecker, which represent in-channel habitat, inundated floodplain habitat, and riparian habitat, respectively.

The Habitat Suitability Index (HSI) is a key component of the HEP that describes the capacity of a given habitat to support a selected species. The “blue book” HSI models for the warbler and the woodpecker have been approved by the National Ecosystem Restoration Planning Center of Expertise (Eco-PCX). The models have been used in other projects in the area, are focused on the target habitat types, and have been coordinated with the USFWS. The steelhead Habitat Suitability Model was developed based on information specific to the Yuba River. YCWA and the Yuba River Development Project Relicensing Participants collaborated in the development of habitat suitability criteria for fish species and life stages to be used in the lower Yuba River instream flow model. These criteria were used to develop the Juvenile Steelhead HSI model, which has been approved by the USACE Headquarters Model Certification Panel for single-use. The memorandum documenting the approval is included in Environmental Appendix D – Attachment 7.

Habitat suitability criteria for each species and associated habitat type were analyzed under a range of river flow conditions. Habitat Units (HUs) are the output of the HEP analysis and were used to calculate the difference between future without project conditions and future with project conditions. Refer to Environmental Appendix D - Attachment 8 for further detail on assessing ecosystem benefits.

3.7 Formulation of Final Array of Alternatives

The next step in the CE/ICA is to formulate alternatives based on ecosystem benefits as expressed through Habitat Units and Class 4 cost estimates. The Institute for Water Resources (IWR) Planning Suite v2.0.9 (certified) is decision support software developed by USACE for the formulation and evaluation of ecosystem restoration alternative plans. The software assists with plan formulation by combining user-defined solutions to planning problems and calculating the effects of each combination, or "plan." In this case, the habitat increments were the solutions and the costs and average annual gains in HUs for the habitat increments were the effects. IWR Planning Suite generated all possible combinations of increments, producing an array of 32 plans, of which 9 were cost effective and 6 were best buys. IWR Planning Suite classifies a plan as cost effective if no other plan provides the same level of output for less cost and if no other plan provides more output for the same or less cost. Best buy plans are a subset of the cost effective plans that are superior financial investments. Best buy plans are the most efficient plans at producing outputs - they provide the greatest increase in outputs for the least increase

in costs. IWR Planning Suite generated 6 best buy plans including the no action alternative, which serve as the final array of alternatives for this study. The alternatives are as follows.

- Alternative 1 is the no action plan and assumes no action is taken as the result of this study.
- Alternative 2 includes only Increment 2 at Upper Gilt Edge Bar and Unnamed Bar, which would result in 23.3 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$9.2 million.
- Alternative 3 includes Increments 2 and 5b at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, and Island B, which would result in 72.8 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$32.8 million.
- Alternative 4 includes Increments 2, 5b, and 5a at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, and Bar C, which would result in 122.2 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$57.8 million.
- Alternative 5 includes Increments 2, 5b, 5a, and 3a at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and Bar A, which would result in 178.6 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$89.4 million.
- Alternative 6 includes Increments 2, 5b, 5a, 3a, and 1 at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, Bar A, and Upstream of Highway 20, which would result in 197.8 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$109.6 million.

3.8 Comparison of Alternatives

Alternatives were compared based on contributions to planning objectives and environmental factors, which were relatively consistent between increments. Each alternative improves the quantity, quality, and complexity of aquatic and riparian habitats and improves lateral connectivity within the high flow channel to various degrees. Larger scale alternatives are generally more effective in addressing the planning objectives. As the increments build upon each other, synergies between existing riparian and aquatic habitats (longitudinal river connectivity) also begin to emerge.

Connectivity of riparian and aquatic habitat significantly increases with the addition of Increment 5a (Alternative 4) which directly connects Increment 5b with the Hallwood Side Channel and Floodplain Restoration project. The Hallwood Project is a planned project of the

USFWS, Teichert Materials, and Western Aggregates which would restore 170 acres of riverine habitat below Daguerre Point Dam. The addition of Increment 3a (Alternative 5) significantly increases habitat connectivity, by connecting Increment 2 and the existing Hammon Bar Restoration Project (5 acres). The Hammon Bar Project was primarily funded by the USFWS, the Bureau of Land Management, and CalTrans' Environmental Enhancement and Mitigation Program and completed in 2012. Increment 3a also connects to existing upland forested areas, providing an extensive riparian corridor for wildlife. Alternative 5 would directly restore 43 acres of aquatic habitat and 136 acres of riparian habitat for a total of approximately 179 acres and leverages 175 acres of habitat restored by the USFWS Anadromous Fish Restoration Program and participating partners.

Contributions to the restoration of significant resources builds as habitat increments are combined to form alternatives. Each alternative includes restoration of riparian habitat that is scarce in the western United States and would provide food and shelter for wildlife, including federally listed threatened species. Each alternative contributes to the goals of laws, plans, and policies to restore riparian habitat and the species it supports, such as the North American Waterfowl Management Plan.

Each alternative also includes restoration of nationally significant aquatic habitat, which has been drastically reduced by the presence of dams and habitat degradation. The alternatives contribute to the goals of laws, plans, and policies to restore aquatic habitat and the species it supports, such as the Anadromous Fish Restoration Program. As habitat increments are added to subsequent alternatives and the scale of restoration is expanded, the alternatives achieve a greater degree of contribution to restoration of significant resources.

The alternatives comparison used the results of the CE/ICA, which displays incremental costs (dollars) and outputs (Average Annual Habitat Units - AAHUs). Incremental costs per incremental AAHUs were used to identify major breakpoints in cost efficiency among the alternatives. The results of the CE/ICA for the final array of alternatives show moderate increases in the incremental cost per AAHU between Alternatives 2 – 5. However, with the addition of Increment 1 in Alternative 6, the incremental cost per AAHU more than triples. The incremental cost per AAHU for Alternative 6 is significantly higher than the smaller scale alternatives, creating a clear breakpoint in the relative efficiency of the alternatives. This analysis is shown in Table 3-9 and Figure 3-3.

Because the habitat increments would all consist of generally similar features, with similar Monitoring and Adaptive Management (MAM), and OMRR&R requirements, costs for MAM and OMRRR would be proportional to the scale and to other costs for the habitat increments. Interest during construction (IDC) would also be proportional to the scale and to other costs for the habitat increments. Consequently, the absence of MAM, OMRR&R, and IDC costs from the CE/ICA does not significantly affect the relative costs of the habitat increments or Best Buy plans, and therefore does not affect plan selection.

Table 3-9. Incremental Costs and Outputs of Alternatives.

Alternative	Increments	Total Costs ¹	Annualized Costs ²	Incremental Annualized Costs	Total Acres	Average Annual Habitat Units (AAHU)	Incremental AAHU	Total Annual Cost per AAHU	Incremental Annual Cost per AAHU
1	No Action	0	0	0	0	0	0	0	0
2	2	\$9,194,000	\$348,895	\$348,895	23.3	14.32	14.32	\$24,364	\$24,364
3	2, 5b	\$32,802,000	\$1,244,773	\$895,878	72.8	35.67	21.35	\$34,898	\$41,905
4	2, 5b, 5a	\$57,789,000	\$2,192,982	\$948,209	122.2	55.06	19.39	\$39,830	\$48,980
5	2, 5b, 5a, 3a	\$89,399,000	\$3,395,521	\$1,202,539	178.6	72.86	17.80	\$46,563	\$67,386
6	2, 5b, 5a, 3a, 1	\$109,640,000	\$4,160,628	\$765,107	197.8	76.48	3.62	\$54,402	\$212,126

¹ Total costs in this table do not include Interest During Construction, Monitoring and Adaptive Management or Operation, Maintenance, Repair, Replacement, and Rehabilitation costs. The absence of these costs does not affect plan selection because they would be proportional to the initial construction costs for each alternative.

² FY2017 discount rate 2.875%, 50 year period.

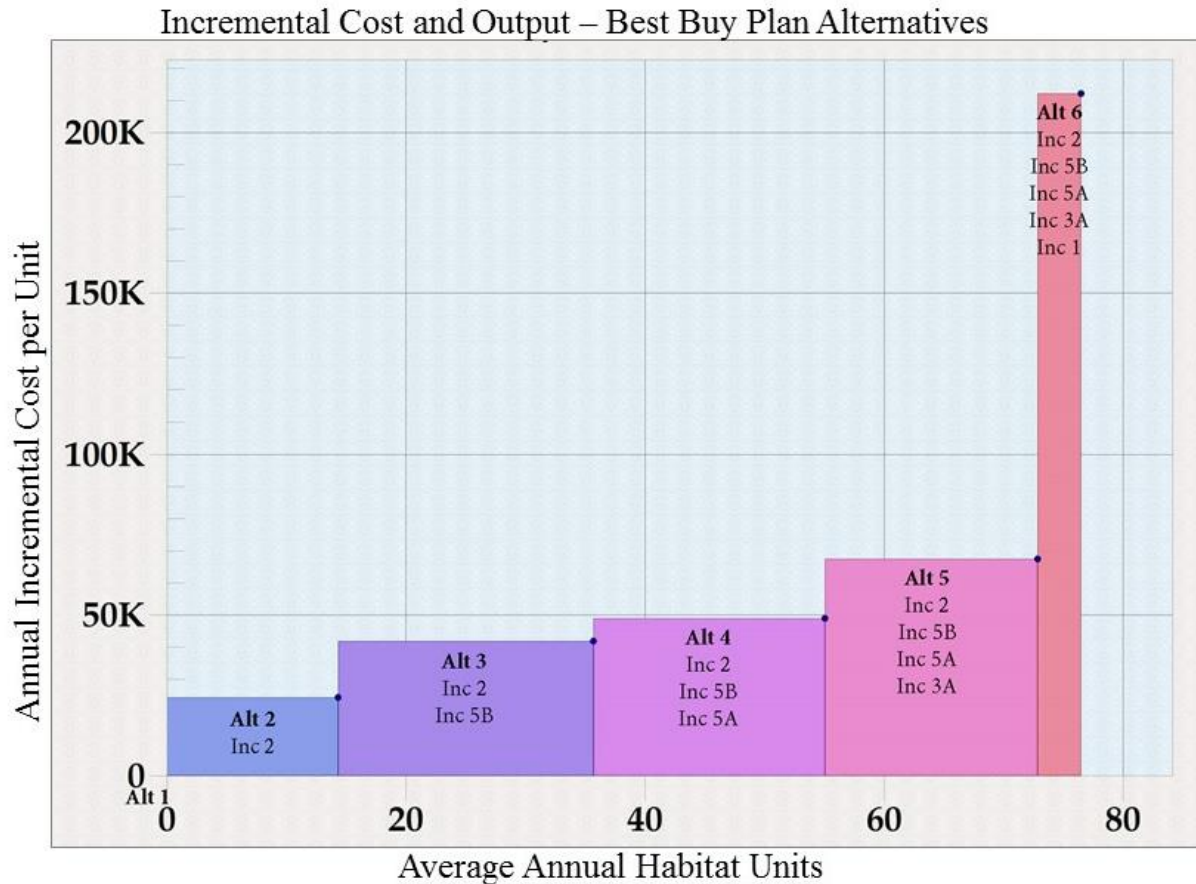


Figure 3-3. Incremental Costs and Outputs of Alternatives.

3.9 Principles and Guidelines Accounts and Evaluation Criteria

Ecosystem model outputs and the CE/ICA results are one measure of the benefits of the alternatives that must be weighed against other evaluation criteria. The 1983 *Principles and Guidelines* (P&G) establishes four accounts to facilitate evaluation and display of effects of alternative plans. The national economic development (NED) account displays changes in the economic value of the national output of goods and services. The environmental quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans. The regional economic development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment). The other social effects (OSE) account displays plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts (e.g., community impacts, health and safety, displacement, and energy conservation).

Table 3-10. P&G Accounts Comparison of Alternative Plans.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
NED	No change	\$348,895 annual cost ¹	\$1,244,773 annual cost	\$2,192,982 annual cost	\$3,395,521 annual cost	\$4,160,628 annual cost
EQ	No change	23.3 acres restored Increased fish and wildlife populations; improved aesthetics; temporary impacts to water quality, air quality and traffic.	72.8 acres restored More benefits to fish and wildlife populations, aesthetics; more temporary impacts to water quality, air quality and traffic than Alternative 2.	122.2 acres restored More benefits to fish and wildlife populations, aesthetics; more temporary impacts to water quality, air quality and traffic than Alternative 3.	178.6 acres restored More benefits to fish and wildlife populations, aesthetics; more temporary impacts to water quality, air quality and traffic than Alternative 4.	197.8 acres restored More benefits to fish and wildlife populations, aesthetics; more temporary impacts to water quality, air quality and traffic than Alternative 5.
RED	No change	Temporary increase in employment and economic activity due to construction expenditures; potential long term reduction in mining or other economic activity on project lands.	More increases to employment, construction expenditures, and other economic activity on project lands than Alternative 2.	More increases to employment, construction expenditures, and other economic activity on project lands than Alternative 3.	More increases to employment, construction expenditures, and other economic activity on project lands than Alternative 4.	More increases to employment, construction expenditures, and other economic activity on project lands than Alternative 5.
OSE	No change	Improved outdoor activities based on increased fish and wildlife populations such as fishing, hunting, and bird watching.	More improvements to outdoor activities than Alternative 2.	More improvements to outdoor activities than Alternative 3.	More improvements to outdoor activities than Alternative 4.	More improvements to outdoor activities than Alternative 5.

¹ See Table 3-15 footnotes

As displayed in Table 3-10, the effects of each alternative would be similar and proportional to the scale of the alternative. Based on this comparison, there is no basis for an exception to the NER plan.

The *Principles and Guidelines* also establishes four evaluation criteria previously described in Section 3.2. The criteria were used to evaluate individual measures and later on to evaluate alternative plans. Based on the comparison in Table 3-11, there is no basis for an exception to the NER plan.

Table 3-11. P&G Evaluation Criteria Comparison of Alternative Plans.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Completeness	Yes	Yes	Yes	Yes	Yes	Yes
Effectiveness	No	Fails to meet longitudinal connectivity objective.	Fails to meet longitudinal connectivity objective.	More effective than Alternative 3; Includes Increment 5a which directly connects Increment 5b with the Hallwood Project.	More effective than Alternative 4; Includes Increment 3a which directly connects Increment 2 and Hammon Bar. Also connects with existing upland forest.	More effective than Alternative 5 - restores more habitat, but Increment 1 does not directly connect to other restoration sites.
Efficiency	Best buy plan, but does not maximize benefits relative to costs.	Best buy plan, but does not maximize benefits relative to costs.	Best buy plan, but does not maximize benefits relative to costs.	Best buy plan, but does not maximize benefits relative to costs.	Best buy plan-maximizes benefits relative to costs.	Best buy plan, but does not maximize benefits relative to costs.
Acceptability	Yes	Yes	Yes	Yes	Yes	Yes

3.10 Recommended Plan

Alternative 1, the no action alternative, would not contribute to project objectives from a national perspective. Ecosystem-related problems existing today would continue and stressors would persist and potentially become exacerbated. Alternative 2, while the lowest cost per AAHU, is very small in scale, would not significantly contribute to the project objectives from a national perspective, and would not maximize benefits relative to costs. Alternatives 3, 4, and 5, with the next lowest costs per AAHU, are very similar in efficiency. Alternative 6 includes Increment 1, which is more than three times the cost per AAHU of the other increments. Alternative 5 maximizes benefits relative to costs and is therefore the NER Plan and the Recommended Plan (RP). Alternative 5 reasonably meets all planning objectives, provides significant ecosystem outputs, and leverages the most restored habitat by other organizations.

The inclusion of appropriate recreation features in the RP was considered by USACE; however, a non-Federal sponsor willing to provide the required 50% cost-share and OMRR&R for recreation features has not been identified. Therefore, no recreation features are proposed. Any proposal for recreation features on lands acquired for the RP would require public access and safety to be addressed, as well as consideration of potential adverse effects on the primary ecosystem restoration purposes of the plan.

Alternative 5, the RP, restores significant ecosystem function, structure, and dynamic processes on 178.6 acres of riverine, riparian, and related habitats in the highly degraded Yuba River System. Alternative 5 is shown below in Figures 3-4a through 3-4d.

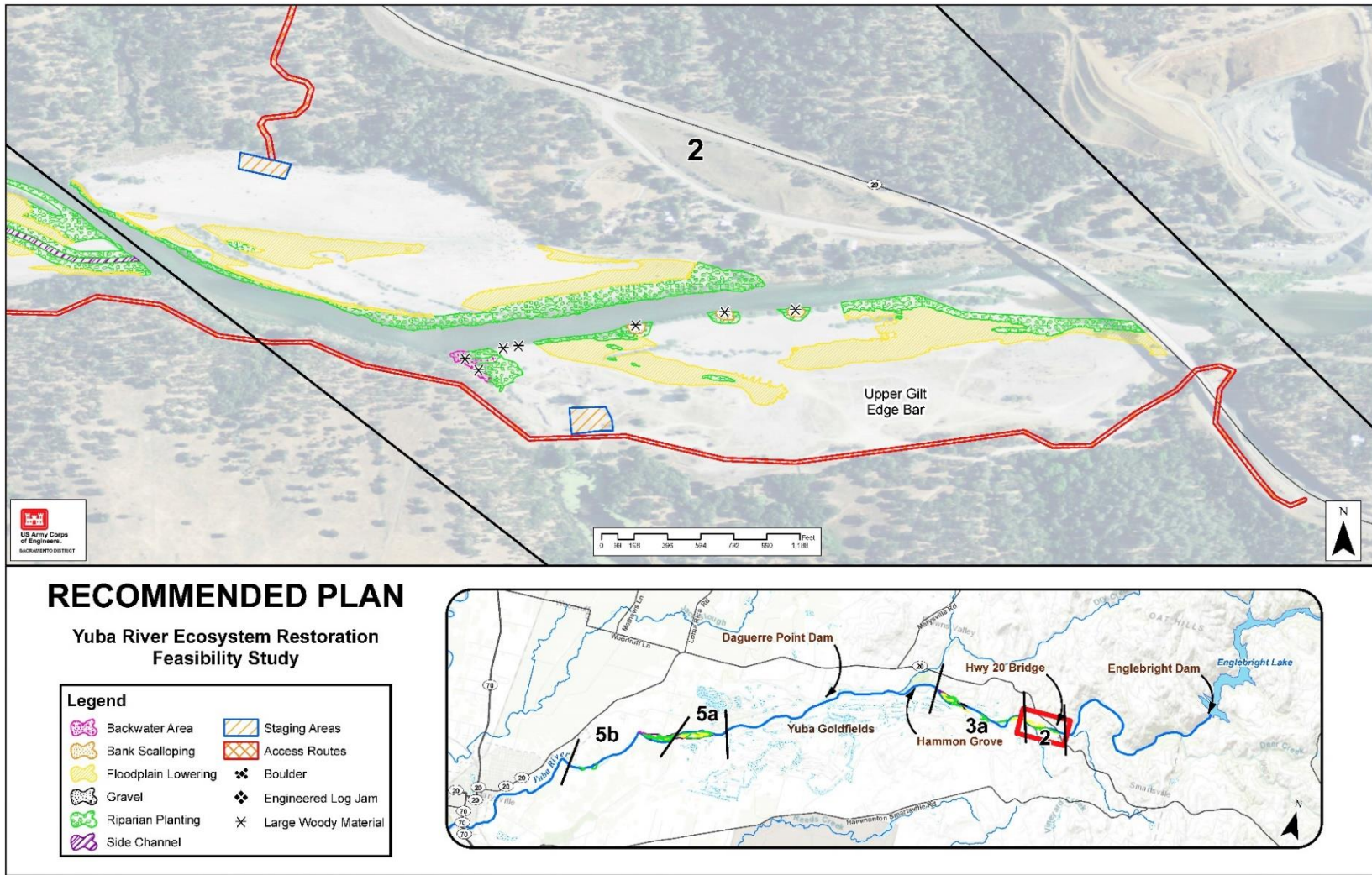


Figure 3-4a. Recommended Plan.

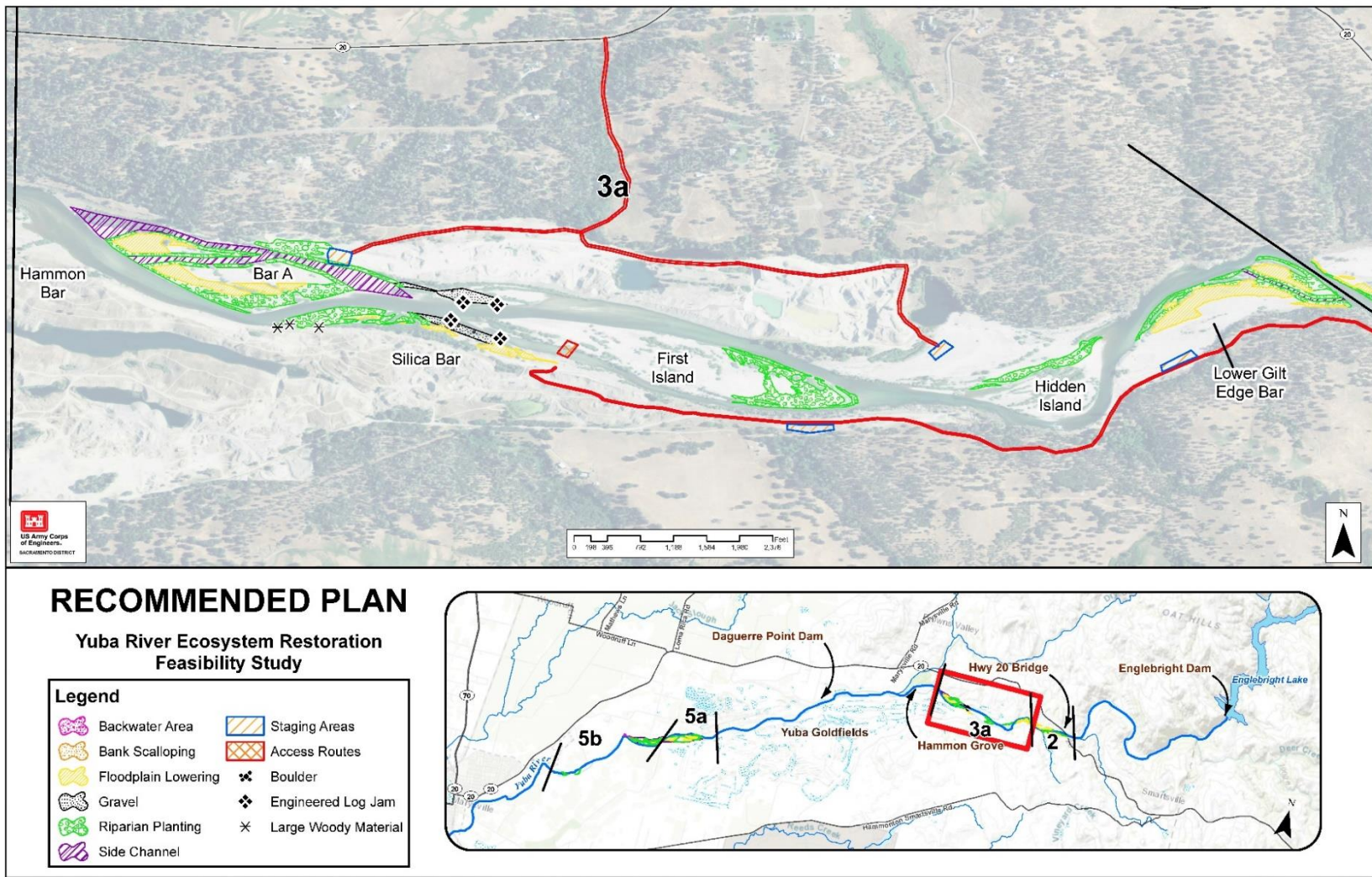


Figure 3-4b. Recommended Plan continued.



Chapter 4 – Affected Environment and Environmental Consequences

This section documents the alternatives considered in the NEPA analysis, describes the pre-project conditions of the environmental resources in the study area, and compares them to the effects of the proposed alternatives. Although Chapter 3 discusses in limited detail the alternatives considered in this analysis Chapter 3 is focused on describing measures and alternatives as they were considered during the plan formulation process. To facilitate a clear identification and understanding of the alternatives considered in the NEPA analysis portion of this document, Section 4.1 describes the alternatives considered in this analysis of affected environment and environmental effects.

Initial evaluation of the effects of the project indicated that there would likely be little to no effect on several resources. These resources are discussed in Sections 4.2.1 through 4.2.4 to add to the overall understanding of the area. Sections 4.3.1 through 4.3.11 describe existing conditions for those resources that are more likely to be affected by implementation of the proposed alternatives. An assessment of the potential impacts and proposed BMPs and avoidance and minimization measures is also included in Sections 4.3.1 through 4.3.11.

4.1 NEPA Alternatives

Although Chapter 3 includes information on the alternatives considered in this NEPA analysis, the discussion in Chapter 3 focuses largely on the formulation and evaluation of alternatives. To facilitate a clear understanding of the analysis of affected environment and environmental effects, the alternatives considered under this NEPA analysis are described below.

4.1.1 Alternatives Considered in Detail

Alternatives 1 – 6 were developed following the USACE plan formulation process described in Chapter 3. These alternatives were formulated through the incremental aggregation of similar restoration actions differing primarily in location. Alternatives 1 – 6 are similar in the nature of proposed actions, environmental effects, and expected outcomes and differ primarily in scope of benefits and impacts. Alternative 1 is the No Action alternative and will be evaluated in further detail in this chapter. Alternative 5 reasonably maximizes ecosystem output and therefore was identified as the NER and Recommended Plan and will be evaluated in further detail in this chapter. Alternative 6 represents an incremental increase in proposed implementation at which efficiency in ecosystem output decreases and will be evaluated in further detail in this chapter.

4.1.1.1 Alternative 1 – No Action Alternative

Alternative 1 is the no action alternative and assumes no action is taken as the result of this study. Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats

along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change.

4.1.1.2 Alternative 5 – Recommended Plan

Alternative 5 is the Recommended Plan and includes 178.6 acres of habitat improvements at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and Bar A along the lower Yuba River (Table 4-1). The habitat improvements correspond to Increments 2, 3a, 5a, and 5b described in Section 3.5. Alternative 5 would result in improvement to the ecosystem by grading near bank areas and planting riparian vegetation to improve hydrogeomorphic processes, increase habitat complexity and value, and increase connectivity between habitats. The total cost of this alternative is \$89.4 million.

Table 4-1. Summary of Project Features for Alternative 5 - Recommended Plan

Feature Type	Total Acres	Total Volume (CY)	Total Length (miles)
Riparian Planting ¹	88.4 (136.1)	--	--
Floodplain Lowering	47.6	101,816	--
Side Channel	35.5 ²	508,614	3.5
Backwater	3.3	15,835	0.2
Bank Scalloping ³	0.3	--	--
Total	178.6⁴	626,265⁵	3.7⁶

¹ - Riparian planting includes areas with existing suitable depth to ground water and areas where proposed floodplain lowering would establish suitable depth to ground water; therefore the total acreage for Riparian Planting includes the acreage of the Floodplain Lowering feature.

² - Side channel quantities include features identified as Channel Constriction

³ - Excavation quantities were not estimated for bank scalloping features but are anticipated to be minor.

⁴ - The total acreage is representative of the total “footprint” of features and does not double count acreage where multiple features may be implemented (i.e., floodplain lowering and planting occurring in the same area).

⁵ - The total volume presented in this table is a simple representation of the amount of material estimated for excavation. Other sections of the report may present excavated amount for Alternative 5 as 689,000 which is a bulked volume (volume x 1.1) for the purpose of supporting cost and feasibility estimates.

⁶ - The total length was only calculated for the aquatic habitat features (sides channels and backwaters) and does not represent the full length of the proposed features.

Features

Although the analysis of affected environment and environmental consequences will evaluate alternatives rather than individual habitat Increments (described in Section 3.5), for consistency and clarity, habitat increments will be used to describe the proposed habitat improvements in each alternative in the sections below.

Habitat Increment 2

Habitat Increment 2 includes; 8.7 acres of riparian planting, 14 acres of floodplain lowering, 0.3 acres of restored backwater area, 0.3 acres of bank scalloping. Table 4-2 shows details for features on Upper Gilt Edge Bar and the unnamed bar.

Upper Gilt Edge Bar. Just downstream of the Highway 20 bridge at Upper Gilt Edge Bar, the floodplain would be lowered to facilitate inundation at 3,000 cubic feet per second (cfs). This flow magnitude was selected to guide the initial design of floodplain elevations as it would be shallowly inundated by a flow that persisted for a 21 day duration in 1 in 2 years during the March-June period (cbec, 2013). Riparian vegetation would be planted along the channel edge.

On the southern bank of Upper Gilt Edge Bar, where the bank is 8-15 feet high, and the edge of the channel is relatively monotonous with little habitat complexity, small scallops would be excavated into the tall and steep banks to increase local topographic diversity and wetted edge. These scallops would be designed to create an inundated alcove at all discharges with the steep slopes surrounding the alcoves feathered to at least a 10:1 slope, providing additional shallow inundated areas with desirable depth/velocity combinations. Initially, these scallops would provide year round rearing habitat to juvenile salmonids. Over time, it is expected that fine sediment may deposit in the scallops creating nursery sites where natural woody vegetation recruitment could occur. The scallops would further facilitate natural recruitment of riparian vegetation, due to shallow access to the water table, and the fine texture of deposited sediments. In addition, Large Woody Material (LWM) would be placed within and protruding from the scallops.

An existing backwater area would be restored allowing for inundation in a typical 50% to 100% Annual Chance of Exceedance (ACE) flood. Riparian vegetation would be planted to increase the structural diversity and extent of existing riparian vegetation. Additional fine material would be introduced to the upper 3 feet of the soil column in excavated areas to increase soil absorption and the amount of soil moisture available to riparian vegetation. LWM would be placed within the backwater to provide aquatic structure.

Unnamed Bar. At the unnamed bar on the north side of the river near River Mile (RM) 17, riparian vegetation would be planted. The site would be restored by lowering areas to increase lateral floodplain connectivity and provide additional opportunity to plant riparian vegetation.

Staging. The staging area on the south side of the river is located on less than 1 acre of disturbed cobble bar land approximately 0.20 mile downstream of the Highway 20 bridge. Access to the Increment 2 staging area would be via Highway 20 to Timbuctoo Place. Vehicles would then loop around back under the Highway 20 bridge to Old Bonanza Ranch Road to the staging area. This staging site would support project actions at Upper Gilt Edge Bar. Access to this staging area would require initial improvements (repaving public asphalt road) and repair of any damages after work is completed.

The staging area on the north side would be located on a cobble bar accessed via Highway 20 and a private gravel road. This staging site would support project actions at Unnamed Bar. Access to this staging site may require construction of a temporary haul road from

the end of the gravel road to connect vehicles to the cobble bar and adjacent proposed restoration site. This work may include paving and grading to facilitate access for haul trucks and other equipment.

Table 4-2. Habitat Increment 2 Details

Feature Type	Acres	Volume (CY)	Length (Miles)
Floodplain Lowering	14.0	30,673	NA
Riparian Planting ¹	8.7 (22.7)	NA	NA
Bank Scalloping	0.3	NA	NA
Backwater Area	0.3	2,489	0.05
Sub-Total	23.3	33,162	0.05

¹ - Riparian planting includes areas with existing suitable depth to ground water and areas where proposed floodplain lowering would establish suitable depth to ground water; therefore the total acreage for Riparian Planting (shown in parentheses) includes the acreage of the Floodplain Lowering feature.

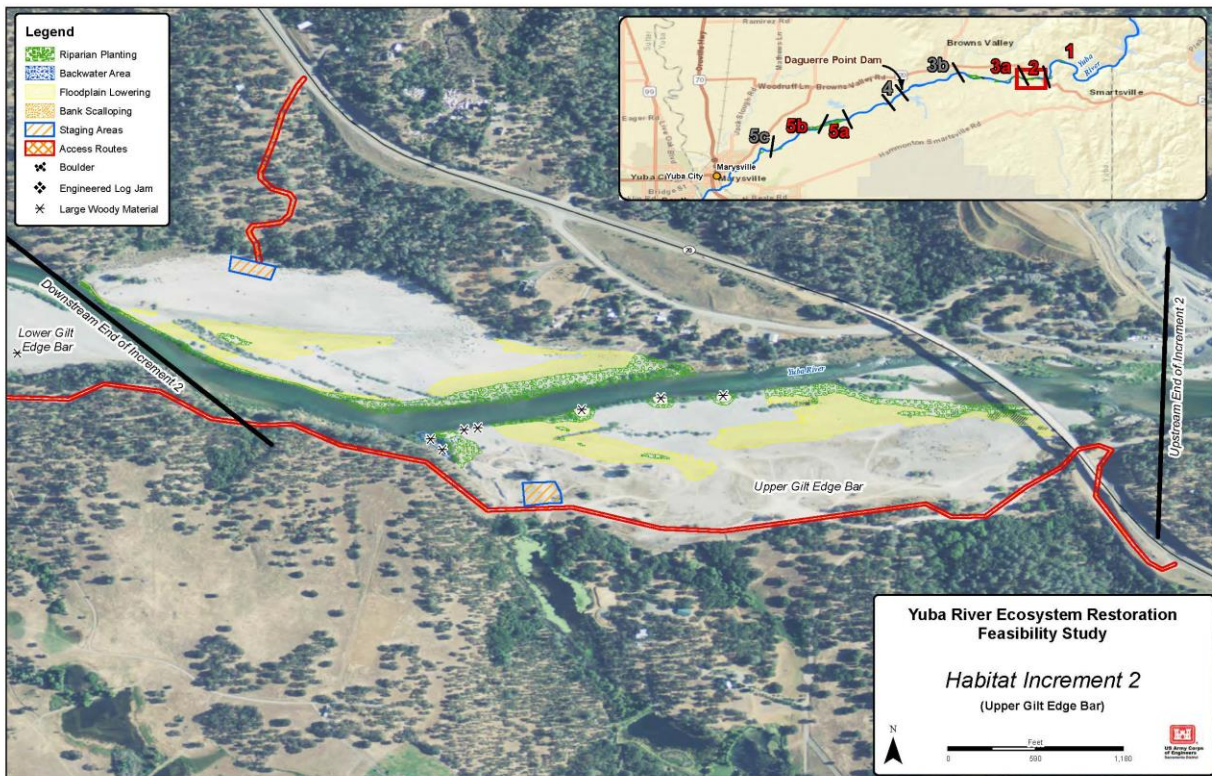


Figure 4-1. Habitat Increment 2

Habitat Increment 3a

Habitat Increment 3a includes 28.7 acres of riparian planting, 13 acres of floodplain lowering, and 11.3 acres of side channel creation. Table 4-3 shows details for features on Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and Bar A.

Lower Gilt Edge Bar. At Lower Gilt Edge Bar, an existing swale feature (at upstream end of Lower Gilt Edge Bar) would be lowered and connected to the channel to become inundated at 3,000 cfs. A patchwork floodplain network of LWM surrounding the restored groundwater-fed swale would be constructed to encourage fine sediment deposition and riparian recruitment, as well as provide edgewater refugia at flows above baseflow.

Hidden Island. Downstream of Lower Gilt Edge Bar, on the alluvial bar on the north side of the river, riparian vegetation would be planted.

First Island. First Island has large expanses of floodplain and high floodplain, and a side channel on the left bank provides spawning and rearing habitat. This area may provide immediate benefit to emerging salmonid fry if allowed access to larger expanses of shallow habitat with riparian cover. To encourage sediment deposition and riparian vegetation recruitment, Engineered Log Jams (ELJs) would be installed in a patchwork configuration, particularly along the apex of First Island just above bankfull elevation.

Silica Bar. Rock and sediment would be deposited along the left bank of Silica Bar, and ELJs would be placed to aid constriction at this location and prevent erosion at a downstream site with potential flood management concerns (cbec, 2013). LWM would be placed along the margins of the downstream terminus of the existing side channel/backwater that is surrounded by an existing stand of diverse, mature, native riparian vegetation, in areas that would not disrupt existing riparian vegetation along the banks of the side channel/backwater area. Floodplain areas would be lowered to facilitate more frequent inundation and riparian vegetation would be planted.

Bar A. Located on the right bank of the river just downstream of First Island, floodplain surfaces would be lowered and riparian vegetation would be planted to facilitate more frequent inundation between 3,000 and 5,000 cfs. Inundation between 3,000 and 5,000 cfs was identified in the cbec (2013) conceptual report to avoid prolonged inundation and potential to induce mortality of riparian vegetation seedlings. Rock and sediment would be deposited along the left bank of Silica Bar, coupled with placement of ELJs to aid river constriction at this location.

A side channel would be created that activates above 3,000 cfs and connects to the low lying area downstream, providing beneficial off-channel habitat with established riparian vegetation. This would create an anabranching side channel (stable multiple-thread channels) in an existing swale within a stand of relatively dense vegetation that includes willows and cottonwoods.

The measures proposed for Bar A overlap with actions proposed by the USFWS AFRP under the Long Bar Restoration Project. As of February of 2018, the Long Bar project was at 65% designs. For this study, the criteria set for assuming a project is part of the Future Without Project Condition is complete funding for design and construction, and environmental permitting

and compliance activities that are substantially achieved. Should the Long Bar project meet these requirements, USACE would drop Bar A from the recommended plan and consider other locations for similar measures.

Staging. There are four staging areas identified for Increment 3a. The staging areas on the north side of the river are each less than 1 acre in size and are located entirely on disturbed cobble bar land. Access to these staging areas would be via Highway 20 to a gravel access road owned and operated by SRI Sand and Gravel Co. Two staging areas would be accessed via this route, with one staging area on the upstream end (Hidden Island area) and on staging area on the downstream end (Bar A area). The access to the staging area for Hidden Island would not see much traffic. Some construction may be required to bring the access route all the way to the bar. The access to the staging area for Bar A could follow existing route used by aggregate company and would likely require some improvements as the road would be used to haul material. Repairs would likely be required after use to meet requirements of current owners.

The staging areas on the south side of the river are each less than 1 acre in size and are located entirely on disturbed cobble bar land. Access to these staging areas would be via Highway 20 to Timbucktoo Place. Vehicles would then loop around back under the Highway 20 bridge to Old Bonanza Ranch Road to the staging area. The upstream staging area is approximately 1 mile west of the Increment 2 staging area and would support project actions at Lower Gilt Edge Bar. The downstream staging area on the south side of the river is approximately 2.5 miles west of the Increment 2 staging area and would support project actions at First Island and Silica Bar. Access to this staging area would likely require grading and widening to allow for sufficient access of haul trucks and other equipment.

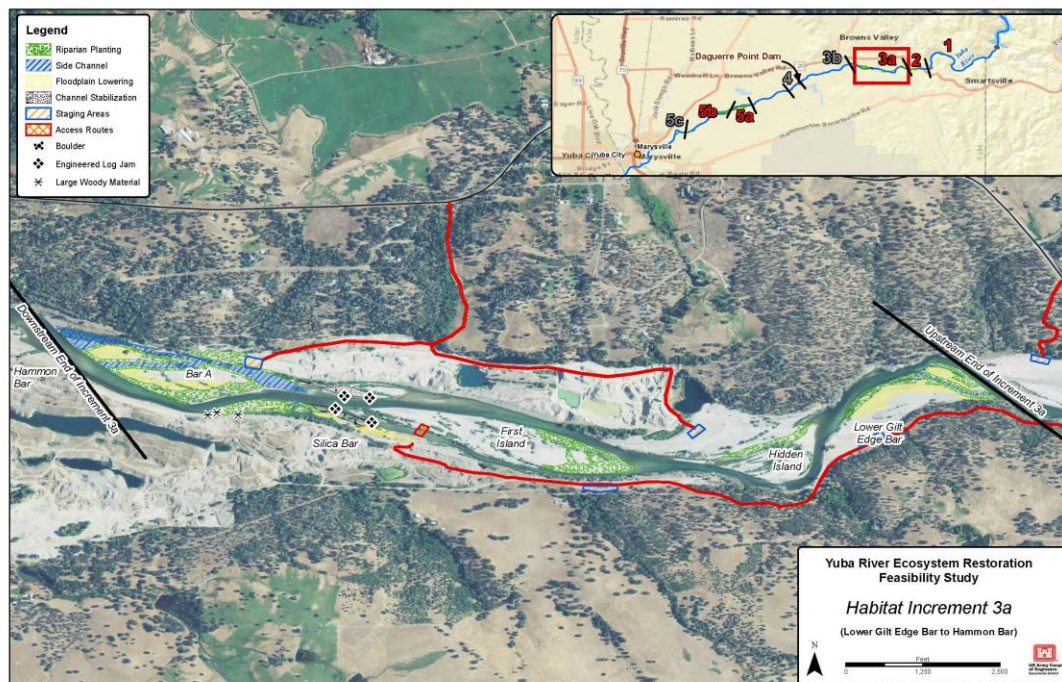


Figure 4-2. Habitat Increment 3a.

Table 4-3. Habitat Increment 3a Details.

Feature Type	Acres	Volume (CY)	Length (Miles)
Floodplain Lowering	13.0	27,872	NA
Riparian Planting ¹	28.7 (41.7)	NA	NA
Side Channel	11.3	186,689	0.87
Channel Stabilization	3.5	NA	NA
Total	56.4	202,993	0.87

¹ - Riparian planting includes areas with existing suitable depth to ground water and areas where proposed floodplain lowering would establish suitable depth to ground water; therefore the total acreage for Riparian Planting (shown in parentheses) includes the acreage of the Floodplain Lowering feature.

Habitat Increment 5a

Habitat Increment 5a includes 21.3 acres of riparian planting, 13 acres of floodplain lowering, and 15.1 acres of side channel creation. Table 4-4 shows details for features on Bar C.

Bar C. Immediately downstream of the Hallwood Side Channel and Floodplain Restoration Project, a historical channel alignment on the north side of Bar C would be restored to inundate at 3,000 cfs and function as swale habitat. The side channel and adjacent floodplain would be lowered and graded. Additionally, riparian vegetation would be planted on each side of the restored swale/side channel. ELJs would be placed in a patchwork configuration at the inflow of the swale, at the upstream end of Bar C. In addition, LWM would be placed in the backwater area at the downstream end of Bar C to increase structural and habitat complexity in the area.

A historical channel alignment on the south side of the bar would be restored by lowering and grading a side channel within a stand of riparian vegetation. The side channel would extend into an existing backwater habitat located at the downstream edge of the Yuba Goldfields. The floodplain on the north side of the side channel would be lowered and planted with riparian vegetation. Boulder structures would be placed to provide hydraulic stability at the inflow section of the side channel at the upstream end of Bar C.

Staging. Located on the south side of the river, the staging area is approximately 1 acre in size and is located on previously disturbed land within the Yuba goldfields. Access to this staging area would be via Highway 70 to Feather River Boulevard. Vehicles would travel northeast on Feather River Boulevard to North Beale Road and turn right. Vehicles would proceed down North Beale road for approximately 1 mile and turn left onto Hammonton Smartsville Road. Approximately 1 mile down Hammonton Smartsville Road, vehicles would turn left onto Simpson Lane, and then take an immediate right onto Simpson Dantoni Road. Simpson Dantoni Road would become Dantoni Road. In approximately 8 miles, vehicles would arrive at the staging area. This staging area would support project actions at Bar C. A portion of the access roads for this staging site are in good condition and would not need any initial

improvements. The final leg of the access route from the entrance of the DeSilva Plant to the staging area and to Bar C may require some widening, grading, and possibly a stream crossing. Repairs would likely be required after construction.

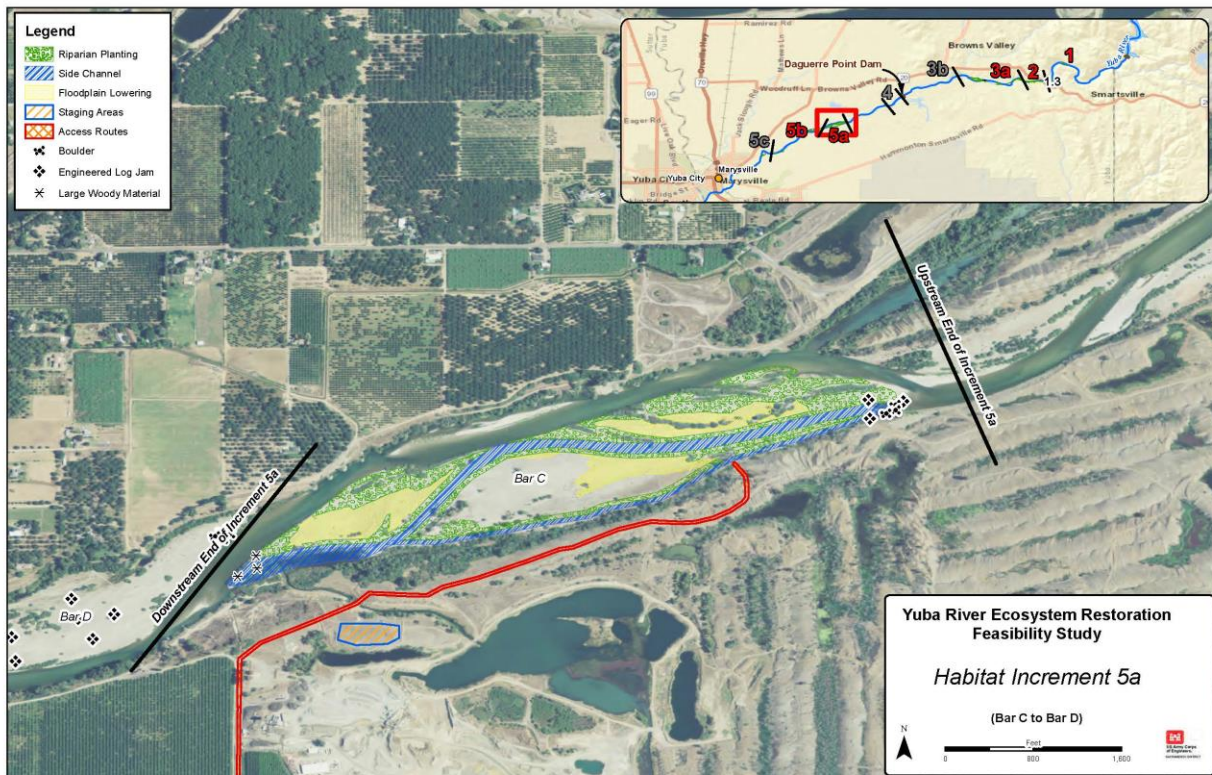


Figure 4-3. Habitat Increment 5a.

Table 4-4. Habitat Increment 5a Details.

Feature Type	Acres	Volume (CY)	Length (Miles)
Floodplain Lowering	13.0	33,545	NA
Riparian Planting ¹	21.3 (34.3)	NA	NA
Side Channel	15.1	194,300	1.9
Total	49.3	227,845	1.9

¹ - Riparian planting includes areas with existing suitable depth to ground water and areas where proposed floodplain lowering would establish suitable depth to ground water; therefore the total acreage for Riparian Planting (shown in parentheses) includes the acreage of the Floodplain Lowering feature.

Habitat Increment 5b

Habitat Increment 5b includes 29.7 acres of riparian planting, 7.7 acres of floodplain lowering, 9.2 acres of side channel creation, and 2.9 acres of restored backwater area. Table 4-5 shows details for features on Narrow Bar, River Mile 6.5, Bar E, and Island B.

