Mendota Pool Bypass and Reach 2B Improvements Project

Draft
Environmental Impact Statement/Report

SAN JOAQUIN RIVER
RESTORATION PROGRAM

State Clearinghouse No. 2009072044

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Table of Contents

S. Executive Summary S-1
- S.1 Introduction and Background S-1
  - S.1.1 Stipulation of Settlement S-5
  - S.1.2 San Joaquin River Restoration Program S-6
- S.2 Purpose and Uses of this Project EIS/R S-7
- S.3 Scoping and Public Involvement Process S-8
- S.4 Purpose and Need for Action and Project Objectives S-9
- S.5 Project Study Area S-10
- S.6 Alternatives Evaluated in this EIS/R S-11
  - S.6.1 No-Action/No-Project Alternative S-12
  - S.6.2 Alternative A S-13
  - S.6.3 Alternative B S-13
  - S.6.4 Alternative C S-13
  - S.6.5 Alternative D S-14
  - S.6.6 Elements Common to All Action Alternatives S-23
- S.7 Environmental Commitments S-26
  - S.7.1 Conservation Strategy S-26
  - S.7.2 Minimize Flood Risk from Interim and Restoration Flows S-29
- S.7 Areas of Known Controversy and Issues to be Resolved S-30
- S.8 Consensus-Based Alternative Selection S-31
- S.9 Summary and Comparison of Impacts and Mitigation Measures S-32

1.0 Introduction 1-1
- 1.1 Background 1-1
  - 1.1.1 Stipulation of Settlement 1-2
  - 1.1.2 San Joaquin River Restoration Program 1-3
  - 1.1.3 Overview of the Mendota Pool Bypass and Reach 2B Improvements 1-4
  - 1.1.4 Scoping and Public Involvement Process 1-7
- 1.2 Purpose and Uses of this EIS/R 1-8
  - 1.2.1 National Environmental Policy Act 1-8
  - 1.2.2 California Environmental Quality Act 1-9
  - 1.2.3 Type of Environmental Document 1-10
  - 1.2.4 Compliance and Permits Supported by this EIS/R 1-11
- 1.3 Relationship to Other SJRRP NEPA and CEQA Documents 1-12
- 1.4 Purpose and Need for Action and Project Objectives 1-13

1.5 Responsibilities of Lead Agencies, Responsible Agency, and Implementing Agencies 1-14
1.6 Project Study Area 1-14
1.6.1 Geographic Area Description 1-14
1.6.2 Description of Existing Conditions within the Study Area 1-15
1.6.3 Description of Local Hydrology 1-21
1.7 Organization of this EIS/R 1-22

2.0 Description of Alternatives 2-1
2.1 Alternatives Formulation Process 2-1
2.1.1 Alternatives Development Process Overview 2-1
2.1.2 Stakeholder Involvement 2-2
2.1.3 Initial Options Formulation 2-7
2.1.4 Alternatives Formulation 2-8
2.1.5 Summary of the Alternatives Evaluation Process 2-9
2.2 Description of Alternatives 2-12
2.2.1 NEPA and CEQA Requirements 2-12
2.2.2 Overview of Alternatives 2-13
2.2.3 No-Action Alternative 2-14
2.2.4 Elements Common to All Action Alternatives 2-15
2.2.5 Alternative A (Compact Bypass with Narrow Floodplain and South Canal) 2-33
2.2.6 Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative 2-47
2.2.7 Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) 2-63
2.2.8 Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) 2-76
2.2.9 Alternatives Comparison Tables 2-84
2.2.10 Environmental Commitments 2-85
2.3 Alternatives Considered and Eliminated from Further Consideration 2-107
2.3.1 Pre-Initial Options Analysis 2-108
2.3.2 Pre-Evaluation Screening 2-110
2.3.3 Initial Alternatives Screening 2-113

3.0 Considerations for Describing the Affected Environment and Environmental Consequences 3-1
3.1 Study Area 3-1
3.1.1 Reach 2 3-1

3.1.2 Reach 3 ... 3-2
3.1.3 Chowchilla Bypass ... 3-2
3.1.4 Delta-Mendota Canal ... 3-2
3.1.5 Mendota Pool ... 3-2
3.1.6 Fresno Slough ... 3-4
3.2 Chapter Contents and Definition of Terms ... 3-4
3.2.1 NEPA and CEQA Requirements ... 3-4
3.2.2 Significance Criteria ... 3-6
3.2.3 Impact Comparisons and Definitions ... 3-7
3.2.4 Impact Levels ... 3-8
3.2.5 Mitigation Measures ... 3-9
3.2.6 Significance After Mitigation ... 3-9
3.2.7 Relationship between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity ... 3-10
3.2.8 Irreversible and Irretrievable Commitments of Resources ... 3-10
3.3 Resources Eliminated from Further Analysis ... 3-10

4.0 Air Quality ... 4-1
4.1 Environmental Setting ... 4-1
4.1.1 Ambient Air Quality ... 4-1
4.1.2 Sensitive Receptors ... 4-16
4.2 Regulatory Setting ... 4-17
4.2.1 Federal ... 4-17
4.2.2 State of California ... 4-20
4.2.3 Regional and Local ... 4-23
4.3 Environmental Consequences and Mitigation Measures ... 4-28
4.3.1 Impact Assessment Methodology ... 4-28
4.3.2 Significance Criteria ... 4-30
4.3.3 Impacts and Mitigation Measures ... 4-31

5.0 Biological Resources – Fisheries ... 5-1
5.1 Environmental Setting ... 5-1
5.1.1 Aquatic Habitat ... 5-1
5.1.2 Aquatic Foodweb ... 5-2
5.1.3 Aquatic Species Known to Occur in the Project Area and Vicinity ... 5-3
5.1.4 Special Status Species ... 5-5
5.2 Regulatory Setting ... 5-11

5.2.1 Federal 5-11
5.2.2 State of California 5-13
5.2.3 Regional and Local 5-15
5.3 Environmental Consequences and Mitigation Measures 5-16
5.3.1 Impact Assessment Methodology 5-16
5.3.2 Significance Criteria 5-17
5.3.3 Impacts and Mitigation Measures 5-18

6.0 Biological Resources – Vegetation 6-1
6.1 Environmental Setting 6-1
6.1.1 Regional Setting 6-1
6.1.2 Project Setting 6-2
6.2 Regulatory Setting 6-13
6.2.1 Federal 6-14
6.2.2 State of California 6-14
6.2.3 Regional and Local 6-16
6.3 Environmental Consequences and Mitigation Measures 6-18
6.3.1 Impact Assessment Methodology 6-18
6.3.2 Significance Criteria 6-20
6.3.3 Impacts and Mitigation Measures 6-21

7.0 Biological Resources - Wildlife 7-1
7.1 Environmental Setting 7-1
7.1.1 Regional Setting 7-1
7.1.2 Project Area 7-2
7.1.3 Special-Status Wildlife Species 7-8
7.2 Regulatory Setting 7-17
7.2.1 Federal 7-17
7.2.2 State of California 7-18
7.2.3 Regional and Local 7-20
7.3 Environmental Consequences and Mitigation Measures 7-21
7.3.1 Impact Assessment Methodology 7-21
7.3.2 Significance Criteria 7-23
7.3.3 Impacts and Mitigation Measures 7-24

8.0 Climate Change and Greenhouse Gas Emissions 8-1
8.1 Environmental Setting 8-1
8.1.1 Greenhouse Gases 8-1
8.1.2 Temperature, Precipitation, and Runoff 8-6

8.2 Regulatory Setting 8-11
8.2.1 Federal 8-11
8.2.2 State of California 8-12
8.2.3 Regional and Local 8-15
8.3 Environmental Consequences and Mitigation Measures 8-15
8.3.1 Impact Assessment Methodology 8-15
8.3.2 Significance Criteria 8-16
8.3.3 Impacts and Mitigation Measures 8-17

9.0 Cultural Resources 9-1
9.1 Environmental Setting 9-1
9.1.1 Regional Setting 9-1
9.1.2 Resources in the Project Area 9-8
9.2 Regulatory Setting 9-13
9.2.1 Federal 9-13
9.2.2 State of California 9-16
9.2.3 Local and Regional 9-17
9.3 Environmental Consequences and Mitigation Measures 9-17
9.3.1 Impact Assessment Methodology 9-17
9.3.2 Significance Criteria 9-18
9.3.3 Impacts and Mitigation Measures 9-20

10.0 Environmental Justice 10-1
10.1 Environmental Setting 10-1
10.1.1 Social and Demographic Characteristics 10-3
10.1.2 Long-term Challenges for Agricultural Lands 10-9
10.2 Regulatory Setting 10-9
10.2.1 Federal 10-9
10.2.2 State of California 10-10
10.2.3 Regional and Local 10-10
10.3 Environmental Consequences and Mitigation Measures 10-11
10.3.1 Impact Assessment Methodology 10-11
10.3.2 Disproportionately High and Adverse Criteria 10-11
10.3.3 Impacts and Mitigation Measures 10-12

11.0 Geology and Soils 11-1
11.1 Environmental Setting 11-1
11.1.1 Geology 11-1
11.1.2 Soils 11-4

11.1.3 Erosion and Sedimentation 11-10
11.1.4 Geomorphology 11-13
11.1.5 Soil Hazards 11-16
11.1.6 Mineral Resources 11-16
11.1.7 Seismicity and Neotectonics 11-22
11.2 Regulatory Setting 11-27
11.2.1 Federal 11-27
11.2.2 State of California 11-28
11.2.3 Regional and Local 11-28
11.3 Environmental Consequences and Mitigation Measures 11-29
11.3.1 Impact Assessment Methodology 11-29
11.3.2 Significance Criteria 11-30
11.3.3 Impacts and Mitigation Measures 11-31

11.0 Geology and Soils 11-1
11.1 Environmental Setting 11-1
11.1.1 Geology 11-1
11.1.2 Soils 11-3
11.1.3 Erosion and Sedimentation 11-8
11.1.4 Geomorphology 11-12
11.1.5 Soil Hazards 11-13
11.1.6 Mineral Resources 11-15
11.1.7 Seismicity and Neotectonics 11-17
11.2 Regulatory Setting 11-22
11.2.1 Federal 11-22
11.2.2 State of California 11-23
11.2.3 Regional and Local 11-23
11.3 Environmental Consequences and Mitigation Measures 11-24
11.3.1 Impact Assessment Methodology 11-24
11.3.2 Significance Criteria 11-25
11.3.3 Impacts and Mitigation Measures 11-26

12.0 Hydrology - Flood Management 12-1
12.1 Environmental Setting 12-1
12.1.1 Historical Perspective of Flood Protection in the San Joaquin River Basin 12-1
12.1.2 Flood Management Structures 12-2
12.1.3 Flood Management Operations and Conditions 12-5
12.1.4 Flood Management Agencies 12-9

12.2 Regulatory Setting 12-11
12.2.1 Federal 12-11
12.2.2 State of California 12-12
12.2.3 Regional and Local 12-12
12.3 Environmental Consequences and Mitigation Measures 12-13
12.3.1 Impact Assessment Methodology 12-13
12.3.2 Significance Criteria 12-13
12.3.3 Impacts and Mitigation Measures 12-14

13.0 Hydrology – Groundwater 13-1
13.1 Environmental Setting 13-1
13.1.1 Regional Setting 13-1
13.1.2 Project Setting 13-12
13.2 Regulatory Setting 13-13
13.2.1 Federal 13-13
13.2.2 State of California 13-14
13.2.3 Regional and Local 13-15
13.3 Environmental Consequences and Mitigation Measures 13-15
13.3.1 Impact Assessment Methodology 13-15
13.3.2 Significance Criteria 13-18
13.3.3 Impacts and Mitigation Measures 13-19

14.0 Hydrology - Surface Water Resources and Water Quality 14-1
14.1 Environmental Setting 14-1
14.1.1 Physical Conditions 14-1
14.1.2 Surface Water Resources 14-3
14.1.3 Geomorphology 14-7
14.1.4 Water Quality 14-17
14.2 Regulatory Setting 14-22
14.2.1 Federal 14-23
14.2.2 State of California 14-25
14.2.3 Regional and Local 14-29
14.3 Environmental Consequences and Mitigation Measures 14-30
14.3.1 Impact Assessment Methodology 14-30
14.3.2 Significance Criteria 14-31
14.3.3 Impacts and Mitigation Measures 14-32

15.0 Hydrology - Wetlands and Aquatic Resources 15-1
15.1 Environmental Setting 15-1

15.1.1 Existing Conditions ... 15-1
15.1.2 Categories for Wetlands and Other Waters of the United States ... 15-1
15.2 Regulatory Setting ... 15-4
15.2.1 Federal ... 15-5
15.2.2 State of California ... 15-6
15.2.3 Regional and Local ... 15-7
15.3 Environmental Consequences and Mitigation Measures ... 15-8
15.3.1 Impact Assessment Methodology ... 15-8
15.3.2 Significance Criteria ... 15-9
15.3.3 Impacts and Mitigation Measures ... 15-10

16.0 Land Use Planning and Agricultural Resources ... 16-1
16.1 Environmental Setting ... 16-1
16.1.1 Land Ownership ... 16-1
16.1.2 Land Use ... 16-3
16.1.3 Agricultural Production ... 16-3
16.1.4 Land Use Planning ... 16-9
16.2 Regulatory Setting ... 16-10
16.2.1 Federal ... 16-10
16.2.2 State of California ... 16-11
16.2.3 Regional and Local ... 16-15
16.3 Environmental Consequences and Mitigation Measures ... 16-16
16.3.1 Impact Assessment Methodology ... 16-16
16.3.2 Significance Criteria ... 16-17
16.3.3 Impacts and Mitigation Measures ... 16-18

17.0 Noise and Vibration ... 17-1
17.1 Environmental Setting ... 17-1
17.1.1 Fundamentals of Acoustics ... 17-1
17.1.2 Ambient Noise Measurements ... 17-5
17.2 Regulatory Setting ... 17-9
17.2.1 Federal ... 17-10
17.2.2 State of California ... 17-11
17.2.3 Regional and Local ... 17-13
17.3 Environmental Consequences and Mitigation Measures ... 17-15
17.3.1 Impact Assessment Methodology ... 17-15
17.3.2 Significance Criteria ... 17-20
17.3.3 Impacts and Mitigation Measures ... 17-23

18.0 Paleontological Resources 18-1
18.1 Environmental Setting 18-1
18.1.1 Physiographic Environment 18-1
18.1.2 Geologic Setting 18-1
18.1.3 Local Paleontological Resources 18-2
18.2 Regulatory Setting 18-4
18.2.1 Federal 18-4
18.2.2 State of California 18-5
18.2.3 Regional and Local 18-5
18.3 Environmental Consequences and Mitigation Measures 18-6
18.3.1 Impact Assessment Methodology 18-6
18.3.2 Significance Criteria 18-8
18.3.3 Impacts and Mitigation Measures 18-8

19.0 Public Health and Hazardous Materials 19-1
19.1 Environmental Setting 19-1
19.1.1 Known Hazardous Material Sites 19-2
19.1.2 Exposure to Disease 19-3
19.2 Regulatory Setting 19-4
19.2.1 Federal 19-4
19.2.2 State of California 19-6
19.2.3 Regional and Local 19-9
19.3 Environmental Consequences and Mitigation Measures 19-9
19.3.1 Impact Assessment Methodology 19-10
19.3.2 Significance Criteria 19-10
19.3.3 Impacts and Mitigation Measures 19-11

20.0 Recreation 20-1
20.1 Environmental Setting 20-1
20.1.1 Recreation Uses 20-1
20.1.2 Recreation Facilities and Areas 20-3
20.1.3 Public Access 20-4
20.2 Regulatory Setting 20-5
20.2.1 Federal 20-5
20.2.2 State of California 20-5
20.2.3 Regional and Local 20-6
20.3 Environmental Consequences and Mitigation Measures 20-6
20.3.1 Impact Assessment Methodology 20-6

20.3.2 Significance Criteria 20-7
20.3.3 Impacts and Mitigation Measures 20-8

21.0 Socioeconomics and Economics 21-1
21.1 Environmental Setting 21-1
21.1.1 Population Trends 21-1
21.1.2 Housing 21-3
21.1.3 Economic Base 21-4
21.1.4 Fiscal Resources of Local Governments 21-6
21.1.5 Value of Agricultural Production 21-8
21.1.6 Fiscal Resources of the Levee District 21-11
21.2 Regulatory Setting 21-13
21.2.1 Federal 21-13
21.2.2 State of California 21-13
21.2.3 Regional and Local 21-13
21.3 Environmental Consequences and Mitigation Measures 21-13
21.3.1 Impact Assessment Methodology 21-13
21.3.2 Significance Criteria 21-16
21.3.3 Impacts and Mitigation Measures 21-16

22.0 Transportation and Traffic 22-1
22.1 Environmental Setting 22-1
22.1.1 Roadway Network 22-1
22.1.2 Study Roadway Segments 22-3
22.1.3 Existing Traffic Volume 22-3
22.1.4 Existing Level of Service 22-4
22.2 Regulatory Setting 22-5
22.2.1 Federal 22-5
22.2.2 State of California 22-5
22.2.3 Regional and Local 22-8
22.3 Environmental Consequences and Mitigation Measures 22-8
22.3.1 Impact Assessment Methodology 22-8
22.3.2 Significance Criteria 22-11
22.3.3 Impacts and Mitigation Measures 22-12

23.0 Utilities and Service Systems 23-1
23.1 Environmental Setting 23-1
23.1.1 Wastewater Collection 23-1
23.1.2 Fire Protection Services 23-1

23.1.3 Law Enforcement Services ... 23-3
23.1.4 Emergency Services ... 23-4
23.1.5 Solid Waste Management ... 23-5
23.1.6 Utility Crossings ... 23-6
23.1.7 Energy ... 23-8
23.1.8 Water Supply Features ... 23-8
23.2 Regulatory Setting ... 23-9
23.2.1 Federal ... 23-9
23.2.2 State of California ... 23-10
23.2.3 Regional and Local ... 23-11
23.3 Environmental Consequences and Mitigation Measures ... 23-14
23.3.1 Impact Assessment Methodology ... 23-14
23.3.2 Significance Criteria ... 23-15
23.3.3 Impacts and Mitigation Measures ... 23-17

24.0 Visual Resources ... 24-1
24.1 Environmental Setting ... 24-1
24.1.1 Critical Public Views ... 24-1
24.1.2 Existing Visual Conditions ... 24-6
24.2 Regulatory Setting ... 24-28
24.2.1 Federal ... 24-28
24.2.2 State of California ... 24-28
24.2.3 Regional and Local ... 24-28
24.3 Environmental Consequences and Mitigation Measures ... 24-30
24.3.1 Impact Assessment Methodology ... 24-30
24.3.2 Significance Criteria ... 24-30
24.3.3 Impacts and Mitigation Measures ... 24-31

25.0 Cumulative Impacts ... 25-1
25.1 Definitions of Cumulative Effects ... 25-1
25.2 Methods and Assumptions ... 25-2
25.2.1 Past and Present Actions ... 25-3
25.2.2 Reasonably Foreseeable Probable Future Actions ... 25-3
25.3 Significance Criteria ... 25-10
25.4 Mitigation Measures for Significant Cumulative Impacts ... 25-10

25.0 Cumulative Impacts ... 25-1
25.1 Definitions of Cumulative Effects ... 25-1
25.2 Methods and Assumptions ... 25-2

25.2.1 Past and Present Actions 25-3
25.2.2 Reasonably Foreseeable Probable Future Actions 25-3
25.3 Significance Criteria 25-10
25.4 Mitigation Measures for Significant Cumulative Impacts 25-10
25.5 Cumulative Effects Analysis 25-11
25.5.1 Air Quality 25-12
25.5.2 Biological Resources – Fisheries 25-13
25.5.3 Biological Resources – Vegetation 25-15
25.5.4 Biological Resources – Wildlife 25-16
25.5.5 Climate Change and Greenhouse Gas Emissions 25-17
25.5.6 Cultural Resources 25-18
25.5.7 Environmental Justice 25-19
25.5.8 Geology and Soils 25-19
25.5.9 Hydrology – Flood Management 25-20
25.5.10 Hydrology – Groundwater 25-20
25.5.11 Hydrology – Surface Water Resources and Water Quality 25-22
25.5.12 Hydrology – Wetlands and Aquatic Resources 25-22
25.5.13 Land-Use Planning and Agricultural Resources 25-24
25.5.14 Noise and Vibration 25-25
25.5.15 Paleontological Resources 25-26
25.5.16 Public Health and Hazardous Materials 25-26
25.5.17 Recreation 25-27
25.5.18 Socioeconomics and Economics 25-28
25.5.19 Transportation and Traffic 25-29
25.5.20 Utilities and Service Systems 25-30
25.5.21 Visual Resources 25-30

26.0 Other NEPA and CEQA Considerations 26-1
26.1 Significant and Unavoidable Impacts 26-1
26.1.1 Construction-Related Air Pollutants 26-3
26.1.2 Agricultural Resources 26-3
26.1.3 Emergency Response Times 26-3
26.2 Relationship between Short-Term Uses and Long-Term Productivity 26-4
26.3 Irreversible and Irretrievable Commitments of Resources 26-5
26.4 Growth-Inducing Impacts 26-6
26.5 Preferred Alternative 26-7
26.6 Environmentally Preferable/Superior Alternative 26-8
26.7 Least Environmentally Damaging Practicable Alternative 26-9