Narrow Bar. A side channel would be constructed at Narrow Bar that would connect to an existing swale at the downstream end of the bar. Existing riparian vegetation would border the created side channel. Another side channel would be created, splitting off from the other side channel through the middle of the bar in the southwest direction. Boulders would be placed to maintain stable hydraulic conditions at the inflow. There is a large expanse of shallow depth to groundwater on Narrow Bar, with some areas of high floodplain. The high floodplain areas would be graded and planted with riparian vegetation. Additionally, floodplain along the main channel would be graded to increase inundation duration and frequency at 3,000 cfs. ELJs would be placed in a patchwork configuration to facilitate riparian recruitment and to restore swale habitat. At the terminus of the anabranching side channel, a backwater area would be created.

River Mile 6.5. A backwater area would be created on the right bank of the river to provide shallow water refugia for salmonids.

Bar E. Riparian vegetation would be planted in the downstream portion of Bar E surrounding a historical channel alignment to restore species and structural diversity. LWM would be placed in the swale/backwater downstream from the existing diversion channel.

Island B. Riparian vegetation would be planted along the upstream portion of this island to create species and structural diversity. ELJs would be placed in a patchwork configuration to encourage native plant recruitment and improve survivability of plantings.

Staging. This Increment would require two staging areas. The staging area located on the north side of the river would be less than 1 acre in size and would be located on previously disturbed land adjacent to a cobble bar. Access to this staging area would be via Highway 20/Browns Valley Road to Hallwood Boulevard. Vehicles would proceed east on Hallwood Boulevard for approximately 2 miles to the end of the road. At the dead-end, vehicles would take a right turn onto a dirt farm road alongside an orchard. The staging area would be located approximately 0.25 mile down the farm road. This staging area would support project actions at Narrow Bar and River Mile 6.5 which involve extensive excavation and material moving, so the routes would need to be improved and widened.

The second staging area would be less than 1 acre in size and would be located on the south side of the river in a previously disturbed area. The access route goes through farmland which would likely not require improvement as there would be only planting activities on these sites. Repairs would need to be made to the road after construction. This staging area would support project actions at Island B and Bar E.

Table 4-5. Habitat Increment 5b Details.

Feature Type	Acres	Volume (CY)	Length (Miles)
Side Channel	9.2	127,625	0.75
Floodplain Lowering	7.7	9,726	NA
Riparian Planting ¹	29.7 (37.4)	NA	NA
Backwater Area	2.9	13,346	0.19
Total	49.5	150,697	0.9

¹ - Riparian planting includes areas with existing suitable depth to ground water and areas where proposed floodplain lowering would establish suitable depth to ground water; therefore the total acreage for Riparian Planting (shown in parentheses) includes the acreage of the Floodplain Lowering feature.

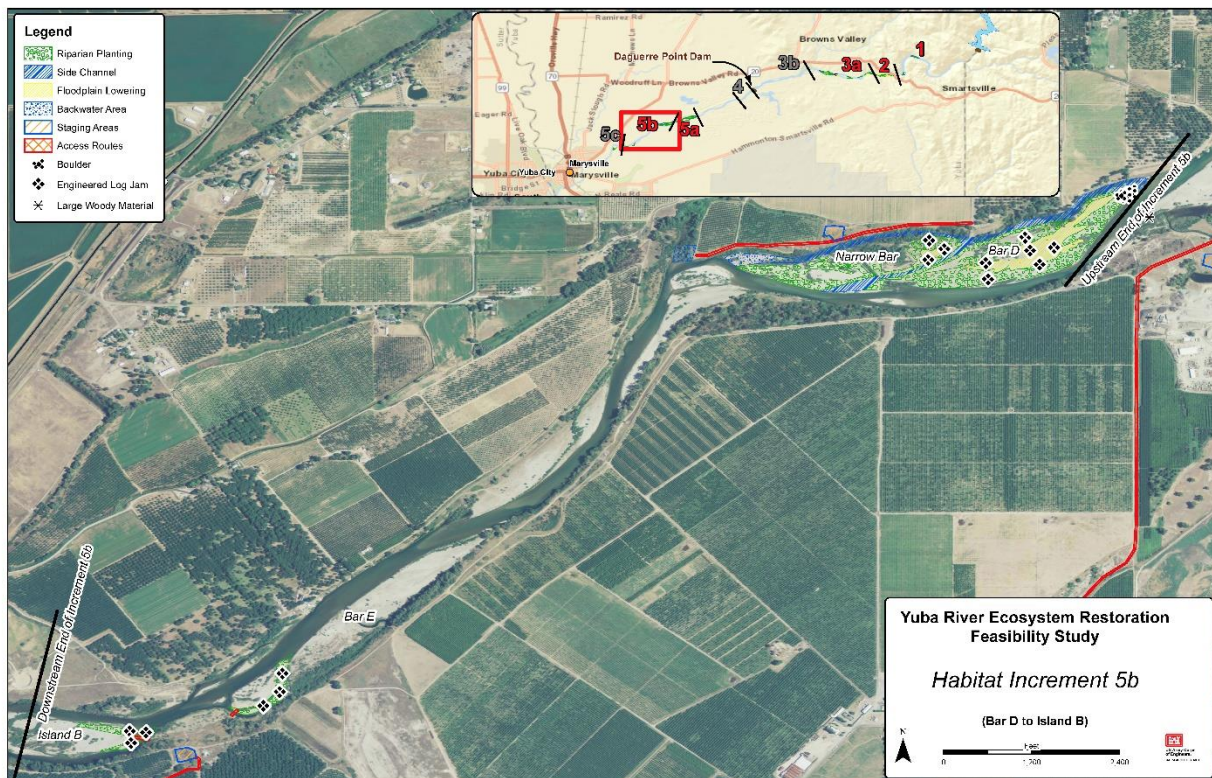


Figure 4-4. Habitat Increment 5b.

Construction Methods

Riparian Planting

Planting would occur with a stinger planting method that uses a specialized planting device mounted on an approximately 45,000 lb excavator to quickly plant cuttings one or two at a time. The stinger device can plant to a maximum depth of nearly 7 feet and the cutting of maximum diameter of approximately 2 inches. Following marking, cutting, and soaking of

cuttings, cuttings would be wrapped in wet blankets and carried by pickup to the excavator for stinger installation. A combination of four native species would be planted, including Fremont cottonwood, black willow, red willow, and arroyo willow (Table 4-6). The planting design is intended to promote hard wood structure (i.e. forest and large wood production) while also providing species and structural diversity. Although arroyo willow is not a tree type willow it is included in the design to create structural diversity known to support neotropical bird habitat. Furthermore, arroyo willow, is underrepresented on the lower Yuba River compared to other shrubby willows (WSI 2012; SYRCL 2013). The planting density for this feature would be 1,500 plants per acre (PPA) with two plants per stinger planting pit. Riparian planting would occur in areas identified with suitable existing depth to groundwater (identified as Riparian Planting in the alternative descriptions) as well as in areas where suitable depth to groundwater is established through floodplain grading or lowering (identified as floodplain lowering in the alternative descriptions).

Table 4-6. Riparian Planting Palette.

Scientific Name	Common Name	Plants Per Acre	Cutting / Container Size	Planting Method
<i>Populus fremontii</i>	Fremont cottonwood	750	Pole cutting	Stinger
<i>Salix gooddingii</i>	Black Willow	250	Pole cutting	Stinger
<i>Salix laevigata</i>	Red willow	250	Pole cutting	Stinger
<i>Salix lasiolepis</i>	Arroyo willow	250	Pole cutting	Stinger
Total		1,500		

Floodplain Lowering/ Grading

This feature includes the excavation or grading of the nearbank area or floodplain. Lowering of the floodplain would occur in areas where the depth to the water table is greater than 10 feet to facilitate riparian planting and survival or shallow water habitat. Grading of the nearbank area or floodplain would consist of shaping the terrain appropriately to create shallow water habitat and/or to decrease the surface distance to groundwater. Nearbank or floodplain modifications would be conducted with the goal of providing water depths with 50 to 100 percent of juvenile spring run Chinook salmon optimal water depth suitability approximately 80 percent of the time during the over-summer juvenile rearing period. The slope of the floodplain grading generally follows a linear extrapolation between the water side and land side limits of the grading area. Floodplain lowering would be performed by self-elevating (paddlewheel) scraper, moving material into a location suitable for loading by excavator and truck.

Side Channel

Side channels would be created to a water depth of 0.5 feet associated with the base flow conditions. Above Daguerre Dam flows are expected to be 730 cfs and downstream of the dam 530 cfs. Side channels would be excavated utilizing common construction equipment (which may include a ~165,000 lb excavator for working in the dry and a ~70,000lb excavator for any

in-water work). Excavation would occur in 8-10' wide swaths moving backwards (away from river), loading directly into trucks. Work would proceed from the interior of the feature moving outward leaving material at the end as a natural coffer dam and access to outward bar points for planting.

Backwater Area

In addition to enhancing juvenile anadromous salmonid rearing habitat, creation of a backwater area (a part of the river not reached by the current, where the water is still) of the lower Yuba River is anticipated to provide enhanced habitat for use by waterfowl, amphibians and other wildlife species. These areas would be at a depth of 7 to 10 feet.

Bank Scaloping

Side channel criteria is applied to this feature as appropriate. This feature would involve excavating small scallops into the tall and steam banks to increase local topographic diversity and wetted edge. The steep slopes surrounding the alcoves would be feathered to a 10 to 1 slope to provide additional shallow inundated areas with desirable depth-velocity combinations over a range of flows.

Large Woody Material (LWM)

Where woody material is described as an addition to bankline, assume woody features are 25 feet in length and 2 feet in diameter. The material would be anchored in the bankline at a 45 degree angle downstream and protrude one third of its total length beyond the bankline into the channel. The floodplain application is where woody material is placed on a floodplain or seasonally inundated area, the woody material would be placed parallel with the flow, anchored with cables boulders and pins (also known as Engineered Log Jams or ELJs).

Boulders

Boulders would be used to slow velocities and stabilize the channel in certain areas. The number and weight of boulders needed per site would be determined during PED using a hydraulic model.

Disposal

A large quantity of earth materials is expected to be hauled away during project construction. 11-13 cy highway dump trucks would be used to haul over off-road access to public paved roads to placement/disposal sites. Disposal of this material is assumed to occur at a licensed disposal facility at a distance of approximately 10 - 20 miles away. Five sites around the North and South sides of the Lower Yuba River are being considered for placement/disposal. If the project is authorized and funded, detailed evaluation of excavated material requirements, identification and detailed technical evaluation of routes would be completed during PED. For a detailed analysis of access and staging see Real Estate Appendix E and Engineering Appendix B - Attachment D.

Access and Staging

Proposed access roads would be developed along existing roadways to the greatest extent possible. Establishing access would require improvements to existing roads (i.e., paving, extension of driveways, widening, and grading) as well as repairs to roads following construction. Additional development of off-road access to the river-bars/ worksite would be required. Access would be constructed utilizing common construction equipment, which may include graders, water trucks, rollers, and gravel trucks. From the proposed staging areas, vehicles accessing the restoration sites would haul primarily on cobble bars along the river. In some cases, temporary haul roads would need to be constructed in order to provide better access to the sites. Occasionally, rather than hauling on cobble bars, vehicles would have access to farm roads. In some cases, access to the restoration sites could only be provided through temporary river crossings. Temporary channel crossings could be constructed by placing clean spawning size gravel to establish a passable depth or through the placement of a temporary structure (i.e., rail car or temporary bridge). These would be placed over the river channel for temporary access as necessary.

Staging areas would be constructed utilizing common construction equipment, which may include graders, water trucks, rollers, and gravel trucks. Preparation of staging areas could include clearing and grubbing, installation of fencing, and BMPs (including installation of silt fences, stabilized construction entrance, drip pads, and fueling station). Potential staging areas have been identified for each increment or group of increments. Each staging area would be half an acre to an acre, depending on the amount of work to be completed. These areas would be the sole locations used for staging of vehicles, materials, and other associated construction equipment. The staging areas have been subject to the same environmental review as the project footprint to ensure that any potential resources would not be adversely affected.

Construction Sequencing

Construction Sequencing for Alternative 5 would follow an annual pattern of mobilization, construction, and demobilization as summarized in Table 4-7 below. Due to the potential for high flows to interact with work sites/ staging areas, all construction would be phased to be accomplished in a particular location in a single season. In general, construction each year would begin with establishment of access and staging of equipment/materials in May. General excavation would begin in June and continue through October. To avoid and minimize impacts to fish species (especially special status anadromous salmonids), in-water work would be limited to July 1st to October 30th. Installation of woody features and boulders would also occur during this time. Preparation for riparian planting, including identification of donor trees would be completed in September each year. Harvest and planting by stinger of riparian plantings would occur in October and November each year. The overall construction of Alternative 5 is anticipated to take place over 4 years.

Table 4-7. Construction Sequencing

Activity	Schedule
Initial clearing and trimming of vegetation	January 1 – February 15
Staging and Access (all features)	May 1 – May 30
Excavation (all features) and Placement of boulders and woody material	General: June 1 – October 31 In-water: July 1 – October 31
Identify trees for harvest	September 1 – September 30
Harvest and planting of riparian vegetation	October 1 – November 30

4.1.1.3 Alternative 6

Alternative 6 includes 197.8 acres of habitat improvements at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, Bar A, and Upstream of Highway 20 along the lower Yuba River. The habitat improvements correspond to Increments included in Alternative 5 (2, 3a, 5a, and 5b) as well as additional features under Increment 1 as described in Section 3.5. Alternative 6 includes all of the features, access, staging, as described under Alternative 5 with the addition of habitat improvements upstream of Highway 20. Alternative 6 would result in improvement to the ecosystem by grading near bank areas and planting riparian vegetation to improve hydrogeomorphic processes, increase habitat complexity and value, and increase connectivity between habitats. The total cost of this alternative is \$109.6 million.

Features

In addition to the Features described under Alternative 5 above, Alternative 6 would include habitat improvements upstream of Highway 20 (Increment 1) which includes 7.4 acres of riparian planting, 5.8 acres of side channel creation, and 6.1 acres of restored backwater area. Including the features described in Alternative 5 and the additional features included in Increment 1, Alternative 6 would include a total of 197.8 acres of habitat improvements (Table 4-8).

Table 4-8. Summary of Project Features for Alternative 6

Feature Type	Total Acres	Total Volume (CY)	Total Length (miles)
Riparian Planting ¹	95.8 (143.5)	--	--
Floodplain Lowering	47.6	101,816	--
Side Channel	44.8 ²	652,777	4.0
Backwater	9.3	102,231	0.3
Bank Scalloping ³	0.3	--	--
Total	197.8⁴	856,824⁵	4.3⁶

¹ - Riparian planting includes areas with existing suitable depth to ground water and areas where proposed floodplain lowering would establish suitable depth to ground water; therefore the total acreage for Riparian Planting includes the acreage of the Floodplain Lowering feature

² - Side channel quantities include features identified as Channel Constriction

³ - Excavation quantities were not estimated for bank scalloping features but are anticipated to be minor.

⁴ - The total acreage is representative of the total "footprint" of features and does not double count acreage where multiple features may be implemented (i.e., floodplain lowering and planting occurring in the same area).

⁵ - The total volume presented in this table is a simple representation of the amount of material estimated for excavation. Other sections of the report may present excavated amount for Alternative 6 as 943,000 CY which is a bulked volume (volume x 1.1) for the purpose of supporting cost and feasibility estimates.

⁶ - The total length was only calculated for the aquatic habitat features (sides channels and backwaters) and does not represent the full length of the proposed features.

Habitat Increment 1

Upstream of Highway 20. In the Timbuctoo Bend area of the lower Yuba River, a side channel would be created to increase aquatic habitat. The side channel would be constructed with native cobble or armored stone. Along the southern bank of the side channel, the floodplain would be graded and planted with riparian vegetation extending across the existing bar to the lower Yuba River. This action would reconnect the river to its floodplain and increase aquatic and riparian habitat.

East of Parks Bar, near Big Ravine, the near-shore area and adjacent floodplain on the south bank of the lower Yuba River would be graded and planted with riparian vegetation adjacent to the Yuba River. Near the confluence of Big Ravine creek, a large backwater area would be created for use by waterfowl, amphibians, and other wildlife species. Table 4-9 shows details for features of Increment 1 Upstream of Highway 20.

Staging. There are two staging areas identified for Increment 1. The staging area at the upstream end of Increment 1 is located on an approximately 1 acre previously disturbed gravel parking lot on the north side of the Yuba River. This staging area would be accessed via Highway 20 to Peoria Road. Peoria Road turns into Scott Forbes Road/Long Bar Road. From Scott Forbes Road/Long Bar Road, the staging area is accessed via a privately owned gravel road. A temporary haul road would be constructed from the staging area to the proposed habitat restoration area.

The downstream staging area is located on approximately 1 acre of grassland adjacent to a private river access road. This staging area would be accessed via Highway 20 to Timbuctoo Place. Vehicles would continue about 0.5 mile east on Timbuctoo Place to the private access road.

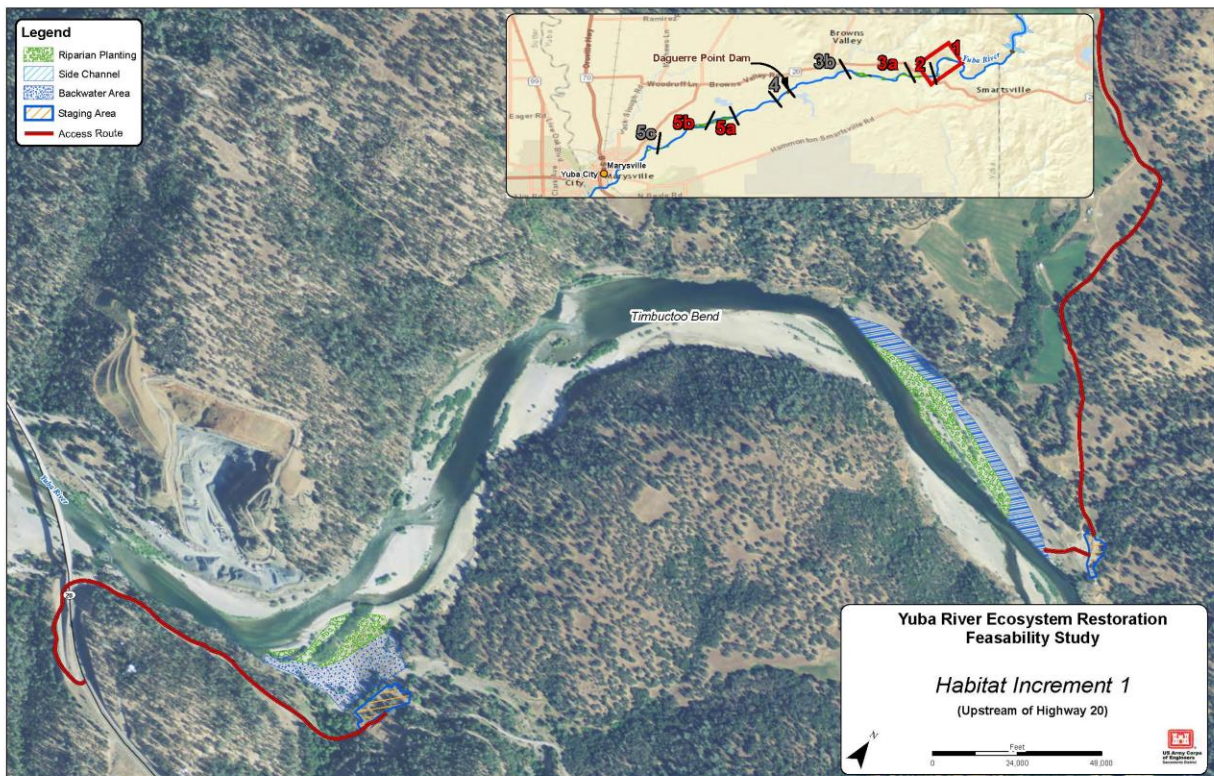


Figure 4-5. Habitat Increment 1.

Table 4-9. Habitat Increment 1 details.

Feature Type	Acres	Volume (CY)	Length (Miles)
Riparian Planting	7.4	NA	NA
Side Channel	5.8	144,163	0.42
Backwater Area	6.1	86,396	0.11
Total	19.3	230,559	0.52

Construction Methods

Construction methods for Alternative 6 would be the same as those described under Alternative 5.

Access and Staging

Alternative 6 would include all of the access and staging areas described under Alternative 5 with the addition of 2 staging areas to support construction of habitat improvements upstream of Highway 20.

Construction Sequencing

Construction sequencing for Alternative 6 would be similar to that described under Alternative 5; however, given additional work associated with additional habitat features, the overall construction of Alternative 6 is anticipated to take place over 5 years.

4.1.2 Alternatives Not Considered in Detail

Measures screened through the plan formulation process prior to the formulation of the final array of alternatives were not considered in detail under this NEPA analysis. Alternatives 1 – 6 were developed following the USACE plan formulation process described in Chapter 3. These alternatives are similar in the types of proposed actions, environmental effects, and expected outcomes and differ primarily in scope. Alternatives 2, 3, and 4 represent subsets of Alternative 5, with proportionally lower anticipated ecosystem output and environmental impacts. Because Alternatives 2, 3, 4 do not offer a significantly different alternative to the recommended plan in terms of meeting project objectives or potential impacts, these alternatives were not considered further in detail.

4.1.2.1 Alternative 2

Alternative 2 includes only Increment 2 at Upper Gilt Edge Bar and Unnamed Bar, which would result in 23.3 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$9.2 million. Alternative 2 would include a subset of features and would employ similar construction methods as those described in the recommended plan. The staging requirements and duration of construction would be proportionally reduced compared to the recommended plan.

4.1.2.2 Alternative 3

Alternative 3 includes Increments 2 and 5b at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, and Island B, which would result in 72.8 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$32.8 million. Alternative 3 would include a subset of features and would employ similar construction methods as those described in the recommended plan. The staging requirements and duration of construction would be proportionally reduced compared to the recommended plan.

4.1.2.3 Alternative 4

Alternative 4 includes Increments 2, 5b, and 5a at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, and Bar C, which would result in 122.2 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is \$57.8 million. Alternative 4 would include a subset of features and would employ similar construction methods as those

described in the recommended plan. The staging requirements and duration of construction would be proportionally reduced compared to the recommended plan.

4.2 Resources Not Considered In Detail

4.2.1 Geology and Seismicity

4.2.1.1 Geology

The major physiographic feature within the project vicinity is the Sierra Nevada Range, which is about 400 miles long and runs south-southeast to north-northwest in the eastern portion of California. The Sierra Nevada crest forms the eastern limit of the Yuba and Bear River Basins and trends north-northwest. Drainage within the Yuba and Bear River Basins is west to southwest from the Sierra Crest to the adjacent floor of the Sacramento Valley. To the east of the basins, down faulting of the eastern Sierra face has affected drainage evolution by creating channels that now have their headwaters facing east.

Uplifting and tilting of the Sierra Block reorganized drainage networks and initiated a period of sustained channel incision, and many of the modern river channels have elevations below Tertiary-age river channels. The ancestral (Tertiary Period) Yuba River had cut about 1,000 feet below a surface defined by San Juan, Washington, and Harmony ridges. These ancestral deep channels drained north-northwest across the strike of the modern drainages. The south branch of the ancestral Yuba River flowed north from Gold Run to Badger Hill, then southwest to Smartsville and Marysville. The ancestral channels were filled first by very coarse, boulder material rich in gold, followed by finer gravel and sand deposits, also rich in gold. These Tertiary gravel deposits are the source of the gold extensively mined in the late 1800s.

The modern Yuba and Bear River Basins drain the northwestern Sierra Nevada via a series of deep canyons separated by high, steep-sided ridges and a parallel drainage network. The parallel drainage network results in narrow ridges between small tributaries, small tributary watersheds, and low tributary sediment loads under natural conditions; prehistoric debris fans at tributary junctions were not common. Stratigraphic evidence indicates the presence of stepped, Quaternary Period terraces similar to piedmont channels flowing out of the Sierra Nevada, but these terraces were generally buried by debris and sediment associated with mining activities. Downtcutting, as noted specifically in the Bear River, through the relatively soft Paleozoic metamorphic rock (Shoofly Complex) has created a deep, v-shaped canyon where short, steep-sided tributary drainages are typical. Distinctive v-shaped inner gorge areas are common in all of the major drainages in the vicinity of the projects (FERC 2014).

The proposed alternatives are small-scale ecosystem restoration projects that would restore the proposed locations to historic conditions. As a result, the project would have no effect on the geologic features in the project area.

4.2.1.2 Seismicity

The study is characterized by low to moderate seismicity, with most seismic activity concentrated east and southeast of the project areas near Lake Tahoe and to the northwest of the project areas, south of Lake Oroville. Expected seismic shaking intensities within the projects area from these nearby faults are considered to be low.

A number of north-to-northwest trending faults cross the projects, most of which are associated with the Foothills Fault System. Among the more significant faults are the Grass Valley Fault, the Melones Fault Zone, the Big Bend/Wolf Creek Fault Zone, the Giant Gap Fault, and the Camel Peak Fault Zone. None of the mapped faults within the project areas has been active in Quaternary time. A portion of the Giant Gap fault south of the projects is designated as having been active in Quaternary time. The nearest active fault (defined by the California Geological Survey as movement within the past 11,400 years) is the Cleveland Hill Fault located to the northwest of the projects near Lake Oroville; that fault had recorded movement in 1975. Other active faults are located to the east and southeast of the projects near Lake Tahoe (FERC 2014). There are no project features that would be sensitive to seismic conditions. As a result, the proposed alternatives would not be impacted by seismicity within the project area.

4.2.2 Socioeconomics and Environmental Justice

The proposed alternatives are located in rural Yuba County, in an area that is designated for natural resources and rural communities. While there are rural farm populations near the study area, any impacts associated with the alternatives would be temporary impacts limited to the construction period. Long-term, residents would benefit from the improved ecosystem along the river. There would be no disproportionately high adverse effects to low-income or minority populations or communities, and the project would not result in population growth or increased population density.

4.2.3 Land Use and Agriculture

Land use in the study area is zoned for natural resources and rural communities. Primarily, the existing land uses in the study area include natural resources and mineral mining adjacent to the river, with farm fields and rural residences present beyond the river channel. All of the proposed restoration increments are located within the active river channel adjacent to the river. Conversion of these lands to habitat features would not significantly change or impact the current land use designations. The project would require the acquisition of land and associated mineral rights to restored areas to ensure that restored areas are protected in perpetuity; however, no operating permitted mining activities would be permanently impacted (Appendix E - Real Estate Plan). Furthermore the preservation of restored areas as open space is compatible with current land use designations. While agricultural fields are present adjacent to the river corridor, no agricultural lands would be impacted by the construction of these restoration features.

4.2.4 Hazardous, Toxic, and Radiological Waste

A Phase I Environmental Site Assessment was performed in conformance with the scope and limitations of the American Society for Testing and Materials (ASTM) Practice E 1527-13 for the Yuba River Ecosystem Restoration Feasibility Study (Engineering Appendix C – Section 9 – Hazardous and Toxic Materials). The records research report and site visit indicates that there are no Recognized Environmental Conditions within or adjacent to the proposed study area. Adjacent properties surrounding the study area appeared well maintained and clean during a site visit. The likelihood of encountering Hazardous, Toxic, and Radiological Waste during the construction of this project is minimal. Elemental mercury and methylmercury are known contaminants of concern in the lower Yuba River; however, no concentrations of any material are anticipated at levels that would be classified as Hazardous or acutely Toxic. The potential for release of contaminant would be addressed through characterization, monitoring, and adaptive controls. Given the results of the Phase I Environmental Site Assessment, the proposed actions would not result in any effects related to hazardous, toxic, or radiological waste.

4.3 Resources Considered in Detail

4.3.1 Air Quality

This air quality section describes the pre-project air quality conditions in the project vicinity and compares them to potential effects of the proposed alternatives on air quality in the project vicinity.

4.3.1.1 Affected Environment

The study area is located in Yuba County and is subject to the regulations and attainment goals and standards of the Northern Sacramento Valley Air Basin (NSVAB) and the Feather River Air Quality Management District (FRAQMD). The topographic features of the NSVAB are the Coast Range to the west, the Sierra Nevada to the east, and the Cascade Range to the north. These mountain ranges wind through the basin and inhibit the dispersion of pollutant emissions.

The predominant annual and summer wind pattern is a full sea breeze, commonly referred to as a Delta breeze. The cool winds of the Delta breeze originate from the Pacific Ocean and flow through a sea-level gap in the Coast Range called the Carquinez Strait. In the winter (December to February), northerly winds predominate. Wind directions in the Sacramento Valley are influenced by the predominant wind flow pattern associated with each season. During about half the days from July through September, the Schultz Eddy prevents the Delta breeze from transporting pollutants north and out of the Sacramento Valley by causing the wind pattern to circle back south and keep air pollutants in the valley.

Criteria Pollutants

The 1970 Federal Clean Air Act (CAA) authorized the establishment of national health-based air quality standards, known as National Ambient Air Quality Standards (NAAQS) and also set deadlines for their attainment. Under the CAA, state and local agencies in areas that exceed the NAAQS are required to develop state implementation plans (SIPs) to show how they would achieve the NAAQS for nonattainment criteria pollutants by specific dates. SIPs are not single documents; rather, they are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, state regulations and Federal controls. The U.S. Environmental Protection Agency (USEPA) is responsible for enforcing the NAAQS primarily through reviewing SIPs that are prepared by each state.

As required by the Federal CAA, the USEPA has established and continues to update the NAAQS for specific criteria air pollutants: ozone (O₃), carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), inhalable particulate matter (PM₁₀), fine particulate matter (PM_{2.5}), and lead (Pb). The NAAQS for these pollutants are listed under “Federal Standards” in Table 4-10 and represent the upper-bound levels of pollutant concentrations deemed necessary by the USEPA to protect the public health and welfare with an adequate margin of safety.

Pursuant to CAA Section 176(c) requirements, USEPA promulgated the General Conformity Rule (GCR), which applies to most Federal actions, including the proposed alternatives. The GCR is used to determine if Federal actions meet the requirements of the CAA and the applicable SIP by ensuring that pollutant emissions related to the action do not:

- Cause or contribute to new violations of a NAAQS.
- Increase the frequency or severity of any existing violation of a NAAQS.
- Delay timely attainment of a NAAQS or interim emission reduction.

A conformity determination under the GCR is required if, through an applicability analysis, the Federal agency determines: the action would occur in a nonattainment or maintenance area; that one or more specific exemptions do not apply to the action; the action is not included in the Federal agency’s “presumed to conform” list; the emissions from the proposed action are not within the approved emissions budget for an applicable facility; and the total direct and indirect emissions of a pollutant (or its precursors), are at or above the *de minimis* emissions levels established in the General Conformity regulations. The *de minimis* emissions levels applied in the applicability analysis will hereafter be referred to as applicability rates.

An action would be determined to conform to the applicable SIP if the action meets the requirements of 40 CFR 93.158(c). In addition, Federal activities may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emissions reductions toward attainment.

The primary pollutants in Yuba County are vehicular emissions and agricultural activities. Light industry and aircraft emissions from Beale Air Force Base also contribute to reduced air quality in the region. The closest air quality monitoring station is located on Almond

Table 4-10. State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	Federal Standard ^a	California Standard ^b	Violation Criteria	
				National	California
CO	8 hour	9 ppm	9 ppm	Not to be exceeded more than once per year	Not to be exceeded
	1 hour	35 ppm	20 ppm	Not to be exceeded more than once per year	Not to be exceeded
NO ₂	Annual	0.053 ppm	0.030 ppm	If exceeded	Not to be exceeded
	1 hour	0.100 ppm	0.18 ppm	The 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 0.100 ppm.	Not to be exceeded
O ₃	8 hour	0.075 ppm	0.070 ppm	The ozone standard is attained when the 4th highest 8-hour concentration measured at each site in a year, averaged over 3 years, is equal to or less than the standard.	Not to be exceeded
	1 hour	N/A	0.09 ppm	N/A	Not to be exceeded
PM ₁₀	Annual	N/A	20 µg/m ³	N/A	Not to be exceeded
	24 hour	150 µg/m ³	50 µg/m ³	The 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m ³ is equal to or less than one.	Not to be exceeded
PM _{2.5}	Annual	12 µg/m ³	12 µg/m ³	The 3-year average of the weighted annual mean must not exceed	Not to be exceeded
	24 hour	35 µg/m ³	N/A	The 24 hour standard is attained when 98% of the daily concentrations, averaged over three years, are equal to or less than the standard	N/A
SO ₂	24 hour	0.14 ppm	0.04 ppm	Not to be exceeded more than once per year	Not to be exceeded
	3 hour	N/A ^c	N/A	N/A	N/A
	1 hour	0.075 ppm	0.25 ppm	The 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 0.075 ppm.	Not to be exceeded
Pb	30 day	N/A	1.5 µg/m ³	N/A	Not to be exceeded or equaled
	Quarter	1.5 µg/m ³	N/A	Not to be exceeded more than once per year	N/A
	3 month	0.15 µg/m ³	N/A	Not to be exceeded more than once per year	N/A

Source: CARB, 2016a

^a 40 CFR 50.4 through 50.13^b California Code of Regulations, Table of Standards, Section 70200 of Title 17^c No National Primary 3 hour standard for SO₂. National Secondary 3 hour standard for SO₂ is 0.5 ppm.µg/m³ micrograms per cubic meter

ppm parts per million

N/A Not Applicable; State and Federal Standards do not exist.

Street in Yuba City. This station monitors NO₂, O₃, PM₁₀, PM_{2.5}, and several weather parameters (CARB 2015). Table 4-11 summarizes air quality data between 2008 and 2015 (any data after 2015 is considered preliminary at this time).

Toxic Air Contaminants

Air quality regulations in California also focus on toxic air contaminants (TACs), known as hazardous air pollutants (HAPs) in Federal regulations. A TAC is an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health (California Office of Environmental Health Hazard Assessment, 2017). TACs are usually present in minute quantities in the ambient air, however, their high toxicity or health risk may pose a threat to the public even at very low concentrations. Unlike criteria air pollutants, for which there are acceptable levels of exposure, there is no safe level of exposure to TACs, as there is no concentration that does not present some risk. TACs are regulated by the USEPA and CARB through regulations that generally require the utilization of best available technology to limit emissions.

Table 4-11. Summary of Air Quality Monitoring Data in Yuba County (2008-2015).¹

Pollutant	Year	Average Period	Maximum Concentration	Exceeds Federal Standard
Ozone	2008	8 hour	0.072 ppm	No
	2009	8 hour1	0.068 ppm	No
	2010	8 hour1	0.066 ppm	No
	2011	8 hour1	0.065 ppm	No
	2012	8 hour1	0.066 ppm	No
	2013	8 hour1	0.064 ppm	No
	2014	8 hour1	0.066 ppm	No
	2015	8 hour1	0.064 ppm	No
PM10	2008	24 hour	66.9 µg/m ³	No
	2009	24 hour24	50.7 µg/m ³	No
	2010	24 hour24	43.1 µg/m ³	No
	2011	24 hour24	54.6 µg/m ³	No
	2012	24 hour24	60.8 µg/m ³	No
	2013	24 hour24	56.1 µg/m ³	No
	2014	24 hour24	45.1 µg/m ³	Insufficient data available
	2015	24 hour24	68.2 µg/m ³	No

Table 4-11 (continued). Summary of Air Quality Monitoring Data in Yuba County (2008-2015).¹

Pollutant	Year	Average Period	Maximum Concentration	Exceeds Federal Standard
PM _{2.5}	2008	Annual	10.1 µg/m ³	No
	2009	Annual	8.9 µg/m ³	No
	2010	Annual	8.2 µg/m ³	No
	2011	Annual	7.3 µg/m ³	No
	2012	Annual	6.9 µg/m ³	No
	2013	Annual	7.7 µg/m ³	No
	2014	Annual	Insufficient data available	NA
	2015	Annual	Insufficient data available	NA
	2008	24 hour	47 µg/m ³	Yes
	2009	24 hour	42 µg/m ³	Yes
	2010	24 hour	36 µg/m ³	Yes
	2011	24 hour	27 µg/m ³	No
	2012	24 hour	26 µg/m ³	No
	2013	24 hour	29 µg/m ³	No
	2014	24 hour	Insufficient or no data available	NA
	2015	24 hour	Insufficient or no data available	NA
NO ₂	2008	1 hour	0.061 ppm	No
	2009	1 hour	0.057 ppm	No
	2010	1 hour	0.059 ppm	No
	2011	1 hour	0.073 ppm	No
	2012	1 hour	0.083 ppm	No
	2013	1 hour	0.0574 ppm	No
	2014	1 hour	0.049 ppm	No
	2015	1 hour	0.0434 ppm	No

1 Almond Street Monitoring Station

2 Data not available for CO, SO₂, or Pb at this monitoring station.

Source: CARB 2016a

The majority of TACs can be attributed to relatively few compounds (CARB, 2011). Of the TACs for which data is available in California, diesel PM, benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride and perchlorethylene are the most hazardous to health. Of these, diesel PM presents the greatest health risk (CARB, 2016b). The PM from diesel-fueled engines is composed of a complex mixture of hundreds of substances and is the most important of the TACs. Diesel fueled internal combustion engines emit diesel PM, but the composition of the emissions varies by many factors, including fuel consumption, operating conditions, engine type, etc. Diesel PM, unlike other TACs has no ambient monitoring data available, as there is no routine measurement currently in existence.

Sensitive Receptors

Some locations are considered more sensitive to adverse effects from air pollution than others. These locations are called sensitive receptors. Sensitive receptors include human populations, particularly children, seniors and the sick. For the purpose of this analysis, sensitive receptors are discussed as the locations in which the sensitive populations are found, and where there is a reasonable expectation of continuous human exposure according to appropriate standards (e.g., 24-hour, 8-hour, and 1-hour). Sensitive land uses and sensitive receptors generally include residences, hospitals, rehabilitation centers and convalescent centers, retirement homes, and schools, playgrounds and childcare centers. Sensitive receptors in the study area include rural residences.

4.3.1.2 Environmental Consequences

Methodology

The methods for evaluating impacts are intended to satisfy the Federal air quality requirements, including the Federal General Conformity Rule, and to disclose effects to fulfill requirements set forth in accordance with NEPA.

To complete the analysis, information was collected on projected construction activities, duration, and timing, equipment use, and activities for each construction year using SMAQMD's Road Construction Emission Model Version (RCEM) 8.1.0. Construction equipment usage from similar projects was analyzed to estimate daily and annual exhaust emissions. Emissions are considered significant if emissions exceed the thresholds established by the applicable air quality agencies. Although construction of the proposed measures is anticipated to take a number of years, activities in any given year would follow the same sequencing. Due in part to limitations in the RCEM to efficiently evaluate multiyear projects with gaps in construction (wet season), modeling was conducted using a worst case scenario approach. Under this approach, modeling was conducted for a single year of construction representative of a reasonable maximum estimate of annual emissions. The modeled annual emissions were then compared against annual emission thresholds to determine the significance of project effects to air quality. Modeling assumptions for each project alternative and methodology are provided in the Environmental Appendix D – Attachment 10a. The following construction sources and activities were analyzed for emissions:

- On site construction off-road equipment emissions (all criteria pollutants)
- On site pickup trucks, onsite haul trucks, and off site haul trucks emissions (all criteria pollutants)
- Off-site worker vehicle emissions (all criteria pollutants)
- On site pickup trucks, on site haul trucks, off site haul truck, and off site worker vehicles entrained fugitive dust emissions for paved and unpaved road entrained dust (PM₁₀ and PM_{2.5})
- On site excavation (cut/fill) fugitive dust (PM₁₀ and PM_{2.5})

Disposal sites have not yet been identified at the time of this writing, but are assumed to be located within a 20 mile radius from the study area. Emissions associated with material activities would fall within the FRAQMD.

Basis of Significance

Adverse effects on air quality were considered significant if implementation of an alternative plan would:

- Violate any Federal ambient air quality standard.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project is in nonattainment under applicable Federal ambient air quality standards (including releasing emissions which exceed quantitative thresholds for ozone precursors).
- Expose sensitive receptors to substantial pollutant concentrations.
- Create objectionable odors affecting a substantial number of people.

State Implementation Plan and General Conformity Applicability Rates

Federal actions need to demonstrate conformity to any SIPs of the regional air basin. Each action must be reviewed to determine whether it: 1) qualifies for an exemption listed in the General Conformity Rule (GCR); 2) results in emissions that are below GCR applicability rates; or 3) would produce emissions above the GCR applicability rates of the specific area. The General Conformity applicability rates for this project are shown below (Table 4-12). These thresholds were applied to the project's estimated emissions and used to determine effect significance as detailed below.

Federal General Conformity Criteria

The USEPA developed the General Conformity Rule, which became effective on January 31, 1994, to implement Section 176c of the Federal CAA. The underlying principle of the General Conformity Rule is that Federal actions must not cause or contribute to any violation of a NAAQS. A conformity determination is required for each pollutant where the total of direct and indirect emissions caused by a Federal action in a nonattainment area could exceed applicability rates listed in the General Conformity Rule (40 CFR 93.153). If the total direct

emissions associated with the project are below the applicability rates indicated in Table 4-12, general conformity requirements do not apply, and the project is considered in conformity and would not result in an adverse effect.

Although the project region is in attainment for the majority of criteria pollutants indicated in Table 4-13, the region was in non-attainment for PM_{2.5} (U.S. Environmental Protection Agency, 2017); therefore, a conformity assessment for PM_{2.5} must be completed. That assessment evaluates whether the project's construction emissions would exceed 100 tons per year of PM_{2.5}.

Table 4-12. General Conformity Applicability Rates.

Pollutant	Federal Attainment Status	Threshold Values (tons/yr.) ¹
Ozone precursor (ROG)	Unclassifiable/Attainment	25
Ozone precursor (NO _x)	Unclassifiable/Attainment	25
CO	Attainment	100
SO ₂	Attainment	100
PM _{2.5}	Nonattainment	100
PM ₁₀	Attainment	100
Pb	Attainment	25

Source: USEPA 2014

¹ Thresholds from 40 CFR Parts 51 and 93.

Table 4-13. Emission Rates for Criteria Pollutants in Nonattainment Areas.

Pollutant	Emission Rate (tons per year)
Ozone (Volatile organic compounds or NO_x)	
Serious nonattainment areas	50
Severe nonattainment areas	25
Extreme nonattainment areas	10
Other ozone nonattainment areas outside an ozone transport region	100
Marginal and moderate nonattainment areas inside an ozone transport region	
Volatile organic compounds	50
NO _x	100
CO: All nonattainment areas	100
SO ₂ or NO ₂ : All nonattainment areas	100
PM₁₀	
Moderate nonattainment areas	100
Serious nonattainment areas	70
PM_{2.5}	
Moderate nonattainment areas	100
Serious nonattainment areas	70
Pb: All nonattainment areas	25

Note: Applicability Rates (*De minimis* emission levels) for conformity applicability analysis.

Source: 40 CFR 51.853

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. Air quality in the area would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Construction of this alternative would result in a short-term, temporary increase in the generation of ROG, CO, NO_x, PM₁₀, and PM_{2.5} emissions from the earthwork operations, motor vehicle exhaust associated with construction equipment, employee commute trips, material transport, material handling, and other construction activities. Annual emissions were calculated based on assumptions of the type of construction equipment required for each construction phase (Environmental Appendix D – Attachment 10a).

Maximum daily emissions (lbs/day) and total construction emissions (tons/year) were calculated from the SMAQMD's Road Construction Emission Model Version 8.1.0 for ROG, NO_x, SO_x, PM₁₀, and PM_{2.5} to evaluate emissions against the Federal thresholds. Table 4-14 summarizes the total emissions for ROG, NO_x, SO_x, PM₁₀, and PM_{2.5} estimated for Alternative 5. Emissions modeling indicate that no Federal thresholds for construction related emissions would be exceeded due to the implementation of Alternative 5 and therefore no mitigation would be required with regards to Federal standards.

Implementation of Alternative 5 would not result in emissions exceeding the general conformity threshold of 100 tons per year of PM_{2.5} therefore the project is in conformity with the NAAQS. State and local thresholds for construction related emissions would be evaluated under a CEQA analysis by the non-federal sponsor and any required mitigation would be implemented as appropriate to reduce potential impacts to air quality to a less than significant level. Alternative 5 has no significant O&M requirements and no long-term impacts on air quality are anticipated.

Impacts to air quality from construction and establishment related activities would be temporary in nature. These impacts would include localized and regional increases in fugitive dust and emissions. The proposed actions are located within a rural area and construction activities would occur away from any sensitive receptors. The project would not create any objectionable odors. Furthermore, BMPs listed below, including use of water trucks during construction and restoration of impacted areas, would be implemented to reduce the short-term construction related impacts of this alternative to air quality. Given these considerations, implementation of Alternative 5 would result in a less than significant impact to air quality.

Table 4-14. Estimated Emissions from Alternative 5.

Site Preparation & Construction	ROG	CO	NO_x	PM₁₀	PM_{2.5}
Total emissions (tons/year) in 2022	0.15	2.35	1.50	1.03	0.24
Federal Threshold (tons/year)	25	100	25	100	100

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats would be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. Alternative 6 would have similar, but incrementally greater, construction related effects to Alternative 5, including short-term, temporary increase in the generation of the previously discussed emissions from earthwork operations, motor vehicle exhaust associated with construction equipment, employee commute trips, material transport, material handling, and other construction activities. The additional work associated with Increment 1 included in Alternative 6 would require an additional year to construct compared to Alternative 5. While the additional work would result in proportionally greater overall emissions, the reasonable worst case scenario/ high potential for emissions for Alternative 6 would be the same as that evaluated for Alternative 5. As with Alternative 5, no Federal thresholds for construction related emissions would be exceeded under Alternative 6 (Table 4-15). Alternative 6 would result in a less than significant impact to air quality.

Table 4-15. Estimated Emissions from Alternative 6.

Site Preparation & Construction	ROG	CO	NO_x	PM₁₀	PM_{2.5}
Total emissions (tons/year) in 2022	0.20	2.99	2.01	1.07	0.26
Federal Threshold (tons/year)	25	100	25	100	100

4.3.1.3 Best Management Practices and Avoidance and Minimization Measures

The following BMPs and avoidance and minimization measures would be implemented to further reduce potential air quality emissions:

- Minimize idling time by either shutting equipment off when not in use or reduce the idling time to five minutes (as required by the state airborne toxics control measure [Title 13, Sections 249(d)(3) and 2485 of the California Code of Regulations]). Clear signage that posts this requirement at the entrances to the site would be required.
- Maintain all construction equipment in proper working conditions according to the manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.

- At least 48 hours prior to the use of heavy-duty, off-road equipment, the contractor would provide FRAQMD with the anticipated construction timeline, including start date, and the names and phone numbers of the project manager and onsite foreman.
- Restrict vehicle speeds of any vehicle or equipment traveling across unpaved areas to no higher than 15-mph.
- Prior to any ground disturbance, including grading, excavating and land clearing, sufficient water would be applied to the area to be disturbed to prevent emitting dust exceeding Ringlemann scale 2 and to minimize visible emissions from crossing the boundary line.
- No trucks would be allowed to transport excavated material off-site unless the trucks are maintained such that no spillage can occur from holes or other openings in cargo compartments.
- Water all exposed surfaces at least twice daily. Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas and access roads.
- Cover or maintain a minimum of two feet of free board space on haul trucks transporting soil, sand, or other loose material on the site. Any haul trucks that would be traveling along freeways or major roadways would be covered.

4.3.2 Climate Change

This section establishes the existing conditions for climate change in the study area. The basis of significance for impacts to climate change are established, including specific emissions standards, thresholds, or other measurements for the various pollutants. The potential effects of the proposed alternatives are discussed, and, as necessary, applicable BMPs and avoidance and minimization measures are described. The authorities for consideration of climate change in all USACE projects are: the USACE Climate Change Adaptation Plan; ECB 2016-25, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects; and ER 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs.

4.3.2.1 Affected Environment

Emissions of Greenhouse gasses (GHGs) are a contributing factor, on a cumulative basis, to global climate change. Global climate change has the potential to result in sea level rise (which may result in flooding of low-lying areas), to affect rainfall and snowfall levels (which may lead to changes in water supply and runoff), to affect temperatures and habitats (which in turn may affect biological and agricultural resources), and to result in many other adverse effects. Although global climate change is inherently a cumulative impact, it is important to remember that any single project is unlikely to be able to generate sufficient GHGs by itself to have a significant impact on the environment. However, the cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which in turn have been shown to be the main cause of global climate change.

Global Climate Trends and Associated Impacts

Global warming is the name given to the increase in the average temperature of the Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Warming of the climate system is now considered by a vast majority of the scientific community to be unequivocal, based on observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC, 2014).

Global mean surface temperatures have risen by 0.74 degrees Celsius ($^{\circ}\text{C}$) $\pm 0.18^{\circ}\text{C}$ when estimated by a linear trend over the last 100 years (1906 to 2005). The rate of warming over the last 50 years is almost double that over the last 100 years ($0.13^{\circ}\text{C} \pm 0.03^{\circ}\text{C}$ versus $0.07^{\circ}\text{C} \pm 0.02^{\circ}\text{C}$ per decade). The causes of this measured warming have been identified as both natural processes and the result of human actions. For the next two decades, a warming of about 0.2°C per decade is projected for a range of emissions scenarios.

The Intergovernmental Panel on Climate Change (IPCC) concludes that variations in natural phenomena such as solar radiation and volcanoes produced most of the warming from preindustrial times to 1950 and had a small cooling effect afterward. However, since 1950, increasing GHG concentrations resulting from human activity such as fossil fuel burning and deforestation have been responsible for most of the observed temperature increase. These basic conclusions have been endorsed by more than 45 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries. Since 2007, no scientific body of national or international standing has maintained a dissenting opinion (DWR, 2012). A review of published climate change studies showed an overwhelming consensus on the anthropogenic global warming (Cook et al. 2016).

Increases in GHG concentrations in the Earth's atmosphere are thought to be the main cause of human-induced climate change. GHGs naturally trap heat by impeding the exit of solar radiation that has hit the Earth and is reradiated back into space as infrared radiation. Some GHGs occur naturally and are necessary for keeping the Earth's surface habitable. However, increases in the concentrations of these gases in the atmosphere above natural levels during the last 100 years have increased the amount of infrared radiation that is trapped in the lower atmosphere, intensifying the natural greenhouse effect and resulting in increased global average temperatures.

The effects of warming of the Earth's atmosphere and oceans affect global and local climate systems. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, in addition to temperature increases (IPCC, 2014). Based on growing evidence, there is high confidence that the following effects on hydrologic systems are occurring: (1) increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers; and (2) warming of lakes and rivers in many regions, with effects on thermal structure and water quality (IPCC, 2014).

There is very high confidence, based on increasing evidence from a wider range of species, that recent warming is strongly affecting terrestrial biological systems, including such changes as earlier timing of spring events (e.g., leaf-unfolding, bird migration, egg-laying); and

poleward and upward shifts in ranges in plant and animal species. Based on satellite observations since the early 1980s, there is high confidence that there has been a trend in many regions toward earlier “greening” of vegetation in the spring linked to longer thermal growing seasons resulting from recent warming (IPCC, 2014).

There is high confidence, based on substantial new evidence, that observed changes in marine and freshwater biological systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. These include shifts in ranges and changes in algal, plankton, and fish abundance in high-latitude oceans; increases in algal and zooplankton abundance in high-latitude and high-altitude lakes; and range changes and earlier fish migrations in rivers (IPCC, 2014).

Changes in the ocean and on land, including observed decreases in snow cover and Northern Hemisphere sea ice extent, thinner sea ice, shorter freezing seasons of lake and river ice, glacier melt, decreases in permafrost extent, increases in soil temperatures and borehole temperature profiles, and sea level rise, provide additional evidence that the world is warming (IPCC, 2014).

Climate Change Conditions in California

With respect to California’s water resources, the most important effects of global warming have been changes to the water cycle and sea level rise. Over the past century, the precipitation mix between snow and rain has shifted in favor of more rainfall and less snow (Mote et al., 2005; Knowles et al., 2006), and snowpack in the Sierra Nevada is melting earlier in the spring (Kapnick and Hall, 2009). The average early-spring snowpack in the Sierra Nevada has decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage (DWR, 2008). These changes have major implications for water supply, flooding, aquatic ecosystems, energy generation, and recreation throughout the state.

Precipitation

Climate change can affect precipitation by changing the overall amount of precipitation, type of precipitation (rain versus snow), and timing and intensity of precipitation events. Changes to these factors propagate through the hydrologic system in California and have the potential to affect snowpack, runoff, water supply, and flood control.

Former State Climatologist James Goodridge compiled an extensive collection of longer-term precipitation records from throughout California. These data sets were used to evaluate whether there has been a changing trend in precipitation in the state over the past century (DWR, 2016). Long-term runoff records in selected California watersheds were also examined. Based on a linear regression of the data, the long-term historical trend for statewide average annual precipitation appears to be relatively flat (no increase or decrease) over the entire record. However, it appears that there might be an upward trend in precipitation toward the latter portion of the record. Precipitation in Northern California appears to have increased between 1 and 3 inches annually between 1890 and 2002 (DWR, 2016).

Snowpack

An increase in the global average temperature is expected to result in a decreased volume of precipitation falling as snow in California and an overall reduction in the Sierra Nevada's snowpack. Snowpack in the Sierra Nevada provides both water supply (runoff) and storage (within the snowpack before melting), which is a major source of supply for California. By 2100, the contributions of snowmelt to runoff would decrease by one third for the western U.S. in the IPCC Representation Concentration Pathway 8.5 scenario (Donogyue et al., 2017). According to the California Energy Commission (CEC), the snowpack portion of the water supply has the potential to decline by 30 to 90 percent by the end of the 21st century (CEC, 2016). A study by Knowles and Cayan projects that approximately 50 percent of the statewide snowpack would be lost by the end of the century (Knowles and Cayan, 2002). Snowpack conditions have been further exacerbated by drought conditions in California over the past several years (Dettinger et al. 2015).

On average, California's annual snowpack has the greatest accumulations from November through the end of March. The snowpack typically melts from April through July. California's reservoir managers rely on snowmelt to fill reservoirs once the threat of large winter and early-spring storms and related flooding risks have passed.

An analysis conducted by DWR of the effect of rising temperatures on snowpack shows that a rise in average annual air temperature of 3°C (5.4°F) would likely cause snowlines to rise approximately 1,500 feet (DWR, 2016). This would result in the equivalent of approximately 5 million acre-feet of water per year falling as rain rather than snow at lower elevations.

Runoff

Runoff is directly affected by changes in precipitation and snowpack. If the amount of precipitation falling as rain rather than snow were to increase earlier in the year, flooding potential could increase. Water that normally would be held in the Sierra Nevada snowpack until spring would flow into the Central Valley concurrently with the rain from winter storm events. This scenario would place more pressure on California's flood control system (DWR, 2016).

Changes in both the amount of runoff and the seasonality of the hydrologic cycle also have the potential to greatly affect the heavily managed water systems of the western United States. The hydrology of the Sacramento River watershed, including the Yuba River, is highly dependent on the interaction between Sierra Nevada snowpack, runoff, and management of reservoirs. Higher snow lines and more precipitation falling in the form of rain rather than snow would increase winter inflows to reservoirs. Higher winter inflows would also likely mean that a greater portion of the total annual runoff volume would occur in the winter, which would translate to higher flows in the Delta in the winter than those that currently occur.

Greenhouse Gas Emissions

As defined in Section 38505(g) of the California Health and Safety Code, the principal GHGs of concern are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃). With the exception of NF₃, these are the same gases named in the USEPA's

Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the CAA. Each of the principal GHGs has a long atmospheric lifetime (one year to several thousand years), and is globally well mixed. In addition, the potential heat trapping ability of each of these gases varies significantly from one another. On a 100-year timescale, methane is about 25 times as potent as CO₂, nitrous oxide is about 298 times as potent as CO₂, and sulfur hexafluoride is about 22,800 times more potent than CO₂ (IPCC, 2007). Conventionally, GHGs have been reported as CO₂ equivalents (CO₂e). CO₂e takes into account the relative potency of non-CO₂ GHGs and converts their quantities to an equivalent amount of CO₂ so that all emissions can be reported as a single quantity.

The primary human-made processes that release these gases include: (1) the burning of fossil fuels for transportation, heating, and electricity generation; (2) agricultural practices that release methane, such as livestock grazing and crop residue decomposition; and (3) industrial processes that release smaller amounts of high global warming potential gases, such as sulfur hexafluoride, PFCs, and HFCs. Deforestation and land cover conversion have also been identified as contributing to global warming by reducing the Earth's capacity to remove CO₂ from the air and altering the Earth's surface reflectance. The major sources of GHGs that are relevant to the project are transportation sources, including the majority of mining emissions, and construction emissions. These are discussed in greater detail below.

Transportation. Transportation is a major source of GHGs in California, accounting for 37% of the State's total GHG emissions in 2015 (CARB, 2017). Transportation emissions within California are generated primarily by combustion of gasoline, diesel, and some alternative fuels by mobile sources. The indicators of vehicular activity, and resulting GHG emissions, are vehicle miles traveled and the fuel economies of the individual vehicles composing the vehicular fleet. Vehicle miles traveled are associated with movement of people and goods on local, regional, and statewide scales.

Construction. Construction emissions are generated when materials and workers are transported to and from construction sites and when machinery is used for construction activities such as trenching, grading, dredging, paving, and building. Construction emissions are not accounted for in a separate category in the California GHG inventory (or other inventories that use IPCC GHG emissions sectors for accounting purposes). Emissions from construction activities are generated for shorter periods than operational emissions; however, GHGs remain in the atmosphere for hundreds of years or more, so once released, they contribute to global climate change unless they are removed through absorption by the oceans or by terrestrial sequestration.

Greenhouse Gas Emissions Inventories. A GHG inventory is a quantification of GHG emissions and sinks within a selected physical and/or economic boundary over a specified time. GHG inventories can be performed on a large scale (i.e., for global and national entities) or on a small scale (i.e., for a particular building or person).

Many GHG emission and sink specifications are complicated to evaluate because natural processes may dominate the carbon cycle. Although some emission sources and processes are easily characterized and well understood, some components of the GHG budget (i.e., the balance of GHG sources and sinks) are not known with accuracy. Because protocols for quantifying

GHG emissions from many sources are currently under development by international, national, state, and local agencies, ad-hoc tools must be developed to quantify emissions from certain sources and sinks in the interim. Table 4-16 outlines the most recent global, national, statewide, and local GHG inventories to help contextualize the magnitude of potential project-related emissions.

Table 4-16. Global, National, State, and Local GHG Emissions Inventories.

Emissions Inventory	CO ₂ e (metric tons)
2010 IPCC Global GHG Emissions Inventory	49,000,000,000
2015 USEPA National GHG Emissions Inventory	66,586,700,000
2015 CARB State GHG Emissions Inventory	4,440,400,000
2010 Yuba County GHG Emissions Inventory	665,411

Sources: IPCC 2014

Biological Resources. Climate change is further exacerbating habitat degradation, fragmentation, and subsequent impacts to wildlife. For example, the Western yellow-billed cuckoo breeds in low- to moderate-elevation native forests lining the rivers and streams of the western United States. They require relatively large, contiguous patches of multilayered riparian habitat for nesting. The loss and degradation of native riparian habitat throughout their range have played a major role in the bird's decline. Climate change has the potential to be an additional stressor to the cuckoo. The warmer temperatures already occurring in the southwestern United States may alter the plant species composition of riparian forests over time (NPS 2015). In the Central Valley, low species richness, poor vital rates, and low abundance of songbirds reflect the loss of riparian habitat integrity (CVJV 2006). In fact, riparian habitat loss may be the most important cause of population declines among songbird species in western North America (DeSante and George 1994) and climate change scenarios predict further changes in vegetation.

Another example of risk from climate change is to the cold-water fish species. The Yuba River watershed is historical habitat for threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, and threatened North American green sturgeon. These anadromous fish species rely on appropriate habitat and cold, clean water to survive. Climate change is likely to reduce availability and access to cold water habitat through increasing average air and water temperatures and change in precipitation patterns (NMFS 2016). Reduced snow packs would cause prolonged periods of low streamflows during summer and early fall in many California rivers. A May 2017 report from biologists at the University of California, Davis, Center for Watershed Sciences and California Trout states that nearly 75 percent of California's salmon, trout, and steelhead would be extinct in 100 years unless critical habitat is protected and restored. If present trends continue, 45 percent of species are likely to be extinct in the next 50 years (Moyle et al, 2017). While hydrology in the Yuba River also would be affected by climate change, particularly by an increase in the percentage of total precipitation that would come as rainfall, New Bullards Bar Reservoir would continue to have a large coldwater pool that would provide cold water for summer and early fall flows in the lower Yuba River.

4.3.2.2 Environmental Consequences

Methodology

The methods for evaluating construction related impacts to climate change are intended to satisfy Federal and State requirements, including NEPA. The authorities for consideration of climate change in all USACE projects are described in the USACE Climate Change Adaptation Plan (USACE 2014); ECB 2016-25 Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects (USACE 2016); and ER 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs (USACE 2013).

Although there is no federal or USACE specific guidance for the evaluation of climate change through the accounting of GHG emissions, nor is there an established federal threshold for significant effects to climate change/ emission of GHGs, the evaluation of project related effects to climate change and establishment of thresholds of significance are within the discretion of the lead NEPA agency. For the purpose of this analysis, the EPA reporting threshold (now-revoked) of 25,000 metric tons CO₂e per year would be adopted as the basis for significance for project related effects to climate change. Although, the reporting threshold has been revoked, it would serve as a suitable basis of significance in the absence of explicit guidance. Annual project emissions of GHGs (metric tons of CO₂e) would be evaluated through the use of the SMAQMD Road Construction Emissions Model. This model was used to evaluate project related effects to Air Quality and is appropriate for use in the evaluation of GHGs. The air quality emissions assessment described in Section 4.2.1 also estimated outputs of CO₂e based on the type of equipment being used, the level of equipment activity, and the associated construction schedules. The outputs from the Road Construction Emissions Model 8.1.0 are included in Environmental Appendix D – Attachment 10a.

Basis of Significance

On October 30, 2009, the USEPA published a rule for the mandatory reporting of GHGs from sources that in general emit 25,000 metric tons or more of carbon dioxide equivalent per year in the United States. On December 18, 2014, CEQ released revised draft guidance that applies to all proposed Federal agency actions, including land and resource management actions. This guidance states that “Agencies are required to consider direct, indirect, and cumulative effects when analyzing any proposed Federal actions and projecting their environmental consequences” and “climate change is a particularly complex challenge given its global nature and inherent interrelationships...however, analyzing the proposed action’s climate impacts and the effects...can provide useful information to decision makers” (CEQ, 2014). Implementation of 40 CFR Part 98 is referred to as the Greenhouse Gas Reporting Program. The purpose of the rule is to collect accurate and timely GHG data to inform future policy decisions.

No specific Federal threshold has been established for identifying significant effects related to construction based emissions of GHG, nor have thresholds been established by the FRAQMD for project related GHG emissions. For the purpose of this study, the EPA reporting threshold described above for GHG emissions would serve as a basis for evaluation of project effects on climate change. The EPA reporting threshold is 25,000 metric tons of CO₂e, per year. GHG emissions above this level would be considered significant.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The resilience of the lower Yuba River to climate change would remain consistent with current conditions. Under this alternative there would be no project related GHG emissions and therefore the No Action alternative would have no significant effect on climate change.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Greenhouse gas emissions would come from the construction equipment required to implement Alternative 5, such as excavators, graders, dozers, etc., as well as from construction worker commute trips to and from the worksite. Following construction, operation and maintenance activities would be limited and associated emissions would not be expected to significantly contribute to climate change. The effects from the implementation of Alternative 5 on climate change related to GHG emissions would be short-term in nature.

Emissions modeling indicates that Alternative 5 could emit up to a maximum annual 2,945 metric tons of CO₂e which is well under the USEPA reporting threshold of 25,000 metric tons of GHGs. Modeling was conducted under a worst case scenario of annual impacts and did not account for any potentially mitigating actions (i.e. carbon sequestration associated with the restoration of riparian vegetation and expansion of aquatic habitat). A separate carbon sequestration analysis indicated that over 50 years Alternative 5 would result in a net gain of over 3,000 metric tons CO₂e of sequestered carbon. The total modeled emissions of GHG CO₂e from Alternative 5 would be offset by sequestered carbon between year 20 and 50 following construction (Table 4-17). The assumptions used to support carbon sequestration analysis are documented in Environmental Appendix D – Attachment 10b. Alternative 5 could lessen the effects of climate change due to GHG emissions by:

- Restoring aquatic and riparian habitats, which may contribute to improving populations' resilience to climate change by increasing availability and quality of suitable habitat.
- Enhancing riparian vegetation communities, which would promote ecosystem resiliency to the future effects of climate change.
- Improving floodplain connectivity, which would improve conditions for the natural establishment/recruitment of native species.

Given that Alternative 5 would not exceed the USEPA reporting threshold for GHGs and is likely to result in a net gain in sequestered carbon over the life of the project, Alternative 5 would result in less than significant effects to climate change. Any impacts would be further

reduced with the implementation of BMPs and improvements to project design and implementation during PED.

Table 4-17. Estimated GHG Emissions from Alternative 5.

	year 1	year 5	year 20	year 50
Estimated Project Emissions (metric tons CO ₂ e)	2,945	8,276	8,276	8,276
Estimated sequestered Carbon (metric tons CO ₂ e)	399	747	1,928	11,410
Net Carbon Produced (metric tons CO ₂ e)	+2,546	+7,529	+6,348	-3,134

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Greenhouse gas emissions would come from the construction equipment required to implement Alternative 6, such as excavators, graders, dozers, etc., as well as from construction worker commute trips to and from the worksite. As with Alternative 5, emissions modeling indicated that emissions from implementation of Alternative 6 (up to a maximum annual 2,945 metric tons of CO₂e) would be well under the USEPA reporting threshold of 25,000 metric tons of GHG. Alternative 6 would result in a greater amount of GHG emissions than Alternative 5, due to the inclusion of additional restoration sites upstream of Highway 20. The additional restoration work would not include different types of effects, but would result in an incremental increase in magnitude of construction related emission effects. Following completion of construction, Alternative 6 would include limited operations and maintenance activities which would not be expected to contribute to any significant GHG emission related effect to climate change. The carbon sequestration analysis indicated that over 50 years the project would result in a net gain of over 1,000 metric tons CO₂e of sequestered carbon. Although Alternative 6 includes additional restoration features which results in a greater amount of sequestered carbon, the overall emissions from Alternative 6 are also greater and would result in a lower net quantity of sequestered carbon than Alternative 5. The total modeled emissions of GHG CO₂e from the project would be offset by sequestered carbon between year 20 and 50 following construction (Table 4-18). The assumptions used to support carbon sequestration analysis are documented in Environmental Appendix D – Attachment 10b.

As with Alternative 5, Alternative 6 could lessen the effects of climate change due to GHG emissions by:

- Restoration of aquatic and riparian habitats may contribute to improving populations resilience to climate change by increasing availability of suitable habitat
- Riparian vegetation communities would be enhanced, which would promote ecosystem resiliency to the future effects of climate change.
- Improved floodplain connectivity would improve conditions for the natural establishment/ recruitment of native species.

Given that Alternative 6 would not exceed the USEPA reporting threshold for GHGs and is likely to result in a net gain in sequestered carbon over the life of the project, Alternative 6 would result in less than significant effects to climate change. Any impacts would be further reduced through the implementation of BMPs and improvements to project design and implementation, Alternative 6 would result in less than significant effects to climate change.

Table 4-18. Estimated GHG Emissions from Alternative 6.

	year 1	year 5	year 20	year 50
Estimated Project Emissions (metric tons CO ₂ e)	2,945	10,665	10,665	10,665
Estimated sequestered Carbon (metric tons CO ₂ e)	422	791	2041	12,082
Net Carbon Produced (metric tons CO ₂ e)	+2,523	+9,874	+8,624	-1,417

4.3.2.3 Best Management Practices and Avoidance and Minimization Measures

The following measures would be implemented to reduce the effects associated with construction related emissions.

- Improve fuel efficiency from construction equipment,
- Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than off-road engines),
- Use alternative fuels for generators at construction sites,
- Encourage and provide carpools, shuttle vans, and secure bicycle parking,
- Reduce electricity use in the construction office by using compact fluorescent bulbs, powering off computers every day and replacing heating and cooling units with more efficient ones.
- Develop a plan to efficiently use water for adequate dust control.

Although construction of either Alternative 5 or Alternative 6 would result in a short-term increase in CO₂e emissions, there would be no long-term operations emissions, and long-term GHG emissions would remain the same with any of the three alternatives. Therefore, there would be no significant effects to climate change as a result of the Preferred Alternative.

4.3.3 Aesthetics

This section establishes the existing conditions for aesthetic resources in the study area. There are no Federal or State laws regulating aesthetic resources in the study area. The potential effects of the proposed alternatives are also discussed, and, as necessary, applicable BMPs and avoidance and minimization measures are described.

4.3.3.1 Affected Environment

The North Yuba, Middle Yuba, and South Yuba rivers originate in the Sierra Nevada. The North Yuba and Middle Yuba rivers converge downstream of New Bullards Bar Reservoir, and the South Yuba River joins just upstream of Englebright Reservoir. The confluence of the Yuba and Feather rivers is located near Marysville.

The visual character of the lower Yuba River area is highly variable. Rolling hills above the river are covered with green grass and wildflowers in the spring, fading to a golden brown in the summer and fall. Annual grasslands dominate areas where land is not being farmed. Interspaced riparian, vernal pool, and wetland habitat is located along river corridors and in annual grassland depressions. Grassland, agricultural fields, as well as some areas of barren land surround the lower Yuba River as it flows toward the Feather River near Marysville, creating a typical to indistinctive, medium to low scenic quality. A few rural residences and small communities also are located throughout this area (USBR, DWR, and YCWA 2007).

Views along the lower Yuba River have been extensively altered due to gold and gravel mining with gravel mining still taking place on both sides of the river. Because the river in this area has undergone extensive human modification, riparian vegetation has only re-established itself in a few small areas. There are large areas with little or no vegetation (BLM 2001).

4.3.3.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts on visual resources was based on a review of landscapes that could be affected by short and long term project-related activities and elements.

Basis of Significance

The proposed alternatives would result in a potentially significant impact to visual resources if it would:

- Have a substantial adverse effect on a scenic vista.
- Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic structures.
- Substantially degrade the existing visual character or quality of the site and its surroundings.
- Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats and their associated visual conditions along the Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation and disruption to associated

processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The lower Yuba River ecosystem's visual resources would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Construction of the lower Yuba habitat improvements would result in temporary impacts to visual resources during construction. These temporary impacts include ground disturbance from excavation, which could also include the presence of dust and temporary stockpile areas. The presence of heavy construction equipment during construction would create a temporary visual disturbance. Additionally, there would be a temporary impact due to the use of staging areas and haul routes to store and move construction equipment around the area. However, these temporary impacts to aesthetics would be low or insignificant, generally restricted to temporary construction periods. Long-term the project would result in improvements to scenic resources that are consistent with the natural visual character of the area. All project features, with the exception of signage or vegetation protection would be natural.

Although the project assumes that all material excavated during construction would be transported off-site to an appropriate established disposal site, the opportunity to identify a suitable disposal site within the Yuba Goldfields could significantly reduce costs and impacts associated with transportation of materials. If this opportunity is found to be feasible, disposal of material within the Yuba Goldfields would likely be compatible with existing visual resources. The Yuba Goldfields are characterized by a large expanse of disturbed area formed by historical and ongoing dredging. Essentially the Yuba Goldfields are largely comprised of large disposal piles of cobble and gravel and additional disposal of excavated material would not represent a significant change in the visual character of the area.

Given that all potential effects would be temporary in nature and the proposed action would result in long term improvements, implementation of Alternative 5 would result less than significant effect to visual resources.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats would be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. Alternative 6 would have similar construction related effects to Alternative 5, with an incrementally higher magnitude from the additional project features. As with Alternative 5, potential effects from Alternative 6 would be temporary in nature and result in long term improvements, and therefore implementation of Alternative 6 would result in a less than significant effects to visual resources.

4.3.3.3 Best Management Practices and Avoidance and Minimization Measures

Since all impacts to aesthetics would be temporary in nature and less than significant, no BMPs and avoidance and minimization measures would be required.

4.3.4 Hydrology and Hydraulics

This section describes the existing hydrologic and hydraulic environment in the study area. The potential effects of the proposed alternatives are also discussed, and, as necessary, applicable BMPs and avoidance and minimization measures are described. Hydrologic frequency data referenced in this section were obtained from multiple sources and are not intended to meet USACE hydrologic analysis requirements for Flood Risk Management decision documents; however, the information presented here is suitable to provide an evaluation of the ecosystem restoration alternatives presented in this report.

4.3.4.1 Affected Environment

The Yuba River watershed includes 1,340 square miles in Sierra, Placer, Yuba and Nevada County. The watershed extends from Marysville in the Sacramento Valley upstream to the Sierra Nevada Mountains in the east up to an elevation of approximately 8,590 feet mean sea level. The Yuba River has three major tributary rivers: the North Yuba River, the Middle Yuba River, and the South Yuba River. These forks flow together to form the main stem Yuba River which drains into the Feather River, then the Sacramento River, and eventually passes through the Sacramento-San Joaquin Bay Delta into the Pacific Ocean. The proposed actions would be restricted to a reach of the main stem Yuba River referred to as the lower Yuba River, which extends from downstream of Englebright Dam to the confluence of the Yuba and Feather Rivers. Upstream of Englebright Dam would be referred to as the upper watershed.

The hydrology of the Yuba River watershed is complex, consisting of numerous dams, reservoirs, and diversion facilities that store and/or transfer water within and out of the basin, altering both the volume and pattern of water, sediment, organic material, and wildlife. Hydrology in the Yuba River watershed has been significantly altered through historic and current human activities. Initially these changes were driven by large scale hydraulic mining and were later driven by construction of dams, reservoirs, and diversions to address watershed issues and manage water resources. The primary factors affecting hydrology and hydraulics of the Yuba River watershed are historic and ongoing mining; the construction and operation of an extensive system of dams, reservoirs, and diversions; and land use changes.

Mining

The Yuba River suffered perhaps the most significant damage from hydraulic mining of any California river. Approximately 1.5 billion cubic yards of mining debris were washed into the Central Valley from five rivers, with the Yuba River accounting for 40 percent of that total (Mount 1995). Gilbert (1917) as cited in Yoshiyama et al. (2001) estimates that “...during the period 1849-1909, 684 million cubic yards of gravel and debris due to hydraulic mining were washed into the Yuba River system – more than triple the volume of earth excavated during the

construction of the Panama Canal”, and Beak Consultants, Inc. (1989) states “The debris plain ranged from about 700 feet wide and up to 150 feet thick near the edge of the foothills to nearly 3 miles wide and 26 feet tall near Marysville” (Beak Consultants, Inc. 1989).

Hydraulic gold mining during the second half of the 19th century resulted in 684 million cubic yards of gravel and debris washing into the Yuba River system. The material moved from the foothills to the valley floor where it raised the river bed by up to 100 feet, resulting in increased frequency and intensity of floods. The California Debris Commission worked to mitigate the impacts of hydraulic mining by constructing debris dams, including Englebright Dam and Daguerre Point Dam, as well as dredging the debris deposited in the lower Yuba River. Dredging of the lower Yuba River continued past initial efforts driven by gold extraction, then later as a source of aggregate. Dredging has resulted in a large 10,000 acre area of undulating dredge spoils berms and ponds. The Goldfields area is porous and acts as a drain for the lower Yuba River above Daguerre Point Dam.

Dam and Diversions

Dam construction and diversions in the Yuba Watershed began to supply gold mining operations with necessary flow to support hydraulic nozzles. Later dams were constructed to sequester the large volumes of mine tailings moving downstream. Several large dams operated by various agencies (Table 4-20) were built for a variety of purposes, including water supply, flood control, hydroelectric power generation and sediment retention (James 2005). The contemporary system is elaborate and complex, consisting of several dams (including 6 over 150 feet in height, and over 50 additional smaller dams) with facilities in place to store and/or transfer water between the sub-watersheds of the Yuba Basin (i.e., North Yuba, Middle Yuba, South Yuba and Deer Creek), as well as out of basin transfers to major watersheds to the north and south (i.e., Feather River, Bear River and American River) (CBEC 2010).

Three projects export significant amounts of water from the Yuba River watershed. South Feather Water and Power Agency (formerly Oroville-Wyandotte Irrigation District) diverts water from Slate Creek (a tributary to the North Yuba River) to the South Fork Feather River via its South Feather Power Project. PG&E’s South Yuba Canal diverts water from the South Yuba River, some of which is consumptively used by the Nevada Irrigation District (NID) and some of which is released into the Bear River Watershed. These diversions also support NID’s Yuba-Bear Hydroelectric Project. PG&E’s Drum-Spaulding Project diverts water from the South Yuba Watershed, via the Drum Canal, to the Drum Forebay. If that water is used at PG&E’s Drum Powerhouse, it is released to the Bear River Watershed. If the water is not used there, it is released to Canyon Creek (a tributary of the North Fork American River), where it is eventually used for consumptive purposes by Placer County Water Agency and other entities.

Table 4-20. Major dams in the Yuba River Watershed (CBEC 2010).

Major Dams	Operating Agency	Date of Completion ¹	Storage (Thousand Acre Feet) ²	Drainage Sub Basin	Drainage Area (mi ²) ⁴
Spaulding	PG&E	~1913	75	South Yuba	118
Bowman	NID	1926	68	Canyon Creek (South Yuba)	28
Fordyce	PG&E	~1926	50	Fordyce Creek (South Yuba)	31
Englebright	USACE	1941	70	Mainstem Yuba	1110
Jackson Meadows	NID	1965	67	Middle Yuba	37
New Bullards Bar	YCWA	1969	966	North Yuba	489

1) Dates indicate most recent completion. At most locations facilities were in place earlier, starting as early as 1849.

2) Approximate impounded storage at time of completion, may be less at present. For example bathymetric surveys of Englebright Reservoir have documented a 25% reduction of the initial volume (Childs et al. 2003).

3) Canyon Creek and Fordyce Creek are tributaries to the South Yuba River.

4) Drainage areas are approximate and provided solely for the purpose of comparison

The size and position within the Yuba Basin of these dams provide the ability to store large volumes of water, and therefore regulate the flow regime. The North Yuba has New Bullards Bar Reservoir, located relatively low in the watershed, functioning as the dominant flood control and water supply reservoir in the basin (LYRFTWG 2005). Storage capability in the Middle Yuba and South Yuba basins is comparably small, totaling approximately 307 thousand acre-feet (TAF), with Lake Spaulding, Bowman Lake, Jackson Meadows Reservoir, Fordyce Lake and several smaller impoundments located in the upper extents of the Yuba Basin (YCWA, 2009). The size and position of these impoundments allow the South Yuba and Middle Yuba to respond to larger precipitation and snow-melt events by sending large flood pulses downstream to Englebright Reservoir, and beyond to the lower Yuba River when the capacity of Englebright Reservoir is exceeded. Since 1969 when New Bullards Bar (the last of the large dams built in the system) was completed, over 100 flow events have flowed over the crest of Englebright Dam.

Lower Yuba River Flows

The Yuba River downstream of Englebright Dam is a single-thread channel, confined in a bedrock canyon in the uppermost 2 miles, then transitions to a wider bedrock valley and finally, to a wide alluvial valley for 19 miles (YCWA 2013). In the lower Yuba River, Englebright and Daguerre Point Dams play an important role in the altered movement of water, sediment and organic matter.

Englebright is a 260 foot high concrete arch dam originally constructed to trap mining sediments and debris. The dam also maintains water elevations that are used for the generation of hydroelectric power and for recreational activities, and the reservoir serves as an afterbay for peak power generation at the New Colgate Powerhouse. During normal flow conditions, water is

released from Englebright reservoir through PG&E's Narrows I hydropower facility and YCWA's Narrows II power facility. These water releases are administered by PG&E and YCWA to maintain Yuba Accord instream flows for fisheries, while also generating hydroelectric power, providing water for irrigation, maintaining reservoir water elevations suitable for recreation, and other beneficial uses. During high flows, unregulated flows pass over the top of Englebright dam into the lower Yuba River.

Approximately halfway between Englebright Dam and the confluence with the Feather River is Daguerre Point Dam. This 25 foot dam was originally constructed to trap hydraulic mining debris. The head of water created by the dam currently supports several non-Federal water diversions. Daguerre Point Dam affects the hydrology and hydraulics of the lower Yuba River by providing base level control for incision for the reach immediately upstream. The dam also creates a river stage differential; the river stage above Daguerre Point Dam is more than 20 feet greater than the river stage below the dam. As a result of this differential and as a result of the high permeability of the Goldfield's rocky soil, water from the Yuba River enters the Goldfield area from above Daguerre Point Dam and then migrates down gradient through the Goldfields, forming interconnected ponds and canals throughout the area (DWR, 1999).

Despite the presence of several significant dams in the watershed, the lower Yuba River still experiences floods capable of inducing geomorphic changes to the mainstem (Pasternack 2009). A study of the geomorphic thresholds in the Timbuctoo Bend Reach identified several values including: 1) a preferential riffle scouring discharge of less than 11,000 cfs; 2) a preferential run scouring discharge range of approximately 9,000 to 25,000 cfs; 3) a preferential pool-scouring discharge of greater than 45,000 cfs; and, 4) a floodplain filling discharge of approximately 20,000 cfs (Pasternack 2009).

The past and present flood regime of the lower Yuba River is divided into two meaningful hydrologic periods: a transitional period from 1904 to 1969, and the contemporary, regulated period beginning in 1970, which followed the completion of all major storage projects within the basin (cbec 2010). Regulation has reduced flood intensity in the lower Yuba River; flood flows with 67% Annual Chance Exceedance (ACE) were reduced 67% from 20,100 cfs to 6,700 cfs; flood flows with a 20% ACE were reduced 40% from 61,400 cfs to 36,900 cfs (cbec 2010). In addition to reducing peak flow values, the large storage reservoirs and in- and out-of-basin transfers alter the annual runoff volume and pattern in the mainstem. In 2007 the Yuba River Accord established minimum flow requirements in the watershed (YCWA 2007) that maintain habitat suitability for fish and wildlife in the lower Yuba River.

The final array of alternatives are located just upstream from the Yuba River near the Marysville gage (Gage Number 114121000). There is very little contributing drainage area between the proposed alternatives and the gage. Therefore, this gage provides a reasonable representation of the inflow conditions at each of the proposed restoration sites. Flows on the lower Yuba River are highly influenced by upstream reservoir regulation for flood management, hydropower, and water supply purposes. As a result, flows measured at the gage prior to the completion of New Bullards Bar Dam (1969) are not considered representative of the current hydrologic conditions with the reach. Annual peak flows measured from 1970 through 2016 (45 years of record) at the Yuba River near Marysville gage have ranged from 673 cfs in water year

1977 to 161,000 cfs in water year 1997. USACE conducted a hydrology study of the Central Valley in 2015 for the California Department of Water Resources. The study, titled Central Valley Hydrology Study, 29 November 2015, presented ACE estimates for peak flows measured at the USGS Yuba River near Marysville Gage (USACE 2015). The estimates were made using reservoir simulations of rare floods and the results were presented for a range of flood magnitudes from 1/10 ACE to 1/500 ACE. Table 4-21 presents these results in tabular format. These flows are considered suitable for evaluation of the ecosystem restoration alternatives presented in this report.

Table 4-21. Peak Discharge vs Annual Chance of Exceedance Estimates, USGS Gage Yuba River near Marysville, from USACE (2015).

Annual Chance of Exceedance	Peak Discharge (CFS)
10% (1/10)	71,700
2% (1/50)	112,000
1% (1/100)	178,000
0.5% (1/200)	212,000
0.2% (1/500)	282,000

4.3.4.2 Environmental Consequences

Methodology

Evaluation of the alternatives' potential impacts on hydrologic and hydraulic resources was based on a review of driving physical and environmental factors that could be affected by short and long term restoration-related activities and elements. In addition, a hydraulic analysis performed primarily for the purpose of evaluating potential ecosystem benefits of the proposed alternatives was used to compare existing conditions to the alternatives in the lower Yuba River. Additional information can be found in the Engineering Appendix C.

Basis of Significance

The thresholds of significance encompass the factors taken into account under NEPA to determine the significance of an impact in terms of its context and intensity. The thresholds for determining the significance of impacts for this analysis are based on the environmental checklist in Appendix G of the State of California's CEQA Guidelines. The alternatives under consideration were determined to result in a significant impact related to hydrology and hydraulics if they would do any of the following:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river in a manner that would result in: (1) substantial erosion or siltation on- or off-site, and (2) substantial increase in the rate or amount of surface runoff in a manner that would result in flooding on- or off-site.

- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.
- Place housing within a 1% ACE flood hazard area.
- Place within a 1% ACE flood hazard area structures which would impede or redirect flood flows.
- Expose people or structures to a significant risk of loss, injury, or death involving flooding.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The hydrologic and hydraulic conditions in the lower Yuba River would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Implementation of Alternative 5 would not affect the primary drivers of hydrology and hydraulics in the watershed (i.e., the extensive system of dams, reservoirs, and diversions resulting in highly managed inflow from upper watershed, natural precipitation patterns, and disruption to sediment transport regime); furthermore effects would be generally limited to the project footprint and areas immediately adjacent. Large scale changes to hydrology and hydraulics are not expected. Inflows and outflows in the lower Yuba River would not be affected by the types of proposed actions. Localized modifications to hydrology and hydraulics could result from project actions, including direct modifications of topography and installation of riparian and hydraulic roughness features. Alternative 5 includes modifications to terrain that involve the excavation and reshaping of terrain to create complex habitat features (i.e. construction of side channels, backwaters, and floodplain lowering). These modifications are designed to affect habitat at low to normal flow (below bankfull) conditions. Under these normal conditions, these modifications would result in additional channel capacity. During normal flood conditions, the lower Yuba River flows into the readily accessible floodplain; during these conditions, project features would be inundated. Alternative 5 would not affect the ability of the river to access high floodplain nor would it affect the hydrology of the watershed and therefore would not result in significant effects to this resource.

Alternative 5 also includes the installation of hydraulic roughness features, including planting of riparian vegetation and installation of woody material and boulders. Installation of woody materials and boulders would be limited and focused on improving and/or maintaining the hydraulic stability of constructed features. Boulders and woody material placements would not be constructed at a scale that would affect the hydrologic or hydraulic conditions of the lower

Yuba River. Alternative 5 includes planting of 136 acres of riparian vegetation which could affect the conveyance of flood flows through the lower Yuba River. Potential impacts to flood flow conveyance from the planting of vegetation would likely be offset through the increase to channel capacity resulting from the excavation of material from topographic modification actions.

Limited hydraulic modeling was completed for this study in support of ecological modeling for proposed actions. The modeling included an evaluation of future without project and future with project conditions under 3 representative flows (750 cfs, 1,850 cfs, and 5,000 cfs). A comparison of future without project and future with project water surface elevations near Marysville gage showed a less than one-hundredth of an inch difference in water surface elevation. The effect to water surface elevation would be expected to be proportionally reduced at higher flows where flows have access to a larger floodplain. Given this limited modeling, Alternative 5 would not be expected to alter the existing large flood patterns or increase flood related risk to structures.

This alternative does not include the construction of any buildings or structures at risk of flooding nor would it increase the risk of flood damage to existing structures. Furthermore, Alternative 5 does not include the construction of any buildings or elements that would be at risk from floods or increase the risk to people from floods. Given the localized (site specific) changes in hydrology and hydraulics and the negligible effects to water surface elevation, Alternative 5 would result in less than significant effects to hydrologic and hydraulic resources. During the Planning Engineering and Design phase, proposed actions would undergo site specific evaluation (including an evaluation of potential impact to flood risk) such that features would be designed to limit any adverse effects to hydrology and hydraulics. Given these considerations, Alternative 5 would be expected to result in less than significant impacts to hydrology and hydraulics.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Potential effects to hydrology and hydraulics from Alternative 6 would be expected to be similar in type and intensity to Alternative 5. Alternative 6 includes additional restoration features upstream of Highway 20, similar in design to those included in Alternative 5. The addition of these features would increase the geographic range in which topographic/ hydraulic improvements would be implemented; however, as with Alternative 5, potential adverse effects to hydrology and hydraulics would be offset by increases to channel capacity. Given these considerations, Alternative 6 is expected to have less than significant effects to hydrology and hydraulics.

4.3.4.3 Best Management Practices and Avoidance and Minimization Measures

Because effects to hydrology and hydraulics from the proposed alternatives are expected to be less than significant, no hydraulic BMPs and avoidance and minimization measures are required.

4.3.5 Vegetation and Wildlife

This section describes the existing vegetation, wildlife, and habitats which occur in the study area. Biological resources such as plants and animals are important because they influence ecosystem functions and values, have intrinsic value, and are subject to a number of statutory and regulatory requirements. Additionally, this section evaluates the effects of the proposed alternatives on vegetation and wildlife resources in the study area and potential BMPs and avoidance and minimization measures to reduce impacts to a less-than-significant level. Coordination with the USFWS was conducted throughout the study as directed by the Fish and Wildlife Coordination Act. A Final Coordination Act Report (CAR) including recommendations from the USFWS is included in Environmental Appendix D – Attachment 4.

4.3.5.1 Affected Environment

The proposed project is located within the Yuba River watershed, which includes three major tributary rivers: The North Yuba, Middle Yuba, and South Yuba Rivers, that flow together to form the Yuba River. The analysis of the affected environment would focus primarily on the lower Yuba River downstream of Englebright Dam, where the proposed restoration areas are located. Elevations range from 158 to 285 feet above mean sea level (Google Earth, 2017). The study area is within the channel of the lower Yuba River, as well as side channels in the floodplain, riparian areas, and the Yuba Goldfields. The Yuba Goldfields, which are the remnant debris piles of past hydraulic mining, have greatly altered the natural environment. Proposed staging areas and access roads are located to the greatest extent possible on existing dirt roads and previously disturbed areas. In some cases access roads would need to be constructed or improved to provide suitable access to project areas. Staging areas would be located along cobble bars, dredger tailings, or in other previously disturbed areas.

A riparian vegetation analysis conducted on the lower Yuba River (LiDAR data collected in 2005 and field verification surveys conducted in July 2011), found that within the bankfull channel (5,000 cfs) vegetation covers approximately 50% of the total area and vegetation covers approximately 20% of the total area within the floodway (21,100 cfs) (Table 4-22). In general, riparian plant cover on surfaces away from the summer baseflow water edge is low, connectivity between older riparian patches and younger patches is low, and species and structural diversity are low throughout most of the study reach compared to riparian zones of similar Central Valley Rivers (CBEC 2010). The longitudinal distribution of species in the Yuba River downstream of the Englebright Dam shows a trend of limited vegetation in the confined, bedrock areas, with increased vegetation in the less-confined, alluvial areas downstream, which is within expected parameters (Naiman et al. 2005). Willow species were the most abundant species covering a total of 70% of the vegetated areas (SYRCL 2013).

The low cover of riparian vegetative cover in portions of the lower Yuba River is likely due to a combination of anthropogenic changes generally related to the legacy effects of mining activities in the watershed. Initial impacts to vegetation resulted from large amounts of waste material washing into the lower Yuba River, burying existing vegetation and altering topography and substrate. The construction of dams and diversions in the watershed have further altered

hydrologic and geomorphologic conditions. These impacts have resulted in the removal of historic riparian habitat and degradation of the conditions that support natural recruitment (magnitude, duration, and frequency of inundation, substrate composition, and topography). Woody material and debris from upstream sources are limited from reaching the lower Yuba River due to multiple barriers upstream (New Bullards Bar, Englebright Dam, Daguerre Point Dam, etc.), therefore limiting the habitat complexity of the lower Yuba River and suitable habitat for special status species.

Table 4-22. Estimates of Existing Cover of Riparian Vegetation

Inundation Zone	Vegetation Cover³_(acres)	Total Area⁴_(acres)	% Riparian Vegetation Cover⁵
In Channel ¹	164.7	319	52
Floodplain ²	264.83	1193	22

¹In channel inundation zone defined as between baseflow (880 cfs upstream DPD and 530 cfs downstream DPD) and bankfull flow (5,000 cfs).

²Floodplain defined as between bankfull flow (5,000 cfs) and floodway filling flow (21,100 cfs)

³Developed by LiDAR in WSI 2012; data did not include Timbuctoo bend to Englebright Dam reaches.

⁴Developed by hydraulic analysis, Landforms of the Lower Yuba River (Wyrick and Pasternack 2012).

Active (low flow) Channel

The riverbed is generally composed of gravel/cobble, minimal bedrock, and sediment. Vegetation is largely absent from the riverbed, except on areas where sediment accumulations, depth, and water flow allow for the establishment of plants, such as sand/gravel bars or shallow banks. The 2016 annual discharge recorded within the lower Yuba River reach just downstream of the project was approximately 1,952 cfs (USGS 11421000, 2017). The river flow is highly regulated by releases from Englebright Dam, channelization, and old mine tailings. In high flow events, multiple side (or secondary) channels are activated. They are highly dynamic in high flows and create a complex river system.

Floodplain features

Many islands or bars are formed within the floodplain. The bars are sedimentary features within the fluvial channels that are typically formed by deposited bed load sediment. Point bars are formed when sediment is deposited along the meander bends and the non-channel bars are formed when sediment is deposited along the middle of a straight channel reach (CRAM Photo Dictionary, 2013). The sediments on the bars range in size and consist of silt, sand, gravel, cobble, and boulders. Due to the sedimentary composition of this river channel, riffles are formed creating portions of rapid flow or surface turbulence in the fluvial channel. While the river does support riparian habitats, the riparian areas are largely distributed in patches along the sides of the floodplain or sparsely situated on top of the gravel bars.

Wildlife

The active channel and floodplain features provide suitable habitat for wildlife by providing nesting, breeding, foraging, and spawning habitat. In addition the riparian vegetation

alongside the floodplain provides food and cover for numerous species of birds, mammals, reptiles, emergent aquatic insects, and amphibians. Species of birds may include the Northern harrier (*Circus cyaneus*), Swainson's hawk (*Buteo swainsoni*), Tricolored blackbird (*Agelaius tricolor*), Loggerhead shrike (*Lanius ludovicianus*), and Song sparrow (*Ammodramus sacannarum*). Reptiles and amphibians may include: pond turtle (*Actinemys marmorta*), green racer (*Coluber constrictor*), and Gilbert's skink (*Eumeces gilbertii*). Bats, such as the Western red bat (*Lasiurus blossevillei*) or Yuma myotis (*Myotis yumanensis*), may also utilize the riparian area. Other common mammal species known to occur in the area include: mule deer (*Odocoileus hemionus*), cougar (*Puma concolor*), and opossum (*Didelphus virginiana*).

Fisheries

The riparian habitat and channel provide rearing habitat for many native and non-native fish species, specifically willows along the banks and gravel bars. Historically, the Yuba River has been a prime spawning location for many fish species since it provided the appropriate temperature, spawning gravel, and riparian cover. As the Yuba River system has been anthropomorphically altered, accessible fish habitat and hydrologic regime has also been disturbed. The influx of dams and mining in the lower Yuba River has altered the movement of sediments, large woody debris, and irregular sediment development, therefore leading to a change in both vegetation development and suitable habitat.