26.8 Comparison of Action Alternatives 26-10
26.8.1 Air Quality 26-10
26.8.2 Biological Resources – Fisheries 26-10
26.8.3 Biological Resources – Vegetation 26-14
26.8.4 Biological Resources – Wildlife 26-14
26.8.5 Climate Change and Greenhouse Gas Emissions 26-15
26.8.6 Cultural Resources 26-15
26.8.7 Environmental Justice 26-15
26.8.8 Geology and Soils 26-16
26.8.9 Hydrology – Flood Management 26-16
26.8.10 Hydrology – Groundwater 26-16
26.8.11 Hydrology – Surface Water Resources and Water Quality 26-16
26.8.12 Hydrology – Wetlands and Aquatic Resources 26-17
26.8.13 Land-Use Planning and Agricultural Resources 26-17
26.8.14 Noise and Vibration 26-17
26.8.15 Paleontological Resources 26-17
26.8.16 Public Health and Hazardous Materials 26-17
26.8.17 Recreation 26-18
26.8.18 Socioeconomics and Economics 26-18
26.8.19 Transportation and Traffic 26-18
26.8.20 Utilities and Service Systems 26-18
26.8.21 Visual Resources 26-18
26.9 Mitigation Monitoring and Reporting Program 26-19
26.9.1 Matrix 26-19
26.9.2 Environmental Commitments 26-35

27.0 Consultation, Coordination, and Compliance 27-1
27.1 Compliance with Related Laws, Rules, Regulations, and Executive Orders 27-1
27.1.1 Federal Requirements 27-1
27.1.2 State Requirements 27-18
27.1.3 Local Plans and Policies 27-28
27.2 Consultation and Coordination 27-29
27.2.1 Project Scoping 27-29
27.2.2 Agencies and Organizations Consulted 27-40
27.2.3 Future Public Involvement 27-41
27.3 Distribution List 27-41

28.0 References 28-1
28.1 Chapter 1 – Introduction 28-1
28.2 Chapter 2 – Description of Alternatives 28-3
28.3 Chapter 3 – Considerations for Describing the Affected Environment and Environmental Consequences 28-6
28.4 Chapter 4 – Air Quality 28-6
28.5 Chapter 5 – Biological Resources – Fisheries 28-8
28.6 Chapter 6 – Biological Resources – Vegetation 28-12
28.7 Chapter 7 – Biological Resources – Wildlife 28-14
28.8 Chapter 8 – Climate Change and Greenhouse Gas Emissions 28-16
28.9 Chapter 9 – Cultural Resources 28-19
28.10 Chapter 10 – Environmental Justice 28-22
28.11 Chapter 11 – Geology and Soils 28-23
28.12 Chapter 12 – Hydrology – Flood Management 28-25
28.13 Chapter 13 – Hydrology – Groundwater 28-26
28.14 Chapter 14 – Hydrology – Surface Water Resources and Water Quality 28-28
28.15 Chapter 15 – Hydrology – Wetlands and Aquatic Resources 28-31
28.16 Chapter 16 – Land-Use Planning and Agricultural Resources 28-32
28.17 Chapter 17 – Noise and Vibration 28-34
28.18 Chapter 18 – Paleontological Resources 28-35
28.19 Chapter 19 – Public Health and Hazardous Materials 28-36
28.20 Chapter 20 – Recreation 28-38
28.21 Chapter 21 – Socioeconomics and Economics 28-40
28.22 Chapter 22 – Transportation and Traffic 28-42
28.23 Chapter 23 – Utilities and Service Systems 28-43
28.24 Chapter 24 – Visual Resources 28-45
28.25 Chapter 25 – Cumulative Impacts 28-46
28.26 Chapter 26 – Other NEPA and CEQA Considerations 28-46
28.27 Chapter 27 – Consultation, Coordination, and Compliance 28-46

29.0 List of Preparers 29-1

30.0 Index 30-1

Appendices

Appendix 4-A Tables

Appendix 4-B Health Risk Assessment Methodology

Appendix 4-C AERMOD Input Files

Appendix 17-A Certification of Calibration for Ambient Noise Survey Equipment

Appendix 17-B Ambient Noise Level Field Measurement Data Sheets

Appendix 17-C Noise Levels and Contour Distances per Scheduled Construction Activity

Appendix 19-A Draft Phase I Environmental Site Assessment

Appendix 22-A. Data Sheets for the 24-hour Average Daily Traffic Count

Tables

Table S-1. Additional Activities Common or Related to Action Alternatives S-9
Table S-2 Conservation Measures for Biological Resources S-22
Table S-3 Summary of Impacts and Mitigation Measures S-26
Table S-4 Summary of Impacts for Environmental Justice S-39
Table S-5. Impacts of Action Alternatives with the Potential to Result in a Cumulatively Considerable Incremental Contribution to a Significant Cumulative Impact S-39
Table 1-1. Restoration and Water Management Framework in Key Settlement Paragraphs 1-3
Table 1-2. Compliance, Consultation, and Coordination to Be Supported by this EIS/R 1-11
Table 2-1. Fish Passage Design Criteria 2-17
Table 2-2. Alternative A (Compact Bypass with Narrow Floodplain and South Canal) Levees, Relocations, and Land Acquisition 2-47
Table 2-3. Potential Species for Revegetation 2-58
Table 2-4. Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) Levees, Relocations, and Land Acquisition 2-62
Table 2-5. Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) Levees, Relocations, and Land Acquisition 2-76
Table 2-6. Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) Levees, Relocations, and Land Acquisition 2-84
Table 2-7. Levees, Relocations, and Land Acquisition 2-84
Table 2-8. Conservation Measures for Biological Resources That May Be Affected by Project Actions 2-87

Table 2-9. Minimum Factors of Safety - Levee Slope Stability 2-102
Table 2-10. Summary of Permits and Approvals that May be Required for the Project 2-107
Table 4-1. 2012 Estimated Annual Average Emissions for the SJVAB (tons per day) 4-7
Table 4-2. Summary of Annual Ambient Air Quality Data (2008–2012) 4-11
Table 4-3. Summary of Attainment Status Designations and Ambient Air Quality Standards in the Project Area and Vicinity 4-13
Table 4-4. Summary of San Joaquin Valley Air Pollution Control District Air Quality Plans 4-25
Table 4-5. SJVAPCD CEQA and General Conformity Rule *de minimis* Thresholds of Significance 4-31
Table 4-6. Total Construction Emissions 4-35
Table 4-7. Ambient CO Concentrations-1hour 4-36
Table 4-8. Annual Ambient PM_{10} and $PM_{2.5}$Concentrations 4-36
Table 4-9. Health Impacts at Maximally Exposed Sensitive Receptor 4-41
Table 4-10. Total Operational Emissions 4-44
Table 5-1. Fish Species in the Vicinity of Reach 2B 5-3
Table 5-2. Threatened or Endangered Fish Species, Associated Critical Habitat, or Essential Fish Habitat Considered as Potentially Occurring Within the Project Area 5-6
Table 6-1. Cross-Reference of Vegetation Alliance, Natural Community, and Plant Community Types 6-3
Table 6-2. Special-Status Vegetation Alliances in the Project Area 6-4
Table 6-3. Federal-, State-, or CNPS-Listed Plant Species with a Potential to Occur in the Project Area 6-9
Table 6-4. Invasive Plant Species Observed in the Project Area 6-12
Table 6-5. Special-Status Vegetation Alliances Potentially Affected by Alternative A 6-24
Table 6-6. Special-Status Vegetation Alliances Potentially Affected by Alternative B 6-30
Table 6-7. Potential Species for Revegetation 6-32
Table 6-8. Special-Status Vegetation Alliances Potentially Affected by Alternative C 6-34
Table 6-9. Special-Status Vegetation Alliances Potentially Affected by Alternative D 6-37
Table 7-1. Wildlife Habitat Types Mapped in the Project Area 7-3
Table 7-2. Special-Status Wildlife Species with a Moderate or High Potential to Occur 7-9
Table 7-3. Federally- and State-Listed or Fully Protected Wildlife Species 7-11
Table 7-4. Other Special-Status Wildlife Species 7-14

Table 7-5. Species Habitat Potentially Affected by Alternative A 7-28
Table 7-6. Species Habitat Potentially Affected by Alternative B 7-39
Table 7-7. Species Habitat Potentially Affected by Alternative C 7-46
Table 7-8. Species Habitat Potentially Affected by Alternative D 7-51
Table 8-1. Total Project GHG Emissions 8-19
Table 8-2. GHG Emissions from Fuel Combustion in Vehicles 8-20
Table 8-3. Potential GHG Reductions from Use of CNG Trucks 8-20
Table 8-4. Total Operational GHG Emissions 8-21
Table 9-1. Previously Conducted Surveys within Project Area 9-9
Table 9-2. Previously Recorded Cultural Resources within Project Area 9-10
Table 9-3. Property Status Under the National Register and California Register 9-12
Table 10-1. Race and Ethnicity of Local Population, 2010 10-4
Table 10-2. Race and Ethnicity of Farm Operators, 2012 10-5
Table 10-3. Race and Ethnicity of Laborers and Helpers, 2006-2010 Estimate 10-6
Table 10-4. Income and Poverty, 2008-2012 Estimate 10-7
Table 10-5. Agricultural Workers Median Annual Wages, 2012 (1st Quarter) 10-8
Table 11-1. General Soils Data in the Project Footprint 11-7
Table 11-2. Acreages of Soil Textures in Project Footprint 11-10
Table 11-3. Generalized Effects on Geomorphic Processes of Major Flood Control and Water Supply Infrastructure 11-12
Table 11-4. Summary of Environmental Concerns 11-32
Table 12-1. Design Capacities of San Joaquin River and Chowchilla Bypass Within the Project Area and Vicinity 12-4
Table 14-1. Temperature Summary 14-2
Table 14-2. Average Monthly Precipitation 14-2
Table 14-3. Flow Averages and Ranges at Flow Stations in the Project Vicinity 14-4
Table 14-4. General Water Quality Indicators at Stations in the Vicinity of Reach 2B, San Joaquin River 14-19
Table 14-5. Interim Flows Water Quality Data, San Joaquin River 14-20
Table 14-6. Basin Plan Water Quality Objectives to Protect Beneficial Uses 14-26
Table 15-1. Project Area Wetlands and Waters of the United States 15-2
Table 15-2. Wetlands and Waters of the United States Potentially Affected by Alternative A 15-13
Table 15-3. Wetlands and Waters of the United States Potentially Affected by Alternative B 15-16