Currently, the river channel and floodplain system provide habitat for different native and non-native species. The once diverse multi-channel system now flows in a single channel, which during extreme flow events inundate the floodplain and create back water pools in the historic mining tails. These large flow events also have the potential to strand fish in the pools. These ponds primarily contain non-native fish such as black bass (*Micropterus* spp.), smaller sunfishes (*Lepomis* spp.), and Western mosquitofish (*Gambusia affinis*). Native fishes are also present in some ponds, including Sacramento sucker (*Catostomus occidentalis*) and Sacramento pikeminnow (*Ptychocheilus grandis*). In addition, non-native fish, non-native bullfrogs (*Lithobates catesbeianus*) and non-native crayfish (*Procambarus clarkii*; *Pacifastacus leniusculus*) have also been observed in the ponds (NMFS 2017).

Furthermore, anadromous fish species in the lower Yuba River include: Central Valley fall-run, Central Valley late fall-run, and Central Valley spring-run Chinook salmon (*Onchorhynchus tshawytscha*) and Central Valley steelhead (*O. mykiss*), green sturgeon (*Acipenser medirostris*) and Pacific lamprey (*Lampetra tridentatus*), as well as nonnative striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*). The lower Yuba River is also home to many non-anadromous native fish species including the resident rainbow trout (*O. mykiss*), Sacramento sucker, hardhead (*Mylopharodon conocephalus*), Sacramento pikeminnow, western roach (*Lavinia symmetricus*), prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gulosus*), speckled dace (*Rhinichthys osculus*), and tule perch (*Hysterothorax traski*). Nonnative fish species include smallmouth bass (*Micropterus dolomieu*), bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), red ear sunfish (*L. microlophus*), and mosquitofish (AECOM, 2015).

Invasive Species

Invasive plant and animal species pose a threat to native species and ecosystems by outcompeting and displacing native species. Invasive species can change the function of habitats and ecosystems. The existing conditions of invasive species, including species, distribution, and intensity, and their impact on the lower Yuba River is not fully understood. Invasive animal species of concern in the project area include but are not limited to the New Zealand Mudsail (*Potamopyrgus antipodarum*) and the Brown-headed cowbird (*Molothrus ater*). Invasive plant species of concern in the project area include but are not limited to the common fig (*Ficus carica*) and tree of heaven (*Ailanthus altissima*).

New Zealand mudsnails were detected along the lower Yuba River in 2016. New Zealand mudsnails are tiny, aquatic snails that reach, on average, up to 4-6 millimeters long. Dense populations of New Zealand mudsnails can displace and out-compete native species, sometimes by consuming up to half the food resources in the waterway. The snails have been linked to reduced populations of aquatic insects, including mayflies, stoneflies, caddisflies, chironomids and other insect groups upon which trout and salmon populations depend (CDFW 2018).

Brown-headed cowbirds occur in the project area. These birds belong to the blackbird family, and can be distinguished from other blackbirds by their smaller size, shorter tail, and thicker head with a stout bill. Brown-headed cowbirds employ a parasitic breeding strategy, in which females do not build nests, but rather lay their eggs in the nests of other birds. In some cases, eggs are laid in nests of smaller species and the larger Brown-headed cowbird will outcompete its smaller nest mates for incoming food or will displace them from the nest. Brown-headed cowbirds lay a large number of eggs per season (up to 30). They usually lay 1 or 2 eggs in each host nest and often remove any eggs present. Nest parasitism lowers the reproductive success of host birds and has led to population declines in several bird species (CDFW 2018).

The common fig occurs in the project area and widely throughout California. The shrub invades riparian forests, streamside habitats, levees and canal banks in the Central Valley and surrounding foothills, along the south coast and coastal flats and coastal scrub on the Channel Islands. The shrub becomes established in riparian areas that have had no recent anthropogenic disturbance but its establishment appears to be promoted by flooding disturbance (Cal-IPC 2018a).

Tree of heaven occur in the project area. This tree is widely but discontinuously distributed in California. It was introduced as a landscape ornamental but escapes gardens and spreads by seeds and creeping roots that produce many suckers. It is most abundant along the coast and in the Sierra foothills, primarily in wastelands and disturbed, semi-natural habitats (Cal-IPC 2018b).

4.3.5.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts to vegetation and wildlife resources was based on a review of vegetation, wildlife, and habitats that occur in the project area and could be affected by short and long term project-related activities and elements.

Basis of Significance

Under NEPA, the significance of project impacts is a function of context and intensity. For biological resources, context refers to the importance (ecological, commercial, scientific, recreational, etc.) or regulatory (i.e. legally protected) status of the resource, and intensity refers to the magnitude – scale and duration – of the impact. Both beneficial and adverse impacts are recognized; either can be significant.

In the study area, the habitats of greatest importance are riverine habitat and adjacent riparian habitat. These habitats are most important because of their degraded and fragmented condition and high value to fish and wildlife species. Losses or gains of population and habitat for special status species may also be significant, depending on the magnitude of the impact relative to the population size and distribution of the species in the region. Finally, any impact leading to new introductions or the expansion of invasive species would also be considered significant in terms of potential far-reaching effects on the ecosystem of the project area. Adverse effects on vegetation and wildlife were considered significant if implementation of an alternative plan would result in any of the following:

- Result in a substantial loss of native vegetation or species.
- Removal, or substantial disturbance of a sensitive natural community.
- Substantial reduction in the quality and quantity of important habitat or access to such habitat for wildlife species.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The lower Yuba River ecosystem's vegetation and wildlife resources would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Under Alternative 5, it is expected that there would be low impacts to the existing vegetation. Construction of permanent aquatic features (secondary channels and backwaters) could result in the removal of existing vegetation and permanent conversion of floodplain to riverine habitat. The final alignment of aquatic features would be revisited in the preconstruction engineering and design phase and existing vegetation would be protected in place when possible. All impacts from removal of vegetation due to construction of permanent aquatic features would be more than offset by associated riparian plantings. Temporary disturbances to vegetation, including removal and/or trimming could occur in areas of the project where grading and excavation would be used to lower the floodplain. The extent of vegetation impacted in this way

would be limited as existing vegetation would be protected in place to the greatest extent possible. Any vegetation removed due to floodplain lowering would be replaced as project design targets the entire lowered floodplain area for planting. Other potential disturbances to vegetation could occur from staging and access activities. Construction access would occur along previously established roads, some paved and some gravel, and no impacts to vegetation from access are anticipated at this time. Staging would generally occur in areas with little vegetation, such as previously disturbed areas, gravel bars within the channel, and parking lots. Trees located in staging areas would be protected in place.

The potential impacts to vegetation from Alternative 5 are summarized in Table 4-23, below. In general, disturbance to existing riparian vegetation would be avoided or minimized (through implementation of BMPs) and any removal of vegetation would be more than offset through proposed planting of riparian vegetation, therefore implementation of Alternative 5 would result in less than significant short-term effects to vegetation, with long-term benefits realized following establishment of newly planted native riparian vegetation.

Table 4-23. Summary of Potential Impacts to Vegetation

Alternative	Construction related impacts	Staging related impacts	Planted vegetation	Net Change in Vegetation
Alternative 5 (RP)	13.4 acres	6 acres	136 acres	116.6
Alternative 6	14.8 acres	7.4 acres	143 acres	120.8

During implementation of the project, common fish and wildlife species could be directly or indirectly affected. Direct effects may include injury or mortality due to movement of large equipment, placement/movement of fill, or construction noise. Indirect effects may include impacts to habitat conditions during construction, but an overall increase in habitat quality is expected from project implementation. It is also expected that there would be temporary effects due to increases in ground disturbing activities and noise generating activities, which could disturb wildlife in and around the project area. This may also cause temporary displacement of wildlife. Implementation of the project also has the potential to spread invasive plant or animal species through the introduction of invasive species due to unwashed, contaminated equipment or through the inadvertent creation of suitable habitat conditions for establishment. Once established, invasive species can outcompete native species or disrupt the availability and distribution of critical habitat elements. With implementation of the BMPs and avoidance and minimization measures described in Section 4.3.5.3, potential project effects associated with the introduction or spread of invasive species would be less than significant.

While short term impacts could occur to wildlife and vegetation from construction related activities, such as floodplain grading, creation of backwater areas and side channels, and placement of woody material and boulders, these actions would result in long term benefits through the enhancement and creation of aquatic and riparian habitat. For example, the creation of backwater areas would not only enhance juvenile anadromous salmonid rearing habitat, but would also provide enhanced habitat for use by waterfowl, amphibians, and other wildlife

species. Furthermore, implementation of BMPs described below would lessen the potential effects of project actions. Project activities would create higher value habitat over the long term for common and special status species of amphibians, reptiles, birds, and mammals. Given these considerations, implementation of Alternative 5 would result in less than significant short-term, construction-related effects to vegetation and wildlife resources, with long-term beneficial effects following project implementation.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

In addition to the increments included in Alternative 5 (2, 3a, and 5), Alternative 6 would also include implementation of Increment 1. Increment 1 would include creation of additional aquatic habitat features, including 1 side channel and 1 backwater area in the Timbuctoo Bend reach of the lower Yuba River, upstream of Highway 20. This increment would also include 4.9 acres of riparian vegetation planted to complement and enhance function of the aquatic habitat features. The construction methods would be the same as those used to implement Alternative 5; therefore it is expected that the same potential types of impacts to vegetation and wildlife would occur. The additional restoration work of Increment 1 would result in a slight increase in potential short term impacts compared to Alternative 5; however, with implementation of BMPs, short term, construction related impacts would be reduced to a less than significant level. Furthermore, implementation of Alternative 6 would result in long term gains in quality and quantity of riparian and riverine habitats. Given these considerations, Alternative 6 would be expected to result in less than significant impacts to vegetation and wildlife resources.

4.3.5.3 Best Management Practices and Avoidance and Minimization Measures

The following measures would be implemented to reduce the potential short-term impacts that could result from the introduction or spread of invasive plant species as result of project construction. BMPs and avoidance and minimization measures for special status species are discussed below in Section 4.2.6.

Prior to work in riparian areas, in-channel work, and floodplain, machinery would be washed to control movement of weeds, invasive species, and sedimentation.

- All equipment entering the river that has been used in or near other Central Valley rivers would be steam cleaned before it is used to minimize the chance of introducing New Zealand mud snails or other invasive species to the project site.
- The project limits would be clearly marked and erosion control fencing would be placed on the edge of work areas that have the potential for run-off or spills. All fencing would be installed prior to construction activities and would be maintained throughout the work period.
- All temporary impacts would be restored to pre-project contours and revegetated as necessary.

- To avoid or minimize the introduction or spread of noxious weeds, the following measures would be incorporated into the proposed project plans and specifications for the project construction sites:
 - Certified, weed-free, imported erosion-control materials (or rice straw in upland areas) would be used.
 - Construction supervisors and managers would be educated by the biological monitor about noxious weed identification and the importance of controlling and preventing their spread. The biological monitor would conduct a tailgate meeting before construction at which handouts identifying noxious weeds would be distributed and workers would be briefed on the techniques used to prevent their spread.
 - To reduce the movement of noxious weeds into uninfected areas, the contractor would stockpile and cover topsoil removed during excavation.
- Ensure that construction contractors limit ground disturbance to the smallest feasible areas and that they implement BMPs along with the planting or reseeding of disturbed areas using native plants to assist in the re-establishment of native vegetation.
- Before construction begins, the project engineer and a qualified biologist would identify locations for equipment and personnel access and materials staging that would minimize disturbance to vegetation and wildlife. During construction, as much understory brush and as many trees as possible would be retained.
- Disturbance, trimming, or removal of vegetation would be conducted during the winter months (November 1 – February 15) to the maximum extent possible to avoid impacts to nesting migratory birds.

4.3.6 Special Status Species

This section describes special status species that either occur or have the potential to occur in the project area that may be potentially impacted by the project. This section evaluates the effects of the proposed alternatives on special status species in the project area. An initial evaluation determined that several species have the potential to occur, or that suitable habitat exists, in the project area.

4.3.6.1 Affected Environment

For the purpose of this analysis, special-status species include species that are legally protected under the Federal Endangered Species Act (ESA), California Endangered Species Act (CESA), or other regulations including rare plant species listed by the native Plant Society. Migratory birds will also be discussed in this section as a broad group of species that are afforded protection under the Migratory Bird Treaty Act (MBTA). Species identified as species of special concern by the California Department of Wildlife (CDFW) were not considered in this analysis; however, these species would be considered in a CEQA compliant environmental

effects analysis. Information on special status species that may be affected by the project was gathered from various resources³:

- USFWS official list of special-status species (Obtained August 16, 2017 through USFWS ECOS-IPaC system)
- NMFS West Coast Region, California Endangered Species Act List (official list obtained August 2017)
- California Natural Diversity Database BIOs (CNDDB) (August 2017)
- California Native Plant Society's online Inventory of Rare and Endangered Vascular Plants of California (August 2017)

Each database was queried for special-status species was based on a search of the USGS 7.5' quadrangles that overlap the affected areas (Yuba City, Browns Valley, and Smartville). All queries were reviewed and suitable habitat for each of the species were compared with the affected areas and project description. In addition to database queries, the public draft EA/IS for the Hallwood Side Channel and Floodplain Restoration Project on the lower Yuba River (USFWS 2017) was referenced for information regarding the potential of occurrence for special status species in the project area. The Hallwood project is within the study area. A total of 31 species were identified as having the potential to occur in the study area, including: 4 amphibians/reptiles, 7 birds, 6 fish, 4 invertebrate, 1 mammal, and 9 plant species. Thirteen of these species were listed as Threatened or Endangered under the ESA. Eleven species were identified as likely to occur or as possibly occurring within the study based on presence of suitable habitat or nearby known occurrences; additional information on these species is provided below. The potential for occurrence of all 31 species is summarized in Table 4-24 below.

Special Status Amphibian Species

California Red-legged Frog

Status: On May 31, 1996, the California Red-legged Frog (CRLF) was listed as "Threatened" by USFWS under the Endangered Species Act (61 FR 25813). Due to threats from invasive species and habitat loss, critical habitat was designated on March 13, 2001 (66 FR 14626). On April 13, 2006, a Special Rule Exemption Associated with Final Listing for Existing Routine Ranching Activities in conjunction with the designation of critical habitat for the species occurred (75 FR 12816).

Distribution and Habitat: The historic range of the CRLF is primarily along the coast from Point Reyes National Seashore in Marin County inland to Redding in Shasta County and

³Following a review of potential species occurrences in December 2018, three species were added for consideration: Foothill yellow-legged frog (*Rana boylei*), Tri-colored blackbird (*Agelaius tricolor*), and bank swallow (*Riparia riparia*).

Table 4-24. Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
Amphibians/reptiles					
<i>Ambystoma californiense</i>	California Tiger Salamander	FT, ST	No designated critical habitat in the Study Area	Restricted breeding in seasonally inundated waters, including artificial ponds, in grassland and oak savannah plant communities, predominantly from sea level to 2,000 ft (609.6 m), in central California	Unlikely; the Study Area does not overlap with species range
<i>Rana boylei</i>	Foothill yellow-legged frog	Sc	NA	Partly-shaded, shallow streams and riffles with a rocky substrate in a variety of habitats; Needs at least some cobble-sized substrate for egg-laying. Needs at least 15 weeks to attain metamorphosis. Breeds in backwaters or pool tailouts in streams, creeks, and rivers with suitable cobble substrate.	Likely; the Study Area overlaps the range and habitat of species

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
<i>Rana draytonii</i>	California red-legged frog	FT	No designated Critical Habitat in the Study area 75 FR 12815-12959, April 16, 2010	Adults require dense, shrubby or emergent riparian vegetation closely associated with deep (>2 1/3-ft), still or slow moving water. Associated with deep pools with dense stands of overhanging willows (<i>Salix</i> spp.) and cattails (<i>Typha latifolia</i>). Well-vegetated terrestrial riparian areas may provide important winter habitat. Aestivate in small mammal burrows and moist leaf litter. Found up to 100 ft from water in adjacent dense riparian vegetation. Cannot inhabit water bodies that exceed 21.1°C (USFWS 2002)	Unlikely; the area of the proposed alternative does not contain suitable habitat for the California red-legged frog due to the presence of bullfrogs and several species of predatory fish, lack of fine sediment substrate used for predator avoidance, and lack of woody material and wrack used for thermal regulation and predator avoidance.
<i>Thamnophis gigas</i>	Giant Garter Snake	FT, ST	No current designated critical habitat rules have been published	Glenn County to southern edge of San Francisco Bay-Delta and from Merced County to northern Fresno County. Found in small, isolated patches of highly modified agricultural wetlands (Wood et. al 2015). Prefers marsh and wetland habitat including sloughs, drainage canals and irrigation ditches associated with rice cultivation (Halstead et al. 2014)	Unlikely; the Study Area does not support preferred habitat characteristics.

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
Birds					
<i>Agelaius tricolor</i>	Tri-colored blackbird	Sc	NA	Largely endemic to California, most numerous in the Central Valley and nearby vicinity. Typically requires open water, protected nesting substrate, and foraging grounds within vicinity of the nesting colony. Nests in dense thickets of cattails, tules, and willow.	Unlikely; the Study Area does not support preferred habitat characteristics.
<i>Buteo swainsoni</i>	Swainson's hawk	ST	NA	Within California Central Valley, the largest population is located between Sacramento and Modesto in the northern San Joaquin Valley. Breeding often occurs in riparian systems with close proximity to agricultural land for foraging (Woodbridge 1998)	Likely; the Study Area overlaps the range of species
<i>Coccyzus americanus</i>	Western Yellow-billed Cuckoo	FT, SE	No critical habitat proposed in the Study Area (79 FR 48547 – 48652; 15 August 2014)	Migrates to area west of the Rocky Mountains to breed in the summer, between June and early September (CDFW 2017). Habitat includes large (>37 acre) patches of riparian thickets or forests with a dense understory (CDFW 2017, Dettling et al. 2015); rare in California, found primarily along Sacramento and Feather rivers (USFWS 2013)	Unlikely; the Study Area does not support large patches of riparian vegetation that are its preferred habitat

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
<i>Elanus leucurus</i>	White-tailed Kite	FP	NA	Valley lowlands west of Sierra Nevada range. Breeds from February to October in dense tree groves, often in riparian zones	Possible; White-tailed kites have been observed nesting close to the project site.
<i>Haliaeetus leucocephalus</i>	Bald Eagle	SE/ FP	NA	Present year-round at higher elevation areas in California, winter resident in other parts of the state. Nest near lakes or flowing rivers for foraging (USFS 2008)	Possible; the Study Area overlaps the range of species
<i>Laterallus jamaicensis coturniculus</i>	California Black Rail	BCC, ST	NA	Rare; resident of saline, brackish, and fresh emergent wetlands (CDFW 2017). Found along the coast from northern Baja California to Bodega Bay, in the San Francisco Bay, Sacramento-San Joaquin Delta, Salton Sea, along the lower Colorado River, an northern Sierra Nevada foothills (CDFW 2017, Richmond et al. 2010)	Unlikely; Study Area does not support freshwater emergent wetland habitat
<i>Riparia riparia</i>	Bank swallow	ST	NA	Neotropical migrant present in California from spring to the fall; breeds in early May through July (CDFW 2017). Colonial breeder that digs nest burrow in fine-textured banks or cliffs near water (CDFW 2017, BSTAC 2013). Nesting colonies primarily in Sacramento River basin (BSTAC 2013).	Unlikely; Study Area does not support freshwater emergent wetland habitat

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
Fish					
<i>Acipenser medirostris</i>	North American Green Sturgeon	FT	Designated critical habitat in the Study Area (50 FR 52301–52351, October 9, 2009).	Mainstream Sacramento River downstream of Keswick Dam (including the Yolo and Sutter bypasses), the Feather River below Oroville Dam, the Yuba River below Daguerre Point Dam, and the Sacramento-San Joaquin Delta (NOAA 2009)	Likely; the Study Area overlaps the range of the species
<i>Hypomesus transpacificus</i>	Delta Smelt	FT, SE	No designated critical habitat in the Study Area (50 FR 65256–65257, December 19, 1994)	Found only from Suisun Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties (Sommer and Mejia 2013). Tolerant of a wide salinity range, from to 2-14 ppt (parts per thousand)	Unlikely; the Study area does not overlap species range or provide suitable habitat for the species
<i>Oncorhynchus mykiss</i>	California Central Valley steelhead	FT	Designated Critical Habitat in the Study Area (70 FR 52488–52536, September 2, 2005)	Sacramento-San Joaquin basin; San Francisco, San Pablo, and Suisun bays eastward to Chipps Island	Likely; the Study Area overlaps the range and habitat of species
<i>Oncorhynchus tshawytscha</i>	Spring-run Chinook Salmon	FT, ST	Designated critical habitat in the Study Area (70 FR 52488–52536, September 2, 2005).	Sacramento-San Joaquin basin; San Francisco, San Pablo, and Suisun bays eastward to Chipps Island	Likely; the Study Area overlaps the range and habitat of species

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
<i>Oncorhynchus tshawytscha</i>	Fall-run Chinook Salmon	MSA	Essential Fish Habitat	Sacramento-San Joaquin basin; San Francisco, San Pablo, and Suisun bays	Likely; the Study Area overlaps the range and habitat of species
<i>Oncorhynchus tshawytscha</i>	Winter-run Chinook Salmon	FE, SE	No designated critical habitat in the Study Area (58 FR 33212–33219, June 16, 1993)	Sacramento basin; San Francisco, San Pablo, and Suisun bays eastward to Chipps Island	Unlikely; the Study Area does not overlap the species range
Invertebrates					
<i>Branchinecta conservatio</i>	Conservancy Fairy Shrimp	FE	No designated critical habitat in the Study Area (71 FR 7117-7316, February 10, 2006)	Northern two-thirds of the California Central Valley, at elevations of 16-476 ft (4.9-145 m). Occur in few fragmented localities with short grass vernal pool landscapes. No occurrences documented near Study Area (Eriksen and Belk 1999, CDFW 2017)	Unlikely; Short grass vernal pool habitats do not occur in the vicinity of proposed project features or activities.
<i>Branchinecta lynchi</i>	Vernal pool Fairy Shrimp	FT	No designated critical habitat in the Study Area (71 FR 7117-7316, February 10, 2006)	Occurs in a variety of vernal pool habitats in California coast ranges and Central Valley and two locations in southern Oregon (USFWS 2006b)	Unlikely; Vernal pool habitats do not occur in the vicinity of proposed project features or activities.
<i>Desmocerus californicus dimorphus</i>	Valley Elderberry Longhorn Beetle	FT	No designated Critical Habitat in the Study Area (45 FR 52803-52807)	Southern Shasta County to Fresno County. Associated with elderberry plants (Talley et al. 2006)	Likely; elderberry plants are present within the Study Area
<i>Lepidurus packardii</i>	Vernal Pool Tadpole Shrimp	FE	No designated critical habitat in the Study Area (71 FR 7117-7316, February 10, 2006)	Vernal pools throughout the California Central Valley. Distribution is patchy within vernal pool complexes (King et al 1996)	Unlikely; Vernal pool habitats do not occur in the vicinity of proposed project features or activities.

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
Mammals					
<i>Corynorhinus townsendii</i>	Townsend's Big-eared Bat	Sc	NA	Throughout California; requires caves, mines, tunnels, buildings or other human-made structures for roosting (CDFW 2017)	Unlikely; Study Area does not support preferred roosting habitat
Plants					
<i>Astragalus tener</i> var. <i>ferrisiae</i>	Ferris' Milk-Vetch	1B.1	NA	Grows in northern California on clay, alkaline soils that are moist in the springtime, and with elevation from 6 to 46 meters (20-150 ft) (USFWS 2005)	Unlikely; Study Area does not overlap species range
<i>Brodiaea sierra</i>	Sierra Foothills Brodiaea	4.3	NA	Found in the Sierra Nevada foothills of Butte, Yuba, and Nevada counties, typically between 320 and 945 m (1050 to 3100 ft) (Preston 2006). Primarily on basic and ultramafic outcrops in chaparral and open areas in foothill woodlands (Preston 2006).	Unlikely; Study Area is below known elevation and does not have ultramafic geology
<i>Clarkia bilba</i> ssp. <i>brandegeae</i>	Brandegee's Clarkia	4.2	NA	Below 2,800 ft in elevation in dry habitats in six northern Sierra counties (USACE 2014). Typically grows in foothill woodland habitat, often in road cuts and gravelly slopes above creeks and rivers.	Unlikely; Study Area does not support preferred habitat
<i>Delphinium recurvatum</i>	Recurved Larkspur	1B.2	NA	Typically found in poorly drained alkaline soils in valley and foothill grasslands and woodlands up to an elevation of 2400 feet	Unlikely; Study Area does not support preferred habitat
<i>Downingia pusilla</i>	Dwarf Downingia	2B.2	NA	Annual herb that grows in foothill woodlands, valley grasslands, freshwater wetlands in vernal pools (Cal Flora 2017)	Unlikely; Study Area does not support habitat requirements

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Scientific Name	Common Name	Status	Critical Habitat	Distribution and Habitat Association	Potential for Occurrence
<i>Juglans hindsii</i>	Northern California black walnut	1B.1	NA	Found throughout riparian forest, riparian woodland communities in California.	Possible; occurrences of this species have been reported in the study area; however, many reported occurrences may be misidentified, hybridized individuals. CNPS notes that only one confirmed native occurrence appears viable as of 2003 (CNPS 2017).
<i>Legenere limosa</i>	Legenere	1B.1	NA	Found in a variety of habitats that include vernal pools, vernal marshes, ponds, sloughs, and floodplains of intermittent streams (USFWS 2005). Typically found within grassland, open woodland, or hardwood forest from 0 to 2000 ft elevation (USFWS 2005)	Unlikely; has not been documented to occur along the Yuba River
<i>Monardella venosa</i>	Veiny Monardella	1B.1	NA	Endemic to California; annual herb found in valley and foothill grasslands in Butte, Sutter, Tuolumne and Yuba counties. Blooms May-July (CNPS 2017)	Unlikely; the Study Area does not overlap the range of the species.
<i>Pseudobahia bahiifolia</i>	Hartweg's Golden Sunburst	FE, 1B.1	No current designated critical habitat rules have been published	Endemic to California; annual herb found in valley and foothill woodlands in several CV counties. Blooms May-September (CNPS 2017)	Unlikely; habitat not present in study area and species is considered extirpated from the area

Table notes on next page

Table 4-24 (cont). Summary of special status species with potential to occur in the study area.

Table notes:

Source: USFWS ECOS IPaC 2017, NMFS 2018; CNDDDB, 2017 and CNPS, 2017

Federal

FE = Listed Endangered under the Federal Endangered Species Act

FT = Listed Threatened under the Federal Endangered Species Act

BCC = Listed as Bird of Conservation Concern

MSA = Magnuson Steven's Fisheries Act Managed Species

State

SE = Listed Endangered under the California Endangered Species Act

ST = Listed Threatened under the California Endangered Species Act

Sc = candidate for listing under the California Endangered Species Act

FP = Listed as Fully Protected under California Fish and Game Code Sections 3511, 4700, 5050 and 5515.

California Native Plant Society Rank

1B = rare, threatened, or endangered in California and elsewhere

2B = rare, threatened, or endangered in California only

.1 = seriously threatened in California

.2 = moderately threatened in California

.3 = not very threatened in California

4 = plants of limited distribution (watch list)

downwards to Baja California and Mexico. The USFWS has quantified the species to live in only 248 streams in 26 counties, whereas it had previously been documents in 46 California Counties. The CRLF is primarily found within wetlands and streams with dense emergent vegetation that is associated with deep still/slow moving water. Other suitable habitat may include backwaters of ponds, marshes, springs, and reservoirs (61 FR 25813). The dense riparian vegetation and leaf detritus provide protection from predators so that they may burrow and also provides shade from the sun to prevent desiccation. Reproduction typically occurs in the late winter or early spring when females will deposit egg masses on emergent vegetation. The eggs will hatch within one to two weeks, metamorphosis occurs between 3.5 to 7 months, and sexual maturity is reached by 3 years of age. The life span of the CRLF is believed to be 8 to 10 years.

Potential for Occurrence in Project Area: It is unlikely that the CRLF is located within the project area. The area of the proposed alternative does not contain suitable habitat for the California red-legged frog due to the presence of bullfrogs and several species of predatory fish, lack of fine sediment substrate used for predator avoidance, and lack of woody material and wrack used for thermal regulation and predator avoidance. These conditions would make it difficult for the species to survive in the project area. The nearest recorded occurrence to the project area was logged 15.45 miles away.

Foothill Yellow-legged Frog

Status: On June 27, 2017, the Foothill Yellow-legged Frog was confirmed as a candidate for listing as an endangered species” by CDFW under the California Endangered Species Act.

Distribution and Habitat: The foothill yellow-legged frog is a medium-sized frog with grainy skin, long legs, and webbed hind feet. Its coloration tends to match its habitat with it typically being gray, brown, or olive and the underside of the rear legs and lower abdomen being yellow. The foothill yellow-legged frog has experienced significant population declines across its range in California including range contraction (Kupferberg et al. 2012). The current range of Foothill Yellow-legged Frog in California is in the coast ranges from Monterey County north and in the foothills of the Sierra Nevada from Kern County north. It is found from near sea level to around 6,000 ft, typically in or near rocky streams in valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadows (Zeiner et al.1990). Foothill yellow-legged frog eats a wide variety of invertebrates including aquatic and terrestrial insects. It is an obligate stream breeder, with females attaching egg masses to substrates in shallow water with low velocities, typically river bars, in the spring to early summer as high flows recede (Wheeler and Welsh 2008). Foothill yellow-legged frog life cycle is synchronized with the seasonal flow regimes of its habitat in California (Yarnell et al. 2008). Altered flow regimes due to dam regulation has been implicated as one of the contributors to population declines as this species is not adapted to these regulated flow regimes (Yarnell et al. 2008, Kupferberg et al 2012). Altered thermal regime in rivers below dams with hypolimnetic releases can also impact the Foothill Yellow-legged Frog by shifting the timing of breeding activity, hatching success, and metamorphosis to later in the season and causing metamorphs to be smaller and leaner compared to metamorphs in unregulated streams (Wheeler et al. 2014).

Potential for Occurrence in Project Area: Foothill yellow-legged frogs are generally found at elevations greater than that of the Proposed Project (Yarnell et al. 2012); however, two recent occurrences of this species were recorded downstream of Englebright Dam and upstream of the nearest proposed project features in Timbuctoo bend (Alternative 6). Given the presence of suitable habitat characteristics and the recent recorded occurrences in the study area, it is likely that the foothill yellow-legged frog would occur in the project area.

Special Status Birds Species

Five special status bird species were identified as having the potential to occur within the study area. Of those species, three were identified as possibly occurring or likely to occur in the study area, including: the Bald Eagle, Swainson's Hawk, and White Tailed Kite.

Bald Eagle

Status: The Bald Eagle was delisted under the ESA but remains listed as Endangered under the California ESA and is also designated as a Fully Protected species under California Fish and Game Code Section 3511.

Distribution: The bald eagle nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin. The bald eagle's winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County.

The bald eagle occurs during its breeding season in a variety of wetland habitats such as seacoasts, rivers, large lakes or marshes or other large bodies of open water with an abundance of fish. The Bald Eagle is an opportunistic forager; food habits highly varied across range and site-specific, based on prey species available. Bald Eagles use carrion of fish, birds, and mammals extensively wherever encountered at sites that provide disturbance-free access from the ground. Bald Eagles hunt from perches or while soaring over suitable habitat and attempt to take most prey on the wing (e.g., fish, waterfowl, and small mammals) but success varies greatly.

Potential for Occurrence: This species may occur in the study area between January and July as the study area provides suitable nesting, rearing, and forage habitat.

Swainson's Hawk

Status: Swainson's hawk is Federally listed as a species of concern protected under the Migratory Bird Treaty Act and State listed as threatened.

Distribution: As many as 17,000 Swainson's hawk pairs may have nested in California at one time (DFG 1994). According to the 2005 California Department of Fish and Game (CDFG) survey, an estimated 1,830 pairs of nesting hawks were found in the California Central Valley. September) and winter in Mexico and South America. The Central Valley population migrates only as far south as central Mexico. Swainson's hawks begin to arrive in the Central Valley in March; nesting territories are usually established by April, with incubation and rearing of young occurring through June (Estep 2003).

Swainson's hawks typically occur in California only during the breeding season (March through September) and winter in Mexico and South America. The Central Valley population migrates only as far south as central Mexico. Swainson's hawks begin to arrive in the Central Valley in March; nesting territories are usually established by April, with incubation and rearing of young occurring through June (Estep 2003).

Swainson's hawks are found most commonly in grasslands, low shrub lands, and agricultural habitats that include large trees for nesting. Nests are found in riparian woodlands, roadside trees, trees along field borders, and isolated trees. Corridors of remnant riparian forest along drainages contain the majority of known nests in the Central Valley (England, Bechard, and Houston 1997; Estep 1984; Schlorff and Bloom 1984). Nesting pairs frequently return to the same nest site for multiple years and decades.

Prey abundance and accessibility are the most important features determining the suitability of Swainson's hawk foraging habitat. In addition, agricultural operations (*e.g.*, mowing, flood irrigation) have a substantial influence on the accessibility of prey and thus create important foraging opportunities for Swainson's hawk. Swainson's hawks feed primarily on small rodents, but also consume insects and birds.

Potential for Occurrence in project area: There is suitable foraging and nesting habitat for the Swainson's hawk adjacent to the study area and potentially within some of the proposed staging areas. The study area is within the normal range of the species and occurrences have been recorded in the area. It is likely that this species would occur with the study area.

White Tailed Kite

Status: The white-tailed kite is protected under the MBTA and is a fully protected species under the California Fish and Game Code. White-tailed kites were threatened with extinction in North America during the early twentieth century. Populations recovered throughout its range in the United States from small populations that survived in California, Texas, and Florida. However, since the 1980s, many white-tailed kite populations have been declining, apparently because of loss of habitat and increased disturbance of nests (Dunk 1995).

The breeding season generally extends from early February through early August. White-tailed kites usually nest in large native trees, although nonnative trees also are occasionally used. Nest trees are generally at the edge of wooded habitat next to open fields. Large trees in areas that have been developed may also be used, although the trees need to be close to open fields for foraging (Dunk 1995). White-tailed kites feed primarily on small mammals including voles (*Microtus* spp.), pocket mice (*Perognathus* spp.), and harvest mice (*Reithrodontomys megalotis*).

Potential for Occurrence: White-tailed kites are likely to nest within or around the study area due to the abundance of suitable nesting habitat and adjacent foraging habitat. Large trees located in the study area provide suitable nesting habitat, and row and field agricultural lands and grasslands provide suitable foraging habitat. Although suitable habitat is present, no occurrences have been reported in the study area on CNDDb, therefore this species has been identified as possibly occurring in the study area.

Migratory Birds

For the purpose of this analysis, migratory birds are considered as a group for their relative likelihood of occurrence due in part to the great number and diversity of species afforded equal protection under a common law, the Migratory Bird Treaty Act (MBTA). A large number of migratory birds are protected under the MBTA. Additionally, USFWS has identified 18 Birds of Conservation Concern (BCC) with potential to occur within the project area. BCCs are species with potential to become candidate species for listing under the ESA. It is likely that many migratory birds would be present in or adjacent to the study area during construction activities and that many species would utilize project features in the future. Migratory birds would be expected to breed, nest, forage, reside, and migrate through the study area during construction and following completion of construction. The likelihood of a particular species to occur within the study area would vary due to differences in behavior, habitat use, and local, regional, and global environmental conditions.

Special Status Fish Species:

California Central Valley Steelhead DPS

Status: The CCV Steelhead DPS was listed as “threatened” on March 19, 1993, by the National Marine Fisheries Service (63 FR 13347). When NMFS completed a 5-year status review of the species, it indicated that the biological status of the species has declined since the previous 5-year review (NMFS 2016b). Critical habitat was designated for the species, which including the lower Yuba River from the Feather River confluence to Englebright Dam, on September 2, 2005 by NMFS (70 FR 52488).

Distribution and Habitat: Historically, the CCV steelhead migrated to the upper reaches of Central Valley streams and rivers up into the foothills for spawning and juvenile rearing. The geographic distribution of the species on the Central Valley rivers has been significantly impaired from the construction of dams and impoundments. The current distribution of the species is now limited to the valley due to impoundments in the lower foothills, therefore restricting movement upstream. This especially impacts the spawning and juvenile rearing of the species, as they are not able to migrate to suitable spawning habitat and have a smaller area to inhabit. The main distribution of the species is limited to the main-stem of the Sacramento River downstream of Keswick Dam, the Feather River downstream of Oroville Dam, the American River downstream of Nimbus Dam, the Mokelumne River downstream of Comanche Dam, and the various tributaries to the Sacramento River system, Delta and San Francisco Bay. The CCV steelhead have access to the Yuba River up to Englebright Dam as the Yuba River is a tributary to the Feather River.

The CCV steelhead is a very complex species with geographically distributed life stages. The adult immigration and holding period in the lower Yuba River is typically from August through March, and the spawning generally occurs from January through April. The majority of downstream movement of the juveniles typically occurs from April through September, but some may stay for one to three years for rearing (USACE 2014).

Potential for Occurrence in Project Area: CCV steelhead are present in the lower Yuba River and would be subject to effects of the project.

Central Valley Spring-run Chinook salmon

Status: On September 16, 1999, the Central Valley Spring-run Chinook salmon was listed as a Federally “threatened” species by the NMFS (64 FR 50394). After review, NMFS updated this listing on April 14, 2014 (79 FR 20802). Critical Habitat for the species was also posted in 70 FR 52488 on September 2, 2005. NMFS completed a 5 year status review in May 2016 (NMFS 2016a). Critical habitat includes the lower Yuba River up to Englebright Dam. The central valley Spring-run Chinook salmon have the ability to make it upstream of Daguerre Point Dam by use of the fish ladders (USACE 2014).

Distribution and Habitat: The central valley Spring-run Chinook salmon has been extirpated from much of its historical range. The species past range typically included the headwaters of major rivers within the Central Valley, but due to dams, water diversions, urbanization/development, logging, grazing, agriculture, and mining, the population of the species has declined. In addition, hybridization of the species with fall-run Chinook salmon and hatchery populations has also affected the species numbers (HDR/SWRI 2007).

Adult spring-run Chinook salmon immigrate and hold in the lower Yuba River from April through September. The adult spawning period extends from September through mid-October. Although dependent upon water temperatures, the embryo incubation period extends from September through December followed by rearing of fry from mid-November through mid-February (YCWA 2017).

Potential for Occurrence in Project Area: Central valley Spring-run Chinook salmon are known to occur within the lower Yuba River and would be subject to effects of the project.

Southern DPS Green Sturgeon

Status: On April 7, 2006, the southern DPS of North American green sturgeon was listed as a Federally threatened species (71 FR 17757). NMFS also designated critical habitat for the Southern DPS of the North American sturgeon on October 9, 2009 (74 FR 52300), which includes the Sacramento River, lower Feather River, lower Yuba River, the Sacramento-San Joaquin River Delta, and San Francisco Estuary.

Distribution and Habitat: Green Sturgeon live in both freshwater and saltwater from the Sacramento River north to British Columbia. It is typical for adults to spend time in oceanic waters, bays, or estuaries when they aren’t spawning. While the southern DPS’ spawning preferences and specific distribution is unclear, it is believed that their spawning habitat is large cobble substrates in turbulent fresh river mainstems from April through July. They also spawn in deep pools or “holes” (NOAA, 2015). While most of the green sturgeon spawning is believed to occur in the Sacramento River, evidence also suggests that they may spawn in the lower Yuba River too. During May 2011, video surveys conducted on the lower Yuba River show five adult sturgeon immediately below Daguerre Point Dam. Additionally, spawning behavior was noted by two of the individuals (AECOM, 2015). While Daguerre Point Dam does have fish ladders

designed for salmonid passage, it is believed that the adult sturgeon are unable to ascend the ladders (YCWA 2011).

Potential for Occurrence in Project Area: Southern DPS of North American green sturgeon are known to occur within the project areas below Daguerre Point Dam and would be subject to project effects in the area.

Essential Fish Habitat (EFH)

According to the Pacific Coast Salmon Fisheries Management Plan, the project location contains designated Essential Fish Habitat for Chinook salmon. There are four major components of Chinook Salmon EFH, which the project area contains: 1) Spawning and incubation, 2) juvenile rearing, 3) juvenile migration corridors, and 4) adult migration corridors and adult holding habitat (NMFS, 2011).

4.3.6.5 Special Status Invertebrates

Valley Elderberry Longhorn Beetle

Status: The USFWS has designated critical habitat for VELB along the American River Parkway and in an area within the Sacramento metropolitan area (54 FR 48229). The species has no State status (the State of California does not list insects).

Distribution and Habitat: The VELB is endemic to the Central Valley and is found in riparian habitats and associated uplands where the elderberry (*Sambucus* spp.), the beetle's food plant, grows. The beetle is a pith-boring species that depends on elderberry plants during its entire life cycle. Larvae feed on tree pith, while adults eat the foliage and possibly the flowers of the plants. The adult stage of the VELB is short-lived, and most of the life cycle is spent in the larval stage. The adults are active from early March through early June with mating occurring in May. Eggs are laid singly, or in small groups, in crevices in elderberry bark and hatch in about 10 days. Larvae bore into the pith of elderberry roots, branches, and trunks to create an opening in the stem within which they pupate, remaining in this stage for one to two years before emerging as adults. After metamorphosing into an adult, the VELB chews a circular exit hole through which it emerges, sometime during the period of late March to June. It has been suggested that the VELB is a poor disperser, based on the spatial distribution of occupied shrubs.

Potential for Occurrence in Project Area: There are seven known CNDDDB records in the vicinity of the project area. Although elderberry shrubs are known to occur throughout the lower Yuba River, the shrubs were found to be most abundant in the downstream-most reaches near Marysville and Hallwood. The majority of plants are distributed in areas above the valley floor and as proximity to the wetted edge of the river increases, the number of plants declines (YCWA 2013b). Given these considerations, elderberry shrubs and VELB may occur in the project area.

Special Status Plant Species

Of the nine special status plant species initially identified as having the potential to occur in the study area, only one species, Northern California black walnut (*Juglans hindsii*) was identified as potentially occurring in the study area.

Northern California black walnut

Status: The Northern California black walnut is ranked as a 1B.1 status species on the CNPS Inventory of Rare and Endangered plants. A 1B.1 ranking identifies the species as rare, threatened, or endangered in California and elsewhere and as seriously threatened in California (CNPS 2017).

Distribution and Habitat: The historic range of the Northern California Black Walnut is in riparian forest and riparian woodland communities at elevations from 150 to 3,000 feet in central and southern California. Most, if not all, natural stands of the species are associated with former Native American camps. The species has become naturalized in the interior coast ranges and Central Valley. The species is threatened by hybridization with orchard trees, urbanization, and conversion to agriculture. Most of the plants in the northern range of the species are assumed to be the result of hybridization with eastern black walnut (*Juglans nigra*) (Stuart 2001).

Potential for Occurrence in project area: Calflora has reported 24 occurrences of this species in Yuba County (source California Department of Fish and Wildlife Vegetation Classification and Mapping Program). CNDDDB reports only one occurrence in the 3 quadrats considered. This species often hybridizes with orchard trees and eastern varieties and it is unclear whether reported occurrences in the study area are valid. Due to uncertainties in the occurrence for this species in the study area has been identified as possible. Surveys would need to be conducted prior to project construction to evaluate potential impacts to this species.

4.3.6.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts to special status species was based on a review of special status species that occur or have the potential to occur in the project area and could be affected by short and long term project-related activities and elements. A list of special-status species was developed by obtaining sensitive species lists from the NMFS, USFWS, CNDDDB, and other projects in the area as described in the affected environment section above. The potential for each species to occur in the project area was then determined through a review of existing information, including recently completed environmental documents for similar projects in the study area. In particular, information on sensitive species in the project area was gathered from Environmental Assessments developed for the Yuba River Canyon Project (USFWS and Yuba County 2016) and the Hallwood Floodplain and Side Channel Restoration Project (USFWS and Yuba County 2017). For species listed under the Federal Endangered Species Act (ESA), formal and informal coordination was conducted under Section 7 of the ESA, with the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS), to evaluate the projects potential affects to those species. Additional coordination was conducted with USFWS under the Fish and Wildlife Coordination Act and with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act to evaluate the projects potential effects on special status species.

Basis of Significance

Under NEPA, the significance of project impacts is a function of context and intensity. For biological resources, context refers to the importance (ecological, commercial, scientific, recreational, etc.) or regulatory (i.e. legally protected) status of the resource, and intensity refers to the magnitude – scale and duration – of the impact. Both beneficial and adverse impacts are recognized; either can be significant.

In the study area, the habitats of greatest importance are riverine habitat and adjacent riparian habitat. These habitats are most important because of their degraded and fragmented condition and high value to fish and wildlife species. Losses or gains of population and habitat for special status species may also be significant, depending on the magnitude of the impact relative to the population size and distribution of the species in the region. Finally, any impact leading to new introductions or the expansion of invasive species would also be considered significant in terms of potential far-reaching effects on the ecosystem of the project area. Adverse effects on special status species were considered significant if implementation of an alternative plan would:

- Directly or indirectly reduce the growth, survival, or reproductive success of species listed or proposed for listing as threatened or endangered under the FESA.
- Directly or indirectly reduce the growth, survival, or reproductive success of substantial populations of Federal species of concern.
- Substantial interference with the movement of any native resident or migratory wildlife species or with the established native resident or migratory wildlife corridors.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The Yuba River ecosystem's habitat would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Implementing Alternative 5 would have direct and indirect effects on the environment, special status species, migratory birds, critical habitat, and EFH. The proposed in channel work, such as lowering and grading near bank areas to facilitate more frequent inundation or for the placement of Engineered Log Jams, would temporarily disturb soil and sediments and cause an increase in turbidity and sedimentation. These effects could potentially interfere with feeding, social organization, spawning, rearing, and juvenile survival in fish species; however, these effects would be expected to be short term and localized to the project area. BMPs and

avoidance and minimization measures would be implemented to minimize effects of sedimentation and turbidity to special status species and habitat.

The project also has the potential to interfere with the movement of native resident or migratory wildlife species through disruption to nesting, foraging, and migratory habitat. Construction related impacts to migratory birds would be limited by protecting existing habitat elements in place and limiting construction related disruptions during critical periods (i.e., nest). Construction would begin in June each year, which would be expected to avoid the primary nesting season for many species. Furthermore, prior to construction, surveys would be conducted to assess the potential for project actions (staging, access, and construction) to impact migratory birds and other vegetation and wildlife resources. In general, staging and access would result in minimal impacts to existing vegetation (Section 4.2.5) and design of features would prioritize the protection of existing vegetation in place.

Proposed staging areas were identified using satellite imagery and a field verification of vegetation has not been performed at this time. There is potential for elderberry shrubs to occur in or near staging areas, especially for staging areas in downstream reaches. Elderberry shrubs are an obligate host plant for the Threatened Valley Elderberry Longhorn Beetles (VELB) therefore a disturbance to any shrubs would represent a potential adverse impact to the VELB. To avoid, minimize, or mitigate impacts to VELB, the project would be implemented following the conservation guidelines described in the Framework for Assessing Impacts to the Valley Elderberry (USFWS 2017).

Construction equipment has the potential to leak toxic substances such as gasoline and diesel, lubricants, and other petroleum-based projects. As a result of spills or leaks in storage containers, the substances could enter waterways within and adjacent to the project site, causing mortality or physiological impairment of fish or disrupt other behavioral patterns. Development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) and other BMPs described below, would reduce potential impacts from leaks to a less than significant level.

The foothill yellow-legged frog may use the aquatic habitat present within the project area in the lower Yuba River and the perennially wet portions of the overflow channel and the basking habitat in adjacent terrestrial areas. The project restoration activities, particularly grading and topographic modification, have the potential to cause harassment, injury, or mortality to foothill yellow-legged frogs if they are present. With implementation of avoidance and minimization measures and BMPs, potential impacts to the foothill yellow-legged frog would be less than significant.

Despite the temporary impacts, the project would be beneficial overall by increasing habitat quality and quantity. Excavating gravel to create additional floodplain and side channels would emulate a more natural river system and create more suitable habitat. Placement of Large Woody Material and Engineered Log Jams would not only stabilize channel features but provide valuable habitat that wildlife may use for feeding, resting, concealment from predators, and rearing. These would also help increase organic matter in the lower Yuba River system and increase habitat complexity. Another long term benefit of the project is to create a more diversified riparian community, which can provide spawning habitat as well as provide shade

which can help lower water temperatures. The lowering and grading of floodplains would improve the availability of habitats used by rearing fish.

Coordination of the Recommended Plan (Alternative 5) with NMFS and USFWS has been conducted through Section 7 ESA formal and informal consultation, the Magnuson-Stevens Fishery Conservation and Management Act, and the Fish and Wildlife Coordination Act. The outcomes of those coordination efforts are summarized below and documented in the Environmental Appendix D.

- NMFS has issued a Biological Opinion for the alternative concluding that the project would not jeopardize populations of Spring-run Chinook, CV steelhead, or green sturgeon, or adversely modify their critical habitat (Environmental Appendix D – Attachment 1). The project would incorporate all BO terms and conditions as directed and recommendations to the greatest extent possible.
- NMFS has also issued recommendations for the project under the Magnuson-Stevens Fishery Conservation and Management Act (Environmental Appendix D – Attachment 1). While construction related activities, including increases in sedimentation, turbidity, and physical disturbance from in channel work, would result in short-term and temporary effects to EFH, the project would result in long-term improvements to the quality of EFH in the project area.
- USFWS has issued a letter of concurrence concluding that the project may affect but is not likely to adversely affect the VELB, yellow-billed cuckoo, and CRLF (Environmental Appendix D – Attachment 2).
- The USFWS has also issued a Coordination Act Report with recommended conservation actions (Environmental Appendix D – Attachment 4). The project would incorporate the recommendations described in the USFWS Coordination Act Report to the greatest extent possible as detailed in Section 6.1.

Although implementation of Alternative 5 could result in short term impacts to special status species and their habitats, through coordination with resource agencies and implementation of BMPs and avoidance and minimization measures potential construction related impacts would be reduced to a less than significant effect. Furthermore, the project would result in long terms gains in habitat quality and quantity; therefore, implementation of Alternative 5 would result in less than significant impacts to special status species.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats would be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. Alternative 6 would have similar construction related effects to Alternative 5, with an incrementally higher magnitude from the additional project features. Because Alternative 6 is not the recommended plan it was not considered in the coordination efforts with resource agencies although it does not represent a significant change in the nature of effects and for the purpose of this analysis it is assumed that similar recommendations and terms and conditions

would apply to implementation of Alternative 6. As with Alternative 5, potential effects to sensitive status species would be short term in nature and with implementation of BMPs and avoidance and minimization measures, implementation of Alternative 6 would result in less than significant effects. Alternative 6 would also be expected to result in incrementally higher improvements to aquatic and riparian habitat than Alternative 5 which would result in long term benefits for special status species.

4.3.6.3 Best Management Practices and Avoidance and Minimization Measures

The following measures would be implemented to reduce the potential short-term impacts to special status fish species as result of project construction and proposed alternative.

- During construction, stockpiling of construction materials, portable equipment, vehicles, and supplies would be restricted to designated construction staging areas.
- USACE would provide a Worker Environmental Awareness Training Program (developed in coordination with NMFS) for construction personnel to be conducted by a qualified biologist (selected in coordination with NMFS) for all construction workers prior to the commencement of construction activities. The program would provide workers with information on their responsibilities with regard to Federally-listed fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this BO.
- Erosion control measures would be implemented as appropriate to prevent sediment from entering surface waters, agricultural water features, and storm drains to the extent feasible, including the use of silt fencing or fiber rolls to trap sediments and erosion control blankets on exposed slopes.
- In addition, the proposed project would include preparation and implementation of a SWPPP in compliance with the State Water Resources Control Board's General Permit for Discharges of Storm Water Associated with Construction Activity.
- Work would be restricted to a window of June 1 to November 30 to minimize impacts to nesting migratory birds. Prior to construction, surveys would be conducted to determine if site specific conditions require further modification of work windows.
- If project activity is scheduled to occur during the nesting season for special-status bird species (March 1–August 31), focused surveys would be conducted in areas of suitable habitat in and within 500 feet of areas subject to disturbance from project activities, including staging. At least one survey would be conducted within 7 days prior to project construction activities to confirm the presence or absence of sensitive status species. Surveys would be conducted by a qualified biologist.
- In water work would be restricted to a window of July 1 – October 31 downstream of Highway 20 and July 1 – August 31 upstream of Highway 20 to minimize impacts to

spawning and rearing fish. In water work windows would be subject to final approval by NMFS.

- Preconstruction environmental surveys would be conducted by qualified biologists and would include a general site evaluation to determine habitat condition and potential for project related effects on vegetation and wildlife. These surveys would also be used to identify any sensitive species habitat (i.e., elderberry shrubs and or spawning redds).
- Preconstruction Swainson's hawk surveys for active nests would be conducted. Swainson's hawk surveys would be completed during at least two of the following survey periods: January 1 to March 20, March 20 to April 5, April 5 to April 20, and June 10 to July 30 with no fewer than three surveys completed in at least two survey periods, and with at least one of these surveys occurring immediately prior to project initiation (Swainson's Hawk Technical Advisory Committee 2000). These surveys would also support an evaluation for active nests (including sensitive species such as raptors and other migratory bird species) or other wildlife use along proposed haul roads, staging areas, and construction sites.
- Straw bales, straw wattles, and silt fences would be installed at each work area as appropriate.
- Operation of heavy machinery in the active channel would be minimized to avoid disturbance of substrates.
- Turbidity and solids would be monitored according to water quality permits. If acceptable limits are exceeded, work would be suspended until acceptable measured levels are achieved.
- Equipment used for the project would be thoroughly cleaned off-site to remove any invasive plant material or invasive aquatic biota prior to use in the project area.
- High visibility fencing would be placed around environmentally sensitive areas and would be avoided during project activities to the maximum extent practicable.
- All food related trash items would be disposed of in closed containers.
- A revegetation plan would be developed and all temporary impact areas would be restored to pre-project contour and revegetated.
- The Corps would conduct elderberry shrub surveys prior to construction and keep a 20-foot buffer between the dripline of an elderberry shrub and any project activities.
- Riparian vegetation removal or trimming would be conducted during the winter months (January and February).
- Terms & Conditions and conservation recommendations from NMFS as documented in the Biological Opinion (Environmental Appendix D – Attachment 1) would be implemented to the extent practicable.

- Recommendations from the NMFS as documented in the Magnuson-Stevens Fishery Conservation and Management Act (Environmental Appendix D – Attachment 1) would be implemented.
- Conservation Measures from USFWS as documented in a Section 7 ESA informal consultation letter of concurrence (Environmental Appendix D – Attachment 2) would be implemented to the extent practicable.
- Recommendations from the USFWS as documented in the Coordination Act Report (Environmental Appendix D – Attachment 4) would be implemented.
- Two weeks prior to any disturbance within suitable habitat for foothill yellow-legged frog, proposed disturbance areas shall be surveyed for adult frogs, tadpoles, or eggs by a qualified biologist. If the species is detected, the biologist shall contact CDFW to determine if moving any of the life stages is appropriate. In making this determination, CDFW would consider if an appropriate relocation site exists. If CDFW approves moving the animals, the biologist shall be allowed sufficient time to move the animals from the work site before work activities begin.

4.3.7 Water Quality

This section describes the existing surface and groundwater resources and quality, and jurisdictional wetlands in the project area. Additionally, this section evaluates the effects of the proposed alternatives on the water resources, surface and groundwater quality conditions, and jurisdictional wetlands in the project area. Qualitative effects on water quality were estimated based on construction practices and materials, location, and duration of construction.

4.3.7.1 Affected Environment

The Yuba River watershed is approximately 1,340 square miles covering Sierra, Placer, Yuba, and Nevada counties (SRWP 2010). The water flows west from the Sierra Nevada Mountains carrying melted snow run-off and water from the three main Yuba River tributary forks down to the confluence with the Feather River. While the primary location of the project is in the lower Yuba River, the overall watershed quality plays a large role in water quality in the project area. Multiple factors affect the water quality of the lower Yuba River including: hydroelectric power generation, dams and reservoirs, mining activities, urbanization, and timber harvesting.

Major dams in the Yuba River watershed completed in dates from 1913 to 1969 include Spaulding, Bowman, Fordyce, Englebright, Jackson Meadows, and New Bullards Bar. Part of the reason the first dams in the Yuba River watershed were created was for gold mining, but later on the use of dams shifted for emphasis on flood control, water supply, and hydropower. The physical, thermal, and chemical changes that occur from water being retained behind dams can greatly affect the downstream quality and temperature of the river.

The lower Yuba River experiences temperature fluctuation from inflows of Deer Creek (RM 22.7), irrigation diversions at Daguerre Point Dam (RM 11.6), and operational releases

from Englebright Dam (RM 24). Furthermore, the general width to flow ratio in conjunction with low riparian cover provide opportunity for solar heating of the water. The water within the lower Yuba River can increase up to 7°C from the release at Englebright Dam to the City of Marysville (RMT 2010), but this is seasonally dependent and influenced by amount of water released from Englebright Dam, solar input, and air temperature. Data taken near Marysville showed that dissolved oxygen concentrations, total dissolved solids, pH, alkalinity, and turbidity are well within acceptable or preferred ranges for salmonids and other key freshwater organisms (USACE 2012).

In 2007, minimum instream flow requirements were established by the Yuba Accord (YCWA, DWR, USBR 2007) to balance consumptive water use with the habitat needs of fish and wildlife. YCWA developed and negotiated an innovative set of agreements that together form a framework- the Lower Yuba River Accord (Yuba Accord) that resolved nearly 20 years of controversy and litigation over instream flow requirements for the lower Yuba River. The Yuba Accord enables YCWA to operate the Yuba River Development Project (FERC No. 2246) for hydropower, irrigation, flood control, recreation and fisheries benefits in an innovative manner that surpasses the YRDP's original requirements. As a comprehensive settlement agreement, the Yuba Accord was the final product of nearly three years of intense negotiations among 17 stakeholders, including local irrigation districts, state and federal resource agencies, and conservation groups.

The Yuba Accord is composed of three interrelated agreements: (1) the Lower Yuba River Fisheries Agreement, which specifies lower Yuba River minimum stream flows and creates a detailed fisheries monitoring and evaluation program; (2) the Water Purchase Agreement, under which YCWA provides annual water supplies for fish and wildlife purposes in the Bay-Delta, CALFED's Environmental Water Account, the State Water Project and the Central Valley Project; and (3) the Conjunctive Use Agreements, which specify the terms of the Yuba Accord's conjunctive use program. The State Water Resources Control Board (SWRCB), in Corrected Water Right Order 2008-0014, amended YCWA's water-right permits to add the Yuba Accord minimum instream-flow requirements, which YCWA had been implementing under pilot programs since 2006.

Mercury contamination from hydraulic mining in the watershed poses a risk to environmental and human health. Mercury was used in hydraulic gold mining to increase the removal of gold from hard rock, but mercury particles would wash through the sluice before they could settle and be confined. The accumulated mercury in river sediments pose a risk to human health through consumption of contaminated fish, drinking potentially unsafe water, and improper handling of sediments (Wentz et al., 2014). From an environmental standpoint, mercury methylation and biomagnification are a problem, especially when the biomagnification occurs in great geographic distribution. Many environmental factors such as temperature, dissolved organic carbon levels, salinity, oxidation-reduction conditions, acidity (pH), and concentration of sulfur in the water and sediments influence the rates of mercury methylation as well as demethylation (Wentz et al., 2014). An increased potential for methylation of mercury has also been linked to hydrologic factors including an increased duration and frequency of inundation (Singer 2016).

Mercury levels in natural systems are often reported as either total mercury (HgT) or as (mono) methylmercury (mmHg). Levels are typically provided in units of µg/L (10⁻⁶) or ng/L (10⁻⁹) for liquid samples or, for soil samples, in mg/kg (equivalent to parts per million or ppm) or ng/g (parts per billion or ppb). Total mercury levels (HgT) measured within the Goldfield sediments analyzed for the Western Aggregate Reclamation Plan ranged from 0.03 mg/kg to 0.59 mg/kg (SMGB 2014). Analysis of the bank sediments near the USGS gage just downstream of the Goldfields found levels generally less than 0.63 mg/kg (James et al. 2009). Hunerlach et al. (2004) sampled above Daguerre Point Dam and analyzed sediments by size fraction. That study found concentrations of total mercury (HgT) up to 0.08 mg/kg in the sandy fraction, and up to 1.1 mg/kg in the clay-silt fraction (slightly higher than downstream in the Goldfields). These are above 'normal' background crustal levels (around 0.05 mg/kg, (James et al. 2009)) and consistent with the finding that Sediment sampling near Marysville yielded similar ranges, from 0.1 mg/kg to 0.7 mg/kg (CEDEN 2006-2007).

4.3.7.2 Environmental Consequences

Methodology

Effects on water quality resources were analyzed qualitatively based on existing water quality monitoring data. Coordination with the Central Valley Regional Water Quality Control Board (CVRWQCB) would occur prior to construction to determine if additional testing would be required. A formal wetland delineation was not conducted, however, for the purpose of this analysis waters within the project area were assumed to be jurisdictional under Section 404 of the Clean Water Act (CWA). In addition, an analysis prepared in accordance with 40 CFR Part 230- Section 404(b)(1) guidelines and ER 1105-2-100, was performed to evaluate the potential for project related discharges into waters of the US to result in unacceptable adverse effects on the aquatic ecosystem (Environmental Appendix D – Attachment 3).

Basis of Significance

Adverse effects on water quality were considered significant if implementation of an alternative plan would:

- Substantially degrade surface water quality such that it would violate criteria or objectives identified in the CVRWQCB basin plan or otherwise substantially degrade water quality to the detriment of beneficial uses.
- Disturb existing channel banks, channel beds, or levees to the extent that erosion and sedimentation could be accelerated.
- Remove, fill, or substantially disturb a jurisdictional wetland.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these

habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The water quality in the area would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Implementation of Alternative 5 would have the potential to impact water quality due to construction related activities and may also affect long term water quality conditions due to changes in habitat types. Increases in sedimentation and turbidity resulting from the restoration activities would be temporary and limited to small and specific areas of the river. With implementation of BMPs to control turbidity and monitoring during construction to ensure turbidity levels are within standards set by the CVRWQCB (to be identified in a Water Quality Certification 401 permit), the impacts to water quality would be low to moderate.

Construction of Alternative 5 has the potential to expose clay and silt sized particles which are known to have elevated mercury levels. The finer sized sediments are easily transported downstream into the wetted channel of the lower Yuba River during high flow events. A fraction of the mercury may then methylate and become toxic to fishes and other biota in the lower Yuba River and in downstream waterbodies. Most of the mercury transport occurs during high winter and spring when high flows and run-off scour channels and inundate floodplains resulting in an increase in suspended sediment (Roth et al. 2001). The inundation of floodplains at the time the project is implemented also plays an important role in the methylation, mobilization, and transport of mercury. Methylmercury has a range of toxic effects to fish including; behavioral, neurochemical, hormonal, and reproductive changes.

The likelihood of encountering Hazardous, Toxic, and Radiological Wastes during the construction of this project is minimal. Elemental mercury and methylmercury are known contaminants of concern in the lower Yuba River; however, no concentrations of any material are anticipated at levels that would be classified as Hazardous or acutely Toxic. The potential for release of contaminant would be further mitigated through characterization, monitoring, and adaptive controls. Should areas of high mercury concentration be identified prior to construction, appropriate steps would be taken to avoid, minimize, or mitigate for the potential impact. These measures could include redesign or relocation of features, coordination with the CVRWQCB to implement appropriate measures, and treatment and or disposal of material. All of the major rivers in the Yuba River watershed have been identified as water bodies impacted by mercury. In a statewide survey conducted by the SWRCB's Surface Water Ambient Monitoring Program, the fish tested for mercury in the tributaries of the Yuba River were the highest in the state (Yuba County, 2015). A loading study conducted by Larry Walker and Associates (1997) conducted from October 1994 to September 1995 indicated that the Feather and American River watersheds accounted for approximately 25% of the total mercury passing from the Sacramento River into the Delta. The Sacramento River in turn accounts for approximately 50% of the total mercury passing into the Delta (USEPA 2015). Although no specific thresholds of significance such as a Total Maximum Daily Load (TMDL) for methylmercury has been established for the Yuba River, plans for the development of TMDLs for tributary rivers to the Delta are underway and

may warrant specific consideration in the future. A TMDL for methylmercury has been established by the SWRCB for the Sacramento-San Joaquin Delta (Delta) under the Delta Mercury Control Program. The TMDL for methylmercury in the Delta states that average methylmercury concentrations should not exceed 0.08 mg/kg in the Delta. Although the Yuba River is likely a major contributor of mercury to the Delta, especially during periods of high flow, there is insufficient data to quantify the contribution of the Yuba River toward the TMDL for methylmercury.

The potential increase for mercury methylation and subsequent downstream transport as the result of implementation of Alternative 5 would consist of two critical components: (1) potential short term increases due to construction related activities; and (2) potential long term increases in methylation of mercury due to changes in environmental conditions.

Short term increases in methylation of mercury and subsequent adverse impacts to water quality would be minimized through implementation of BMPs, including monitoring during project construction. Surveys would be conducted during PED to identify locations of high risk for mercury contamination and designs would be adjusted accordingly to avoid or minimize risk.

Construction equipment have the potential to leak toxic substances such as gasoline and diesel, lubricants, and other petroleum-based products. As a result of spills or leaks in storage containers, the substances could enter waterways within and adjacent to the project site, causing mortality or physiological impairment of fish or disrupt other behavioral patterns. Development and implementation of a SWPPP, SPCCP, and other BMPs described below, would reduce potential impacts from leaks to a less than significant level.

Long term risks associated with general water quality are low. Overall the long term impacts of the restoration activities would provide a higher quality riverine system and improve water quality. The restored vegetated riparian areas would improve long-term water quality by providing shade that would help moderate stream temperatures and light penetration; and providing root structure and woody material that would help stabilize stream banks, moderate stream velocities, reduce channelization, and reduce erosion and suspended sediments. Potential long term risks associated with increases in mercury methylation are related to project actions of increasing the duration and frequency of inundation of floodplain areas. Methylation of mercury occurs on floodplains as conditions are created that support microbes capable of methylation of mercury and as conditions that support these microbes increase, the rate of methylation could also increase. The potential increase in methylated mercury associated with increased duration and frequency of inundation cannot be quantified, however, the scope of the project can be expressed in acres.

Implementation of Alternative 5 would result in the increase of 38.8 acres of permanently inundated habitat and 47.6 acres of seasonally inundated floodplain habitat. Combined, these habitat improvements represent an increase in duration and frequency of inundation in 86.4 acres of habitat which represents approximately 3% of the full alluvial river corridor (Wyrick and Pasternack 2012). Due to the wide variety of factors that contribute to methylation of mercury, it is not possible to directly quantitatively relate an increase in the frequency and duration of inundation of floodplain areas to an increase in the mercury contamination of a system; however,

the comparatively small area of change (compared to the full area contributing to baseline mercury contamination) proposed under this alternative serves to demonstrate the scope of this potential impact.

A formal wetland delineation was not conducted, however, for the purpose of this analysis waters within the project area were assumed to be jurisdictional under Section 404 of the CWA. Although implementation of Alternative 5 would result in temporary and permanent discharges of fill material (including placement of LWM, boulders, and cobble to improve aquatic habitat structure and hydraulic integrity) into waters of the U.S., the alternative would be expected to result in a net increase in waters of the US. The quantity of fill material is not known at this time but would be far less than the 626,265 cubic yards of material (approximately 192 Olympic swimming pools) to be excavated resulting in improvement or creation of up to 86.6 acres of aquatic habitat (floodplain lowering, side channels, backwaters, and bank sculpting; Tables 4-1).

Given the long-term benefits to water quality associated with implementation, net increase in waters of the US, and anticipated minor changes to potential for mercury methylation, implementation of Alternative 5 would be expected to result in less than significant impacts to water quality.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats would be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. Alternative 6 would have similar construction related effects to Alternative 5, with an incrementally higher magnitude from the additional project features; these effects would be short term in nature and with implementation of BMPs and BMPs and avoidance and minimization measures, less than significant. Improvements to aquatic and riparian habitat would result in long term benefits for special status species. As with Alternative 5, Alternative 6 would be expected to result in a net increase in waters of the U.S., including the excavation of 856,824 cubic yards of material (approximately 262 Olympic swimming pools) resulting in improvement or creation of up to 112.3 acres of aquatic habitat (floodplain lowering, side channels, backwaters, and bank sculpting; Table 4-8). Given the long term benefits to water quality associated with implementation, net increase in waters of the US, and anticipated minor changes to potential for mercury methylation, implementation of Alternative 6 would be expected to result in less than significant impacts to water quality.

4.3.7.3 Best Management Practices and Avoidance and Minimization Measures

Avoidance, minimization, and conservation measures are measures and practices adopted to reduce or avoid adverse effects that could result from project construction or operation. The following sections describe the avoidance, minimization, and conservation measures adopted for the proposed alternative. These measures would be incorporated in construction documents (plans and specifications) prepared for the proposed alternative and would thus be contractually

required of all construction contractors. Measures that would be implemented to avoid or minimize effects to water quality including potential effects related to mercury would include:

- Comply with relevant environmental regulations
 - The project would comply with Section 401 of the Clean Water Act and obtain certification for project-related activities to control sediment from entering the main river channel during construction. To minimize risk from additional fine sediments, all trucks and equipment would be cleaned away from flowing water.
 - In addition, the proposed project would include preparation and implementation of a SWPPP in compliance with the State Water Resources Control Board's General Permit for Discharges of Storm Water Associated with Construction Activity.
- Minimize potential discharges
 - Straw bales, straw wattles and silt fences would be installed at source sites for each project, as appropriate.
 - Operation of heavy machinery in the active channel would be minimized to avoid disturbance of substrates.
 - The project limits would be clearly demarcated. Erosion control fencing would be placed at the edges of construction where the construction activities are upslope of aquatic habitats to prevent washing of sediments into these features including the use of silt fencing or fiber rolls to trap sediments and erosion control blankets on exposed slopes. All fencing would be installed prior to any construction activities beginning and would be maintained throughout the construction period.
 - Substrates, either obtained onsite or from a commercial source, would be appropriately screened prior to being placed in the river to avoid introduction of fine material into the Yuba River. On-site substrates would be screened and sorted; substrates imported from a commercial source, if necessary, would be clean-washed and of appropriate size.
 - In-stream construction would proceed in a manner that minimizes sediment discharge.
 - In-water work would be minimized. Construction would occur to the greatest extent possible at low flows and "in-the- dry."
- Monitor water quality
 - Turbidity and settleable solids would be monitored according to water quality permits. If acceptable limits are exceeded, work would be suspended until acceptable measured levels are achieved.
 - Throughout the construction period, water quality (turbidity, settleable material, and/or visible construction pollutants) would be monitored as required by Section 401 Regional Water Quality Control Board (RWQCB) certification requirements

to ensure that it stays within acceptable limits. This would include regular grab samples to monitor turbidity and settleable material. Construction pace would be slowed and/or stopped if turbidity exceeds criteria established by the RWQCB.

- Total mercury concentrations from excavated fine sediments (fines) would be evaluated to ensure materials used within the restoration footprint are below or within an acceptable range of natural background levels. Excavated fines would be monitored and tested regularly, following methods in the Stillwater Sciences Mercury Assessment conducted at Merced River Ranch (2004). For construction activities that involve fines, samples would be randomly collected every other day from the material being excavated or stockpiled. All samples would be delivered to and analyzed by a qualified laboratory located within driving distance of the project site. The laboratory would supply collection jars and collection methods, and sampling quantities would follow laboratory instructions. Thresholds shall be established for acceptable mercury levels, in coordination with the RWQCB as a part of the Section 401 permit process; sampling results would be compared to these established thresholds. If fines contain acceptable levels of mercury, they could be placed in upslope areas away from drainages, and used to provide a soil matrix for re-vegetation of riparian species, or to serve as a base above which additional topographic variation is created. If fines are determined to contain mercury above acceptable levels, they may be buried and capped with coarser materials, or hauled off-site for proper disposal, based upon resource agency direction. As laboratory turn-around times are generally short (less than 48 hrs.), the monitoring team would obtain approximate real-time information about any potential mercury-related issues. All on-site construction activities involving the use and/or placement of fines would cease, if mercury measurements above established thresholds are observed, to allow for coordination with appropriate resource agencies, for the assessment of contamination potential and the appropriate type(s) of use and/or disposal.
- Maintain clean Equipment
 - Equipment used for the project would be thoroughly cleaned off-site to remove any invasive plant material or invasive aquatic biota prior to use in the action area.
 - Oil and grease used in equipment would be vegetable based.
 - All equipment working within the stream corridor would be inspected daily for fuel, lubrication, and coolant leaks; and for leak potentials (e.g., cracked hoses, loose filling caps, stripped drain plugs); and, all equipment must be free of fuel, lubrication, and coolant leaks.
 - Vehicles or equipment would be washed/cleaned only at approved off-site areas. All equipment would be steam cleaned prior to working within the stream channel to remove contaminants that may enter the river and adjacent lands. All

equipment would be fueled and lubricated in a designated staging area located outside the stream channel and banks.

- All equipment entering the river that has been used in or near other Central Valley rivers would be steam cleaned before it is used to minimize the chance of introducing New Zealand mud snails or other invasive species to the project site.
- All hazardous materials, such as fuels, oils, solvents, etc., would be stored in sealable containers in designated locations that are at least 100 feet away from drainages or other aquatic habitats. All fueling and maintenance of vehicles and other equipment would occur within designated areas or at least 100 feet away from drainages or other aquatic habitats.
- Avoid disturbance to sensitive resources
 - Environmentally sensitive areas, sensitive plant species and wetland areas would be avoided during project activities to the maximum extent practicable.
 - High visibility fencing would be placed around these areas to minimize disturbance.
 - Soil and excavated material and/or fill material would be stockpiled in existing clearings when possible.
 - During construction operations, stockpiling of construction materials, portable equipment, vehicles, and supplies would be restricted to the designated construction staging areas. To eliminate an attraction to predators, all food-related trash items, such as wrappers, cans, bottles, and food scraps, would be disposed of in closed containers. Revegetation would occur on all areas temporarily disturbed from construction activities.
- Restore temporarily disturbed areas
 - All access and staging areas would be treated with erosion control measures after project completion each season. Erosion control measures would include placement of erosion control fabric on any upland slopes or ground areas (outside of the active channel) disturbed by equipment travel, coir logs for roadside trapping of fine sediment from the roadway, and hay and straw over other disturbed ground surfaces.
 - All temporary impact areas would be restored to pre-project contour and revegetated.
 - A revegetation plan would be developed to address all temporarily impacted native areas.
- Establish Contingencies
 - A SPCCP would be prepared that identifies any hazardous materials to be used during construction; describes measures to prevent, control, and minimize spillage of hazardous substances; describes transport, storage and disposal procedures for

these substances; and outlines procedures to be followed in case of a spill of a hazardous material. The SPCCP would require that hazardous and potentially hazardous substances stored onsite be kept in securely closed containers located away from drainage courses, agricultural areas, storm drains, and areas where stormwater is allowed to infiltrate. It would also stipulate procedures, such as the use of spill containment pans, to minimize hazard during onsite fueling and servicing of construction equipment. Finally, the SPCCP would require that all agencies listed in the SPCCP be notified immediately of any substantial spill or release.

- Spill prevention kits would be in close proximity to construction areas and workers would be trained in their use.

4.3.8 Transportation

This section describes the existing transportation system within the study area and evaluates the construction-related effects of the alternatives on the transportation system.

4.3.8.1 Affected Environment

Roadways in Yuba County are classified into the following categories in the Yuba County General Plan (Yuba County, 2011):

- Freeway: a multi-lane divided highway with a minimum of two lanes in each direction and access provided at interchanges.
- Conventional Highway: a roadway with limited access and few cross streets generally along high-volume corridors that connect cities or unincorporated communities.
- Arterial: a road that accommodates longer distance travel, but also provides access to adjacent residential, commercial, and industrial properties.
- Collector Road: a two-lane roadway that collects traffic from adjacent developments and delivers that traffic to Freeways, Highways, and Arterials. These roads have limited to moderate access control.
- Local road: a road that provides direct access to abutting land and provide for traffic movement within a single-neighborhood or part of a neighborhood. Local roads are designed for low traffic volumes and speeds.

To evaluate a roadway's operational characteristics, a simple grading system is used that compares the traffic volume carried by a road with that road's design capacity. Levels of service (LOS) are used to measure the quality of operational conditions within a traffic stream based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. Six LOS range from A (best) to F (worst) and describe each type of transportation facility discussed above.

Most analyses typically use service flow rates at LOS C, D, or higher to describe acceptable operating service for facility users. LOS E generally is considered unacceptable for planning purposes, unless there are extenuating circumstances or attain a higher LOS is not feasible or extremely costly. For LOS F, it is difficult to predict flow due to stop-and-start conditions. LOS are typically described in terms of traffic operating conditions for intersections, and would be applicable to roadway conditions, as shown in Table 4-25 below.

Table 4-25. Regulatory Criteria for Roadways and Intersections.

Level of Service (LOS)	Description of Traffic Conditions
A	Conditions of free flow; speed is controlled by the driver's desires, speed limits, or roadway conditions.
B	Conditions of stable flow; operating speeds beginning to be restricted; little or no restrictions on maneuverability from other vehicles.
C	Conditions of stable flow; speeds and maneuverability more closely restricted; occasional backups behind left-turning vehicles at intersections.
D	Conditions approach unstable flow; tolerable speeds can be maintained, but temporary restrictions may cause extensive delays; little freedom to maneuver; comfort and convenience low; at intersection, some motorists, especially those making left turns, may wait through one or more signal changes.
E	Conditions approach capacity; unstable flow with stoppages of momentary duration; maneuverability severely limited.
F	Forced flow conditions; stoppages for long periods; low operating speeds.

Source: Transportation Research Board 2000

The haul routes that are proposed for use to access the staging areas and project sites are generally described in Section 4.1. Table 4-26 displays the existing levels of service for these roadways and the LOS Threshold established by Yuba County, where available. Many of the proposed haul roads are small local farm roads, some of which are privately owned and operated dirt or gravel roads. In these cases, no existing data is available, but based on the rural nature of these roads it is assumed that they have existing low traffic counts and only sporadic use.

Table 4-26. Existing Conditions on Major Roadways in the Study Area.

Roadway	Cross Street	Type of Road	Peak Daily Traffic Count	Level of Service Threshold
Highway 20	Hallwood Boulevard	Conventional Highway	10,300	13,500 (LOS D)
Highway 20	Marysville Road	Conventional Highway	7,600	13,500 (LOS D)
Highway 70	Feather River Boulevard	Freeway	17,600	77,400 (LOS D)
Hammonton Smartsville Road	N/A	Collector Road	2,100*	7,800 (LOS D)

Source: Caltrans 2015; Yuba County 2011

* Average Daily Traffic rather than Peak Daily Traffic

4.3.8.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts on transportation resources was based on a review of transportation infrastructure in the area that could be affected by short and long term project-related activities and elements. The traffic analysis compares the traffic conditions anticipated under with-project conditions against the rated level of service of project area roads (Table 4-26). The project would be considered to have a significant adverse effect if construction related traffic increased the traffic beyond the level of service for any road in the project area. Impacts to level of service is evaluated as increases to daily average traffic conditions and daily peak traffic conditions.

Although Alternative 6 would require an additional season to construct, activities in any given year would follow the same sequencing. Furthermore, both alternatives would be constructed using the same equipment and level of effort in any given year. Therefore, a single analysis provides a suitable assessment of the potential project effects to traffic for both Alternative 5 and Alternative 6. To complete the analysis, information was collected on projected construction activities, duration, and timing, equipment use, and activities for each construction year. Assumptions incorporated into this analysis were based on feasibility level design and cost estimates. The traffic analysis is included in the Environmental Appendix D – Attachment 11.

Basis of Significance

Adverse effects on transportation were considered significant if implementation of an alternative plan would result in any of the following:

- Cause a reduction in the LOS below the established LOS D threshold (Table 4-26);
- Result in inadequate emergency access.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The traffic conditions in the area would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

As described in Section 4.1, the proposed action would include the hauling of disposal material from the restoration sites to an offsite disposal facility. For the purpose of this analysis estimates of increases to traffic focused on the number of workers and associated commute trips as well as the number of haul truck trips (export or import of material). These values were used to develop estimates of increases to traffic for each major project phase. The assumptions used in the traffic analysis are documents in Environmental Appendix D – Attachment 11. The excavation phase would result in the greatest number of construction related traffic at 654 daily trips. For the purpose of this analysis, the excavation phase would be used as a representative of the average increase to traffic conditions. The staging phase would result in an increase of 530 daily trips and the planting phase would result in an increase of 390 daily trips. The peak daily trips would occur during October when the excavation phase and the planting phase overlap. Therefore, the peak traffic conditions can be estimated as the sum of estimated increase to daily trips under the excavation phase and the planting phase; 1,044 daily trips. This estimate is conservative as it includes buffers of 100 daily trips for both the excavation and the planting phase and also double counts some daily trips associated with road maintenance activities. The analysis also assumes that all traffic would be routed down the same road which adds to the conservative nature of the estimated increase to traffic conditions. The average and peak daily trips were added to the estimates of peak daily trips under existing conditions to estimate the total average and peak daily trips that could occur under with-project conditions (Table 4-27). Under this analysis, neither increases to average daily traffic conditions nor increases to peak daily traffic conditions would result in an exceedance of the level of service for any road in the project area (Table 4-27). The results of this analysis are further discussed in Section 4.3.8 of the Final Feasibility Report/ Environmental Assessment.

All restoration sites would be located along the lower Yuba River and no public roadways would be altered by a construction action. In addition, there would not be additional significant public hazards created by the construction of Alternative 5. There would be no change in the emergency access conditions in the study area. There is the potential that the additional presence of heavy construction vehicles on the roadways could cause damage to the roadways. However, with implementation of the proposed BMPs and avoidance and minimization measures, this damage would be less than significant. Given these considerations,

implementation of Alternative 5 would result in less than significant effects to transportation in the area.

Table 4-27. Traffic Conditions – Alternative 5 and Alternative 6.

Roadway	Peak Daily Traffic Count	Level of Service Threshold (+654 trips)	With-Project Average Daily Traffic (+1,044 trips)	With-Project Peak Daily Traffic
Highway 20	10,300	13,500 (LOS D)	10,954	11,344
Highway 20	7,600	13,500 (LOS D)	8,254	8,644
Highway 70	17,600	77,400 (LOS D)	18,254	18,644
Hammonton Smartsville Road	2,100*	7,800 (LOS D)	2,754	3,144

Source: Caltrans 2015; Yuba County 2011

* Average Daily Traffic rather than Peak Daily Traffic

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats would be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. As stated above, although Alternative 6 would require an additional season to construct, activities in any given year would follow the same sequencing. Furthermore, both alternatives would be constructed using the same equipment and level of effort in any given year. Therefore, the traffic analysis conducted for Alternative 5 is representative of the effects that would occur under the implementation of Alternative 6. As with Alternative 5, construction activities under Alternative 6 would not increase average daily traffic conditions or increase peak daily traffic conditions that would result in an exceedance of the level of service for any road in the project area (Table 4-27). All other effects, including potential damage to roadways, would be short term in nature and with implementation of BMPs and avoidance and minimization measures, less than significant. Given these considerations, implementation of Alternative 6 would result in less than significant effects to transportation in the area.

4.3.8.3 Best Management Practices and Avoidance and Minimization Measures

In order to further reduce the effects from traffic, measures would be implemented which could include, but are not limited to, the following:

- The contractor would be required to prepare a Traffic Control and Road Maintenance Plan and coordinate it with Yuba County.
- Parking for construction trucks, equipment, and worker vehicles would be confined to the designated staging areas.

- Emergency vehicle access would be made available at all times. The contractor would be required to coordinate with local emergency responders to inform them of the construction activities, impacts, and schedule prior to construction.
- The construction contractor would assess damage to roadways used during construction and repair all potholes, fractures, or other damages.
- Following construction, any temporary access and haul routes would be restored to pre-project conditions.

4.3.9 Recreation

This section describes the existing recreational setting within the study area and evaluates the construction-related effects of the alternatives on the recreational opportunities.

4.3.9.1 Affected Environment

The primary recreation activities within the project area are fishing, boating, recreational exercise and wildlife viewing. Other activities may include hunting, swimming, and gold panning. Hiking and boating opportunities in the lower Yuba River are limited by poor access. Informal public river access in the 24-mile long lower Yuba River is available at Parks Bar approximately 5 miles northwest of Smartsville and the Hallwood Avenue Access approximately five miles northeast of Marysville. Off-road vehicle (OHV) activities are popular on the sand bars adjacent to Parks Bar.

Formal recreation areas along the Yuba River that are operated by Yuba County include Sycamore Ranch and Hammon Grove Parks near the Dry Creek and lower Yuba River confluence. Sycamore Ranch is a 90 acre park that includes both tent and RV camping, picnic areas, horseshoe pits, volleyball courts, and a boat launch. Hammon Grove is a smaller 46 acre day-use park adjacent to Sycamore Ranch that features picnic areas, hiking trails, and horseshoe pits. These parks are located just downstream of the proposed Increment 3a restoration area (Yuba County 2007).

Where access is available, fishing, picnicking, rafting, kayaking, tubing, and swimming are the dominant recreational uses. The lower Yuba River offers excellent American shad, Chinook salmon, and steelhead, smallmouth bass, and striped bass fishing. Although USACE maintains large warning signs and a portage trail around Daguerre Point Dam, boating deaths have occurred when people passed over the dam into the plunge pool below.

4.3.9.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts on recreational resources was based on a review of recreational opportunities in the area that could be affected by short and long term project-related activities and elements.

Basis of Significance

Impacts to recreation would be considered significant if implementation of an alternative would result in any of the following:

- Eliminate or substantially restrict or reduce the availability, access, or quality of existing recreation sites or opportunities in the project area.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, there would be no improvements to the riparian and aquatic habitat along the Yuba River and no associated impacts to recreation. Unless another organization decided to implement habitat improvement measures, the recreation conditions in the area would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

The proposed habitat restoration increments would not directly impact either of the formal recreation sites in the study area. However, temporary impacts would occur to the informal recreation access points and recreation users of the river itself. There are proposed staging areas located in the vicinity of both the Hallwood and Parks Bar river access points. The proposed staging areas would not restrict access at these locations, but they would cause the area to have a temporary degraded recreation experience due to the presence of heavy construction equipment, increased dust, and noise. Additional temporary impacts could occur during construction from the deployment of temporary stream crossings to facilitate construction access to some restoration sites. Temporary stream crossings could be constructed from placement of rail cars or other temporary structures or through the placement of clean spawning gravel to establish a passable depth. When present, passage on the water by boat would be restricted in the immediate area of the bridge. Stream crossings would only be placed in a manner in which free passage of boats remained accessible through an alternative channel. If appropriate, measures would be established to accommodate portage around any area affected by a temporary stream crossing.

Additionally, there would be a long-term impact to the informal recreational uses, including informal use of OHV, as some restoration sites would be constructed in and adjacent to these areas. The restoration sites would not be suitable for some informal activities, including OHV activities, however, since these are informal recreation uses in the area, and since there would still be an abundance of land available for these activities, this impact would be considered less than significant.

Given that all impacts to recreation would be temporary in nature and restricted to areas of construction and that recreational opportunities would be available outside of the immediate construction area along the lower Yuba River throughout the duration of construction implementation of Alternative 5 would result in less than significant impacts to recreational resources. Any impacts would be further reduced through implementation of the proposed BMPs and avoidance and minimization measures below.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Impacts resulting from implementation of Alternative 6 would include all of the impacts described under Alternative 5, with the addition of the presence of an additional staging area in the vicinity of Parks Bar. The impacts associated with this additional staging area would be consistent with those described in Alternative 5. These additional impacts would be less than significant, with the implementation of the proposed BMPs and avoidance and minimization measures.

4.3.9.3 Best Management Practices and Avoidance and Minimization Measures

To reduce effects to recreation areas to less than significant, the following measures would be implemented:

- To ensure public safety, flaggers, warning signs, and signs restricting access would be posted before and during construction, as necessary.
- Temporary fencing would be erected in order to prevent public access to the project areas during construction.
- In areas where recreation traffic, including boating, intersects with construction vehicles, traffic control would be used to maintain public safety, as appropriate.
- Inform boaters, fishermen, and other recreators of project activities.
- Provide project safety information including maps of any restricted access areas at least 2 weeks in advance.
- Stream crossings would not be implemented in a manner that restricted passage across all navigable channels in a reach of the river.
- As appropriate, measures would be established to accommodate portage around any area affected by a temporary stream crossing.

4.3.10 Cultural Resources

This chapter describes the environmental setting associated with cultural resources, assesses the effects to cultural resources that would result from implementation of the proposed alternative, and presents BMPs and avoidance and minimization measures that would reduce these effects to a less than significant level. Cultural resources are defined in this chapter as prehistoric and historic archaeological sites, the historic built environment, and traditional cultural properties.

4.3.10.1 Affected Environment

The lower Yuba River, between Englebright Dam and the city of Marysville covers more than thirty linear miles and crosses different physiographic zones and biomes. This includes the nearly level alluvial plain of the Sacramento Valley Floor near Marysville and the western foothills of the Sierra Nevada Mountains near Englebright Dam. The current, overall Area of

Potential Effects (APE) as defined in the Programmatic Agreement (PA) for this project, includes the riverbed as defined by the ordinary high water mark from the base of Englebright Dam in the east to the eastern boundary of Marysville to the west, with several extensions above the ordinary high water mark to account for staging areas and vehicle access from existing highways. The current APE is 2751 acres. It would be necessary to further refine the APE as design and construction proceed, likely resulting in a much smaller final APE. The history of human occupation and exploitation of the areas surrounding this environmentally diverse project area is long and complex. Prehistoric occupation of the area likely began around 10,000 years ago. Traditional Native American cultures and technologies developed over the subsequent millennia until roughly 200 years ago. With the arrival of the first Europeans, Native American culture was consequently subsumed by Early European settlement of California, mining development, hydroelectric development and water control, transportation, and development of agriculture, including cattle ranching. Archaeological evidence from these various aspects of human history is located within various portions of the proposed project area.

Methods Used to Identify Cultural Resources

As the lead federal agency it is USACE responsibility to identify historic properties within the project area and to assess the potential adverse effects under Section 106 of the National Historic Preservation Act (NHPA) (36 CFR 800). Initial inventory efforts for this feasibility study were conducted by a USACE, Sacramento District archaeologist. The inventory tasks comprised background research utilizing in-house resources including maps, photographs, site records, reports, and primary source literature from previous USACE projects conducted in the vicinity of the project area. Records searches were also conducted at the Northeast Information Center in Chico California.

A tribal consultation list provided to USACE by the Native American Heritage Commission (NAHC) indicated various Native American Tribes with interests in the Yuba River. These Tribes were contacted by USACE in July 2017 and provided with maps of the project area and descriptions of the proposed project measures. USACE also requested information regarding cultural resources within the project area.

Cultural Resource Expectations

Approximately five percent (160 acres) of the APE has been inventoried for historic properties, with an additional 1117 acres of the Yuba Gold Fields investigated to a lesser degree. No historic properties have been identified as a result of these inventories or investigations. Known historic and prehistoric archaeological sites exist in and just outside of the APE. Due to the small inventoried area and lack of sites identified within it, it is difficult to estimate a likely site density for the area. The following discussion, though, identifies what types of sites are likely to be found in contexts that may occur in the uninventoried areas.

Based on the consideration of environmental and cultural background information and the results of the limited cultural resources investigations in the project vicinity, the types of archaeological sites that are likely to be found include prehistoric archaeological surface features such as artifact scatters, bedrock mortars, isolated artifacts, and buried prehistoric archaeological deposits. Large sites with complex deposits and features may represent remnants of large

settlements or villages and small or low density surface scatters may represent camps or activity areas. While it is possible that an unusually stable portion of the river floodplain may contain preserved prehistoric sites or materials, the high degree of historic scouring and mining related cobble deposition likely means that few if any intact prehistoric sites would be found in the floodplain, but are more likely to be found in the uplands where access routes and staging areas may be located.

Mining in many ways drove Euro-American settlement of the area. In the Yuba River Basin, mining has a relatively long history, was developed to an industrial scale by the end of the nineteenth century, and was responsible for the documented massive environmental impacts to river drainages throughout the Sacramento Valley. Also, considering the project's location within lower Yuba River stream channel, it is expected that mining sites and features would constitute dominant elements of the surrounding landscape. As mentioned previously, the undulating dredge piles of the Yuba Gold Field cover almost 10,000 acres. Aside from ubiquitous mining spoil, dredge, or tailing piles, it is also expected that other mining related features such as roads, ditches, canals, abandoned equipment, foundations, and debris are common in the project area.

Remnants of historic settlements, agricultural features, and the remains of historic infrastructure that developed concurrently with mining in the area are also expected to be frequent within the project area. These features may include foundations, historic debris scatters, old roads and trails, and canals.

Known Cultural Resources

Archival research and the records search revealed that a limited number of archaeological surveys have been conducted in and around the proposed project area. This background research also revealed two known prehistoric and nine historic sites within the proposed project area (Table 4-28). The prehistoric sites included an isolated artifact (Site P-58-001896) recorded in ca. 1973 by Peak and Associates. This comprised an isolated granitic mano situated in an open valley near the intersection of Highway 20 and a surface road that runs south to Yuba River and the Yuba Gold Fields. This site has not been formally evaluated, but as an isolated artifact this site may potentially lack the elements of integrity required for assessing significance and eligibility. Site P-58-388 was recorded by J. Wood and E. Smith in 1975 as a possible midden mound. Nine chert and basalt flakes were reportedly collected from the surface of the site and disturbance from building, disking, plowing, cattle grazing, grading, and erosion was noted. This site has not been evaluated and is potentially eligible for listing on the National Register of Historic Properties (NRHP).

Table 4-28. Cultural Resources Within the Project Area.

Primary Site Number	Trinomial Site Number	Site Description	Eligibility Status
P-58-1896	Not assigned	Isolated granitic <i>mano</i> .	Not eligible.
Not assigned	Not assigned	Daguerre Point Dam, 1910–1963.	Not evaluated
Not assigned	Not assigned	Hallwood-Cordua Canal, 1911-1947.	Not evaluated
Not assigned	Not assigned	Yuba Gold Fields, 1903–1968.	Not evaluated
P-58-1619	Not assigned	South Yuba Levee, 1876.	Not evaluated
P-58-307	CA-YUB-289H	Hydraulic mining site.	Not evaluated
P-58-311	CA-YUB-293H	Historic canal.	Not evaluated
P-58-312	CA-YUB-294H	Hydraulic mining site.	Not evaluated
P-58-388	CA-YUB-370	Possible Prehistoric midden mound with chert and basalt flakes.	Not evaluated
P-58-594	CA-YUB-576H	Historic electrical power line route consisting of cleared path with old decayed power poles.	Not evaluated
P-58-1287	CA-YUB-1243H	Dredge mining tailings.	Not eligible

Historic resources within the APE include Daguerre Point Dam, the Hallwood-Cordua Canal, the Yuba Gold Fields, three historic mining sites, a remnant of an electrical power line, a historic canal, and a portion of the Yuba River South Levee (Table 4-28). None of these sites have been assessed for integrity, significance, or NRHP eligibility.