Table 15-4. Wetlands and Waters of the United States Potentially Affected by Alternative C 15-17
Table 15-5. Wetlands and Waters of the United States Potentially Affected by Alternative D 15-19
Table 16-1. Land Ownership 16-3
Table 16-2. Existing Land Use 16-5
Table 16-3. Cropping Patterns 16-5
Table 16-4. Important Farmland 16-7
Table 16-5. Lands under Williamson Act Contract 16-8
Table 16-6. General Plan Land Use Designations 16-10
Table 16-7. Effects on Agricultural Land Uses 16-21
Table 16-8. Agricultural Effects by Crop Type, Alternative A 16-22
Table 16-9. Conversion of Designated Farmland 16-25
Table 16-10. Agricultural Effects by Crop Type, Alternative B 16-30
Table 16-11. Agricultural Effects by Crop Type, Alternative C 16-34
Table 16-12. Agricultural Effects by Crop Type, Alternative D 16-38
Table 17-1. Sound Levels of Typical Noise Sources and Noise Environments 17-3
Table 17-2. 24-hour Sound Level Measurement at LT-1 (dBA) 17-6
Table 17-3. 24-hour Sound Level Measurement at LT-2 (dBA) 17-7
Table 17-4. 24-hour Sound Level Measurement at LT-3 (dBA) 17-8
Table 17-5. Short-Term Sound Level Measurements at ST-1 (dBA) 17-9
Table 17-6. Land Use Compatibility of Community Noise Environments 17-12
Table 17-7. Fresno County Exterior Noise Level Standards for Noise-Sensitive Land Uses Affected by Non-Transportation Noise Sources (dBA) 17-13
Table 17-8. Madera County Exterior Noise Level Standards for Noise-Sensitive Land Uses Affected by Non-Transportation Noise Sources (dBA) 17-14
Table 17-9. City of Mendota Exterior Noise Level Standards for Noise-Sensitive Land Uses Affected by Non-Transportation Noise Sources (dBA) 17-14
Table 17-10. Construction Equipment Noise Emission Levels 17-15
Table 17-11. Vibration Source Levels for Construction Equipment 17-19
Table 17-12. Ground-Borne Vibration and Ground-Borne Noise Impact Criteria for General Assessment 17-23
Table 17-13. Change in Traffic Noise between Existing Conditions and No-Action Alternative 17-24
Table 17-14. Change in Traffic Noise between No-Action Alternative and Alternative A 17-28

Table 17-15. Change in Traffic Noise between Existing Condition and Alternative A 17-28
Table 17-16. Alternative A Operational Activity ADTs 17-30
Table 17-17. Alternative A Maintenance Activity ADTs 17-31
Table 17-18. Change in Traffic Noise between No-Action Alternative and Alternative B 17-33
Table 17-19. Change in Traffic Noise between Existing (2009) Condition and Alternative B (2009) (CNEL dBA) 17-33
Table 17-20. Alternative B Operational Activity ADTs 17-34
Table 17-21. Alternative B Maintenance Activity ADTs 17-35
Table 17-22. Change in Traffic Noise between No-Action Alternative and Alternative C 17-38
Table 17-23. Change in Traffic Noise between Existing Conditions and Alternative C 17-38
Table 17-24. Alternative C Operational Activity ADTs 17-39
Table 17-25. Alternative C Maintenance Activity ADTs 17-40
Table 17-26. Change in Traffic Noise between No-Action Alternative and Alternative D 17-43
Table 17-27. Change in Traffic Noise between Existing Conditions and Alternative D 17-43
Table 17-28. Alternative D Operational Activity ADTs 17-44
Table 17-29. Alternative D Maintenance Activity ADTs 17-45
Table 18-1. Rock Unit Description in Reach 2B, San Joaquin Valley, CA 18-3
Table 18-2. UCMP Locality Results for the Project Vicinity (Fresno County, Madera County, and the Restoration Area) 18-4
Table 19-1. Summary of Federal Regulations Applicable to Hazardous Materials/Waste Handling 19-4
Table 19-2. Summary of State Regulations Applicable to Hazardous Materials/Waste Handling 19-6
Table 19-3. Local Public Schools 19-27
Table 19-4. Fire Stations in the Project Vicinity 19-28
Table 21-1. Historical, Current, and Projected Population 21-3
Table 21-2. Population, Reach 2B Census Tracts, 2010 21-4
Table 21-3. Housing Trends, 2000-2010 21-4
Table 21-4. Historical and Current Labor Force, 1990–2012 21-5
Table 21-5. Unemployment Rate, 2000-2012 (percent) 21-5
Table 21-6. Employment by Industry Sector, 2012 21-6
Table 21-7. Revenues and Expenditures in Fresno County, 2000-2011 (Select Years) 21-7

Table 21-8. Revenues and Expenditures in Madera County, 2000-2011 (Select Years) ... 21-8
Table 21-9. Agricultural Production Values, Annual Average, 2001-2011 ... 21-9
Table 21-10. Existing Agricultural Production Values in the Reach 2B Project Area ... 21-10
Table 21-11. Regional Economic Benefits – Existing Agricultural Production in Reach 2B ... 21-11
Table 21-12. Regional Economic Benefits by Industry – Existing Agricultural Production in Reach 2B ... 21-11
Table 21-13. Lower San Joaquin Levee District Maintenance Costs ... 21-12
Table 21-14. Annual Change in Agricultural Production Values ... 21-19
Table 21-15. Regional Economic Effects, Agricultural Production ... 21-20
Table 21-16. Regional Economic Effects, Construction and Operations ... 21-22
Table 22-1. Study Roadway Segments ... 22-4
Table 22-2. Study Roadway Segments – Existing Conditions ... 22-4
Table 22-3. Roadway Level of Service Descriptions ... 22-10
Table 22-4. Fresno County Volume Thresholds for Roadway Level of Service for Uninterrupted Flow Highways ... 22-10
Table 22-5. Madera County Regional Transportation Plan Roadway Capacity/Level of Service ... 22-11
Table 22-6. Roadway Segments LOS – Existing and No-Action Construction Conditions ... 22-13
Table 22-7. Roadway Segments LOS – 2035 No-Action and Alt. A Construction Conditions ... 22-14
Table 22-8. Roadway Segments LOS – Existing and Alt. A Project Construction Conditions ... 22-15
Table 22-9. Roadway Segments LOS – 2035 No-Action and Alt. B Construction Conditions ... 22-18
Table 22-10. Roadway Segments LOS – Existing and Alt. B Project Construction Conditions ... 22-18
Table 22-11. Roadway Segments LOS – 2035 No-Action and Alt. C Construction Conditions ... 22-21
Table 22-12. Roadway Segments LOS – Existing and Alt. C Project Construction Conditions ... 22-22
Table 22-13. Roadway Segments LOS – 2035 No-Action and Alt. D Construction Conditions ... 22-25
Table 22-14. Roadway Segments LOS – Existing and Alt. D Project Construction Conditions ... 22-25
Table 23-1. Fresno County Fire Protection District and CAL FIRE Stations Nearest to the Project Area ... 23-2

Table 23-2. Madera County Fire and CAL FIRE Stations Nearest to the Project Area 23-3
Table 23-3. Fresno County Recycling/Transfer Station Facilities 23-6
Table 23-4. Potentially Affected Water Resource Infrastructure 23-24
Table 23-5. Potentially Affected Electric and Gas Infrastructure 23-25
Table 25-1. Reasonably Foreseeable Future Actions Included in the Qualitative Analysis of Cumulative Resource Area Effects in the PEIS/R 25-4
Table 25-2. Project Impacts with the Potential to Result in Cumulatively Considerable Incremental Contributions to Significant Cumulative Impacts 25-12
Table 26-1. Summary of Significant and Unavoidable Impacts 26-1
Table 26-2. Levees, Land Acquisition, and Construction Duration 26-11
Table 26-3. Features and Conditions of the Action Alternatives 26-11
Table 26-4. Mitigation Monitoring and Reporting Program 26-21
Table 26-5. Conservation Measures for Biological Resources 26-35
Table 27-2 List of Public Agencies That Provided Comments 27-31
Table 27-3 List of Individuals and Nongovernmental Organizations that Provided Comments 27-32

Figures

Figure S-1. Overview of the SJRRP Restoration Area and the Project Vicinity S-2
Figure S-2. Project Footprint and Vicinity S-3
Figure S-3. Plan View of Alternative A (Compact Bypass with Narrow Floodplain and South Canal) S-12
Figure S-4. Inset Map of Alternative A (Compact Bypass with Narrow Floodplain and South Canal) S-13
Figure S-5. Plan View of Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) S-14
Figure S-6. Inset Map of Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) S-15
Figure S-7. Plan View of Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) S-16
Figure S-8. Inset Map of Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) S-17
Figure S-9. Plan View of Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) S-18
Figure S-10. Inset Map of Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) S-19

Figure 1-1. Overview of the SJRRP Restoration Area and the Project Vicinity 1-5
Figure 1-2. Project Footprint and Vicinity 1-6
Figure 1-3. Reach 2B Channel without Interim Flows (12/15/09) 1-17
Figure 1-4. View from downstream of the Chowchilla Bifurcation Structure in Reach 2B (12/15/09) 1-18
Figure 1-5. Inside of one of the bays at the Chowchilla Bifurcation Structure (12/15/09) 1-19
Figure 1-6. Concrete sill and bordering riprap along the downstream edge of the Chowchilla Bifurcation Structure in Reach 2B (12/15/09) 1-19
Figure 1-7. San Mateo Avenue Crossing of Reach 2B looking from north bank to south bank (12/15/09) 1-20
Figure 1-8. San Mateo Avenue crossing of Reach 2B showing single culvert beneath the road (12/15/09) 1-20
Figure 1-9. Downstream face of Mendota Dam (5/28/09) 1-21
Figure 1-10. Restoration Flow hydrographs by restoration year type (Reach 2B) 1-23
Figure 2-1. Alternatives Formulation Process 2-2
Figure 2-2. Alternatives Formulation Process Diagram 2-8
Figure 2-3. Example Floodplain Grading Approaches 2-22
Figure 2-4. Existing Infrastructure in the Project Area 2-24
Figure 2-5. Construction Access Routes 2-26
Figure 2-6. Plan View of Alternative A (Compact Bypass with Narrow Floodplain and South Canal) 2-34
Figure 2-7. Inset Map of Alternative A (Compact Bypass with Narrow Floodplain and South Canal) 2-35
Figure 2-8. Supplementary flow system plan-view diagram 2-39
Figure 2-9. Potential Inundation Acreage by Flow for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) 2-43
Figure 2-10. Plan View of Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) 2-49
Figure 2-11. Inset Map of Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) 2-50
Figure 2-12. Potential Inundation Acreage by Flow for Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) 2-56
Figure 2-13. Plan View of Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) 2-65
Figure 2-14. Inset Map of Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) 2-66