Construction of Daguerre Point Dam started in 1910 under the purview of the California Debris Commission to contain mining debris following the decision in the Woodruff vs. Bloomfield case. Through subsequent decades, additions and modifications were made and a significant portion of the dam was rebuilt. Specifically, three training walls were completed in 1935, construction or modifications of fish passages were completed in 1937, 1942, 1949, and 1952, and a major portion of the dam was rebuilt in 1963. Daguerre Point Dam appears to represent a unique and old water and sediment control feature associated with a significant aspect of California’s history: portions of the dam are likely more than 100 years old, dam modifications were completed more than fifty years ago; it largely functions as originally intended; and fish passages were added relatively early. The dam is therefore potentially eligible for NRHP listing. However, Daguerre Point Dam has not been fully recorded using the California State Department of Recreation Form 523B for buildings, structures, or objects and it has not been formally evaluated using NRHP Criteria A, B C, or D.

The Hallwood-Cordua Canal was built sometime between 1911 and 1947 to divert water for agriculture. A concrete outlet structure and retaining walls were added in 1964 following the 1964 flood and modern metal diversion gates to channel water into the Stahl Ditch were recently added. Some portions are concrete lined and previously recorded sections of the ditch measure 22 feet wide and 6 feet deep. Portions of the original canal may remain and as the canal is more than 50 years old, it may potentially be eligible for NRHP listing. However, the Hallwood-Cordua Canal has not been fully recorded using the California State Department of Recreation

Form 523B for buildings, structures, or objects and it has not been formally evaluated using NRHP Criteria A, B C, or D.

The project area within the Yuba River drainage runs through roughly 8.1 miles of the expansive Yuba Gold Fields. As a result of almost seventy years of placer dredge mining 9,700 acres hydraulic mining debris from the Yuba River floodplain were shaped into irregular undulating mounds of gravel and cobbles interspersed with ponds. Although the Yuba Gold Fields have not been formally assessed as a historic property, its association with Wendell P. Hammon, arguably a key historic figure in regards to the development of the placer dredge mining industry, suggests the Yuba Gold Fields is potentially NRHP eligible.

Sites P-58-307, P-58-312, and P-58-1287 are all mining sites located along the Yuba River. Sites P-58-307 and P-58-312 are hydraulic mining sites with related features. For P-58-307, this includes a canal, washing pits, out wash, and other possible associated features. Site P-58-1287 appears to be an old remnant of the Yuba Gold Fields. This site, however, has been recently disturbed. Although they may be NRHP eligible, none of these mining sites have been formally evaluated.

The historic canal was in use when recorded in 1975. From the original site record it appears this is an agricultural irrigation feature. If this site has retained its integrity since it was recorded as a functional canal in 1975, it is potentially eligible for NRHP listing.

The South Yuba Levee was recorded in 2002; however, the researchers were not able to directly access the levee during the investigation. Its current condition, and therefore, the integrity of the levee is currently unknown. According to the California State Department of Parks and Recreation Primary Record for the site, construction of the levee was first done in 1876. This indicates the feature is potentially eligible for NRHP listing.

Background research and the records search conducted for the project indicated that significant portions of the project area have not been adequately surveyed for cultural resources. The eleven sites identified during initial inventory efforts highlights the potential for additional resources within the current project area. Without a more complete understanding of the overall density of sites and distribution of site types within the project area, the overall impacts of the project on cultural resources cannot be determined.

4.3.10.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts on cultural resources was based on a review of known cultural and historically significant resources in the area that could be affected by short and long term project-related activities and elements. The analysis also considered the potential for unknown cultural and historically significant resources to be disturbed through project activities.

Basis of Significance

Any adverse effects on cultural resources that are listed or eligible for listing in the NRHP (i.e., historic properties) are considered to be significant (36 CFR 800.5). Effects are considered to be adverse if they:

- Alter, directly or indirectly, any of the characteristics of a cultural resource that qualify that resource for the NRHP so that the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association is diminished.

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The cultural resources in the area would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

All of the project related measures, such as riparian planting, floodplain lowering, floodplain terracing and grading, side channel excavations, bank scalloping, and the placement of large woody material and boulders would be limited to the stream channel of the lower Yuba River. Considering the extensive alterations of the stream channel through destructive hydraulic and dredge mining practices, which also in many cases extended beyond the proposed action areas, the potential that these activities could also reveal buried or otherwise obscured prehistoric archaeological deposits is low. Proposed access routes and staging areas in unsurveyed portions of the study area may contain cultural resources and any modifications to these areas, such as grading, have the potential to impact resources.

Potential indirect impacts to cultural resources, primarily vandalism, could result from increased access to, and use of, the general area during construction. Such disturbance could result in significant disturbances to cultural deposits, the loss of information and the alteration of a site's overall integrity.

Most of the known sites described above have not been evaluated for eligibility for listing on the NRHP and the proposed alternatives have not been adequately surveyed for the presence of additional resources. There is also potential for the presence of more eligible resources within the project area. Therefore, the proposed alternative's full potential to adversely affect cultural resources is currently unknown. Because of this, USACE developed a programmatic agreement (PA; Cultural Appendix B) for this undertaking, in accordance with 36 CFR 800.14(2). USACE coordinated the development of the PA (executed in November 2018) with the State Historic Preservation Officer, the Advisory Council on Historic Preservation, tribes, and other interested parties. The PA contains stipulations regarding identifying cultural resources, assessing resources

for significance and eligibility, and determining the effects of the undertaking upon NRHP eligible resources. The PA includes conditions to resolve adverse effects to these resources. In all cases, USACE would attempt to avoid and minimize the effects of the undertaking upon cultural resources. The PA also contains stipulations on post Section 106 review discoveries and the treatment of human remains. Given these considerations, the implementation of Alternative 5, would result in less than significant impacts to cultural resources.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats would be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. Alternative 6 would therefore have incrementally higher construction related effects compared to Alternative 5, due to construction of additional project features; however, as with Alternative 5, these effects would be short term in nature and with implementation of stipulations in the PA to resolve adverse effects, would result in a less than significant impact to cultural resources. As with Alternative 5, efforts would be made to avoid and minimize the effects to cultural resources.

4.3.10.3 Best Management Practices and Avoidance and Minimization Measures

To reduce effects to cultural resources to less than significant, the following measures would be implemented:

USACE developed a Programmatic Agreement (Cultural Appendix B) in coordination with the State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP), tribes, and other interested parties that would include mitigation measures for potential significant impacts or adverse effects to known and unknown historic properties.

4.3.11 Noise

This section describes the existing acoustic conditions within the study area and evaluates the construction-related effects of the alternatives on the acoustic environment.

4.3.11.1 Affected Environment

Sound is energy that is transmitted through the air as the result of a disturbance or vibration, which may evoke an auditory sensation. Noise is generally defined as sound that is loud, unpleasant, unexpected, or disagreeable.

Sound is characterized by various parameters that include the rate of oscillation of sound waves (frequency or pitch), the speed of propagation, and the pressure level or energy content (amplitude). In particular, the sound pressure level is the most common descriptor used to characterize the loudness of an ambient sound level. Due to the human ear's ability to detect a wide range of sound-pressure fluctuations, sound-pressure levels are expressed in logarithmic units called decibels (dB). Since the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent rating scale has been devised to relate noise to human

sensitivity. The A-weighted decibel scale (dBA) provides this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear.

Typical sounds range from 40 dBA (very quiet) to 100 dBA (very loud). Conversation is roughly 60 dBA at three to five feet. As background noise levels exceed 60 dBA, speech intelligibility becomes increasingly difficult. Noise becomes physically discomforting at 110 dBA. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level.

Several rating scales have been developed to analyze the adverse effect of community noise on people. Development of these scales has considered that the potential effect of noise on people largely depends on the total acoustical energy content of the noise, as well as the time of day when the noise occurs. The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of the noise. The noise descriptors most often used to describe traffic, community, and environmental noise are defined below (Caltrans 2008):

- **Leq:** the equivalent energy noise level, is the average acoustic energy content of noise during the time it lasts. Thus, the Leq of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure, no matter what time of the day or night they occur.
- **Ldn:** the day-night average noise level, is a 24-hour average Leq, with a 10-dBA penalty added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for the greater noise sensitivity of people at night.
- **Lmax:** the maximum instantaneous noise level during a specific period of time. The Lmax may also be referred to as the peak (noise) level.
- **CNEL** (community noise equivalent level): A noise level similar to the Ldn described above, but with an additional 4.77-dBA penalty for the noise-sensitive hours between 7 p.m. and 10 p.m., which are typically reserved for relaxation, conversation, reading, and television. When the same 24-hour noise data are used, the CNEL value is typically about 0.5 dBA higher than the Ldn value.

Yuba County has adopted a noise ordinance, codified as Chapter 8.20 of the Yuba County Ordinance Code, to protect the citizens of Yuba County from unnecessary, excessive, and annoying noise and vibration and maintain quiet in areas that exhibit low noise levels. The maximum permissible noise levels for different land uses are shown in Table 4-29 below. The noise ordinance also states that where the ambient noise level is less than designated in this listing, the governing permissible noise level is the respective maximum noise level shown. Furthermore, the noise ordinance also states that it is unlawful for construction or repair work that causes discomfort or annoyance to occur within a residential zone between the hours of 10:00 p.m. and 7:00 a.m. without a permit.

Local regulation of noise involves implementation of general plan policies and noise ordinance standards. Local general plans identify general principles intended to guide and influence development plans. Local noise ordinances typically set forth standards related to construction activities, nuisance-type noise sources, and industrial property-line noise levels. Noise in the Project Area is regulated by the Yuba County General Plan Noise Element and Yuba County noise ordinance (Yuba County 2011).

The existing Yuba County General Plan Noise Element was adopted in 1980 and contains objectives for acceptable noise exposure for several land use designations. The recommended noise level criteria are summarized in Table 4-30. These designations are established for land use planning purposes and are intended to apply to long-term exposure to noise.

Most of Yuba County is rural in nature and areas of the county that are not urbanized are relatively quiet. Areas of the county that are more urbanized are subjected to higher noise levels due to roadway traffic, industrial activities, and other human activities.

Table 4-29. Recommended Ambient Allowable Noise Level Objectives.

Land Use	7 a.m. to 10 p.m. (dBA)	10 p.m. to 7 a.m. (dBA)
Low Density Residential	50	50
Multi-Family Residential	55	50
Schools	45	45
Retail/Commercial	60	55
Passive Recreation Areas	45	45
Active Recreation Areas	70	70
Hospitals/Mental Facilities	45	40
Agriculture	50	50
Neighborhood Commercial	55	55
Professional Office	55	55
Light Manufacturing	70	65
Heavy Manufacturing	75	70

Source: Yuba County 2011

Table 4-30. Yuba County Noise Regulations.

Zone	Time Period	Ambient Level	Maximum Permissible Noise Levels (dBA)
Single-family residential	10 p.m. to 7 a.m.	45	55
	7 p.m. to 10 p.m.	50	60
	7 a.m. to 7 p.m.	55	65
Multi-family residential	10 p.m. to 7 a.m.	50	60
	7 a.m. to 10 p.m.	55	65
Commercial-BP	10 p.m. to 7 a.m.	55	65
Commercial	7 a.m. to 10 p.m.	60	70
M1 (General industrial)	Any time	65	75
M2 (Extractive industrial)	Any time	70	80

Source: Yuba County 2011

Table 4-31. Population Density and Associated Ambient Noise Levels.

	dBA, Ldn
Rural	40–50
Suburban	
Quiet suburban residential or small town	45–50
Normal suburban residential	50–55
Urban	
Normal urban residential	60
Noisy urban residential	65
Very noisy urban residential	70
Downtown, major metropolis	75–80
Under flight path at major airport, 0.5 to 1 mile from runway	78–85
Adjoining freeway or near a major airport	80–90

Sources: Cowan 1984; Hoover and Keith 1996.

Within the county, major sources of noise include roadway traffic on state routes, major arterials, and other roadways; railroad noise; aircraft operations at Beale Air Force Base and Yuba and Sutter County Airports; and fixed noise sources from industrial, commercial, mining, and farming activities. People who live or work within the influence of these facilities may experience noise levels which could be considered annoying. Table 31 summarizes typical ambient noise levels based on population density.

Sensitive receptors in the study area that would be impacted by construction noise include intermittent rural residences along the river corridor. Additionally, any wildlife using the

area would be considered a sensitive receptor. Recreationists using the river access points and boating on the river could also be disturbed by construction noise.

4.3.11.2 Environmental Consequences

Methodology

Evaluation of the project's potential impacts on acoustic conditions was based on a review of sensitive receptors in the area that could be affected by short and long term project-related activities and elements.

Basis of Significance

Effects associated with noise would be considered significant if an alternative would result in any of the following:

- Exposure of sensitive receptors to or generation of noise levels in excess of the standards established by the Yuba County General Plan and Yuba County Noise Ordinance (75 dBA maximum between the hours of 7 am - 10 pm);
- Substantial long-term increase (an increase in 5 dBA) in ambient noise levels in the project vicinity above levels without the project (50 dBA).

Alternative 1 – No Action

Under the No Action Alternative, USACE would not participate in ecosystem restoration in the Yuba River watershed. As a result, recovery of riparian and aquatic habitats along the lower Yuba River would rely on the implementation of small, independent projects which may fail to address fragmentation of these habitats and disruption to associated processes of these habitats. Outside of the immediate areas of these projects, long-term recovery of the lower Yuba River would rely largely on natural processes, which may be insufficient to address the scope of ecosystem degradation in the face of continued and expanding stressors, including natural resource use, regional development, and climate change. The ambient acoustic conditions in the area would remain consistent with current conditions.

Alternative 5 – Lower Yuba Habitat Increments 2, 3A, 5a, and 5b

Construction activity noise levels at and near the Project Areas would fluctuate depending on the particular type, number, and duration of uses of various pieces of construction equipment. Construction-related material haul trips would raise ambient noise levels along haul routes, depending on the number of haul trips made and types of vehicles used. Table 4-32 shows typical noise levels produced by various types of construction equipment.

Table 4-32. Typical Noise Levels from Construction Equipment.

Construction Equipment	Noise Level (dBA, Leq at 50 feet)
Backhoe	80
Bulldozer	85
Air-Compressor	81
Concrete Mixer	85
Generator	81
Grader	85
Jack Hammer	88
Loader	85
Paver	89
Pile Driver	101
Scraper	89

Source: Cowan 1984, Federal Transit Administration 1995

Construction activities associated with the Project would be temporary in nature and related noise impacts would be short-term. Construction would occur between the hours of 7 a.m. to 7 p.m., up to seven days a week. The noise associated with the construction activities would typically fall within Yuba County's construction exemption for noise, limited to the hours described above (Yuba County Ordinance Code, §8.20.310). During that time, residents, wildlife, and recreationists adjacent to the river would be exposed to increases in noise. Based on the noise falling within the construction exemption, this would be considered less than significant. However, the BMPs and avoidance and minimization measures listed below would be implemented to further reduce noise, as applicable.

Alternative 6 – Lower Yuba Habitat Increments 1, 2, 3a, 5a, and 5b

Implementation of Alternative 6 would result in similar impacts to those described under Alternative 5, with incrementally higher magnitude related to the additional construction included in habitat Increment 1. The addition of Increment 1 would not change the nature or significance of the potential construction related impacts to noise levels, therefore Alternative 6 would result in less than significant impacts to the acoustic environment. The BMPs and avoidance and minimization measures listed below would be implemented to further reduce the noise effects.

4.3.11.3 Best Management Practices and Avoidance and Minimization Measures

The following BMPs and avoidance and minimization measures would be implemented to reduce the adverse effects on noise as much as possible:

- Construction activities would be limited to the hours of 7:00 a.m. to 7:00 p.m., up to seven days a week in accordance with the Yuba County Noise Ordinance exemptions for construction (Yuba County Ordinance Code, §8.20.310).

- Construction equipment noise would be minimized during construction by muffling and shielding intakes and exhaust on construction equipment (per the manufacturers' specifications) and by shrouding or shielding impact tools.
- All equipment, haul trucks, and worker vehicles would be turned off when not in use for more than 5 minutes.
- Prior to construction of each Phase, the city or county would provide written notification to potentially affected residents, workers, and the general public identifying the type, duration, and frequency of construction activities. Notification materials would also identify a mechanism for residents to register complaints with the city or county if construction noise levels are overly intrusive or construction occurs outside the required hours. The city or county would take corrective action.
- Reduce vehicle and truck speeds to 15 miles per hour.

This page intentionally left blank.

Chapter 5 - Cumulative Impacts

The Council on Environmental Quality's regulations for implementing NEPA define a cumulative effect as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

This section discusses the potential cumulative effects of the Yuba River Ecosystem Restoration Feasibility Study when added to other past, present, and reasonably foreseeable future actions. As presented in Section 4.2.1 – 4.2.12, 12 resources are identified as potentially impacted by the project. These resources could experience a cumulative effect related to the project, and are therefore evaluated below. As described in Section 4.1, other resources (geology, seismicity, land use, and socioeconomics) would not be affected, and are therefore not evaluated below.

5.1 Methodology and Geographic Scope of the Analysis

5.1.1 Methodology

The cumulative effects analysis determines the combined effect of the proposed project with other past, present, and reasonably foreseeable projects. Cumulative effects were evaluated by identifying projects in and around the study area with effects that, when combined with the effects of the proposed alternatives, could have significant adverse or beneficial effects. These potential effects are combined with the potential adverse or beneficial effects of the proposed alternatives to determine the type, length, and magnitude of potential cumulative effects. Significance of cumulative effects is determined by meeting Federal and State mandates and the specific criteria identified throughout Chapter 4 of this document for the affected resources.

5.1.2 Geographic and Temporal Scope

The geographic and temporal scope that could be affected by the project varies depending on the type of environmental resource being considered. As an ecosystem restoration project, adverse effects are generally expected to be limited to short term construction related actions. For most resources, effects would generally be confined in geographic scope to the immediate project area, specifically the Lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers. The temporal scope would be limited to actions with effects that overlap with the estimated duration of construction for the project (generally a 3 year construction period beginning approximately in 2022). Potentially affected air and water resources extend beyond the confines of the project footprint due to the dynamic nature of these resources. Table 5-1 presents the general geographic areas associated with the different resources addressed in this cumulative effects analysis.

5.2 Past, Present, and Reasonably Foreseeable Future Projects

Projects and actions with the potential to result in cumulative effects are summarized below in Table 5-2. The exact construction timing and sequencing of these projects are not yet determined or may depend on uncertain funding sources. All of these projects are required to evaluate the effects of the proposed project features on environmental resources in the area. In addition, BMPs and avoidance, minimization, or mitigation measures must be developed to avoid or reduce any adverse effects to less than significant based on Federal and local agency criteria. Those effects that cannot be avoided or reduced to less than significant are more likely to contribute to significant cumulative effects in the area.

The Yuba River Ecosystem Restoration Feasibility Study and related projects would be located in a rural area of Yuba County. Relevant projects are projects that are related or similar projects that are reasonably foreseeable, and have the potential to affect the same resources and fall within the same geographic and temporal scope. A cumulative impact refers to two or more individual effects which, when considered together, are significant or compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects.

5.3 Cumulative Impacts Analysis

5.3.1 Air Quality

Construction of the proposed alternatives would result in emissions of criteria pollutants, as displayed in Table 4-14; however, with the implementation of BMPs and avoidance and minimization measures these emissions are expected to be below the thresholds of the CAA. All of the related projects discussed above and in Section 1.5 would cumulatively contribute to emissions of criteria pollutants throughout the region, particularly if projects are constructed concurrently, which could have a significant cumulative effect on air quality. It is anticipated that each of these projects would implement separate mitigation plans, as required by air quality control agencies, to reduce the emissions to below significance levels.

5.3.2 Climate Change

For the purposes of NEPA, the analysis of the effects of GHG emissions is essentially a cumulative effects analysis that is subsumed within the general analysis and discussion of climate change impacts. Therefore, the direct and indirect effects analysis for GHG emissions presented in Section 4.3.2 adequately addresses the cumulative impacts for climate change from the proposed action and alternatives.

5.3.3 Aesthetics

Short-term impacts to visual resources would result from the presence of construction equipment in the river corridor during construction activities. The proposed alternatives,

cumulatively with the Hallwood Side Channel and Floodplain Restoration Project, would result in a net increase of aquatic and riparian vegetation. These restoration actions would improve the current visual character of the river, which would be a beneficial effect and would reduce any potential significant impacts from ongoing projects along the river, such as the sand and gravel mining operations.

Table 5-1. Geographic Areas that Would Be Affected by the YRER Feasibility Study.

Resource	Geographic Scope	Temporal Scope
Vegetation and Wildlife	lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers	For the duration of construction and the establishment period.
Special Status Species	lower Yuba River, Feather River, Sacramento River	For the duration of construction and the establishment period.
Water Quality	lower Yuba River, Feather River, Sacramento River	For the duration of construction
Air Quality	Regional Air Quality District (FRAQMD)	For the duration of construction
Climate Change	Regional and Global Environment	For the duration of construction
Aesthetics	lower Yuba River	For the duration of construction and the establishment period.
Hydrology and Hydraulics	lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers	For the duration of construction
Transportation	Yuba County	For the duration of construction
Hazardous, Toxic, and Radiological Waste	lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers	For the duration of construction
Noise	Immediate vicinity of the individual sites of construction activity	For the duration of construction
Recreation	lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers	For the duration of construction
Cultural Resources	Immediate vicinity of the individual sites of construction activity	For the duration of construction

Table 5-2. Past, Present, and Reasonably Foreseeable Future Projects

Project Name/ Proponent	Description	Potential cumulative effects
Hallwood Side Channel and Floodplain Restoration Project USFWS, Bureau of Reclamation	Rehabilitate and enhance juvenile rearing habitat for CV fall-run and spring-run Chinook salmon and CCV steelhead in the Lower Yuba River, below Daguerre Point Dam. In addition, the Proposed Project would enhance riparian vegetation through direct planting and improved natural recruitment. (status: construction started 2018)	All resources affected during construction action
Yuba River Canyon Salmon Habitat Restoration Project USFWS (Anadromous Fish Restoration Program)	Increase the spawning success and enhance juvenile rearing of the Central Valley spring-run Chinook salmon ESU. (status: construction anticipated 2018)	All resources affected during construction action
Long Bar Restoration Project USFWS and SYRCL	Restore at least 40 acres of floodplain habitat and nearly one mile of off channel habitat at the downstream end of Long Bar. This will include floodplain lowering, side channel enhancement, riparian planting, and large woody debris placement. (status: in planning)	All resources affected during construction action
Yuba Goldfields Sand and Gravel Mining Teichert Aggregates, Western Aggregates, and Baldwin Contracting Company And Springer Family Trust Hallwood Aggregate Facility	Ongoing aggregate dredging along the lower Yuba River. (status: ongoing)	All resources affected during construction action
Voluntary Conservation Measures USACE	Annual habitat improvement actions related to the ongoing operation and maintenance of Daguerre Point Dam including placement of large woody material and spawning gravel. (status: ongoing)	All resources affected during construction action
Yuba County General Plan Update Yuba County	The Yuba County General Plan Update Final EIR, in part, evaluated cumulative biological impacts in 2030 associated with implementing the general plan (Yuba County 2011). The cumulative effects assessment stated that past development in Yuba County, ranging from conversion of land to agricultural production to recent expansion of urban development, has resulted in a substantial loss of native habitat to other uses. (status: actions implemented under general plan update ongoing)	All resources affected during construction action

5.3.4 Hydrology and Hydraulics

Implementation of the proposed project would alter the hydrology and hydraulics of the lower Yuba River on a site specific scale; however, the driving factors of hydrology and hydraulics in the lower Yuba River would not be affected. Existing projects control the hydrology and hydraulics of the lower Yuba River to a large extent. Some key projects affecting hydrology and hydraulics in the lower Yuba River are New Bullards Bar, Englebright, and Daguerre Point Dams, levee projects, ongoing sand and gravel mining, and agricultural diversions. Flows in the lower Yuba River are regulated to meet minimum flows. During periods of high precipitation and runoff from the upper watershed, the lower Yuba River is subject to high flows that may pass over the crests of Englebright and Daguerre Point Dams.

In general other projects with the potential to have impacts to hydrology and hydraulics, include existing projects that may augment the magnitude, duration, and frequency of flows through the Lower Yuba river (i.e. flood control, power generation, and water supply), as discussed above. Additionally, some projects have the potential to physically alter the river channel (i.e., habitat restoration projects). A number of laws regulate and/or require consideration of flood risk and it is expected that any project that could augment the flow of water through the lower Yuba River would be required to consider adverse impacts to flood risk and ensure that no cumulative impact to flood risk would occur. Potential cumulative impacts from modification of the river channel (habitat restoration) is unlikely, restoration projects would also be generally subject to consideration and mitigation of and potential effects to flood risk. One other major habitat restoration project in the area, the Hallwood Side Channel and Floodplain Restoration Project, involves the removal of a large amount of material from the channel, including a training berm that would result in a net decrease in flood risk. The project would result in an increase to channel capacity and would not contribute to a cumulative risk to flood events in the study area.

5.3.5 Vegetation and Wildlife

Implementation of the proposed alternatives would contribute to restoration and expansion of riverine and riparian habitat and would benefit aquatic and wildlife species in decline due to the degradation of these habitat types in the study area. As a result, because the YRERS contributes beneficial effects, any cumulative adverse effects that would result from the combination of the other local projects in the area would be minimized by implementation of the proposed alternatives. As a result, the study would not contribute to a cumulative adverse impact on vegetation and wildlife. The YRERS, in combination with the other restoration projects discussed in Section 1.5, such as the Hallwood Side Channel and Floodplain Restoration Project, would contribute to the overall future health of the lower Yuba River and would improve overall habitat conditions. As a result, any cumulative impacts associated with the study would be beneficial.

5.3.6 Special Status Species

Implementation of the project has the potential to affect special status species through short-term construction-related impacts, such as an increase in turbidity from earth moving activities. However, planned avoidance and minimization measures would limit adverse impacts to a less-than-significant level. By creating new and enhancing existing riverine and riparian habitats, the study would bring significant ecosystem benefits to special status fish species, such as salmonids, steelhead, and green sturgeon. In conjunction with the restoration actions proposed by other projects, such as the Hallwood Side Channel and Floodplain Restoration Project, the proposed restoration project would create new near shore habitat for listed species and improve the overall health of the lower Yuba River's ecosystem. As a result, the study, in combination with these other local projects, would result in beneficial cumulative effects due to improved riparian and aquatic habitat conditions along the Lower Yuba River.

5.3.7 Water Quality

Construction activities have the potential to temporarily degrade water quality through the direct release of soil and construction materials into water bodies or the indirect release of contaminants into water bodies through excavation activities. Related projects, including the Hallwood Side Channel and Floodplain Restoration Project, the Yuba River Canyon Salmon Habitat Restoration Project, ongoing voluntary conservation measures related to DPD continuing operations and maintenance, as well as continuous sand and gravel mining in the lower Yuba River area could be under construction during the same timeframe as this project. If construction occurs during the same timeframe water quality could be diminished primarily due to increased turbidity.

In particular, since the Hallwood Project consists of a similar type of construction as the proposed alternatives, the associated cumulative impacts would be the same as those described in Section 4.2.7 for the YRERS, only at a greater magnitude. This could include an increase in potential methylmercury bioaccumulation associated with an increase in turbidity from construction of the side channels. Additionally, the creation of side channels associated with these projects would result in an increase in flooded, aquatic habitat in the system, which could also result in potential increases in mercury in the system. However, USACE would test for mercury prior to construction, and BMPs would be applied to both the YRERS and Hallwood projects to reduce potential impacts associated with increased turbidity.

All projects would be required to coordinate with the RWQCB and overall water quality would be required to meet the Basin Plan objectives. The proposed riverine and riparian restoration activities associated with the study would result in less-than-significant effects to water quality. Degradation of water quality from the project would be short term and limited to the construction period. The project would not cumulatively contribute to long-term adverse effects that may result from development projects.

5.3.8 Transportation

The study would not have a significant impact on local roadways or traffic in the study area. The only potential impacts are associated with the increase in traffic due to hauling of material on local roadways. Related projects with ongoing operations, like the sand and gravel mining in the area, or any proposed project that is constructing concurrently with the YRERS would cumulatively contribute to increases in traffic. However, ongoing operations such as the local mining practices is part of the baseline condition and both the YRERS and any other proposed short-term construction project would be expected to implement separate traffic control and mitigation plans, which would reduce the impacts to transportation to below significance levels.

5.3.9 Recreation

Cumulative impacts to recreation are primarily related to other construction projects that could occur during the same time frame as those considered for this study and within the same vicinity as both this study and local recreation opportunities. Recreation opportunities are limited along the Lower Yuba River due to lack of access. The proposed YRERS, Hallwood Side Channel and Floodplain Restoration Project, and other proposed actions are not expected to overlap with formal recreation access points. There would be some disturbance along the river for kayakers or other river users, but these impacts would be short-term and less than significant because of the amount of activity that is part of the baseline condition, including the ongoing gravel and sand mining. The resulting improved riparian and aquatic habitat from these restoration projects would create a more pleasant recreational experience long-term along the river, which would be a beneficial cumulative effect.

5.3.10 Cultural Resources

Cumulative impacts to cultural resources would be primarily related to other construction projects that could occur during the same timeframe as those considered for this study and within the same vicinity as this study. For this study, impacts to cultural resources are considered significant if the proposed alternative would result in any adverse effects on cultural resources that are listed or eligible for listing in the NRHP (i.e., historic properties). Effects are considered adverse if they alter, directly or indirectly, any of the characteristics of a cultural resource that qualify that resource for the NRHP so that the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association is diminished. It is anticipated that each of these projects would conduct separate coordination with appropriate groups and implement separate mitigation plans to reduce the impacts to cultural resources to below significance levels. It is important to acknowledge that even with implementation of BMPs and avoidance and minimization measures, the full extent of adverse effects may not be mitigated and it is possible that these remnant effects for separate projects could contribute to some degree of cumulative impact; however, given the nature of the proposed alternative, current understanding of cultural resources in the area, and other construction projects occurring in the same time and area, remnant effects to cultural resources would not likely result in a significant cumulative effect.

5.3.11 Noise

Short term increases to noise levels in the project area would result from construction activities. These effects generally fall within Yuba County's construction exemption for noise and would therefore not result in a significant impact. Other projects could cumulatively contribute to noise levels if they occur in the immediate vicinity of the project actions, however, due to the nature of the construction activities which require a closed construction site to comply with OSHA Safety Standards, this is unlikely to occur. Noise attenuates over distance to become less than significant and as a result would not combine with any of the related projects listed in Section 1.5 or in Table 5-1 above to create a cumulative effect on ambient noise levels.

Chapter 6 – Compliance with Applicable Laws and Regulations

The status of the proposed action's compliance with applicable Federal environmental requirements is summarized below. Prior to initiation of construction, the work would be in compliance with all applicable Federal laws and Executive Orders.

6.1 Federal Laws

Clean Air Act, as amended, PL 91-604; 42 U.S.C. 1857h-7, *et seq.* Full Compliance. The USEPA is the Federal agency responsible for managing the Nation's air quality. USEPA establishes national ambient air quality standards, and oversees the air quality plans developed and implemented by the states. FRAQMD is responsible for developing local district air quality management plans and enforcing regulations pertaining to air emissions in the study area. As discussed in Section 4.3.1, the proposed action would not exceed national ambient air quality standards based on modeled estimates of emission rates during construction of the project.

On November 30, 1993, the USEPA promulgated final general conformity regulations at 40 CFR 93B for Federal activities. These regulations apply to a Federal action in a non-attainment or maintenance area if the total emissions of the criteria pollutants and precursor pollutants caused by the action equal or exceed certain applicability rates, thus requiring the Federal agency to make a determination of general conformity. As discussed in Section 4.3.1, at least part of the study area is in non-attainment for PM_{2.5}. Modeled estimates of emission rates during construction of the project demonstrate that the proposed action would not exceed applicability rates; therefore, the project is consistent with the State Implementation Plan and meets the requirements of Section 176(c).

Clean Water Act, PL 92-500; 33 U.S.C. 1251, *et seq.* Partial Compliance. The USEPA is the Federal agency responsible for managing the Nation's water quality. USEPA establishes national water quality standards and oversees the water quality plans developed and implemented by the states. The CVRWQCB is responsible for developing local district water quality management plans, issuing permits, and enforcing regulations pertaining to water quality in the study area. In addition, USACE is responsible for issuing Section 404 permits for projects that involve discharge of fill material into Waters of the U.S.

The proposed action would involve discharge of fill material into Waters of the U.S. in the lower Yuba River. Although USACE does not issue permits for their own projects, USACE does comply with the guidelines and substantive requirements of Section 404, including Sections 404(b)(1) and 401. As discussed in Section 4.3.7, a Section 404(b)(1) analysis was conducted on the recommended plan and is included in the Environmental Appendix D – Attachment 3. The analysis concluded that the project would not result in significant effects to water quality. The construction contractor would be required to implement the measures listed in the BMPs and avoidance and minimization measures subsection of Section 4.3.7 to avoid or minimize adverse effects on the aquatic ecosystem. Initial coordination with the CVRWQCB was conducted and the CVRWQCB has indicated its support for the project and acknowledges the future

requirement to obtain a Section 401 water quality certification prior to initiation of construction (Environmental Appendix D – Attachment 5).

Prior to initiation of construction, the contractor would be required to prepare a SWPPP and then submit a Notice of Intent form to the CVRWQCB, requesting approval of the work. This storm water plan and an In-Water work plan would identify the measures to be implemented by the contractor to avoid or minimize any adverse effects of construction on surface waters.

The project would be in full compliance with the CWA after obtaining a Section 401 water quality certification prior to construction.

Endangered Species Act of 1973, as amended, PL 93-205; 16 U.S.C. 1531, *et seq.* Full Compliance. USACE obtained a list of the Federally threatened, endangered, proposed, and candidate species that have the potential to occur in the study area via the USFWS ECOS-IPaC website on August 16, 2017. Based on the locations of the proposed work, the listed species that could be affected by the proposed action include the Yellow-billed Cuckoo, California Red-legged Frog, and Valley Elderberry Longhorn Beetle under the jurisdiction of the USFWS and Southern DPS green sturgeon, Central Valley steelhead, and Central Valley spring-run Chinook salmon under the jurisdiction of NMFS. USACE drafted and submitted Biological Assessments discussing the potential effects of the proposed action to USFWS and NMFS requesting initiation of formal consultation with NMFS (for Southern DPS green sturgeon, Central Valley steelhead, and Central Valley spring-run Chinook salmon) and informal consultation with USFWS (for Yellow-billed Cuckoo, California Red-legged Frog, and Valley Elderberry Longhorn Beetle) following or concurrent with public review of the FR/EA. USFWS has transmitted a letter of concurrence that the project may affect, but is not likely to adversely affect the species of concern (Environmental Appendix D – Attachment 4c). NMFS issued a Biological Opinion, dated 18 October 2018, determining that implementation of the Recommended Plan would not jeopardize any of the species of concern or adversely modify their critical habitat (Environmental Appendix D – Attachment 1b). The project is in full compliance with this Act.

Fish and Wildlife Coordination Act of 1958, as amended, PL 85-624; 16 U.S.C. 661, *et seq.* Full Compliance. The USFWS is the Federal agency responsible for administering this act, which requires Federal agencies to coordinate with USFWS and State wildlife agencies during the planning of projects that would result in the control or modification of a natural stream or body of water. The FWCA intends that wildlife conservation be given equal consideration with other features of these projects. USACE initiated coordination with USFWS early in the planning process.

The USFWS prepared a Final Coordination Action Report (CAR) (Appendix D – Attachment 4). This report details the vegetation, wildlife, and fisheries resources in the project area; evaluates the potential effects of the proposed action on those resources; and provides

recommendations for consideration by USACE. The recommendations and discussion of USACE's responses are below.

USACE would adopt and implement all of the recommendations provided by USFWS in the CAR. The CAR is included in the Final integrated FR/EA to be distributed for public and agency review. With receipt of the CAR and consideration of the recommendations, the study is in full compliance with the FWCA. The USFWS requests to be involved in the PED phase of the project and would provide an updated CAR at that time.

Recommendation 1 – *“Avoid impacts to woody vegetation to the maximum extent possible by removing the least amount of vegetation and choosing to trim trees and shrubs to allow access for equipment and construction in the footprint.”*

Response – This recommendation would be adopted to the greatest extent possible. Designs and implementation of construction would incorporate appropriate BMPs as described in this FR/EA to protect in place native vegetation to the greatest extent possible.

Recommendation 2 – *“Incorporate climate-smart principles into the planning process of this project. Point Blue has developed a set of five guiding principles which can be found at <http://www.pointblue.org/our-science-and-services/conservation-science/habitat-restoration/climate-smart-restoration-principles>. Currently the Corps has a rather small planting palette for the proposed project. We recommend that you expand the number of species to maximize the number of months that food resources are available to wildlife species. We also recommend planting a wide range of plant species that could be successful in a range of future climate scenarios.”*

Response – This recommendation would be adopted to the greatest extent possible. The project has considered effects to the project from climate change including changes in inland hydrology patterns and potential effects related to sea level rise. The project would continue to give consideration to effects from climate change and incorporate climate-smart principles to the maximum extent possible during the PED phase. The natural substrate in the areas targeted for restorative planting are dominated by coarse substrate, which creates a challenging environment for establishment of vegetation. The project proposes to address these challenges by adopting unique method of planting in which pole cuttings are installed in holes down to the level of the water table. The unique planting methods limit the species which can be planted; however, USACE would work with USFWS during the PED phase to incorporate to the greatest extent possible, any additional measures or techniques, to improve the successful establishment and value of planted vegetation. There is potential for the project to incorporate an expanded planting palette into restoration of staging areas; additional sites may be identified during PED in which an expanded planting palette could be implemented.

Recommendation 3 – *“When scheduling construction, ensure that the Migratory Bird Treaty Act is complied with. In particular, any vegetation removal should be done during the non-nesting season. Work occurring during the nesting season that could adversely affect avoided vegetation should have a pre-construction nesting bird survey to identify any nesting migratory birds. Appropriate buffers should be designed and maintained in the event nesting migratory birds are found.”*

Response – This recommendation would be adopted to the greatest extent possible. Necessary removal or trimming of vegetation for the project would be conducted to the greatest extent possible during the non-nesting season (approximately January – February). Pre-construction surveys would be conducted by a qualified biologist to identify any potential impacts to nesting migratory birds. In the case that potential effects are identified, appropriate buffers would be established in coordination with the USFWS.

Recommendation 4 – *“Given the planned refinement of the project in PED the Corps should continue to coordinate with the Service under the FWCA as the project description is refined. The Service will work with the NMFS and CDFW in developing recommendations to any proposed changes beyond those included in this report. The Service, NMFS, and CDFW should be included in the development of planting and long term monitoring plans.”*

Response – This recommendation would be adopted to the greatest extent possible. USACE would engage with project partners, the USFWS, NMFS, and other resource agencies, as appropriate, during the refinement of project actions during PED, including planting and monitoring plans.

Recommendation 5 – *“Include within the planting contract a provision for the contractor to plant understory species after some of the woody canopy has established. Studies have shown that planting late successional understory species after woody canopy has become established increases success of understory plants. This will provide a more diverse and climate resilient habitat for wildlife species over the project life (Johnston 2009).”*

Response – This recommendation would be adopted to the greatest extent possible; however, due to the unique and challenging conditions of the project area, the opportunity to implement the recommendation is limited. The natural substrate in the areas targeted for restorative planting are dominated by coarse substrate, which creates a challenging environment for establishment of vegetation. The project proposes to address these challenges by adopting unique method of planting in which pole cuttings are installed in holes down to the level of the water table. Plantings established with this method through efforts of the USFWS and South Yuba River Citizens League demonstrate that although the planting method is successful, the canopy would not develop to a point (in terms of height, cover, and geomorphic influence) in which it would be appropriate to install understory plants within a reasonable period of time. Although the installed vegetation when mature would promote the natural recruitment of fine sediments and organic material that supports suitable conditions for the establishment of understory riparian vegetation, the uncertainty in the time required for those processes to occur preclude reasonable long term planning and commitment of resources for a secondary planting effort. USACE recognizes that the potential benefits associated with the recommendation and would include the recommendation in the O&M manual as a potential adaptive management measure to be implemented by the non-Federal sponsor.

Recommendation 6 – *“Incorporate native pollinator habitat within the planting plan. Pollinator habitat has decreased resulting in a loss of pollinators. In addition to benefiting the habitat complexity there are benefits to creating pollinator habitat near agricultural areas.”*

Response – This recommendation would be adopted to the greatest extent possible. The natural substrate in the areas targeted for restorative planting are dominated by coarse substrate, which creates a challenging environment for establishment of vegetation. The project proposes to address these challenges by adopting unique method of planting in which pole cuttings are installed in holes down to the level of the water table. The unique planting methods limit the species which can be planted; however, USACE would work with USFWS during the PED phase to incorporate to the greatest extent possible, any additional measures or techniques, to improve the successful establishment and value of planted vegetation. There is potential for the project to incorporate an expanded planting palette into restoration of staging areas; additional sites may be identified during PED in which an expanded planting palette could be implemented.

Recommendation 7 – *“The Service should be included in the development of a long-term operation and maintenance plan for the created habitat.”*

Response – This recommendation would be adopted to the greatest extent possible. The Operations and Maintenance Manual would be prepared in consultation with the non-Federal sponsor as required by USACE regulation. USACE and the non-Federal sponsor would coordinate with USFWS during the development of the Operations and Maintenance Manual to incorporate measures to the greatest extent possible that ensure long term success of the restoration project features.

In addition to recommendations received from the USFWS, NMFS included in their Biological Opinion, recommendations under the FWCA. Those recommendations and USACE’s response are documented below.

Recommendation 1 – *“At any project site within the action area that experiences foot traffic, the Corps should post interpretive signs describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.”*

Response – This recommendation would be adopted. Interpretive signage would be incorporated into project sites as is practicable. Short-term signage would be placed in the project areas during construction to inform the public of the design, implementation schedule, potential effects to public access or recreational use, and ecosystem benefits. Long-term interpretative signage would be placed in areas where the public is expected to access the habitat areas

Magnuson-Stevens Fishery Conservation and Management Act of 1996, as amended, PL 104-267; 16 U.S.C. 1801, et seq. Full Compliance. The Magnuson-Stevens Act establishes a management system for national marine and estuarine fishery resources. This legislation requires that all Federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect Essential Fish Habitat (EFH). Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon Fishery Management Plan must also be considered. USACE incorporated an EFH effects analysis into the Biological Assessment provided and requested consultation under the Magnuson-Stevens Act, in parallel with the Section 7 ESA consultation. NMFS issued a BO, dated 18 October 2018, that included a determination that the project would adversely affect

EFH for Pacific Coast Chinook Salmon. NMFS issued recommendations, discussed below, under the Magnuson-Stevens Act in a subsection of the Biological Opinion for the proposed project and the study is in full compliance.

Recommendation 1 – *“The Worker Environmental Awareness Training should be provided by a NMFS approved fish biologist. The program should provide workers with information on their responsibilities with regard to ESA listed anadromous fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this opinion. Written documentation of the training must be submitted to NMFS within 30 days of the completion of training. HAPCs that would benefit from implementation of this training include (1) complex channels and floodplain habitats, (2) thermal refugia and (3) spawning habitat.”*

Response – This recommendation would be adopted. Prior to construction, a Worker Environmental Awareness Training would be conducted, by a qualified fish biologist selected in coordination with NMFS, to provide information on worker responsibilities with regard to ESA listed anadromous fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this opinion. Written documentation of the training would be submitted to NMFS within 30 days of the completion of training.

Migratory Bird Treaty Act of 1928, as amended; 16 U.S.C. 715, et seq. *Full Compliance.* USFWS is the Federal agency responsible for administering this act, which implements a treaty between the U.S. and Great Britain (for Canada), Mexico, Japan, and the Soviet Union (now Russia) for the protection of migratory birds. Unless permitted by regulations, this law prohibits anyone to "pursue, hunt, take, capture, kill, attempt to take, capture or kill ... any migratory bird ...or any part, nest, or egg of any such bird" (16 U.S.C. 703). Areas in the study area have foraging, resting, nesting, and breeding habitat for numerous migratory birds. To the extent possible, USACE would schedule construction outside periods of nesting to avoid or minimize effects on migratory birds. In any case, prior to initiation of construction, surveys would be conducted by a qualified biologist, selected in coordination with USFWS, to determine the presence of migratory birds and/or their nests in or near the work areas. If active nests are found, the USFWS would be contacted for advice and recommendations for how to avoid disturbance and whether a permit is necessary. With the implementation of these actions, the study would be in full compliance with this Act.

It is important to note that a key interpretation of the Migratory Bird Treaty Act (MBTA) related to deliberate and incidental take of migratory birds was overturned on December 22, 2017, when the Department of the Interior (DOI) Office of the Solicitor's Opinion M-37050 that interpreted the statute as not prohibiting incidental take but instead only applying to "direct and affirmative purposeful actions that reduce migratory birds, their eggs, or their nests, by killing or capturing, to human control." This change in the DOI interpretation raises the question of whether other federal agencies can or should change their approach to avoiding the incidental take of migratory birds. New regulations are in preparation by the USFWS to

implement these changes. Environmental commitments made to comply with MBTA may need to be changed, added to, or deleted during PED phase if new regulations are in place at that time.

Any consideration of a new approach to protecting migratory birds also needs to take into account the courts' interpretation of the MBTA, other authorities that require migratory birds to be protected, and the agency's own authorities and missions. To date, five Circuit Courts of Appeal have addressed the question of whether the MBTA prohibits incidental take or only intentional take. The courts are split in how they interpret the statute. Only the Supreme Court can provide a definitive interpretation. Separately, the Fish and Wildlife Coordination Act (16 U.S.C. 661-666c) and Executive Order 13186 impose upon federal agencies certain requirements aimed at conserving migratory birds. Additionally, the U.S. Army Corps of Engineers Environmental Operating Principles provide that USACE would "proactively consider environmental consequences of all Corps activities and act accordingly."

In light of the uncertainty regarding the correct interpretation of how the MBTA applies to incidental take and in light of the other authorities and policies that encourage or require the conservation of migratory birds, USACE would continue to work to minimize the incidental take of migratory birds to the extent practicable, and would coordinate as appropriate with the U.S. Fish and Wildlife Service, until further clarification is provided.

National Environmental Policy Act of 1969, as amended, PL 91-190; 42 U.S.C. 4321, et seq. *Full Compliance upon signature of FONSI.* The Council on Environmental Quality (CEQ) is responsible for ensuring that Federal agencies operate in accordance with NEPA, which requires full disclosure of the environmental effects, alternatives, potential mitigation, and environmental compliance procedures of most Federal management, regulation, or funding activities that affect the environment. NEPA requires the preparation of an environmental document to ensure that Federal agencies accomplish the law's purposes. Although, final public review is not required under NEPA for an EA, the Final FR/EA would undergo a state and agency review in compliance with USACE policy for the review of feasibility studies. The Finding of No Significant Impact (FONSI) would not be signed until after state and agency review, following completion of a Chiefs Report and ASA review. Full compliance with NEPA would be achieved when the FONSI is signed and the Final FR/EA made available to commenting agencies and the public.

National Historic Preservation Act of 1966, as amended, PL 89-655; 54 U.S.C. 300101, et seq. *Full Compliance.* The SHPO in each state is responsible for ensuring that Federal agencies comply with Section 106 of this act, which requires that they consider the effects of a proposed undertaking on properties that have been determined to be eligible for, or included in, the National Register of Historic Places. The Section 106 review process consists of four steps: (1) identification and evaluation of historic properties; (2) assessments of the effects of the undertaking on historic properties; (3) consultation with the SHPO and appropriate agencies to develop a plan to address the treatment of historic properties; and (4) concurrence from the SHPO regarding the agreement or results of consultation.

As discussed in Section 4.3.11, both archeological and historic sites are found in the study area. Although proposed project actions are unlikely to affect known cultural resources, portions of the study area are unsurveyed and may contain cultural resources and additional cultural resources may be discovered during construction; therefore, the full extent of potential effects from proposed project actions are unknown at this time. In accordance with 36 C.F.R. § 800, the implementing regulations of Section 106 of the National Historic Preservation Act (NHPA), the Corps has determined that the recommended plan has the potential to result in adverse effects to historic properties. In order to take into account the potential effects of the proposed project on historic properties, the Corps developed a Programmatic Agreement (PA) in coordination with the State Historic Preservation Officer, tribes, and other interested parties, which contains stipulations regarding identifying cultural resources, assessing resources for significance and eligibility, determining the effects of the undertaking upon NRHP eligible resources, and mitigating any effects to these resources. Signing of the PA by the Corps and the SHPO evidences the legal commitment by the Corps as the lead Federal agency to comply with Section 106 of the NHPA. The Final PA was executed on 12 December 2018 (Cultural Appendix B) and the study is in full compliance with the National Historic Preservation Act of 1966.

Resource Conservation and Recovery Act of 1976, PL 94-580; 7 U.S.C. 1010, *et seq.*

Full Compliance. The USEPA is the Federal agency responsible for administering this act, which regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. The lower Yuba River has known elevated levels of mercury, arsenic, and other hazardous materials that may be disturbed due to project actions. The full extent of the contamination and potential for the project to result in adverse environmental effects is unknown at this time. A Phase I Environmental Site Assessment was performed in conformance with the scope and limitations of ASTM Practice E 1527-13 for the Yuba River Ecosystem Restoration Feasibility Study (Engineering Appendix B – Section 9 – Hazardous and Toxic Materials). The records research report and site visit indicates that there are no Recognized Environmental Conditions within or adjacent to the proposed study area. Adjacent properties surrounding the study area appeared well maintained and clean during a site visit. The completion of a Phase I Site Assessment puts the study in full compliance with this Act.

6.2 Executive Orders

Executive Order 13112, Invasive Species, February 3, 1999. *Full Compliance.* This EO directs Federal agencies to prevent the introduction of invasive species, provide for their control, and minimize their economic, ecological, and human health effects. As discussed in Section 4.3.5, invasive species are found throughout the study area. Prior to construction, the construction contractor would be required to prepare an invasive species control plan to be approved by USACE and acceptable to appropriate Federal and State resource agencies. The study is in full compliance with this order.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994. *Full Compliance.*

This EO directs Federal agencies not to exclude persons from participation in, deny persons the benefits of, or subject persons to discrimination under their programs, policies, and activities because of their race, color, or national origin. As discussed in Section 4.2, the proposed action would have no disproportionate effects on minority or low-income populations in the study area. Therefore, the study would not be subject to this order.

Executive Order 11988, Floodplain Management, May 24, 1977. *Full Compliance.*

This EO directs Federal agencies to avoid, to the extent possible, long- and short-term adverse effects associated with the occupancy or modification of the base flood plain (1% annual event), as well as to avoid direct and indirect support of development in the base flood plain, wherever there is a practicable alternative. As discussed in Section 4.3.4, the proposed action would have no measurable effect on the (FEMA's 100-year) floodplain in the lower Yuba River. In addition, because of the nature of the proposed work, the proposed action would not directly or indirectly support development in the floodplain. The study is in full compliance with this order.

Executive Order 11990, Protection of Wetlands, May 24, 1977. *Full Compliance.*

This EO directs Federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance their natural and beneficial values. As discussed in Section 4.3.5, the proposed action would have a net positive effect on study area aquatic and riparian habitats by creating additional ephemeral and seasonal riverine and riparian habitats. Consequently the study would be in full compliance with this order.

Chapter 7 – Public Agency Involvement and Review

This chapter describes the public involvement activities associated with the Yuba River Ecosystem Restoration Feasibility Study. To date, public involvement for the study has included completion of a planning charrette; agency meetings and coordination; public notices, media releases (including a website), public meetings; and distribution of the draft interim Feasibility Report/ Environmental Assessment for public review and comment. It is important to note that the scope of this study has been reduced in a number of ways: (1) plan formulation (as described in Chapter 3) resulted in a reduction in geographic scope of the measures carried forward for study in the final array of alternatives; and (2) the PDT determined that the remaining measures would not result in any significant impacts and reduced the scope of the analysis from an Environmental Impact Statement (EIS) to an Environmental Assessment.

7.1 List of Agencies and Persons Consulted

USACE has been coordinating with various Federal, State, and local agencies throughout the duration of the study to discuss the concerns and issues of these agencies regarding the project, including:

- Yuba County Water Agency (non-Federal sponsor)
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- California Department of Fish and Wildlife
- California Department of Water Resources
- U.S. Forest Service
- Central Valley Regional Water Quality Control Board
- Feather River Air Quality Management District
- Advisory Council on Historic Preservation
- California State Historic Preservation Officer
- United Auburn Indian Community
- Enterprise Rancheria

Additional Federal, State, and local agencies and organizations participated in the public scoping process through submission of comments.

7.2 Public Meetings and Workshops

Following the release of the Notice of Intent (NOI) on October 9th, 2015 and Notice of Preparation (NOP) October 12th, 2015, USACE and YCWA hosted a series of four joint NEPA/CEQA public scoping meetings. The NOI is included in the Environmental Appendix D – Attachment 9a. The complete schedule of public scoping meetings included:

- Meeting #1 – Wednesday, October 28, 2015, 1:00 p.m. – 3:00 p.m. at John E. Moss Federal Building Stanford Room (650 Capitol Mall, Sacramento, CA 95814).
- Meeting #2 – Thursday, October 29, 2015, 5:00 p.m. – 7:00 p.m. at Nevada County Library Community Room (980 Helling Way, Nevada City, CA 95959).
- Meeting #3 – Wednesday, November 4, 2015, 5:00 p.m. – 7:00 p.m. at Yuba County Government Center Marysville and Wheatland Conference Room (915 8th Street, Marysville, CA 95901).
- Meeting #4 – Thursday, November 5, 2015, 4:00 – 6:00 p.m. at the Downieville Community Hall (322 Main Street, Downieville, CA 95936).

The meeting locations were chosen because they are each central to various parts of the large geographic region encapsulated in the study area. The meeting times were chosen to accommodate both the workday schedules of public agency representatives and the general public, including residents and business owners.

The meetings were open-house style workshops in which attendees could read and view the information about the proposed alternatives and interact with project staff, including representatives of USACE and YCWA. The views expressed in the scoping meeting are summarized below.

7.3 Scoping Comments

Public scoping comments were requested for submission within 30 days after the last scoping meeting (December 5, 2015). A total of 180 people attended the public meetings and a total of 224 comments were received during the public comment period. In general public comments expressed a high degree of support for ecosystem restoration in the Yuba River watershed. The health of the native fisheries in the Yuba River watershed has been at the center of extensive study and public debate and the great majority of comments were related to this issue. Many commenters expressed a specific interest in the study evaluating potential fish passage opportunities associated with USACE owned dams (Daguerre Point Dam and Englebright Dam). Fish passage at these and other barriers in the watershed is complicated by ongoing resource use and legacy environmental challenges. There is a general desire and expectation for this feasibility study to evaluate and recommend a plan that progresses or ends the ongoing debate over the natural resource management in the watershed. Participation in public meetings and submission of comments reflects an engaged public with a high level of awareness of issues and interest in outcomes. Although the range of proposed restoration actions

included in the RP would result in significant ecosystem restoration outcomes, the absence of proposed solutions to fish passage (connectivity) problems may be perceived as disappointing.

A summary of comments received during public scoping recorded in the project files.

7.4 Public Review and Comments on the Draft Feasibility Report/ Environmental Assessment

The draft FR/EA was circulated for public review for a 45 day period⁴ (January 08, 2017 -February 23, 2018). Letters were sent to interested parties notifying them of the availability of the document and the time and location of public workshops. Public workshops were held in locations within the project area, including:

- Marysville - Tuesday, January 16, 2018, 5:00pm - 7:00pm at Yuba County Government Center Marysville and Wheatland Conference Room (915 8th Street, Marysville, CA 95901).
- Sacramento⁵ - Friday February 2, 2018, 1:00 pm - 3:00 pm at John E. Moss Federal Building Stanford Room (650 Capitol Mall, Sacramento, CA 95814).

An electronic version of the draft FR/EA was made available for download on the Sacramento District, Corps of Engineers website (<http://www.spk.usace.army.mil/Missions/EnvironmentalProjects/Yuba-River-Eco-Study/>). Hard copies of the final draft FR/EA were provided to area libraries, including:

- Sacramento Public Library Central Branch - 828 I Street, Sacramento, Ca 95814
- Nevada County Public Library - 980 Helling Way, Nevada City, Ca 95959
- Yuba County Library- 303 Second Street, Marysville, Ca 95901
- Downieville Branch Library- 318 Commercial Street, Downieville, Ca 95936

During the public review period, 61 comments were received. Comments were submitted verbally and written during public meetings and were received throughout the comment period by email and mail. Public comments ranged from complete support to total opposition to the recommended plan. In general, there was support for ecosystem restoration in the watershed and support for the proposed actions in the recommended plan, but also a desire for additional ecosystem restoration actions, especially fish passage and dam removal. The most frequently recurring themes among the concurrent review comments were as follows:

⁴ Although NEPA identifies a 30 day minimum public review period for an Environmental Assessment, USACE Sacramento District provided a 45 day review to enhance the opportunity for public participation in refining the draft FR/EA.

⁵ The public meeting in Sacramento was originally scheduled for January 22, 2018; however, due to uncertainty regarding Congressional action to allocate funding of governmental functions, including USACE, the meeting was cancelled and rescheduled after a budget was passed.

- Plan Formulation for Daguerre Point Dam Fish Passage - Extensive study has been conducted on the condition of fish passage at Daguerre Point Dam and there is more than enough information to evaluate and recommend a fish passage improvement action at Daguerre Point Dam.
- Life Safety - Fish passage improvements at Daguerre Point Dam should consider the potential decrease in hazard to life safety associated with Daguerre Point Dam.
- Scope of the recommended plan - The recommended plan does not go far enough in addressing ecosystem degradation and planning objectives.
- US Army Corps of Engineers Study Authority and Responsibilities - The study should have included a fish passage action in the recommended plan because the US Army Corps of Engineers is the only Agency with the authority to improve these structures and it is the Corps' responsibility to address this issue.
- Habitat Measure Design, Risk, and Resiliency - The habitat restoration measures in the recommend plan are unsustainable and would not result in long term improvements to ecosystem value.
- Potential Impacts Related to Mercury - The project does not include adequate avoidance, minimization, or mitigation measures to address potential impacts related to mercury.

All comments received during the public review period were considered and incorporated into the final FR/EA, as appropriate. The Environmental Appendix D – Attachment 9b documents the comments received during public review of the draft document and USACEs responses.

This page intentionally left blank.

Chapter 8 – Recommended Plan

This chapter describes the Recommended Plan (also called the preferred alternative for NEPA purposes), as well as procedures and cost sharing requirements to implement the plan. A schedule and list of further studies are also included.

8.1 Recommended Plan

The plan identified as the RP is Alternative 5 (Figures 8-1-1 through 8-1-4). The RP is described in detail below.

8.1.1 Features and Accomplishments

The RP is composed of nature-based features that restore ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Nature-based features are those created by human design, engineering, and construction that work in concert with natural processes or mimic as closely as possible conditions which would occur in the area absent human changes to the landscape or hydrology.

The principal features of the RP include restoration of approximately 43 acres of aquatic habitat including side channels, backwater areas, bank scallops, and channel stabilization. These features would provide shallow, low velocity, rearing habitat and refugia for juvenile anadromous salmonids and potentially increase benthic macroinvertebrate producing habitat. Engineered log jams (ELJs) and placement of boulders and large woody material have been incorporated in the RP at strategic locations. ELJs and boulders would be placed at actively eroding banks or sites with high velocities and shear stresses. These features would promote bank stabilization, add structural complexity, provide velocity refuge for juvenile fish, and modify local hydraulics and sediment transport.

The RP also includes about 136 acres of riparian habitat restoration consisting of floodplain lowering and grading and riparian vegetation plantings, which would increase the quantity and quality of riparian habitat in the river corridor. The RP addresses fragmentation of habitat by targeting areas adjacent to existing vegetation that have been unable to initiate revegetation through natural processes due to substrate composition and depth to groundwater. Floodplain lowering reconnects the river to its floodplain and makes planting feasible where it was not previously due to excessive groundwater depths. Four native species would be planted to provide species and structural diversity, including arroyo willow, which is known to support neotropical bird habitat (RHJV 2004). When the restored riparian habitat is inundated by high flows, it would also function as aquatic habitat, providing additional feeding habitat and refugia for juvenile fish.

This page intentionally left blank.

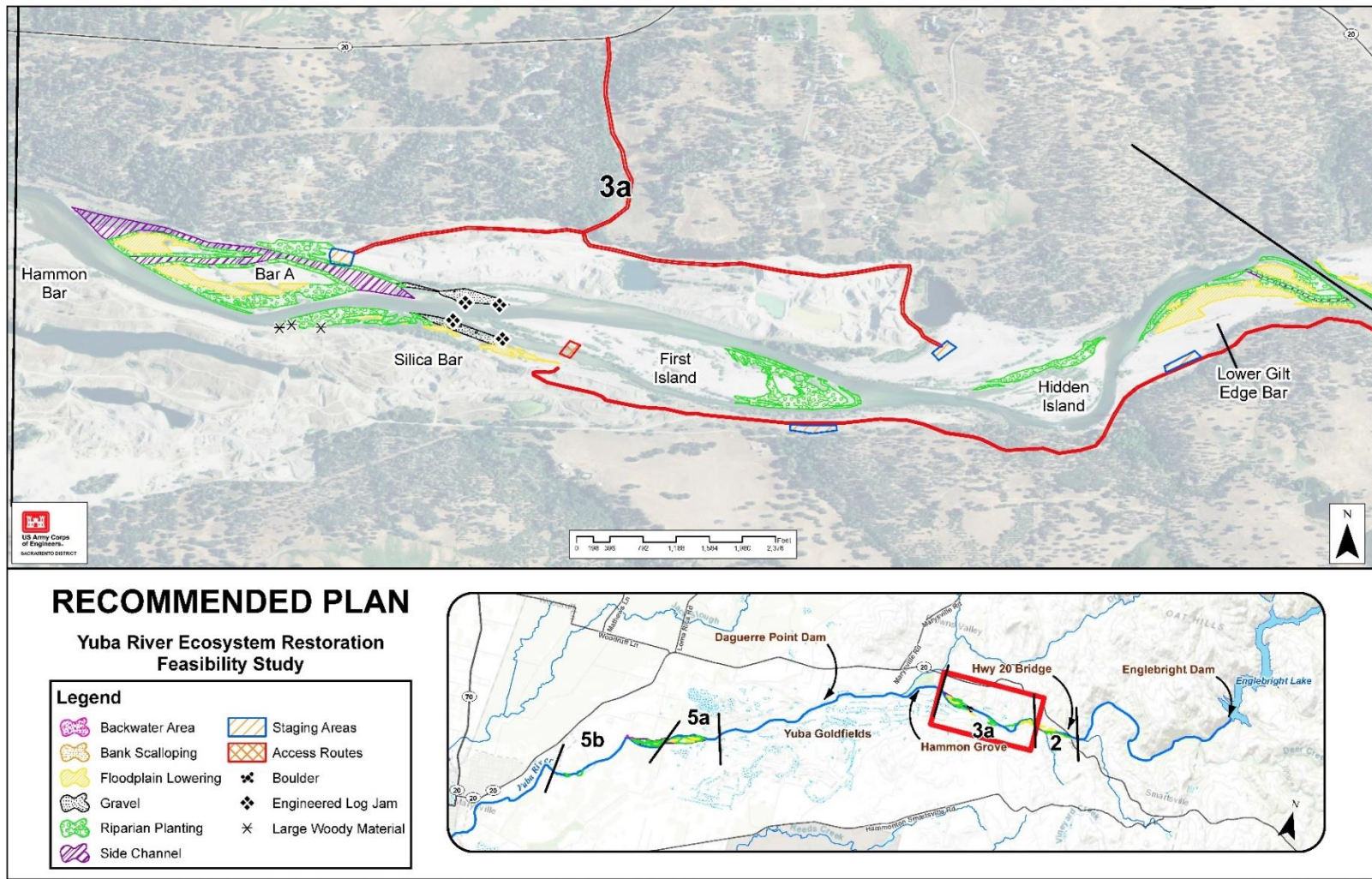


Figure 8-1-2. Recommended Plan continued.

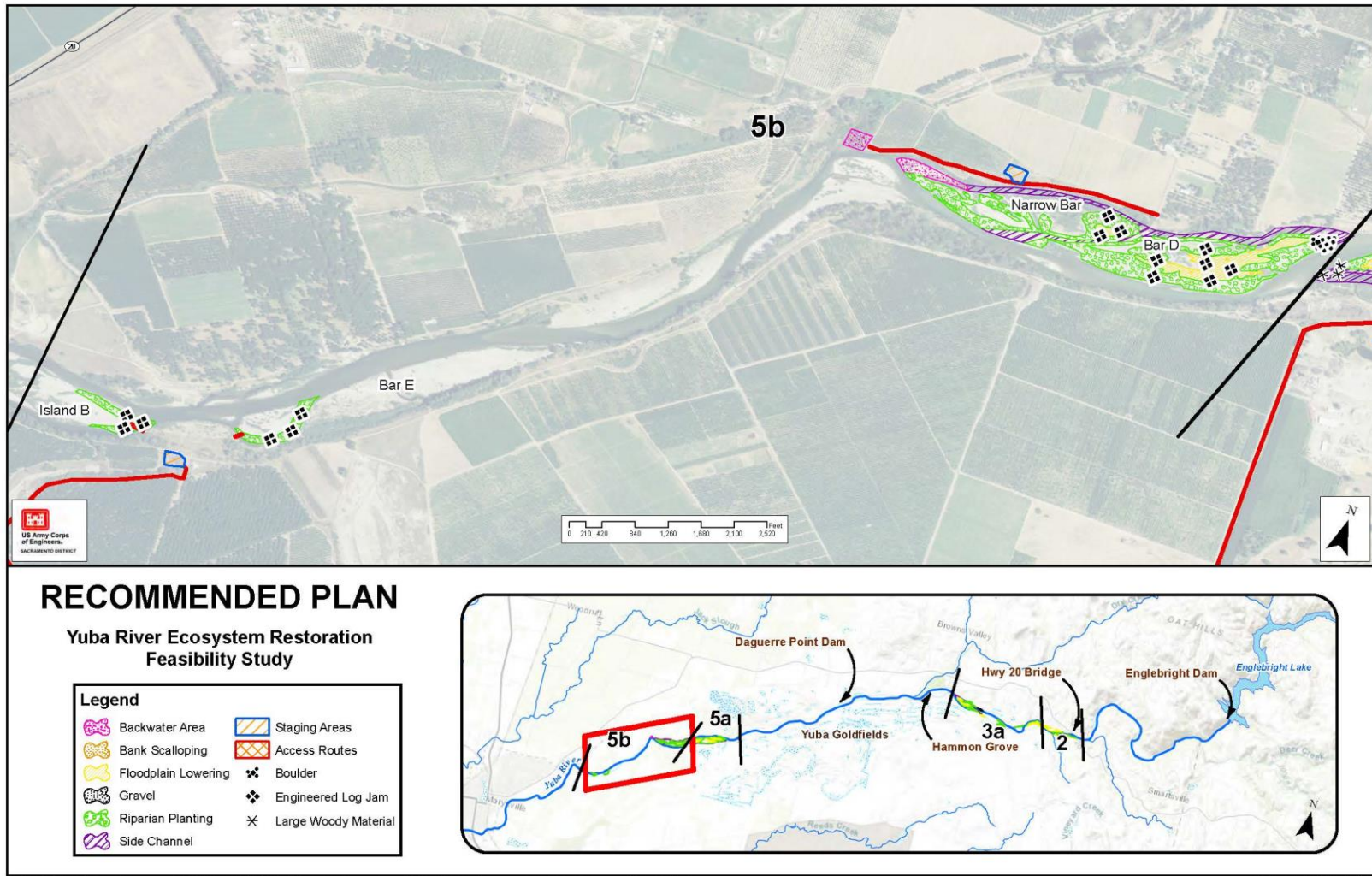


Figure 8-1-4. Recommended Plan continued.

Additionally, a Monitoring and Adaptive Management Plan is included in the Environmental Appendix D - Attachment 6 of this report. Monitoring and Adaptive Management costs are currently estimated to be \$2,384,000 for monitoring and \$9,400,000 for adaptive management. The total first project cost of this alternative is \$97,219,000.

To various degrees, the recommended plan addresses all of the objectives of the feasibility study. Longitudinal river connectivity would be increased by improving approximately five river miles of aquatic habitat, improving refuge, rearing, and food production options for migrating fish along the lower Yuba River. The recommended plan would also reduce gaps between areas of suitable aquatic habitat, including other restoration projects such as the Hallwood Side Channel and Floodplain Restoration Project and the Hammon Bar Restoration Project.

The lower Yuba River is an ideal location for a restoration project because the river still produces one of the largest fall-run Chinook Salmon populations in the Central Valley and also supports California Central Valley steelhead and spring-run Chinook salmon, which are federally listed as threatened. Also, the Yuba River does not have a hatchery facility and therefore hosts one of the last remaining wild salmon runs in the Sierra Nevada Mountain range. Historically, the Yuba River has supported a substantial percentage of salmon in the Sacramento River basin and in 2009 – 2010, salmon spawning in the Yuba River made up 14 to 20 percent of all salmon spawning in the Sacramento River basin (Yuba RMT 2013). The ability of the Yuba River to support salmonids despite extensive habitat degradation is aided by the fact that New Bullards Bar Reservoir would continue to have a large cold water pool that would provide cold water for summer and early fall flows in the lower Yuba River.

Climate change would likely affect hydrology in the watershed, however the recommended plan would continue to provide environmental benefits because the regulated flow environment (due to upstream reservoirs) would largely alleviate expected climate change impacts and the monitoring and adaptive management plan would ensure plant establishment and correct design deficiencies. Climate change could cause increased air temperatures, reduced snowpack, earlier spring melt, more frequent and intense atmospheric river storms, and chronic long duration hydrologic drought. However, cold water from New Bullards Bar Reservoir would persist and base flows are managed to support habitat within the context of physical and legal constraints. Additionally, features of the Recommended Plan are most vulnerable to extreme hydrology in the first 10 to 20 years of establishment, which is the timeframe that Adaptive Management and OMRR&R activities could mitigate climate change effects.

The creation of functioning, diverse, and interconnected habitats on the lower Yuba River would contribute to the recovery of nationally and regionally significant resources. Endangered Chinook salmon and steelhead require riverbanks with structural complexity, side-channels, backwaters, at appropriate depths and velocities that the recommended plan would provide. The restoration of aquatic and riparian habitat would reduce the scarcity of these important habitats. Restoration of riparian habitat along the lower Yuba River would be particularly beneficial to migratory birds on the Pacific Flyway. Despite significant habitat loss throughout the Central Valley, California still supports some of the largest concentrations of wintering waterfowl and shorebirds found anywhere in the world (The Nature Conservancy, 2018). The recommended

plan would add to the quilt of managed wetlands and bird-friendly agricultural lands that support migratory birds.

Systems / Watershed Context

Although designed to stand alone, the RP complements other efforts underway on the Yuba River. As described in the Future Without Project Condition Section, USFWS has been funding stream restoration projects through its Anadromous Fish Restoration Program (AFRP). The RP was formulated to not impede or be dependent upon the AFRP; however, the RP in conjunction with the AFRP would synergistically contribute to the goal of restoring aquatic and riparian habitat (Figure 8-2). Specifically, restoration of riparian habitat is a high priority because less than 5% of the historic riparian habitat remains throughout western United States.

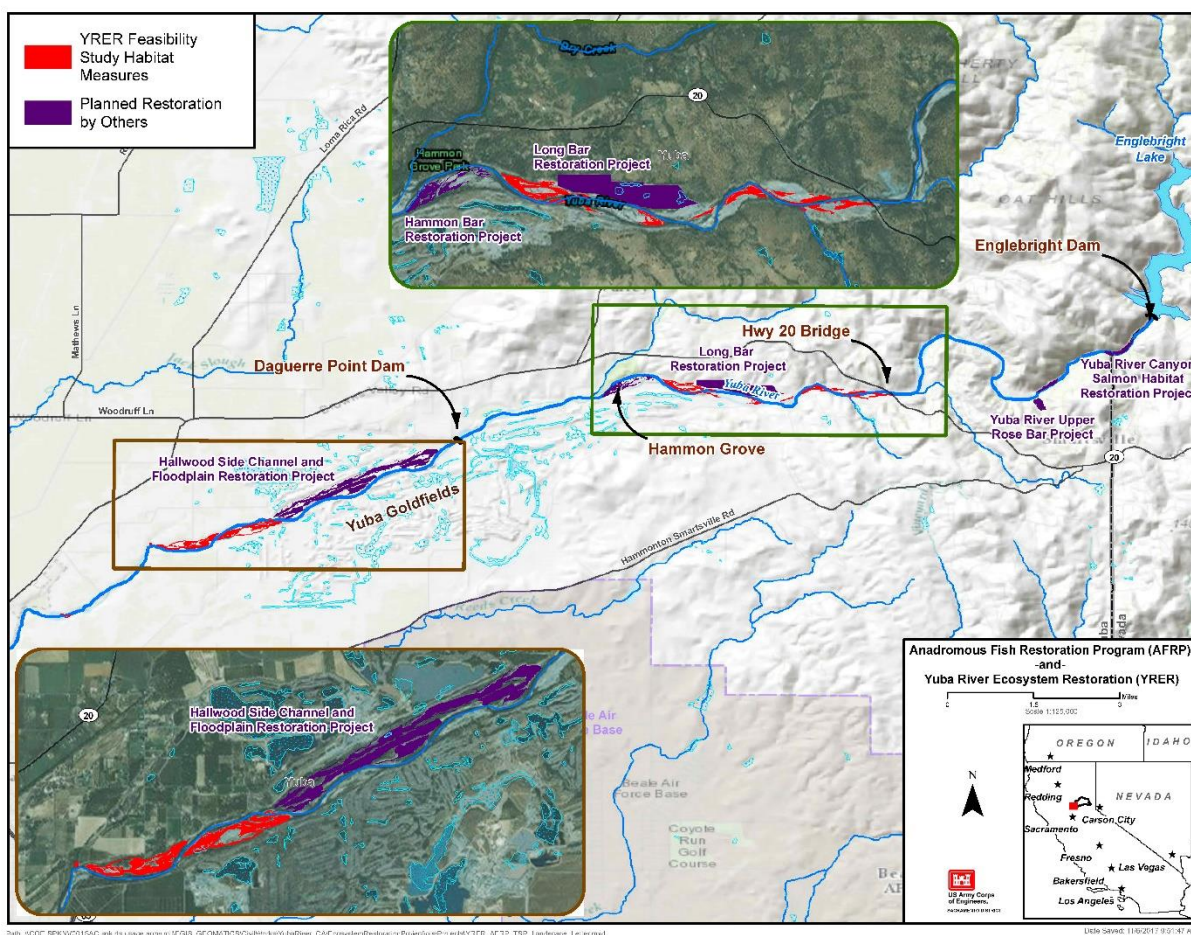


Figure 8-2. Yuba River Ecosystem Restoration RP and AFRP Measures.

8.1.1.1 Environmental Operating Principles

Environmental Operating Principles were developed to ensure that USACE missions include totally integrated sustainable environmental practices. The Principles provided corporate direction to ensure the workforce recognizes USACE's role in, and responsibility for, sustainable use, stewardship, and restoration of natural resources across the Nation. The Environmental Operating Principles are:

1. Foster sustainability as a way of life throughout the organization.
2. Proactively consider environmental consequences of all USACE activities and act accordingly.
3. Create mutually supporting economic and environmental sustainable solutions.
4. Continue to meet corporate responsibility and accountability under the law for activities undertaken by USACE which may impact human and natural environments.
5. Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.
7. Employ an open, transparent process that respects the views of individuals and groups interested in USACE activities.

The RP supports the Environmental Operating Principles in the following ways:

- The project avoids environmental impacts while maximizing restoration of historic aquatic and riparian habitat (Principles 1, 2, 3, and 4).
- The proposed habitat restoration is a sustainable solution because natural processes would be improved and continue without human intervention (Principles 1, 2, 4, and 5).
- The study leverages scientific knowledge by proposing a solution based on extensive research and a proven history of success in the study area (Principle 6).
- Stakeholder meetings and public workshops were held throughout the study process, which allowed USACE to achieve a balance of project goals and public concerns (Principle 7).

8.1.1.2 USACE Campaign Plan

The mission of USACE is to provide vital public engineering services in peace and war to strengthen the Nation's security, energize the economy, and reduce risks from disasters. In order to meet this mission, the agency has developed the USACE Campaign Plan (FY18-22) as a component of the corporate strategic management process to establish priorities, focus on the

transformation initiatives, measure and guide progress, and adapt to the needs of the future. The goals of the Campaign Plan are:

1. Support National Security
2. Deliver Integrated Water Resources Solutions
3. Reduce Disaster Risk
4. Prepare for Tomorrow

The RP contributes to Goal 2, Deliver Integrated Water Resources Solutions, by accomplishing the following:

- The study prioritized and executed decision-making earlier in the study schedule, using a progressive and iterative planning process to address key areas of uncertainty, rather than spending critical time and funding resources collecting and analyzing all possible data points. This enabled USACE to deliver the study on time and within budget and recommend a risk-informed solution.
- The study adopted existing data to analyze the watershed and arrive at a recommended solution on time and within budget.

8.1.2 Federal Interest

The Federal interest in restoration of the ecosystem of the Yuba River watershed is demonstrated by the national significance of the resources associated with restoration of ecosystem structure, function, and processes. Per ER 1105-2-100, significance of resources and effects is derived from institutional, public, and technical recognition.

8.1.2.1 Institutional Recognition

Institutional significance of a resource means its importance is recognized and acknowledged in the laws, plans, and policies of government and private groups. Many plans, laws, policies, and ordinances have been developed to protect resources in the Yuba River as demonstrated below.

- Laws and Programs
 - Federal Endangered Species Act – 13 species occur or have the potential to occur in the study area that have been listed as Threatened or Endangered under the ESA.
 - The Lower Yuba River is Designated Critical Habitat for Federally listed threatened Chinook salmon, steelhead trout, and green sturgeon.
 - Migratory Bird Treaty Act (MBTA) – many migratory birds protected under the MBTA breed, nest, forage, reside, and migrate through the study area.
 - Birds of Conservation Concern (BCC) – the US Fish and Wildlife Service (USFWS) has identified 18 BCCs with potential to occur within the project area.

BCCs are species with potential to become candidate species for listing under the ESA.

- Central Valley Project Improvement Act (CVPIA) – the CVPIA directs the Secretary of the Interior to develop and implement a program that makes all reasonable efforts to double natural production of anadromous fish in Central Valley streams (Section 3406(b)(1)).
- Anadromous Fish Restoration Program (AFRP) – the AFRP works to achieve the doubling goal through a variety of projects throughout the Central Valley of California. The USFWS work cooperatively with other federal, state and local agencies, non-profits and private landowners on projects that increase available juvenile and adult salmon habitat.
- Ecosystem Restoration Program (ERP) – the ERP is a multi-agency effort aimed at improving and increasing aquatic and terrestrial habitats and ecological functions in the Delta and its tributaries. The ERP Focus Area includes the Delta, Suisun Bay, the Sacramento River below Shasta Dam, the San Joaquin River below the confluence with the Merced River, and other major tributary watersheds directly connected to the Bay–Delta ecosystem below major dams and reservoirs. Principle participants overseeing ERP are the California Department of Fish and Wildlife (CDFW), the United States Fish and Wildlife Service (USFWS), and NOAA’s National Marine Fisheries Service (NMFS), collectively known as the ERP Implementing Agencies.
- California Endangered Species Act – 8 species occur or have the potential to occur in the study area that have been listed as Threatened or Endangered under the California ESA.
- California Native Plant Society Inventory of Rare and Endangered Plants of California – 9 species of rare plants occur or have the potential to occur in the study area.
- Plans
 - North American Waterfowl Management Plan – an international treaty signed by Canada, the United States, and Mexico that protects waterfowl and migratory birds in North America, including the Pacific Flyway and migratory stops in the Yuba River watershed.
 - NMFS Central Valley Salmon and Steelhead Recovery Plan – recommends multiple actions in the lower Yuba River that would help contribute to recovery of Central Valley spring-run Chinook Salmon and CCV steelhead. In recovery action YUR-1.3, NMFS recommends to “develop programs and implement projects that promote natural river processes, including projects that add riparian habitat and instream cover”. In recovery action YUR-2.2, NMFS recommends to “increase floodplain habitat availability in the lower Yuba River” (NMFS 2014).

- Habitat Expansion Plan for Central Valley spring-run Chinook Salmon and CCV steelhead (DWR and PG&E 2010) – the plan recommends three actions on the lower Yuba River to provide conditions that would encourage development of an independent spring-run Chinook salmon population and provide ancillary benefits to steelhead.
- California Department of Fish and Wildlife publications
- Salmon and Steelhead Restoration and Enhancement Plan (1990)
- Lower Yuba River Fisheries Management Plan (1991)
- Restoring Central Valley Streams – A Plan for Action (1993)
- Steelhead Restoration and Management Plan (1996)
- Strategic Plan for Trout Management (2003)
- Yuba County General Plan – the plan identifies strategies for the conservation and restoration of natural resources and states that the County would support cooperative restoration, development, and promotion of natural resource with the USFWS, USACE, the Bureau of Reclamation, the US Forest Service and other public agencies with an interest in Yuba County’s water and wildlife assets.
- Lower Yuba River Accord – The Lower River Yuba Accord is a consensus-based, comprehensive program designed to protect and enhance 24 miles of the lower Yuba River extending from Engle bright Dam downstream to Yuba River's confluence with the Feather River. The Yuba Accord addresses water management in the lower Yuba River until a new FERC license is issued for the Yuba River Development Project. The Yuba Accord is composed of three interrelated agreements: 1) the Lower Yuba River Fisheries Agreement, which specifies lower Yuba River minimum stream flows and creates a detailed fisheries monitoring and evaluation program; 2) the Water Purchase Agreement, under which YCWA provides annual water supplies for fish and wildlife purposes in the Bay-Delta, CALFED's Environmental Water Account, the State Water Project, and the Central Valley Project; and 3) the Conjunctive Use Agreements which specify the terms of the Yuba Accord's conjunctive use program.

8.1.2.2 Public Recognition

Public recognition means some segment of the general public considers the resource to be important. Protecting the Yuba River has inspired public groups to organize and act as well as public-governmental collaborations to solve resource issues. The Yuba River also supports a significant fly fishing industry and many local residents have fostered deep connections to the river.

- South Yuba River Citizen’s League (SYRCL) – the mission statement is as follows, “SYRCL unites the community to protect and restore the Yuba River. Motivated by our

love for this watershed, we advocate powerfully, engage in active stewardship, educate the public, and inspire activism from the Sierra to the sea.”

- SYRCL has organized and funded several projects and programs focusing on river clean up, education, science, monitoring, and habitat restoration.
- The Sierra Fund – the Sierra Fund’s mission is to restore ecosystem and community resiliency in the Sierra Nevada. A program objective is to assess and restore ecosystems of the forests, meadows, and rivers impacted by the Gold Rush through projects that demonstrate multiple benefits such as improving water quality, water storage and ecosystem resiliency in the region, especially in light of predicted climate change impacts on the Sierra Nevada.
- American Rivers – in 2011, American Rivers named the Yuba River as one of America’s most endangered rivers citing dams that have damaged river health and blocked access to more than 120 miles of historic salmon and steelhead habitat for over 70 years.
- Friends of the River – in 2016, this non-profit organization filed a lawsuit alleging Yuba River operations violate the federal endangered species act.
- California Trout (CalTrout) – CalTrout is a non-profit organization whose mission is to protect and restore wild trout, steelhead, salmon and their waters throughout California
 - CalTrout is a founding partner of the Central Valley Salmon Habitat Partnership is a science-based, multi-stakeholder forum of conservation and fisheries organizations, local, state and federal agencies and private sector partners working together to build robust fisheries and self-sustaining wild populations of Central Valley Salmonids.
- Yuba Salmon Partnership Initiative (YSPI) – the Yuba Salmon Partnership Initiative is a collaboration between the California Department of Fish and Wildlife (CDFW), National Marine Fisheries Service (NOAA Fisheries), Yuba County Water Agency (YCWA), American Rivers, Trout Unlimited, and California Sportfishing Protection Alliance to return spring-run Chinook salmon and possibly steelhead to more than 30 miles of the North Yuba River.
- Cosumnes, American, Bear, Yuba (CABY) – an integrated regional water management group that represent Cosumnes, American, Bear, and Yuba watershed region, supported by bond funding provided by the California Department of Water Resources.
 - The CABY Integrated Regional Water Management Plan is a planning document that identifies broadly-supported goals, objectives, strategies, actions and projects within the CABY region to address long-term water supply needs, protection of water quality, and enhancement of environmental and habitat resources.
 - CABY has applied successfully for several Implementation Grants with projects ranging from meadow restoration and abandoned mine remediation to lining canals and installing water meters.

8.1.2.3 Technical Recognition

Technical recognition of a resource is based upon scientific or other technical criteria that establishes significance. Riparian and wetland ecosystems are critical for wildlife, yet are exceedingly rare. Studies have documented that at least 80% of historic riparian habitat has been lost in the Western United States and less than 5% of historic riparian forests remain in the Central Valley of California. Federally listed threatened species that rely on riparian habitat in the Yuba River watershed include the Western yellow-billed cuckoo, Valley elderberry longhorn beetle and California red-legged frog.

Additional Federally listed threatened species include spring-run Chinook salmon, steelhead, and green sturgeon. The lower Yuba River is essential to the conservation of these species and has therefore been designated as critical habitat. The Yuba River does not have a hatchery facility and therefore hosts one of the last remaining wild salmon runs in the Sierra Nevada Mountain range. Conservation and expansion of habitat is essential to the recovery and long term survival of anadromous fish which are keystone species in Yuba River watershed and California ecosystems. Historically, salmon and steelhead were present in the watershed in great abundance and the nutrients from salmon carcasses were a very important part of the ecosystem. The decline of these fish in the watershed and in the region has resulted in the elimination of a major source of nutrients on which many species rely. One study in the northwest identified 137 species of animals that utilize the nutrients from salmon carcasses (Cederholm 2000). Numerous other studies have identified that salmon nutrients are taken up by the vegetation along streams, consumed by animals and birds, and contribute to more productive aquatic ecosystems.

The lower Yuba River is along the Pacific Flyway for migratory birds, which have long been an indicator of ecosystem health. Recent evidence suggests that many songbird populations that migrate each year between temperate breeding areas and tropical winter quarters are declining and that these declines have accelerated in recent years. The neotropical migrants that breed in the West reside primarily in riparian habitats. California's riparian habitat provides important breeding and over wintering grounds, migration stopover areas, and corridors for dispersal. The loss of riparian habitats may be the most important cause of population decline among land bird species in western North America.

Climate change is further exacerbating habitat degradation, fragmentation, and subsequent impacts to wildlife. A May 2017 report from biologists at the University of California, Davis, Center for Watershed Sciences and California Trout states that nearly 75 percent of California's salmon, steelhead, and trout would be extinct in 100 years unless critical habitat is protected and restored. If present trends continue, 45 percent of California's native salmon, steelhead, and trout are likely to be extinct in the next 50 years.

8.1.2.4 The Recommended Plan and Resource Significance

The creation of functioning, diverse, and interconnected habitats on the lower Yuba River would contribute to the recovery of regionally and nationally significant resources. Endangered Chinook salmon and steelhead require riverbanks with structural complexity, side-channels, and backwaters, at appropriate depths and velocities that the RP would provide. The restoration

actions of the RP would reduce the scarcity of important aquatic and riparian habitats. Restoration of riparian habitat along the lower Yuba River would be particularly beneficial to migratory birds on the Pacific Flyway. Despite significant habitat loss throughout the Central Valley, California still supports some of the largest concentrations of wintering waterfowl and shorebirds found anywhere in the world (The Nature Conservancy, 2018). The recommended plan would add to the quilt of managed wetlands and bird-friendly agricultural lands that support migratory birds.

8.1.3 Monitoring and Adaptive Management

Monitoring and adaptive management are essential tools to ensure the long term successful establishment of the proposed habitat features and associated ecosystem benefits. This is especially true for nature-based features, which are more susceptible to environmental conditions than conventional structural measures. Given that the recommended plan entirely consists of nature-based features, monitoring and adaptive management plays an important role in addressing the uncertainties related to the design and long-term performance of those features. The Monitoring and Adaptive Management Plan (M&) (Environmental Appendix D – Attachment 8) describes monitoring activities, criteria for ecosystem restoration success, triggers for implementation of adaptive management, and potential adaptive management measures. Monitoring and adaptive management elements were developed for the key habitat types affected by the proposed action: riverine habitat and riparian habitat. Monitoring activities are estimated at \$2,384,000. Adaptive management measures are estimated at \$9,400,000. Although, the goal of the M& is to ensure long-term project success, the monitoring and adaptive management measures would only occur until the project features demonstrate a trajectory toward long-term sustainability. Per USACE implementation guidance for Section 1161 of Water Resources Development Act (WRDA) of 2016, monitoring under the M& would continue until the district engineer determines the criteria for ecosystem restoration success have been met. Within a period of ten years from the completion of construction of an ecosystem restoration project (or component of a project), monitoring shall be a cost-shared project cost. Any additional monitoring required beyond ten years would be the responsibility of the non-Federal sponsor. Following successful establishment of project features and completion of the M& requirements, the project would be maintained under an OMRR&R manual.

8.1.4 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Routine operation and maintenance requirements for the RP are expected to be minimal. Requirements would likely consist of litter control and maintaining site controls and access capabilities. No public access facilities or other features requiring active operation would be included in the project. The non-Federal sponsor would need to periodically inspect the project to prevent encroachments or other damage caused by human activities and to determine whether any repair, replacement, or rehabilitation of project features is needed.

Section 1161 of the WRDA 2016 states that the responsibility of a non-Federal interest for operation and maintenance of the nonstructural and non-mechanical elements of a project, or

a component of a project, for ecosystem restoration shall cease 10 years after the date on which the Secretary of the Army determines the criteria for ecosystem restoration success have been met. All restoration features of the Recommended Plan have been identified as nonstructural. Therefore, operation and maintenance of the restoration features would cease 10 years after success criteria are met. If structural features are added during the pre-construction engineering and design phase to provide the intended project outputs, those features would need to be maintained as structural features with ongoing operation and maintenance.

The cessation of operation and maintenance of restoration features poses low risk to the ecological success and sustainability of project features and functions. Control of invasive plant species or other vegetation management is not anticipated to be necessary after the ecological success criteria are met. Should flood events damage a stand of vegetation, it is expected that improved depth to groundwater, source seed availability, and improved substrate conditions would encourage appropriate seed dispersal, germination, and establishment of new growth. Additionally, disruptions from flood events would create new age classes within the vegetation stands, creating natural variability in composition, structure, and function. Natural disruptions and regeneration of vegetation are a component of dynamic ecosystem processes and evidence of a self-sustaining feature.

According to USACE guidance (ER 1110-2-401), “Repair is considered to entail those activities of a routine nature that maintain the project in a well-kept condition. Replacement covers those activities taken when a worn-out element or portion thereof is replaced. Rehabilitation refers to a set of activities as necessary to bring a deteriorated project back to its original condition. Repair, Replacement and Rehabilitation actions are to conform to the project as-built plans and specifications unless other arrangements are made with the district commander.” If rehabilitation of the project is required because of natural changes in the morphology of the river channel and floodplain, conforming the project to the original plans and specifications may not be the most practical or ecologically preferable method of providing the intended ecological outputs of the project. Therefore, the Sacramento District commander would consider other plans proposed by the non-Federal sponsor for rehabilitation of the project that would provide equivalent ecological outputs within the project site.

Section 1161 of WRDA 2016 does not specifically limit the duration of a non-Federal sponsor’s responsibility for repair, replacement, and rehabilitation of the non-structural and non-mechanical elements of an ecosystem restoration project. However, there is no specific statutory requirement for repair, replacement, and rehabilitation of specifically authorized ecosystem restoration projects, and it would not be reasonable to require repair, replacement, and rehabilitation to continue after operation and maintenance have ceased. Therefore, the sponsor’s responsibility for repair, replacement, and rehabilitation of the non-structural and non-mechanical elements of the project would cease when their responsibility for operation and maintenance ceases.

Subsequent to the completion of the design of the project features and prior to construction, a draft OMRR&R manual would be prepared in coordination with the non-Federal sponsor and affected resource agencies. A final OMRR&R manual would be prepared after the completion of construction and provided to the non-Federal sponsor.

8.1.5 Real Estate

The non-Federal sponsor would be responsible for the acquisition of about 692 acres in fee title along with about 6 acres of temporary work area easements and 21 acres of access routes to implement the RP. The estimated fee title acquisition acreage is greater than the physical restoration acreage to avoid creating uneconomic parcel remnants while providing the lands needed for construction, monitoring, adaptive management, and OMRR&R of the restoration features. In addition, implementation of the RP would require acquisition of 33 parcels with severed mineral rights. Mineral rights would be acquired at fair market value. No relocation costs are currently anticipated. A Real Estate Plan is included as Appendix E.

The estimated cost of acquiring the Real Estate necessary to implement the project includes a 50% contingency due to limitations in mapping, unforeseen presence of improvements, possible third party property rights, possible severance damages, and potential for litigation by landowners. Particularly significant factors involve the likely change in the river location due to the recent high rainfall and flooding in California which are not reflected in the aerial photography used in the development of costs. There are active gravel pits in the project area and footprint. The value of marketable gravel is potentially high on some of the takings. While the estimated quantities and value of sand and gravel were researched to some extent, there was inadequate information available regarding the potential value of residual gold and other valuable minerals that can be extracted from gold mining tailings using improved technology. Additional investigation into these factors would occur during the Preconstruction Engineering and Design phase.

8.1.6 Plan Economics

The project first cost was estimated on the basis of October 2018 price levels and amounts to \$97,219,000. Table 8-1 shows this cost by cost account. Estimated average annual costs were based on the October 2018 discount rate of 2.875 percent, a period of analysis of 50 years, and four years of physical construction. Table 8-2 shows the average annual costs and outputs.

Table 8-1. Estimated Costs of RP.

Item	Cost (\$1,000s)
Lands and Damages	9,060
Relocations ¹	0
Construction (Fish and Wildlife Facilities) ²	58,491
Planning, Engineering, Design	14,489
Construction Management	3,396
Monitoring	2,384
Adaptive Management	9,400
Total First Cost	97,219

¹No relocations required.