Figure 2-15. Potential Inundation Acreage by Flow for Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) 2-71
Figure 2-16. Typical distribution of vegetation alliances along a restored Reach 2B riparian bank section 2-73
Figure 2-17. Plan View of Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) 2-78
Figure 2-18. Inset Map of Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) 2-79
Figure 2-19. Potential Inundation Acreage by Flow for Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) 2-82
Figure 3-1. Chowchilla Bifurcation Structure 3-3
Figure 3-2. Mendota Pool 3-3
Figure 4-1. Location of Ambient Air Quality Monitoring Stations...................... 4-10
Figure 4-2. Location of Existing Sensitive Receptors 4-17
Figure 7-1. Wildlife Habitat.. 7-3
Figure 8-1. 2010 Estimated Breakdown of Agricultural GHG Sources for California 8-4
Figure 8-2. Change in the Total Runoff into Millerton Reservoir Relative to 1990 Decade 8-8
Figure 8-3. Changes in Runoff to Friant Dam from 1990s to 2070s based on Analysis of 112 Different Combinations of Global Climate Models and Emission Scenarios 8-8
Figure 8-4. Comparison between Measured and Equilibrium Water Temperatures in Reach 2B for Calendar Year 2012.................................. 8-10
Figure 8-5. Increase in Equilibrium Water Temperature for a Range of Increases in Air Temperature.. 8-10
Figure 10-1. Census Tracts near Reach 2B... 10-2
Figure 11-1. Regional Geology 11-3
Figure 11-2. Physiographic Soil Types in the Central Valley and Delta............. 11-6
Figure 11-3. General Soils Type in the Project Footprint.................................... 11-9
Figure 11-4. Erodible Soils in the Project Footprint... 11-15
Figure 11-5. Corrosion Level of Soils to Concrete in the Project Footprint 11-18
Figure 11-6. Corrosion Level of Soils to Uncoated Steel in the Project Footprint 11-19
Figure 11-7. Soil Shrink-Swell Classes in the Project Footprint....................... 11-20
Figure 11-8. Aggregate Mines in the Project Footprint.................................... 11-21
Figure 11-9. Oil and Gas Fields in the Project Area and Vicinity..................... 11-22
Figure 11-10. Active Faults in the Project Area and Vicinity 11-25
Figure 11-11. Active Faults and Historical Seismicity in the Project Area and Vicinity (M>= 3.0) 1800-2009 11-26

Figure 11-12. Calculated Peak Ground Acceleration in the Project Area and Vicinity 11-26
Figure 11-13. Inundation in the Project Area and Vicinity due to Catastrophic Dam Failure 11-27
Figure 12-1. Levee Flood Protection Zones in the San Joaquin River Basin 12-6
Figure 12-2. Peak Annual Flows in the San Joaquin River below Friant Dam 12-9
Figure 12-3. Flow Duration Curve for Flows from Reach 2B 12-18
Figure 12-4. Flood Frequency Curve for Flows from Reach 2B 12-19
Figure 13-1. Approximate Boundary of Corcoran Clay and Transect Lines for Hydrogeologic Cross Sections 13-3
Figure 13-2. Generalized Hydrogeologic Cross Sections in San Joaquin River and Tulare Lake Hydrologic Regions 13-4
Figure 13-3. Historical Groundwater Pumping and Irrigated Agricultural Acreage for San Joaquin River Hydrologic Region 13-6
Figure 13-4. Land Subsidence in the San Joaquin River and Tulare Lake Hydrologic Regions 13-7
Figure 13-5. Historical Groundwater Pumping and Irrigated Agricultural Acreage for Tulare Lake Hydrologic Region 13-10
Figure 13-6. Reach 2B Monitoring Well Atlas 13-13
Figure 13-7. Location of Cross Sectional Seepage Model Cross-Sections 13-17
Figure 13-8. Potential Areas with Depths to Groundwater Less than Monitoring Thresholds – Alternatives A and C 13-25
Figure 13-9. Potential Areas with Depths to Groundwater Less than Monitoring Thresholds – Alternative B 13-28
Figure 13-10. Potential Areas with Depths to Groundwater Less than Monitoring Thresholds – Alternative D 13-31
Figure 14-1. Major River Systems Upstream of Reach 2B 14-3
Figure 14-2. Monitoring Locations 14-5
Figure 14-3. Aerial Photograph from 2009 (Top) and California Debris Commission Mapping from 1914 (Bottom) of Reach 2B 14-8
Figure 14-4. Sinuosity of the San Joaquin River between Friant Dam and the Merced River 14-9
Figure 14-5. Average Slope of the San Joaquin Valley and River between Friant Dam and the Merced River 14-9
Figure 14-6. Mean Daily Flow Duration Curves at the Friant Gage under Full Natural Flow, Pre-Friant Dam and Post-Friant Dam Conditions 14-10
Figure 14-7. View Looking Upstream of the San Joaquin River near the Apex of the Bend about River Mile 213.3, Downstream from the Chowchilla Bypass 14-11

Figure 14-8. Main Channel Cross Section Profile in the Vicinity of River Mile 213.3 (Downstream View) 14-11
Figure 14-9. Modeled Top Widths along Reach 2B at Discharges of 1,200 and 2,000 cfs based on 2009 LiDAR Topography 14-12
Figure 14-10. Modeled Cross-Sectionally-Averaged Flow Depths along Reach 2B at Discharges of 1,200 and 2,000 cfs based on 2009 LiDAR Topography 14-12
Figure 14-11. Existing Bankfull Discharge in the Portions of Reach 2B Upstream from the Normal Backwater Effect of Mendota Dam based on the Ground Elevations Outside the Interior Levees 14-13
Figure 14-12. View Looking Downstream from San Mateo Avenue 14-13
Figure 14-13. Main Channel Cross Section Profile about 500 feet Downstream from San Mateo Avenue, in the Area Shown in Figure 12 (Downstream View) 14-14
Figure 14-14. View of 200,000 Cubic Yard Sediment Trap in the Chowchilla Bypass just Downstream from the Chowchilla Bifurcation Structure 14-15
Figure 14-15. Hydrologic Soil Groups in Floodplain of Reach 2B 14-16
Figure 14-16. Typical Cross Section Profile of San Joaquin River and Overbanks about River Mile 212.1, Downstream from the Chowchilla Bifurcation Structure 14-17
Figure 16-1. Land Ownership in the Project Area 16-2
Figure 16-2. Existing Land Use in the Project Area 16-4
Figure 16-3. Cropping Patterns in the Project Area 16-5
Figure 16-4. Important Farmland in the Project Area 16-7
Figure 16-5. Lands under Williamson Act Contract 16-8
Figure 16-6. General Plan Land Use Designations 16-9
Figure 17-1. Project Area and Ambient Noise Measurement Locations 17-2
Figure 17-2. Ambient Noise Level Measurement and Modeled Receiver Locations 17-18
Figure 21-1. Census Tracts near Reach 2B 21-2
Figure 22-1. Transportation Setting of the Project Area and Affected Roadways 22-2
Figure 23-1. Utilities in the Project Area 23-8
Figure 24-1. Viewing Positions at the San Mateo Avenue Crossing (Top), Mendota Pool Park and Vicinity (Middle), and Mendota Dam Area (Bottom) 24-9
Figure 24-2. Views of the Riparian Vegetation within the San Joaquin River Channel Looking to the Northwest (Top) and to the East (Bottom), VP 1 24-11
Figure 24-3. Views to Northeast across Mendota Pool of Mowery Bridge from VP 2 (Top) and from Picnic Site at VP 3 (Bottom) 24-14

Figure 24-4. Views from VP4: Looking Southwest across Mendota Pool Park toward Mendota (Top); Looking Northwest into Center of Park (Bottom) 24-15
Figure 24-5. Panoramic View Left (Top) to Right (Bottom), Looking Southwest to West from VP 5, at Northeast Corner of Mendota Pool Park 24-16
Figure 24-6. View to Northeast from VP 6 Showing Picnic Area, Restroom, and Levee Blocking View of Mendota Pool (Top); View to Northwest from VP 7 of Ball Field, Night Lighting, and Various Utilities in Background (Bottom) 24-17
Figure 24-7. Two Views Looking North from Bass Ave. (Top): VP 8, within Mendota Pool Park and (Bottom): VP 9 at North Edge of Park along DMC 24-18
Figure 24-8. Panoramic View Looking Southeast, Left (Top) Continuing to Right (Bottom), across Mendota Pool from Mendota Dam, VP 10 24-21
Figure 24-9. Panoramic View Looking Northwest to Northeast, Left (Top) Continuing to Right (Bottom), along Bass Ave. from VP 11 24-22
Figure 24-10. Views of the San Joaquin River Looking South from Bass Ave., VP 12 (Top) and VP 13 (Bottom) 24-23
Figure 24-11. Views across San Joaquin River from Area below Mendota Dam: Facing Southeast toward Dam, VP 14 (Top); Facing Northeast Downstream, VP 15 (Bottom) 24-24
Figure 24-12. Panoramic View of Bass Ave. Residences from VP 13, Looking Southwest to West, Left (Top) Continuing to Right (Bottom) 24-26
Figure 24-13. Views from and near Gate at North End of Bass Ave., Looking North (Top) and Northeast (Bottom) 24-27

List of Abbreviations and Acronyms

°C	degree Centigrade
°F	degree Fahrenheit
μg/L	microgram per liter
μg/m^3	micrograms per cubic meter
μS/cm	microsiemens per centimeter
4,4’-DDD	dichlorodiphenyldichloroethane
4,4’-DDE	dichlorodiphenyldichloroethylene
AAQS	Ambient Air Quality Standards
AB	Assembly Bill
ACHP	Advisory Council on Historic Preservation
Act	San Joaquin River Restoration Settlement Act
ADRP	Archaeological Data Recovery Program
ADT	average daily traffic
AIA	Air Impact Assessment
alpha-HCH	alpha-hexachlorocyclohexane
APE	Area of Potential Effect
ARB	California Air Resources Board
B.P.	Before Present
BACT	Best Available Control Technology
Basin Plan	Water Quality Control Plan for the Sacramento and San Joaquin River Basins
BMP	Best Management Practice
CAA	Federal Clean Air Act
CAAA	Federal Clean Air Act Amendments of 1990
CAAQS	California Ambient Air Quality Standards
CAL FIRE	California Department of Forestry and Fire Protection
Cal/EPA	California Environmental Protection Agency
Cal/OSHA	California Occupational and Health Administration
CAL-IPC	California Invasive Plant Council
CalRecycle	California Department of Resources, Recycling, and Recovery
Caltrans	California Department of Transportation
CCAA	California Clean Air Act
CCID	Central California Irrigation District
CDF	California Department of Finance
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act

CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHP	California Highway Patrol
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CNPPA	California Native Plant Protection Act
CNPS	California Native Plant Society
CNRA	California Natural Resources Agency
CO	Carbon monoxide
CO2e	Carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
Court	U.S. Eastern District Court of California
CPUC	California Public Utilities Commission
CRHR	California Register of Historical Resources
CSLC	California State Lands Commission
CT	Census Tract
CTR	California Toxics Rule
CVFED	Central Valley Floodplain Evaluation and Delineation
CVFPB	Central Valley Flood Protection Board
CVHM	Central Valley Hydrologic Model
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
dB	decibels
dBA	A-weighted decibels
DDT	dichlorodiphenyltrichloroethane
Delta	Sacramento-San Joaquin Delta
DFW	California Department of Fish and Wildlife
DHS	California Department of Health Services
DMC	Delta-Mendota Canal
DOC	California Department of Conservation
DOE	California Department of Water Resources, Division of Engineering
DOGGR	California Department of Conservation Division of Oil, Gas, and Geothermal Resources
DOT	U.S. Department of Transportation
DPR	California Department of Pesticide Regulation
DSOD	California Department of Water Resources, Division of Safety of Dams
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
EA	Environmental Assessment
EC	electrical conductivity

EDD	California Employment Development Department
EFH	essential fish habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EIS/R	Environmental Impact Statement/Environmental Impact Report
EMFAC	Emission Factors Modeling Software
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
ESU	Evolutionarily Significant Unit
Exchange Contractors	San Joaquin River Exchange Contractors
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
Flood Control Project	Lower San Joaquin River Flood Control Project
Flood Operation Manual	Flood Control Project's Operation and Maintenance Manual for Levee, Irrigation and Drainage Structures, Channels and Miscellaneous Facilities
FMMP	California Farmland Mapping and Monitoring Program
FONSI	Finding of No Significant Impact
fps	feet per second
FR	Federal Register
Fresno COG	Fresno County of Government
FTA	Federal Transit Administration
FWA	Friant Water Authority
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal Year
g	acceleration due to Earth's gravity
GAMAQI	Guide for Assessing and Mitigating Air Quality Impacts
GCM	Global Climate Model
GHG	greenhouse gas
GIS	Geographic Information System
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HEC-RAS	Hydrologic Engineering Center River Analysis System
HSG	Hydrologic Soils Group
IMPLAN	Impact Analysis for Planning
I-O	input-output
IEPR	Integrated Energy Policy Report
in/year	inches per year
IPCC	Intergovernmental Panel on Climate Change

IS	Initial Study
ISMP	Invasive Species Management Plan
ISR	Indirect Source Review
Ldn	Day-Night Noise Level
Leq	Equivalent Noise Level
LESA	Land Evaluation and Site Assessment
Levee District	Lower San Joaquin Levee District
Lmax	Maximum Noise Level
LN	The sound level exceeded N percent of the time
LOS	Levels of Service
LSJLD	Lower San Joaquin Levee District
MBTA	Migratory Bird Treaty Act
mg/L	milligram per liter
mm/year	millimeters per year
MMRP	Mitigation Monitoring and Reporting Program
MND	Mitigated Negative Declaration
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mph	miles per hour
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
N2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAL	Numeric Action Limit
NEPA	National Environmental Policy Act
NGO	Non-governmental organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO	Nitric oxide
NO2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice of Determination
NOE	Notice of Exemption
NOI	Notice of Intent
NOP	Notice of Preparation
NOx	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NRHP	National Register of Historic Places
NTU	nephelometric turbidity unit
NWP	Nationwide Permit

OEHHA	California Office of Environmental Health Hazard Assessment
OES	Office of Emergency Services
OHV	off-highway vehicle
OHWM	ordinary high water mark
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PCB	polychlorinated biphenyl
PEIS/R	Program Environmental Impact Statement/ Environmental Impact Report
PG&E	Pacific Gas and Electric Company
PM10	particulate matter with an aerodynamic resistance diameter of 10 micrometers or less
PM2.5	Fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less
Pool	Mendota Pool
ppb	parts per billion
ppm	parts per million
PRD	Permit Registration Documents
Project	Mendota Pool Bypass and Reach 2B Improvements Project
RA	Restoration Administrator
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Area	the San Joaquin River Restoration area from Friant Dam to the Merced River confluence
RHA	Rivers and Harbors Act
RHJV	Riparian Habitat Joint Venture
RM	river mile
RoadMod	Roadway Construction Emissions Model
ROD	Record of Decision
ROG	Reactive Organic Gases
RTP	Regional Transportation Plan
RWA	Recovered Water Account
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
Secretary	Secretary of the U.S. Department of the Interior
Settlement	Stipulation of Settlement
SFEI	San Francisco Estuary Institute
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SJRRP	San Joaquin River Restoration Program
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District
SJVDP	San Joaquin Valley Drainage Program

SMARA	California Surface Mining and Reclamation Act
SO2	Sulfur dioxide
SR	State Route
SRH-1DV	Sedimentation and River Hydraulics One Dimensional Vegetation Model
State	State of California
SVP	Society of Vertebrate Paleontology
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
T-BACT	Best Available Control Technology for toxic air contaminants
TAC	Technical Advisory Committee
TAF	thousand acre-feet
TDS	Total Dissolved Solids
Tg	teragram
TM	Technical Memorandum
TMDL	Total Maximum Daily Load
UCMP	University of California Museum of Paleontology
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VdB	vibration decibels
VMC	Visual Modification Class
VP	Viewing Position
WHR	California Wildlife Habitat Relationship System
WNV	West Nile Virus

1.0 Introduction

This Environmental Impact Statement/Report (EIS/R) documents the assessment of environmental effects of the implementation of the Mendota Pool Bypass and Reach 2B Improvements Project (Project), a component of Phase 1 of the overall San Joaquin River Restoration Program (SJRRP). The SJRRP was established in late 2006 to implement the Stipulation of Settlement (Settlement) in *Natural Resources Defense Council (NRDC), et al., v. Kirk Rodgers, et al*.

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the Federal lead agency under the National Environmental Policy Act (NEPA), and the California State Lands Commission (CSLC), as the State of California (State) lead agency under the California Environmental Quality Act (CEQA), prepared this EIS/R for the Project. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Act) (Public Law 111-11).

1.1 Background

Originating high in the Sierra Nevada Mountains, the San Joaquin River carries snowmelt from mountain meadows to the valley floor before turning north and becoming the backbone of tributaries draining into the San Joaquin Valley. The San Joaquin River is California's second longest river and discharges to the Sacramento-San Joaquin Delta (Delta) and, ultimately, to the Pacific Ocean through San Francisco Bay.

Historically, the San Joaquin River supported a rich and diverse ecosystem influenced by seasonal runoff patterns. During winter and spring months, runoff from Sierra Nevada streams would spread over the valley floor and slowly drain to the Delta, providing rich habitat supporting numerous aquatic and wildlife species, including Chinook salmon.

Over the past two centuries, development of water resources transformed the San Joaquin River. In the late 1880s, settlers in the Central Valley drained large areas of valley floor lands and put these lands into agricultural production, supported by small and seasonal diversion dams on the river and a series of water conveyance and drainage canals. Hydroelectric project development in the upper portions of the San Joaquin River watershed harnessed power from the river and modified the natural flow patterns.

In 1942, Reclamation completed construction of Friant Dam on the San Joaquin River. With the completion of Madera Canal in 1945 and Friant-Kern Canal in 1951, Friant Dam diverted San Joaquin River water supplies to over 1 million acres of highly productive farmland along the eastern portion of the San Joaquin Valley. Operation of the dam ceased flow in some portions of the river and contributed to the extirpation of salmon runs in the San Joaquin River upstream from the confluence with the Merced River.

1.1.1 Stipulation of Settlement

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC) filed a lawsuit, known as *NRDC, et al., v. Kirk Rodgers, et al.*, challenging the renewal of long-term water service contracts between the United States and the Central Valley Project (CVP) Friant Division contractors. On September 13, 2006, after more than 18 years of litigation, the Settling Parties, including NRDC, Friant Water Authority (FWA), and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of a Settlement subsequently approved by the U.S. Eastern District Court of California (Court) on October 23, 2006. Public Law 111-11, signed on March 30, 2009, authorizes and directs the Secretary of the Interior (Secretary) to implement the Settlement. The Settlement establishes two primary goals:

- **Restoration Goal –** To restore and maintain fish populations in "good condition" in the main stem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management Goal –** To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim and Restoration flows provided for in the Settlement.

To achieve the Restoration Goal, the Settlement calls for releases of water from Friant Dam to the confluence of the Merced River (referred to as Interim and Restoration flows), a combination of channel and structural modifications along the San Joaquin River below Friant Dam, and reintroduction of Chinook salmon. Restoration Flows are specific volumes of water to be released from Friant Dam during different water year types, according to Exhibit B of the Settlement and began on January 1, 2014; Interim Flows were experimental flows that began in 2009 and continued until Restoration Flows were initiated, with the purpose of collecting relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse.

To achieve the Water Management Goal, the Settlement calls for recirculation, recapture, reuse, exchange or transfer of the Interim and Restoration flows to reduce or avoid impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration flows. In addition, the Settlement establishes a Recovered Water Account (RWA) and program to make water available to all of the Friant Division long-term contractors who provide water to meet Interim or Restoration flows to reduce or avoid the impact of the Interim and Restoration flows on such contractors.

The Settlement and the Act authorize and direct specific physical and operational actions that could potentially directly or indirectly affect environmental conditions in the Central Valley. Areas potentially affected by Settlement actions include the San Joaquin River and associated flood bypass system, tributaries to the San Joaquin River, the Delta, and water service areas of the CVP and State Water Project (SWP), including the Friant Division. Settlement Paragraphs 11 through 16 describe physical and operational actions (see Table 1-1).

Table 1-1.
Restoration and Water Management Framework in Key Settlement Paragraphs

Settlement Paragraph	Description of Constraint or Assumption
11	Identifies specific channel and structural improvements considered necessary to achieve the Restoration Goal. Includes a reach-by-reach list of improvements.
12	Acknowledges that additional channel or structural improvements not identified in Paragraph 11 may be needed to achieve the Restoration Goal.
13	Identifies specific volumes of water to be released from Friant Dam during different year-types (Restoration Flows), and provisional water supplies to meet the Restoration Flow targets as provided in Exhibit B of the Settlement. Stipulates the release of Restoration Flows no later than January 1, 2014, subject to then-existing channel capacities.
14	Stipulates that spring-run and fall-run Chinook salmon be reintroduced to the San Joaquin River between Friant Dam and the confluence of the San Joaquin River with the Merced River no later than December 31, 2012, consistent with all applicable law and after commencement of sufficient flows and the issuance of all necessary permits. Assigns priority to wild spring-run Chinook salmon over fall-run Chinook salmon.
15	Specifies that Interim Flows begin no later than October 1, 2009, and continue until Restoration Flows can begin, to collect relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse.
16	Requires that the Secretary of the Interior develop and implement a plan for recirculation, recapture, reuse, exchange, or transfer of the Interim and Restoration flows to reduce or avoid impacts to water deliveries for all Friant Division long-term contractors. This paragraph also calls for establishment of an RWA and program to make water available to the Friant Division long-term contractors who provide water to meet Interim or Restoration flows.

Key:
RWA = Recovered Water Account

1.1.2 San Joaquin River Restoration Program

The SJRRP comprises several Federal and State agencies responsible for implementing the Settlement. Implementing Agencies include: Reclamation, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), California Department of Water Resources (DWR), and California Department of Fish and Wildlife (DFW). In addition, the Settlement stipulates that a Technical Advisory Committee be established, comprising six members appointed by NRDC and FWA. The Settlement also calls for a Restoration Administrator (RA) to be appointed by NRDC and FWA, to facilitate the Technical Advisory Committee and provide specific recommendations to the Secretary in coordination with the Technical Advisory Committee. The RA's duties are defined in the Settlement, and include making recommendations to the Secretary on the release of Interim and Restoration flows. The RA is also responsible for consulting with the Secretary on implementing actions under Paragraph 11 of the Settlement, and for identifying and recommending additional actions under Paragraph 12 of the Settlement. In addition, the RA is responsible for consulting with the Secretary on the reintroduction of Chinook salmon under Paragraph 14 of the Settlement and flow releases under Paragraphs 13 and 15. The Secretary will diligently pursue completion of project-specific actions in consultation with the RA.