²Fish and Wildlife Facilities account includes all ecosystem restoration features (excavation, grading, planting, etc.).

Table 8-2. Economic Costs and Benefits of RP.

Item	Costs (\$1,000s)	Benefits
Investment Cost		
First Cost ¹	97,219	
Interest During Construction ²	5,353	
Total Investment Cost	102,572	
Annual Cost		
Annualized First Cost	3,892	
Average Annual OMRR&R	15	
Total Average Annual Cost	3,907	
Annual Benefits Non-monetary (Ecosystem)		72.86 AAHUs

¹Based on October 2018 price levels with a 2.875% discount rate and a 50-year period of analysis.

²IDC assumes 4-year construction period, FY2019 discount rate of 2.875%

8.1.7 Cost Sharing

Table 8-3 shows costs apportioned as either Federal or non-Federal costs based on October 2018 price levels.

Table 8-3. Summary of Cost-Sharing Responsibilities of the RP.

Item	Federal (\$1,000s)	Non- Federal (\$1,000s)	Total First Costs (\$1,000s) ¹
Lands, Easements, Rights-of-Way, Relocations and Disposal Sites	0	9,060	9,060
Construction (Ecosystem Restoration)	58,491	0	58,491
PED	14,489	0	14,489
Construction Management	3,396	0	3,396
Monitoring	2,384	0	2,384
Adaptive Management	9,400	0	9,400
<i>Subtotal</i>	<i>88,160</i>	<i>9,060</i>	<i>97,219</i>
Cash Contribution	-24,967	24,967	
<i>Total</i>	<i>63,192</i>	<i>34,027</i>	<i>97,219</i>
<i>Percentage</i>	<i>65%</i>	<i>35%</i>	

¹Based on October 2018 price levels with a 2.875% discount rate and a 50-year period of analysis.

8.1.8 Risk and Uncertainty

In general, the ability of the RP to provide the expected accomplishments depends on the validity of pertinent assumptions, base data, and analytical techniques used in this study; the successful completion of future studies, designs, and construction; and appropriate operation, maintenance, and rehabilitation after construction. However, nature-based features may be affected by conditions and processes differently than conventional structural measures. Addressing the uncertainties related to the design and long-term performance of nature-based features could require additional monitoring and potential adaptive management measures to ensure continued functional performance. Nature-based features must be evaluated for effectiveness, including reliability and performance of those features over time and over an expected range of conditions. Engineering guidance on the reliability and performance of some natural and nature-based features is still emerging, so close coordination with subject matter experts is required.

The Yuba River is a dynamic system, experiencing periods of drought and flood. There is a risk that severe conditions may alter restoration features and potentially reduce the effectiveness of the proposed project. Although there is dynamism in the Lower Yuba River, all measures in the recommended plan are located on perennial landforms in the Yuba River. The habitat measures in the Recommended Plan were designed and located based on morphologic analyses and expert judgment (references discussed in Section 3.5). Appendix C – Engineering and its Attachment HH-A contain a geomorphic assessment of all habitat measures in the Recommended Plan and a qualitative and quantitative cost-risk assessment.

In the qualitative assessment, consequences of channel change were roughly categorized by assessing channel change where measures are proposed and assigning a qualitative damage probability category (e.g., very low – low – medium – high) that could be incurred from anticipated changes under a similar hydrologic regime over the next 10-50 years. Detailed categorical inputs for qualitative damage probability and severity analysis were conducted for each measure and component parts (where applicable) in Increments 2, 3a, 5a and 5b, to enable evaluation based on materials used, degree of disturbance to sediment deposits, and location within each complex of morphological features. Increment-specific assumptions and rationales are described, with appropriate imagery and mapping records in Attachment HH-A and summarized in short, targeted notes Appendix C Table C-2-3.

For a time-integrated analysis of potential damage, source documents were assessed for the periods of record or analysis, combined with the dominant processes noted for each reach defined by cbec (2013), the specific areas and types of change noted by Wyrick and Pasternack (2015), the type and location of measure to be implemented, and professional judgment used to assign damage category, probability, and severity should the event or anticipated change occur. Results of the quantitative cost-risk assessment are presented in Appendix C Tables C-15-3 and C-15-4 and summarized in the following three paragraphs.

Riparian vegetation plantings pose moderate risk when the plants are newly installed. The risk begins to reduce as the plants adapt to the environment over time and is further reduced when the plants are firmly established. The assessment assumed total vegetation replacement if

damages are incurred in the first two years, 80% replacement may occur in the next 3 years assuming some amount of monitoring-based treatment method and recovery testing may occur. For example, an area damaged by a flood may be revegetated by natural recruitment to some extent, so an additional year of monitoring may be the selected action rather than replanting in that year to assess the site for natural recovery capabilities. The following 5 years might enable a 50% replacement, with lessons learned from the first 5 years. In summary, the risk to riparian planting shifts from moderate to low as the plants become established and can withstand greater stress.

Floodplain lowering is the foundation for the majority of the riparian planting measures, so that the plants can reach groundwater and survive. Similar repair assumptions were made for floodplain lowering measures (total repair in the first 2 years, 80% in the next 3 years, and 50% repair activities in the next 5 years). Should damage to riparian plantings also accrete the gravel bar, additional floodplain lowering would have to occur. Should damage to riparian plantings also scour the gravel bar, another location within the project footprint would be identified and likely, that location would need to be lowered as well.

To account for risks to floodplain lowering and riparian plantings, the Monitoring and Adaptive Management Plan would be applied to ensure the long term, successful establishment of proposed habitat features and associated ecosystem benefits. After success criteria are met, OMRR&R of nonstructural and nonmechanical features would be required for 10 years per Section 1161 of the WRDA of 2016. The cessation of OMRR&R after 10 years poses low risk to the ecological success and sustainability of the project because restoration features and functions would be well established at that point.

Both assessments suggested that the construction of side channels, backwaters, engineered log jams, and large woody material on the perennial gravel bars would be corrected through the establishment period as part of construction, if necessary, and the features would naturally evolve as river processes occur over time. Because floodplain elevations would be lowered to suitable conditions, it is assumed that natural morphological changes would occur, both creating and destroying suitable habitat in dynamic equilibrium. During the Preconstruction Engineering and Design phase, detailed surveying, further hydrodynamic and morphologic modeling, and other technical assessment would be performed prior to the generation of final plans and specifications for habitat restoration measures, should this project be authorized and appropriated by Congress.

In accordance with Engineering and Construction Bulletin 2018-14, a qualitative analysis of climate change impacts to inland hydrology was conducted. The results of this analysis can be found in Appendix C, Section 2.3.2 and Attachment HD-A. The analysis demonstrated that climate change would likely impact inland hydrology in the project area; however, the proposed project is expected to be fairly resilient to those impacts. Successful restoration could depend on one or more of the following variables, some of which would likely be impacted by climate change.

- Hydrology/water management
- Suspended sediment
- Fresh water plant communities

Project features that create additional shallow water habitat may be affected by changes in water surface elevation. Project features that include riparian planting may be affected by increased periods of drought or excessive heat. However, the proposed project is expected to be fairly resilient to climate change because water temperature and flow are maintained by releases from upstream reservoirs to benefit wild salmon and steelhead on the lower Yuba River.

Construction of the proposed project features would not increase any vulnerabilities in the watershed associated with the ecosystem restoration business line and has the potential to increase resilience to the current levels of vulnerability. The proposed creation of aquatic features and contouring of the floodplain would improve the access of riparian vegetation to ground water and create dynamic habitats for increased benthic macroinvertebrate production.

Climate change is a source of uncertainty regarding long-term project performance and resiliency. Because all alternatives in the final array would be affected similarly by climate change, it was not a factor in selection of the RP.

8.2 Plan Implementation

This section describes the remaining steps to potential authorization of the project by Congress and implementation by USACE and the sponsor.

8.2.1 Report Completion and Approval

The Final FR/EA would circulate for state and agency review as required by the Flood Control Act of 1944, as amended. The Chief of Engineers signs the report signifying approval of the project recommendation. This report would be submitted to the Assistant Secretary of the Army for Civil Works, who would coordinate with the Office of Management and Budget and submit the report to Congress.

8.2.3 Project Authorization and Construction

If the project is authorized by Congress, construction funds must be appropriated for the project by Congress before a Project Partnership Agreement (PPA) can be signed by USACE and the sponsor and before detailed project design and construction could begin. A project management plan outlining Federal and non-Federal obligations, requirements, tasks, costs, and schedule from design through construction would also be prepared.

8.2.4 Division of Responsibilities

8.2.4.1 Federal Responsibilities

USACE would first accomplish Preconstruction Engineering and Design (PED) studies. After the PPA is signed and the non-Federal sponsor provides the required lands, easements, rights-of-way, relocations, and disposal areas (LERRD), and cash contribution, the Federal Government would construct the project. The Federal Government would be responsible for cost-shared monitoring until criteria for ecosystem restoration success have been met, up to a maximum of ten years from the completion of construction.

8.2.4.2 Non-Federal Responsibilities

It is the intention of the non-Federal sponsor to implement analysis and consultation under CEQA after Congressional authorization and before the PPA is signed.

Under the PPA, the non-Federal sponsor would be responsible to USACE for LERRDs, cash contributions, and all OMRR&R requirements (see items of cooperation in Chapter 9). Any required ecological monitoring beyond ten years would be included in the OMRR&R requirements.

Views of Non-Federal Sponsor

The non-Federal sponsor supports the Recommended Plan.

Financial Capability of Sponsor

The non-Federal sponsor has indicated that it intends to fund the project, pending further development through the final report and supporting documents. The non-Federal sponsor has provided self-certification of financial capability.

Project Cost-Sharing Agreements

A Design Agreement must be executed between USACE and the non-Federal sponsor in order to cost share the development of detailed plans and specifications. Before construction is started, the Federal Government and the non-Federal sponsor would execute a PPA. The PPA defines the responsibilities of the parties throughout the project's design, construction, and operational phases, and specifies the non-Federal sponsor's required financial and real estate contributions.

8.2.5 Schedule

If the project is authorized in 2019, construction activities could start as early as 2022. The following is a schedule showing the approval and construction phases of the project, assuming optimal funding.

District Engineer's Transmittal	JAN 2019
Chief of Engineers Report	JUL 2019

Potential Congressional Authorization	OCT 2019
USACE and Sponsor Sign Design Agreement	NOV 2019
Initiate PED	2019
Initiate Construction	2022
Complete Physical Construction	2025
Complete Plant Establishment Period	2030
Complete Monitoring	2040

8.2.6 Further Analysis During the Design Phase

During Preconstruction Engineering and Design (PED), some additional studies would be undertaken as part of developing detailed designs for the project and avoiding and minimizing potential environmental effects. Upon initiation of PED, any new information that has been collected by others would be considered before undertaking these additional studies. These additional studies include:

- Hydraulic modeling for project design;
- PED level Value Engineering Study;
- Topographic surveys for project design;
- Geomorphic and scour analysis;
- Development of operation and maintenance manual.

In addition to studies conducted to inform design, preconstruction environmental surveys would be conducted to evaluate the potential for project actions to impact vegetation, wildlife, and sensitive species.

- Swainson's hawk surveys would be conducted prior to construction to evaluate the potential for the project to effect nesting Swainson's hawks. This survey would also serve to evaluate the potential for the project to affect nesting raptors and other migratory birds in general.
- Vegetation and habitat surveys would serve to identify any potential impacts to sensitive species or high value habitat that could otherwise be avoided during construction. This survey would also serve to identify any elderberry shrubs. Cultural resource surveys would be conducted to evaluate the risk to cultural and historic resources.
- Two weeks prior to any disturbance within suitable habitat for foothill yellow-legged frog, proposed disturbance areas shall be surveyed for adult frogs, tadpoles, or eggs by a qualified biologist. If the species is detected, the biologist shall contact CDFW to determine if moving any of the life stages is appropriate. In making this determination, CDFW would consider if an appropriate relocation site exists. If CDFW approves

moving the animals, the biologist shall be allowed sufficient time to move the animals from the work site before work activities begin.

Chapter 9 – Recommendations

I have given consideration to environmental, social, and economic effects, and the engineering feasibility of the recommended plan, which is also the National Ecosystem Restoration (NER) Plan. I recommend the transmission of this report to Congress for authorization of the NER Plan, as a Federal project, with such modifications thereof as in the discretion of the Commander, U.S. Army Corps of Engineers, may be advisable. The estimated first cost of the recommended plan is \$97,219,000 and the estimated average annual OMRR&R cost is \$15,000 (October 2018 price level). The Federal portion of the estimated first cost is \$63,192,000. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

- a. Provide 35 percent of total project costs as further specified below:
 1. Provide 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
 2. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;
 3. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total project costs;
- b. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the funds verifies in writing that the funds are authorized to be used to carry out the project;
- c. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the project, hinder operation and maintenance of the project, or interfere with the project's proper function;
- d. Shall not use the project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;
- e. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of

materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

- f. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, except as limited by Section 1161 of the Water Resources Development Act of 2016, Public Law 114-322 (33 U.S.C. 2330a(e)), at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;
- g. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;
- h. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;
- i. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as would properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;
- j. Comply with all the requirements of applicable Federal laws and implementing regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352, as amended (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Army Regulation 600-7 issued pursuant thereto; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (labor standards originally enacted as the Davis-Bacon Act , the Contract Work Hours and Safety Standards Act, and the Copeland Anti-Kickback Act);
- k. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations

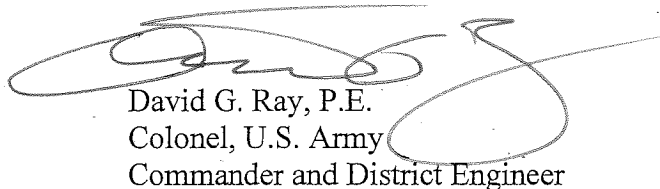
unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

- l. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;
- m. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that would not cause liability to arise under CERCLA; and
- n. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213[j]), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties would be advised of any modifications and would be afforded an opportunity to comment further.

14 JAN '19

Date



David G. Ray, P.E.
Colonel, U.S. Army
Commander and District Engineer

This page intentionally left blank.

Chapter 10 – List of Preparers

The individuals listed in the following table were primarily responsible for the preparation of this report.

Table 10-1. List of Preparers.

Name	Experience	Credentials	Role in the Study
Stefanie Adams, Cultural Resources Specialist	9 years Environmental Planning and Cultural Compliance, USACE	BA: Linguistics	Document organization/preparation
Anne Baker, Senior Environmental Manager	11 years NEPA and Environmental Planning, USACE	BA: English	Document preparation, environmental planning
Diego A. Benavidez, Civil Engineer	8 years Cost Engineering, USACE	GS: Civil Engineering Technology; Certified Cost Engineering Technician	Cost engineering
Tom Borrowman, Civil/Environmental Engineer	14 years, USACE	MS: Civil Engineering	Engineering Technical Lead
Nate Eskridge, GIS/Cartographer	2.5 years Geomatics Section, USACE; 2 years Military Installation GIS, US Marine Corps; 3 years Engineering Technician/GIS, Bureau of Reclamation; 8 years Active Army GIS	BS: Information Technology	Geographic Information System activities
Michael Fong, Biological Science Environmental Manager	5 years Environmental Planning and Compliance, USACE	BS: Biology; Certificate: Field Ecology	Environmental Lead, environmental planning and compliance
Melissa Hallas	9 years, USACE	BS: Engineering	Lead Planner; plan formulation and evaluation, document preparation
Gene Maak	32 years, USACE	BS: Engineering	Hydraulic Lead – Ecosystem Output Modeling
Scott Miner, Regional Technical Specialist	36 years Water Resources Planning, USACE	BS: Biology; MS: Wildland Resource Science	Plan formulation, policy and review

Table 10-1 (cont). List of Preparers.

Name	Experience	Credentials	Role in the Study
Vanessa Niño-Tapia, Civil Designer	4 years Civil Design, USACE	BS: Civil Engineering; MS: Civil Engineering	Lead Civil Designer
Patrick O'Day Archeologist	20 years experience in archaeology and cultural resources	PhD: Anthropology	Lead Cultural Resources
Steven Highland	15 years experience in archaeology and cultural resources	BA & MA: Anthropology PhD: Anthropology	Lead Cultural Resources
Laurie Parker	26 years, USACE; Civil Works Projects; Real Estate, Planning, Project Management and Engineering; California	B.A. Geography	Lead Real Estate
Brooke Schlenker, Certified Water Resources Planner	15 years, USACE; Military and Civil Works Projects; Planning, Environmental, and Engineering; California and Georgia	MS: Physical Science; BS: Integrated Science and Technology	Lead Planner; plan formulation and evaluation, document preparation
Jesse Schlunegger, P.E., Hydraulic Analysis Section Chief	14 Years of Experience in Water Resources Engineering	BS: Civil and Environmental Engineering, Registered Professional Engineer in California	Hydraulic Engineer, Technical Advisor, document review
Corrie Stetzel, Water Resources Planner	2 years Water Resources Planning, USACE; 2 years Environmental Compliance, National Park Service	BS: Community and Regional Development	Lead Planner; document preparation, plan formulation
Chelsea Stewart, Project Manager	3 years Civil Works Project Manager, USACE; 5 years Natural Resources Specialist, Bureau of Reclamation	BA: Nature and Culture	Project oversight

Chapter 11 – References

- Angel, M. 1882. *History of Placer County*. Thompson and West. Oakland.
- Barr, C. B. 1991. The distribution, habitat, and status of the valley elderberry longhorn beetle *Desmocerus californicus dimorphus*. U.S. Fish and Wildlife Service. Sacramento, California.
- Bank Swallow Technical Advisory Committee (BSTAC). 2013. Bank Swallow (*Riparia riparia*) Conservation Strategy for the Sacramento River Watershed, California. Version 1.0. www.sacramentoriver.org/bans/
- Baumgart, Don. 2002. Pressure Builds to End Hydraulic Gold Mining. Nevada County Gold. Retrieved from <http://nevadacountygold.com/about/41-about/167-pressure-builds-to-endhydraulic-gold-mining>.
- Beak Consultants, Inc. 1989. Yuba River Fisheries Investigation, 1986-1988. Summary Report of Technical Studies on the Lower Yuba River, California. Prepared for Sate of California Resources Agency Department of Fish and Game.
- Beals, R.L. 1933. Ethnography of the Nisenan. *University of California Publications in American Archaeology and Ethnology*: 31(6):335-414. Berkeley.
- California Air Resources Board (CARB). 2011. Toxic Air Contaminant Identification List. visit: <https://www.arb.ca.gov/toxics/id/taclist.htm>
- California Invasive Plant Council (Cal-IPC). 2018a. Plant Assessment Form. *Ficus carica*. <https://www.cal-ipc.org/plants/paf/ficus-carica-plant-assessment-form/>. Accessed October 2018.
- California Invasive Plant Council (Cal-IPC). 2018b. Invasive Plants of the Sacramento River Watershed. *Ailanthus altissima*. <https://www.cal-ipc.org/plants/profile/ailanthus-altissima-profile/>. Accessed October 2018.
- CARB. 2015. Quality Assurance Air Monitoring site information on 773 Almond Street, Yuba City, CA, 95992. visit: https://www.arb.ca.gov/qaweb/site.php?s_arb_code=51898
- CARB. May 4, 2016a. Table 4-1. State and Federal Ambient Air Quality Standards. visit: <https://www.arb.ca.gov/research/aaqs/aaqs2.pdf>
- CARB. April 12, 2016b. Summary: Diesel Particulate Matter Health Impacts. visit: https://www.arb.ca.gov/research/diesel/diesel-health_summ.htm
- CARB. 2017 California Greenhouse Gas Emission Inventory: 2000 – 2015. Version June 6, 2017.
- California Department of Fish and Wildlife (CDFW). 2016. California Natural Diversity Database. Sacramento, CA. <http://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp>. Accessed August 2017.

- California Department of Fish and Wildlife (CDFW). 2018. California's Invaders: New Zealand Mudsail. Retrieved from <https://www.wildlife.ca.gov/Conservation/Invasives/Species/NZmudsail>
- California Department of Fish and Wildlife (CDFW). 2018. California's Invaders: Brown-headed cowbird. Retrieved from <https://www.wildlife.ca.gov/Conservation/Invasives/Species/Cowbird>
- California Department of Transportation (Caltrans). 2015. Traffic Census Program. Retrieved from <http://www.dot.ca.gov/trafficops/census/>
- California Department of Water Resources (DWR), 1999. Yuba Goldfields Fish Barrier Project. Preliminary Engineering Report.
- California Department of Water Resources (DWR). 2008. Managing an Uncertain Future. Climate Change Adaptation Strategies for California's Water. October 2008.
- California Department of Water Resources (DWR). 2016 Hydroclimate Report for Water Year 2016. DWR Bulletin 120. 32 pages. www.wrcc.dri.edu/monitor/cal-mon/index.html.
- California Energy Commission (CEC) Staff. 2016. 2016 Integrated Energy Policy Report Update. California Energy Commission. Publication Number: CEC-100-2016-003-CMF.
- California Native Plant Society 2017. Inventory of Rare and Endangered Plants of California (online edition, v8-03 0.39). Website <http://www.rareplants.cnps.org>
- CEDEN. 2006-2007. California Environmental Data Exchange Network [Internet]. Sacramento, CA. Available from: <http://www.ceden.org>. Station Codes: 515XYRAMV, 515YBAMVL.
- cbec, inc. (cbec). 2013. Hydrologic and Geomorphic Analysis to Support Rehabilitation Planning for the Lower Yuba River from Parks Bar to Marysville. Prepared for the South Yuba River Citizens League with Funding Provided by the Anadromous Fish Restoration Program.
- cbec, Inc.; South Yuba River Citizens League; and McBain & Trush, Inc. (cbec et al.) 2010. Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach of the Lower Yuba River. November 2010. Prepared for the USFWS with Funding Provided by the Anadromous Fish Restoration Program.
- Cederholm, C. J., D. H. Johnson, R. E. Bilby, L.G. Dominguez, A. M. Garrett, W. H. Graeber, E. L. Greda, M. D. Kunze, B.G. Marcot, J. F. Palmisano, R. W. Plotnikoff, W. G. Percy, C. A. Simenstad, and P. C. Trotter. 2000. Pacific Salmon and Wildlife - Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report, Prepared for D. H. Johnson and T. A. O'Neil (Managing directors), Wildlife-Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife, Olympia, Washington.
- Chamberlain, William Henry and Harry L. Wells. 1879. History of Yuba County, California with illustrations descriptive of its scenery, residences, public buildings, fine blocks and

- manufactories, from original sketches by artists of the highest ability. Thompson and West. Oakland.
- Childs, J.R., N.P. Snyder, M.A. Hampton. 2003. Bathymetric and geophysical surveys of Englebright Lake, Yuba-Nevada Counties, California. U.S. Geological Survey Open-File Report: 03–383.
- Cook, John, Naomi Oreskes, Peter T Doran, William R L Anderegg, Bart Verheggen, Ed W Maibach, J Stuart Carlton, Stephan Lewandowsky, Andrew G Skuce, and Sarah A Green. 2016. Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*. Volume 11, number 4. 8 pages.
- Cook, Sherburne F. 1955. The Epidemic of 1830-1833 in California and Oregon. University of California Publications in American Archaeology and Ethnology 3(3): 303-326. Berkeley.
- Cook, Sherburne F. 1976. *The Conflict Between the California Indians and White Civilization*. University of California Press. Berkeley.
- Council on Environmental Quality (CEQ). 2014. Guidance to Federal Agencies for considering effects of greenhouse gas (GHG) emissions and climate change. 31-pages. visit: https://obamawhitehouse.archives.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf
- Daily Appeal*. 11/28/1880. *New Bridge*.
- Delay, P.J. 1924. *History of Yuba and Sutter Counties, California*. Historic Record Company. Los Angeles, California.
- Dettling, M. D., Seavy N. E., Howell C. A. and T. Gardali. 2015. Current status of Western Yellow-billed Cuckoo along the Sacramento and Feather rivers, California. *PloS one* 10(4): p.e0125198.
- Dettinger, Michael D. and Michael L. Anderson. January 1, 2015. Storage in California's Reservoirs and Snowpack in Time of Drought. *San Francisco Estuary and Watershed Science*. 13(2). ISSN 1546-2366.
- Donogyue, Li, Melissa L. Wrzesien, Michael Durand, Jennifer Adam, and Dennis P. Lettenmaier. June 28, 2017. How much runoff originates as snow in the western United States, and how will that change in the future? *Geophysical Research Letters*. volume 44, issue 12, pages 6163-6172.
- Dougherty, J. W. 1990. The Obsidian Projectile Points of the King-Brown Site: CA-SAC-29, Sacramento County, California. Unpublished Masters Thesis, Department of Anthropology, California State University, Sacramento.
- Elsasser, Albert B. 1960. Reports of the University of California Archaeological Survey No. 51: *The Archaeology of the Sierra Nevada in California and Nevada*. The University of California Archaeological Survey. Berkeley.

- Elsasser, Albert B. 1978. Development of regional prehistoric cultures. In R. F. Heizer, vol. ed., *Handbook of North American Indians, Vol. 8: California*: 37-58. Washington, D.C.: Smithsonian Institution.
- Eriksen, C. H., and D. Belk. 1999. Fairy shrimps of California's puddles, pools and playas. Mad River Press, Inc., Eureka, CA.
- Fagan, B. 2003. *Before California: An Archaeologist Looks at Our Earliest Inhabitants*. Alta Mira, Walnut Creek.
- Faye, Paul-Louis. 1923. Notes on the Southern Maidu. University of California Publications in American Archaeology and Ethnology 20(3):35-53. Berkeley.
- Forbes, Jack. 1969. *Native Americans of California and Nevada*. Naturegraph Publishers. Healdsburg.
- Gifford, E.W. 1927. Southern Maidu Religious Ceremonies. *American Anthropologist* 29(3):214-257.
- Gilbert, G.K. 1917. *Hydraulic-Mining Debris in the Sierra Nevada*. U.S. Geological Survey Professional Paper 105. Washington, D.C.
- Greenland, P. 2001. *Hydraulic Mining in California: A Tarnished Legacy*. The Arthur H. Clark Company. Spokane, Washington.
- Gudde, E.G. 1975. *California Gold Camps*. University of California Press. Berkeley.
- Halstead, B. J., Wylie, G. D. and M. L. Casazza. 2014. Ghost of habitat past: historic habitat affects the contemporary distribution of giant garter snakes in a modified landscape. *Animal Conservation* 17(2): 144-153.
- Heizer, Robert F., and Albert B. Elsasser. 1953. *Some Archaeological Sites and Cultures of the Central Sierra Nevada*. University of California Archaeological Survey Reports 21:1-42. Berkeley.
- HDR (2016). Yuba River Ecosystem Restoration Feasibility Study Habitat Measures, Prepared for the US Army Corps of Engineers Sacramento District and Yuba County Water Agency, October 2016.
- Holliday, J.S. 1981. *The World Rushed In: The California Gold Rush Experience, An Eyewitness Account of a Nation Heading West*. Simon and Schuster. New York.
- Hoover, Mildred, Hero Rensch, Ethel Rensch, and William N. Abeloe. 1966. *Historic Spots in California*. Stanford University Press.
- Humphreys, S.E. 1969. *The Archaeology of New Bullards Bar*. San Francisco: Report to the National Park Service.
- Hunerlach, M.P., Alpers, C.N., Marvin-DiPasquale, M., Taylor, H.E., and De Wild, J.F., 2004, Geochemistry of mercury and other trace elements in fluvial tailings upstream of Daguerre Point Dam, Yuba River, California, August 2001: U.S. Geological Survey Scientific Investigations Report 2004-5165, 66 p.

- Intergovernmental Panel on Climate Change (IPCC). 2014. Climate Change 2014. Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
- Jackson, R. J., and H. S. Ballard. 1999. *Once Upon A Micron: A Story of Archaeological Site CA-ELD-145 Near Camino, El Dorado County, California*. Submitted to CALTRANS District 3, Environmental Branch, Marysville. Submitted by Pacific Legacy, Incorporated. Cameron Park, California.
- Jackson, Turrentine W., Rand Hebert, and Stephen Wee. 1982. Tahoe National Forest: History of the Tahoe National Forest: 1840-1940. United States Department of Agriculture. Tahoe National Forest Report No. 15.
- James, L.A. 2005. Sediment from Hydraulic Mining Detained by Englebright and Small Dams in the Yuba Basin. *Geomorphology*, 71(1-2): 202-226.
- James, L.A. 2015. Designing forward with an eye to the past: Morphogenesis of the lower Yuba River. *Geomorphology*, 251: 31-49.
- James, L.A., Singer, M.B., Ghoshal, S. and Megison, M. 2009. Historical channel changes in the lower Yuba and Feather rivers, California: Long-term effects of contrasting river-management strategies, in James, L.A., Rathburn, S.L., and Whittecar, G.R. eds., *Management and Restoration of Fluvial Systems with Broad Historical Changes and Human Impacts: Geological Society of America Special Paper 451*, p. 57-81.
- Jenkins, Jennifer C.; Chojancky, David C.; Heath, Linda S.; Birdsey, Richard A. 2004. Comprehensive database of diameter-based biomass regressions for North American tree species. GTR NE-319. Newtown Square, PA; U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 1-45.
- JRP Historical Consulting Services and Caltrans. 2000. *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures*. Caltrans Environmental Program/Cultural Studies Office; Sacramento, California.
- Justice, Noel D. 2002. *Stone Age Spear and Arrow Points of California and the Great Basin*. Indiana University Press. Bloomington.
- Kapnick, Sarah and Hall, Alex. 2009. Observed Climate – Snowpack Relationships in California and their Implications for the Future. *Journal of Climate*, Volume 23, 3446 - 3456.
- Kelley, R.L. 1954. *Forgotten Giant: The Hydraulic Gold Mining Industry in California*. University of California Press. Berkeley.
- Kelley, R.L. 1959. *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley, A Chapter in the Decline of the Concept of Laissez Faire*. The Arthur C. Clark Company. Glendale, California.
- Kelley, R.L. 1989. *Battling the Inland Sea: American Political Culture, Public Policy, and the Sacramento Valley, 1850-1986*. University of California Press. Berkeley.

- Kelsey, Charles E. 1971. Census of Non-reservation California Indians, 1905-1906 Berkeley, California: Archaeological Research Facility, Department of Anthropology, University of California. Berkeley.
- King, J. L., Simovich M. A., and R. C. Brusca. 1996. Species richness, endemism and ecology of crustacean assemblages in northern California vernal pools. *Hydrobiologia* 328:85-116.
- Knowles N, Cayan DR. 2002. Potential effects of global warming on the Sacramento/San Joaquin watershed and the San Francisco estuary. *Geophysical Research Letters*, Vol. 29, No. 18, pgs 38-1 – 38-4. <https://doi.org/10.1029/2001GL014339>
- Knowles N, Dettinger MD, Cayan DR. 2006. Trends in snowfall versus rainfall in the western United States. *Journal of Climate* 19:4545– 4559. <https://doi.org/10.1175/JCLI3850.1>
- Kowta, Makoto. 1988. The Archaeology and Prehistory of Plumas and Butte Counties, California: An Introduction and Interpretive Model, California Archaeological Site Inventory, Manuscript on file at the Northeast Information Center.
- Kroeber, A.L. 1925. Handbook of the Indians of California. Bureau of American Ethnology Bulletin 78. Government Printing Office, Washington D.C. (reprinted in 1976 by Dover Publications Inc.). New York.
- Kupferberg, S. J., Palen, W. J., Lind, A. J., Bobzien, S., Catenazzi, A., Drennan, J. O. E. and M. E. Power. 2012. Effects of Flow Regimes Altered by Dams on Survival, Population Declines, and Range-Wide Losses of California River-Breeding Frogs. *Conservation Biology* 26(3): 513-524.
- Kyle, Douglas E. 1990. Historic Spots in California. Stanford University Press. Stanford.
- Lindley, S. T., and coauthors. 2007. Framework for assessing viability of threatened and endangered chinook salmon and steelhead in the Sacramento-San Joaquin Basin. Pages 3-26 in San Francisco Estuary & Watershed Science. California Bay-Delta Science Program and John Muir Institute of the Environment.
- Lindstrom, S. G., S. A. Waechter, M. Rucks, and R. Reno. 2007. *Volume I: Report: From Ice Age to Ice Works: Archaeological, Ethnohistorical, and Historical Studies for the Truckee River Legacy Trail Project (Phase 3)*. Submitted by Far Western Anthropological Research Group, Inc., Davis. Submitted to Town of Truckee. Truckee, California.
- Littlejohn, H.W. 1928. Nisenan Geography. Manuscript in Bancroft Library, University of California, Berkeley.
- Lower Yuba River Fisheries Technical Working Group (LYRFTWG). 2005. Draft Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration; Multi-Agency Plan to Direct Near-Term Implementation of Prioritized Restoration and Enhancement Actions and Studies to Achieve Long- Term Ecosystem and Watershed Management Goals. Prepared by the Lower Yuba River Fisheries Technical Working Group, funded by CALFED and the Yuba County Water Agency.

- May, J.T., Hothem, R.L., Alpers, C.N., & Law, M.A. 2000. Mercury bioaccumulation in fish in a region affected by historic gold mining: The South Yuba River, Deer Creek, and Bear River Watersheds, California, 1999: U.S. Geological Survey Open File Report 00-367, 30 p. Available online: <http://ca.water.usgs.gov/archive/reports/ofr00367/index.html>.
- May, P.R. 1970. *Origins of Hydraulic Mining in California*. The Holmes Book Company, Oakland, California.
- McGuire, Kelly R. 2007. Models Made of Glass: A Prehistory of Northeast California. In *California Prehistory: Colonization, Culture, and Complexity*, edited by Terry L. Jones and Kathryn Klar. Alta Mira Press, Walnut Creek, California.
- McGuire, K., S. A. Waechter, and D. C. Young, Daron Duke. 2006. *Volume I - Prehistoric Sites: Archaeological Investigations at the Alder Hill Prehistoric Basalt Quarry, Nevada County*. Submitted by Far Western Anthropological Research Group, Inc., Davis. Submitted to East West Partners. Truckee, California.
- Merriam C.H. 1966-67. Ethnographic Notes on California Tribes. Robert F. Heizer, ed. 3 pts. University of California Archaeological Survey Reports 68. Berkeley.
- Mitchell, W. T. 2010. Age, Growth, and Life History of Steelhead Rainbow Trout (*Oncorhynchus mykiss*) in the Lower Yuba River, California. March 2010.
- Moratto, Michael J. 2004. *California Archaeology*. Second Printing. Coyote Press, Salinas.
- Mote, P.W., A.F. Hamlet, M.P. Clark, and D.P. Lettenmaier, 2005. *Bull. Amer. Meteor. Soc.*, 86, 39–49, <https://doi.org/10.1175/BAMS-86-1-39>
- Mount, J.F. 1995. *California Rivers and Streams: The Conflict Between Fluvial Process and Land Use*. University of California Press, Berkeley.
- National Marine Fisheries Service (NMFS). 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office. July 2014.
- National Marine Fisheries Service (NMFS). 2016a. 5-Year Review: Summary and Evaluation of *Central Valley Spring-run Chinook Salmon Evolutionarily Significant Unit*. NMFS West Coast Region. April 2016.
- National Marine Fisheries Service (NMFS). 2016b. 5-Year Review: *Summary and Evaluation California Central Valley Steelhead Distinct Population Segment*. NMFS West Coast Region. May 2016.
- Nadeau, Remi. 1965. *Ghost Towns and Mining Camps of California*. Los Angeles: Ward Ritchie Press.
- The Nature Conservancy. 2018. Stories in California: California Migratory Birds – The global benefits of saving the pacific flyway. <https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/california/howwe-work/california-migratory-birds.xml>. Accessed October 16, 2018.

- Pagenhart, Thomas. 1969. *Water Use in the Yuba and Bear River Basins, California*. Doctoral Dissertation for the University of California, Berkeley.
- Pasternack, G.B. 2009. SHIRA-Based River Analysis and Field-Based Manipulative Sediment Transport Experiments to Balance Habitat and Geomorphic Goals on the Lower Yuba River. Cooperative Ecosystems Studies Unit (CESU) 81332 6 J002 Final Report, University of California at Davis.
- Peterson, Robert M. 1977. *A Case study of a Northern Californian Indian Tribe: Cultural Change to 1860*. R and E Research Associates. Reed and Eterovich. Saratoga, California.
- Pittman, Ruth. 1995. *Roadside History of California*. Mountain Press Publishing Company, Missoula, MT.
- Powell, James Lawrence. October 1, 2016. The Consensus on Anthropogenic Global Warming Matters. *Bulletin of Science, Technology & Society*. Volume: 36. Issue 3. Page(s): 157-163.
- Powers, S. 1976 [1877]. *Tribes of California. Contributions to North American Ethnology 3*. United States Geological and Geographical Survey of the Rocky Mountain Region, Washington. Reprinted by the University of California Press, Berkeley.
- Preston, R. E. 2006. *Brodiaea sierrae* (Themidaceae), a new species from the Sierra Nevada foothills of California, USA. *Novon: A Journal for Botanical Nomenclature* 16(2): 254-259.
- Richmond, O. M, Chen, S. K., Risk, B. B., Tecklin, J. and Beissinger, S. R, 2010. California Black Rails depend on irrigation-fed wetlands in the Sierra Nevada foothills. *California Agriculture* 64(2): 85-93.
- Ritter, Eric W. 1970a. Northern Sierra Foothill Archaeology: Culture History and Culture Process. In *Papers on California and Great Basin Prehistory*, edited by Eric W. Ritter, Peter W. Schulz and Robert Kautz, pp.173-184. Center for Archaeological Research at Davis. Publication 2. Davis, California.
- Ritter, Eric W. 1970b. The archaeology of 4-Pla-101, the Spring Garden Ravine site. In E.W. Ritter, ed., *Archaeological investigations in the Auburn Reservoir area, Phase II-III*: 270-538. Report to the National Park Service. San Francisco.
- Ritter, Eric W. (ed.) 1970c. *Archaeological Investigations in the Auburn Reservoir Area, Phase II-III*. Report to the National Park Service. San Francisco.
- Ritter, Eric W., and R.G. Matson. 1972. Form categories, cluster analysis, and multidimensional scaling: A case study of projectile points. *Southwestern Lore* 37(4):102-116.
- Robinson, William W. 1948. *Land in California: The Story of Mission Lands, Ranchos, Squatters, Mining Claims, Railroad Grants, Land Scrip, Homesteads*. University of California Press. Berkeley, California.

- Rosenthal, Jeffrey S. 2008. Volume I: Synthesis. The Prehistory of the Sonora Region: *Archaeological and Geoarchaeological Investigations for Stage I of the East Sonora Bypass Project, State Route 108, Tuolumne County, California*. Far Western Anthropological Research Group, Inc. Davis, California.
- Roth, D. A., H. E. Taylor, J. Domagalski, P. Dileanis, D. B. Peart, R. C. Antweiler, and C. N. Alpers. 2001. Distribution of inorganic mercury in the Sacramento River water and suspended colloidal sediment material. *Archives of Environmental Contamination and Toxicology* 40:161–172.
- Singer, Michael B. Et al. 2016. Hydrologic indicators of hot spots and hot moments of mercury methylation potential along river corridors. *Science of the Total Environment*. Vol. 568, Pages 697-711. October 15, 2016.
- State Mining and Geology Board (SMGB). 2014. Western Aggregates LLC Yuba County Operations Amended Reclamation Plan – Draft Environmental Impact Report. SCH No. 2013042008. October 2014.
- Transportation Research Board. 2000. Highway Capacity Manual. Washington, D.C.
- Uldall, H.J. and W. Shipley. 1966. Nisenan Texts and Dictionary. University of California Press, Berkeley. UCPL 46.
- USACE. 2014. Voluntary Conservation Measures – Habitat Enhancement on the Lower Yuba River. Yuba County, CA. Draft Environmental Assessment. July 2014.
- U.S. Army Corps of Engineers (USACE). 2015. Central Valley Hydrology Study. November 29, 2015.
- United States Ninth Circuit Court. 7 Jan 1884. Woodruff v. North Bloomfield Gravel Mining Company.
- U.S. Bureau of Land Management (BLM). 2001. Riparian Area Management: The Use of Aerial Photography to Manage Riparian-Wetland Areas. Technical Reference 1737-10. Denver, CO.
- U.S. Bureau of Reclamation (USBR), California Department of Water Resources (DWR), and Yuba County Water Agency (YCWA). 2007. Lower Yuba River Accord Environmental Impact Statement/Environmental Impact Report.
- USFWS. 2005. Recovery plan for vernal pool ecosystems of California and Southern Oregon. Portland, OR
- USFWS. 2006. Final Critical Habitat for Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)-Vernal Pool Species. Sacramento, CA. U.S. Fish and Wildlife Service (USFWS) and Yuba County. 2016. Yuba River Canyon Salmon Habitat Restoration Project. Environmental Assessment/ Initial Study. Prepared by ESA. December 2016.
- U.S. Fish and Wildlife Service (USFWS) and Yuba County. 2017. Hallwood Side Channel and Floodplain Restoration Project on the Lower Yuba River. Environmental Assessment/ Initial Study. Public Draft. October 2017.

- Voegelin, E. 1942. *Cultural element distributions XX: Northeast California*. University of California Anthropological Records 7(2):47–252.
- Waechter, Sharon A. and William W. Bloomer. 2009. *Tahoe Reach Revisited: The Latest Pleistocene/Early Holocene in the Tahoe Sierra*. *SCA Proceedings* 22:1-8.
- Wentz, D.A., Brigham, M.E., Chasar, L.C., Lutz, M.A., and Krabbenhoft, D.P. 2014. Mercury in the Nation's streams— Levels, trends, and implications: U.S. Geological Survey Circular 1395, 90 p., <http://dx.doi.org/10.3133/cir1395>.
- West, James G., Wallace Woolfenden, James A. Wanket, and R. Scott Anderson. 2007. Late Pleistocene and Holocene Environments. Pp. 11-34 in *California Prehistory: Colonization, Culture and Complexity*. Editors Terry L. Jones and Kathryn A. Klar. AltaMira Press, Lanham, MD.
- Wheeler, C. A. and H. H. Welsh Jr. 2008. Mating strategy and breeding patterns of the foothill yellow-legged frog (*Rana boylei*). *Herpetological Conservation and Biology* 3(2): 128-142.
- Wilson, N.L. 1972. Notes on Traditional Foothill Nisenan Food Technology. Center for Archaeological Research at Davis Publication Number 3, pp. 32-38.
- Wilson, N.L. and A.H. Towne. 1978. Nisenan. In *Handbook of North American Indians*, Vol. 8, California. Smithsonian Institution, Washington, D.C. pp. 387-397.
- Wood, D. A., Halstead B. J., Casazza M. L., Hansen, E. C., Wylie, G. D. and A. G. Vandergast. 2015. Defining population structure and genetic signatures of decline in the giant gartersnake (*Thamnophis gigas*): implications for conserving threatened species within highly altered landscapes. *Conservation Genetics* 16(5): 1025-1039.
- Woodbridge, B. 1998. Swainson's Hawk (*Buteo swainsoni*). In the riparian bird conservation plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/riparian_v-2.html
- Work, John. 1945. *Fur Brigade to the Bonaventura: John Work's California expedition, 1832-1833*, for the Hudson's Bay Company. California Historical Society.
- Wyrick, J. R. and G. Pasternack. 2012. Landforms of the Lower Yuba River. Prepared for the Yuba Accord River Management Team as part of the Lower Yuba River Monitoring and Evaluation Program.
- Yarnell, S. M., ed. 2008. Quantifying Physical Habitat Heterogeneity in an Ecologically Meaningful Manner: A Case Study of the Habitat Preferences of the Foothill Yellow-legged Frog (*Rana boylei*). Nova Science .
- Yarnell, S. M., Lind A. J., Mount J. F. 2012. Dynamic flow modelling of riverine amphibian habitat with application to regulated flow management. *River Research and Applications* 28: 177–191.
- Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historical and Present Distribution of Chinook Salmon in the Central Valley Drainage of California. Contributions to the Biology of Central Valley Salmonids. Fish Bulletin 179, Volume 1.

- Yuba Accord River Management Team (RMT). 2009. Appendix M of the Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead Final Habitat Expansion Plan Habitat - Expansion for Spring-Run Chinook Salmon and Steelhead in the Lower Yuba River Prepared for the HEA Steering Committee by Members of the Yuba Accord River Management Team.
- Yuba Accord River Management Team (RMT). 2010. Lower Yuba River Water Temperature Objectives – Technical Memorandum. November 2010.
- Yuba Accord River Management Team (RMT). 2013. Aquatic Resources of the Lower Yuba River – Past, Present & Future, Yuba Accord Monitoring and Evaluation Program, Draft Interim Report. April 2013.
- Yuba County. 2007. Yuba County Parks Overview. Yuba County Department of Public Works. Retrieved from <http://www.co.yuba.ca.us/departments/community%20development/public%20works/parks/default.aspx>
- Yuba County. 2011. Yuba County 2030 General Plan. Yuba County Community Development & Services Agency. Prepared by AECOM. Sacramento, California.
- Yuba County. 2015. Yuba Count Integrated Regional Water Management Plan (IRWMP) 2015 Update. Adoption Draft. Prepared by the Yuba County Regional Water Management Group in collaboration with Burdick & Company. May 2015.
- Yuba County Water Agency (YCWA). 2007. Yuba River Development Project FERC Project No. 2246. Final Fisheries Agreement. Retrieved from <http://www.yubaaccordrmt.com/Yuba%20Accord%20Documents/Forms/AllItems.aspx?RootFolder=%2fYuba%20Accord%20Documents%2fYuba%20Accord%20Documents&FolderCTID=%2639586C5B0%2d7D95%2d45E5%2dA951%2d795AB3A3A8AF%7d>
- Yuba County Water Agency (YCWA). 2009. Yuba River Development Project - FERC Project No. 2246 – Preliminary Information Package - Public Information – Hydrology Report. Yuba County Water Agency, Marysville, CA.
- Yuba County Water Agency (YCWA). 2013a. Yuba River Development Project - FERC Project No. 2246 – Technical Memorandum 1-2, Channel Morphology Downstream of Englebright Dam. June 2013. Yuba County Water Agency, Marysville, CA.
- Yuba County Water Agency (YCWA). 2013b. Yuba River Development Project FERC Project No. 2246. Technical Memorandum 6-2. Riparian Habitat Downstream of Englebright Dam.
- Yuba County Water Agency (YCWA). 2014. Cultural Resources Inventory, National Register of Historic Places Evaluations, and Finding of Effect for the Yuba River Development Project Relicensing, Nevada, Yuba, and Sierra Counties, California. Yuba River Development Project. FERC Project No. 2246. Yuba County Water Agency.

- Yuba County Water Agency (YCWA). 2016. Historic Properties Management Plan. Yuba River Development Project. FERC Project No. 2246. Yuba County Water Agency.
- Yuba County Water Agency (YCWA). 2017. Applicant-Prepared Draft Biological Assessment for Central Valley Spring-Run Chinook Salmon, Central Valley Steelhead and North American Green Sturgeon, in Volume IV of YCWA's June 2, 2017 Amended Final License Application to FERC. Yuba River Development Project. FERC Project No. 2246. June 2017.
- Yuba County Water Agency (YCWA), California Department of Water Resources (DWR), and U.S. Bureau of Reclamation (USBR). 2007. Draft Environmental Impact Report/Environmental Impact Statement for the Proposed Lower Yuba River Accord. State Clearinghouse (SCH) No: 2005062111. Prepared by HDR|Surface Water Resources, Inc.
- Zeiner, D. C., Laudenslayer Jr. W. F., Mayer K. E., and White M., eds. 1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California.