Exhibit C of the Settlement sets forth milestone dates for the purposes of implementing the Settlement. The Implementing Agencies acknowledge that some of the implementation, including this project, is unavoidably behind schedule and have developed a Draft Framework for Implementation with a revised schedule (SJRRP 2015).

1.1.3 Overview of the Mendota Pool Bypass and Reach 2B Improvements

The Project includes the construction, operation, and maintenance of the Mendota Pool Bypass and improvements in the San Joaquin River channel in Reach 2B (Figure 1-1). The Project consists of a floodplain width which conveys at least 4,500 cubic feet per second (cfs), a method to bypass Restoration Flows around Mendota Pool, and a method to deliver water to Mendota Pool. The Project footprint (Figure 1-2) extends from approximately 0.3 mile above the Chowchilla Bifurcation Structure to approximately 1.7 miles below the Mendota Dam. The Project footprint comprises the area that could be directly affected by the Project. The Project may also indirectly affect nearby portions of Reach 2A and Reach 3. The Project study area or "Project area" includes areas directly and indirectly affected by the Project. The Project area is in Fresno and Madera counties, near the town of Mendota, California.

The Mendota Pool Bypass and Reach 2B improvements defined in the Settlement are (Settlement Paragraph 11[a]):

> *(1) Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cfs from Reach 2B downstream to Reach 3. This improvement requires construction of a structure capable of directing flow down the bypass and allowing the Secretary to make deliveries of San Joaquin River water into Mendota Pool when necessary;*

> *(2) Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass channel.*

Because the functions of these channels may be inter-related, the design, environmental compliance, and construction of the two are being addressed as one project. The Project would be implemented consistent with the Settlement and the Act, with implementation dates clarified by the Implementation Framework (SJRRP 2015).

The Mendota Pool Bypass would include conveyance of at least 4,500 cfs around Mendota Pool (or the Pool) from Reach 2B to Reach 3 and a fish barrier, if appropriate, to direct upmigrating adult salmon into the bypass. The bypass could be accomplished by constructing a new channel around Mendota Pool or by limiting Mendota Pool to areas outside of the San Joaquin River. This action would include the ability to divert 2,500 cfs to the Pool if water deliveries are required for the San Joaquin River Exchange Contractors (Exchange Contractors) and may consist of a bifurcation structure in Reach 2B. The bifurcation structure would include a fish passage facility to enable up-migrating salmon to pass the structure and a fish screen, if appropriate, to direct out-migrating fish into the bypass channel and minimize or avoid fish entrainment to the Pool.

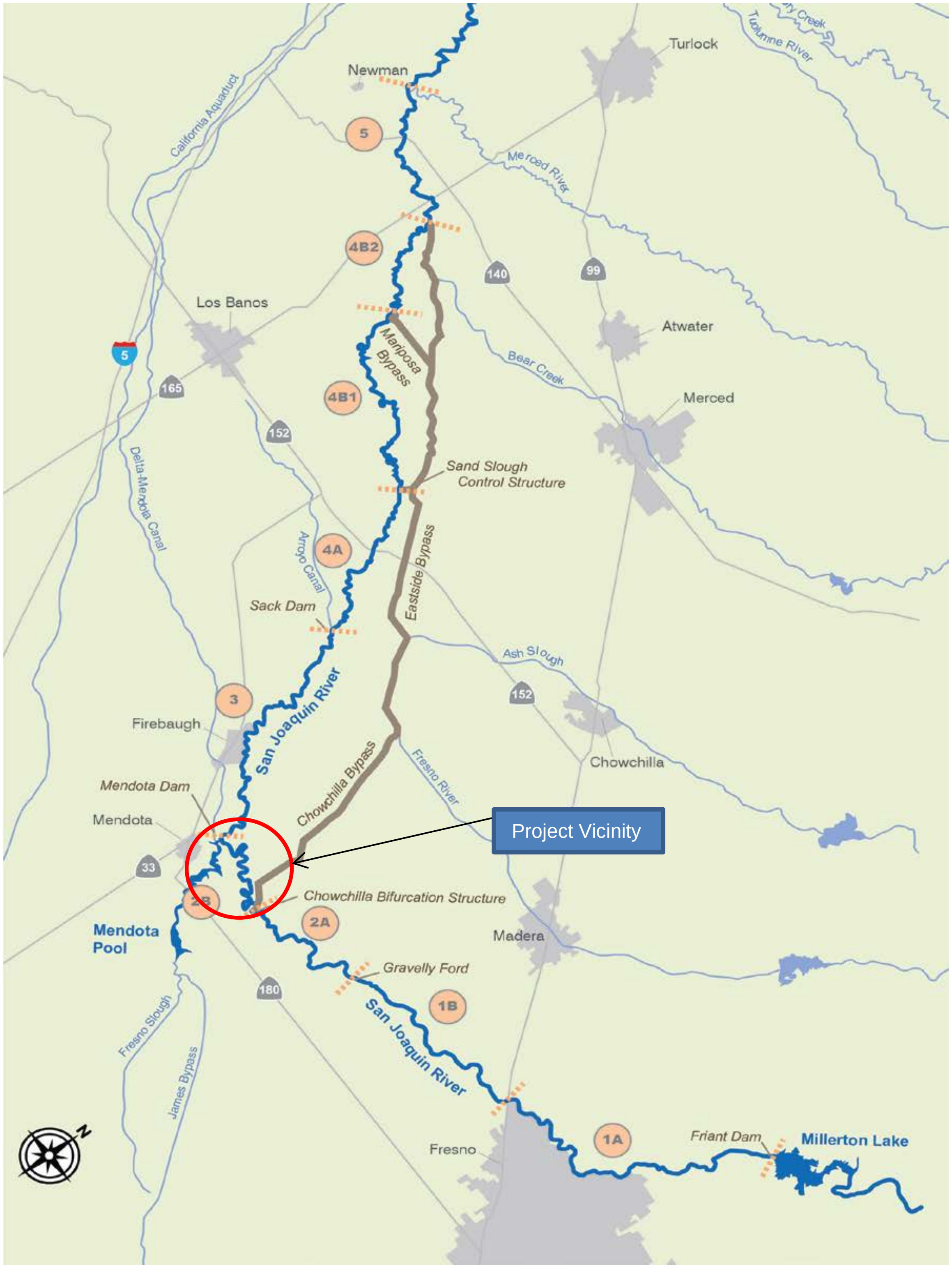


Figure 1-1.
Overview of the SJRRP Restoration Area and the Project Vicinity

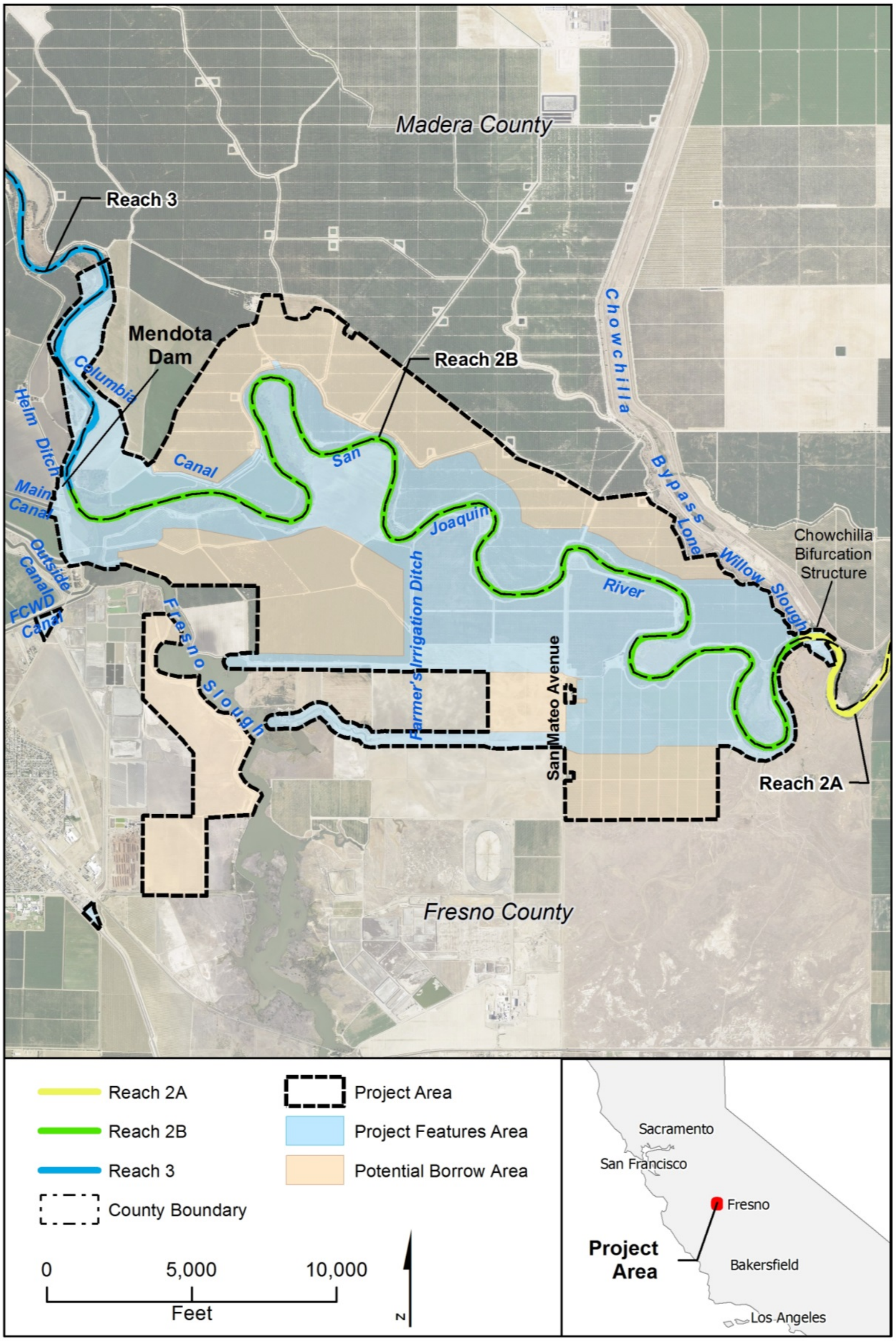


Figure 1-2.
Project Footprint and Vicinity

Improvements to Reach 2B would include modifications to the San Joaquin River channel from the Chowchilla Bifurcation Structure to the new Mendota Pool Bypass to provide a capacity of at least 4,500 cfs with integrated floodplain habitat. The options under consideration include potential levee setbacks along Reach 2B to increase the channel and floodplain capacity and provide for floodplain habitat. Floodplain habitat is included along the Reach 2B portion of the Project as required by the Settlement; floodplain habitat is being considered along the Mendota Pool Bypass channel because Central Valley floodplains have been shown to be of value to rearing juvenile salmon as they migrate downstream (Jeffres 2008, Grosholz 2006, Sommer 2004, Sommer 2001). In addition, the SJRRP *Fisheries Management Plan* (SJRRP 2010a) and *Minimum Floodplain Habitat Area for Spring and Fall-Run Chinook Salmon* report (SJRRP 2012a) describe that sufficient floodplain habitat is an important feature for meeting salmon population targets.

Improvements included in the project could potentially be implemented in a phased approach to facilitate scheduling and funding. Phased implementation is discussed further in Section 2.2.4.

1.1.4 Scoping and Public Involvement Process

The lead agencies conducted public and stakeholder outreach activities to engage and inform all interested parties of Project activities. Engaging those interested parties helped to inform the process for scoping the Project alternatives and development of this EIS/R. Reclamation initiated the NEPA process by issuing a Notice of Intent (NOI) on July 13, 2009, and DWR initiated the CEQA process by issuing a Notice of Preparation (NOP) on the same day, to prepare an EIS/R and hold public scoping meetings. (Although initial CEQA actions were conducted by DWR, subsequent actions during the EIS/R process have been conducted by the CSLC as the State lead agency.)

The EIS/R scoping comment period began the date the NOI was issued and ended on August 14, 2009. The Implementing Agencies convened two public meetings, one each in Fresno (July 28, 2009) and Firebaugh (July 29, 2009), to inform the public and interested stakeholders about the Project, and to solicit comments and input on the scope of the EIS/R. Reclamation and DWR received comments from 29 entities, including Federal and State agencies, local interest groups, local residents, farmers, landowners, public advocacy groups, and individuals. The comments received were summarized in a Public Scoping Report released February 2010 (SJRRP 2010b). The NEPA scoping process also serves as the scoping process for compliance with other Federal laws such as the National Historic Preservation Act, Section 106.

Public involvement and outreach activities have enabled the Implementing Agencies to involve stakeholders and incorporate public and stakeholder input into the development of major Project documents, including this EIS/R. These activities seek to create an open and transparent process through which the general public, stakeholders, affected Third Parties, and other interested parties can track and participate in SJRRP activities, including the formulation of alternatives for this EIS/R. Ongoing public outreach activities conducted in support of the Project include the following:

- Hosting Project-specific landowner meetings as well as participating in SJRRP Technical Feedback Meetings with subject-matter experts, Settling Parties, affected stakeholders, and the general public to obtain information and viewpoints from individual attendees; provide updates on the status of Project work products; keep the Technical Feedback Group up-to-date with the current status of the Project; gather feedback on Project documents; and discuss potential opportunities and constraints that may arise. The format of obtaining and disseminating information through the landowner meetings and Technical Feedback Group meetings is intended to be flexible to address the issues and documents at hand and to accommodate the needs of the SJRRP, Settling Parties, stakeholders, and the general public.
- Making available technical memoranda and other milestone Project documents to the general public, stakeholders, affected Third Parties, and other interested parties on the SJRRP website.

The lead agency must, whenever practicable, use a consensus-based management approach to the NEPA process, as required by 43 Code of Federal Regulations (CFR) 46.110. Consensus-based management "involves outreach to persons, organizations or communities who may be interested in or affected by a proposed action with an assurance that their input will be given consideration by the Responsible Official in selecting a course of action" (43 CFR 46.110 (a)). This EIS/R was developed with a consensus-based management approach. The completed and ongoing activities conducted in support of the Project, as described above, constitute outreach performed in support of this approach.

1.2 Purpose and Uses of this EIS/R

The purpose of this EIS/R is to analyze the project-specific direct, indirect, and short-term/long-term impacts of implementing the Project as directed by the Act, consistent with NEPA/CEQA requirements. This EIS/R serves as an informational document for decision makers, public agencies, non-government organizations, and the general public regarding the potential direct and indirect environmental consequences of implementing any of the alternatives. Consistent with CEQ Regulations, 40 CFR Part 46.425, and State CEQA Guidelines, Alternative B has been identified as the preferred alternative. No sooner than 30 days after the Final EIS/R is published, Reclamation will prepare a Record of Decision (ROD). Similarly, CSLC will take actions on whether to certify the EIR, approve a project, and file a Notice of Determination (NOD).

1.2.1 National Environmental Policy Act

NEPA provides an interdisciplinary framework for Federal agencies to take environmental factors into account during a decision making process (42 United States Code [USC] 4321, 40 CFR 1500.1). NEPA requires an Environmental Impact Statement (EIS) whenever a proposed major Federal action (e.g., a proposal for legislation or an activity financed, assisted, conducted, or approved by a Federal agency with Federal agency control) significantly affects the quality of the human environment. Section

1508.14 of the CEQ Regulations defines the human environment to include "the natural and physical environment and the relationship of people with that environment."

The EIS, in conjunction with other relevant material, is used by the Federal Government to plan actions and make decisions. Section 1502.1 of the CEQ Regulations states that the primary purpose of an EIS is to serve as an action-forcing device to insure that the policies and goals defined in NEPA are infused into the ongoing programs and actions of the Federal Government. As an informational document, an EIS provides a rigorous and objective evaluation of all reasonable alternatives; full and open disclosure of environmental consequences before agency action; an interdisciplinary approach to project evaluation; identification of measures to mitigate impacts; and an avenue for public and agency participation in decision making. NEPA defines mitigation as avoiding, minimizing, rectifying, reducing or eliminating, or compensating for an action (40 CFR 1508.20). NEPA also requires evaluating a proposed action and alternatives at an equal level of analysis.

NEPA requires that a lead agency "include [in an EIS] appropriate mitigation measures not already included in the proposed action or alternatives" (40 CFR 1502.14(f)). An EIS must also include discussions of "means to mitigate adverse environmental impacts (if not fully covered under § 1502.14(f))" (40 CFR 1502.16(h)). In preparing a ROD under 40 CFR 1505.2, a lead agency must "[s]tate whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not. A monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation."

1.2.2 California Environmental Quality Act

The State CEQA Guidelines (Cal. Code Regs., tit. 14, § 15064, subd. (f)(1)) require that an EIR be prepared whenever a project may have a significant effect on the environment. Section 15064, subdivision (d) states that "[i]n evaluating the significance of the environmental effect of a project, the lead agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project." An EIR is an informational document used to inform public agency decision makers and the general public of the significant environmental effects of a project, identify possible ways to mitigate or avoid the significant effects, and describe a range of reasonable alternatives to the project that could feasibly attain most of the basic objectives of the project while substantially lessening or avoiding any of the significant environmental impacts. When determining whether to approve a project, State and local public agencies are required by CEQA to consider the information presented in the EIR.

State CEQA Guidelines section 15126.6, subdivision (a) also requires that an EIR "describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives." A range of reasonable alternatives is analyzed to define issues and provide a clear basis for choice among options. CEQA requires that the lead agency consider alternatives that would avoid or reduce one or more of the significant impacts identified for a project in an EIR. The State CEQA Guidelines state that the range of alternatives required to be evaluated in an EIR is governed by a "rule of reason;" the EIR needs to set forth only those alternatives necessary to permit a reasoned choice and to select and discuss them in a manner to foster meaningful public participation and informed decision making (§ 15126.6, subd. (f)). Consideration of alternatives focuses on those which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly (§ 15126.6, subd (b)). CEQA does not require alternatives to be evaluated in the same level of detail as the proposed project.

CEQA requires that State and local government agencies consider the potential environmental effects of projects over which they have discretionary authority before taking action on those projects (Pub. Resources Code, § 21000 et seq.). CEQA also requires that each public agency avoid or mitigate to less-than-significant levels, wherever feasible, the significant environmental effects of projects it approves or implements. The significant environmental impacts are addressed in written findings that are supported by substantial evidence in the record (State CEQA Guidelines, § 15091). If a project would result in significant and unavoidable environmental impacts that cannot be feasibly mitigated to less-than-significant levels, the project can still be approved, but the lead agency's decision makers must make a "statement of overriding considerations" explaining in writing the specific economic, legal, social, technological, or other considerations that they conclude, based on substantial evidence, make those significant effects "acceptable" (State CEQA Guidelines, § 15093).

1.2.3 Type of Environmental Document

Program-level actions (and some project level actions) were analyzed in the Program Environmental Impact Statement/Environmental Impact Report (PEIS/R) (SJRRP 2011a). The program-level, or first-tier, analysis was performed in accordance with CEQ Regulations (40 CFR 1502.20), and consistent with California Public Resources Code sections 21093 and 21094; California Code of Regulations, Title 14, sections 15152 and 15168; and 40 CFR 1500.4(i), 1502.4(b), and 1502.20, among others. The program-level analysis has considered broad environmental effects of implementing the Settlement and has identified mitigation measures and performance standards that apply to project-level actions implemented as part of the Settlement.

Project-level analyses, such as this EIS/R which analyzes a portion of the Program area, can incorporate the findings of the PEIS/R by reference through "tiering," or incorporating by reference general discussions from the PEIS/R. Incorporation of previous analysis by reference is encouraged for NEPA analysis under the CEQ Regulations (40 CFR §§ 1500.4 and 1502.21).

> *Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference*

> *unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference (§ 1502.21).*

The State CEQA Guidelines also allow for incorporation by reference when project-specific analysis is tiered from previous analysis (§§ 15150 and 15152).

This EIS/R presents project-level analyses of the actions described in each alternative (see Chapter 2, "Description of Alternatives"). Other potential actions considered for evaluation but not included in the Action Alternatives (described in the Project Description Technical Memorandum, Attachment A, "Alternatives Evaluation" (SJRRP 2012b)) are not prohibited from future implementation, but would require separate analysis pursuant to NEPA and/or CEQA at a project level of detail.

1.2.4 Compliance and Permits Supported by this EIS/R

The SJRRP will obtain all necessary permits, as required by law. This EIS/R supports the needed permits, petitions, and similar compliance, coordination, and consultation efforts for the Project actions. Permits that may be required are shown in Table 1-2 and described in Chapter 27.0, "Consultation, Coordination, and Compliance."

Table 1-2.
Compliance, Consultation, and Coordination to Be Supported by this EIS/R

Resource Applicable	Laws/Regulations/Permits	Regulating Agency/Agencies
All	San Joaquin River Restoration Settlement Act	Secretary of the Interior
Wetlands and Waters of the United States	Section 10 of the Rivers and Harbors Act – Individual or General Permit	U.S. Army Corps of Engineers
	Section 401 of the Clean Water Act – Water Quality Certification or Waiver	Regional Water Quality Control Board
	Section 402 of the Clean Water Act – National Pollutant Discharge Elimination System permit(s)	State Water Resources Control Board and Regional Water Quality Control Board
	Section 404 of the Clean Water Act – Individual or General Permit	U.S. Army Corps of Engineers
Federally Listed Species	Section 7 of the Federal Endangered Species Act – Section 7 Consultation	U.S. Fish and Wildlife Service and National Marine Fisheries Service
Fish and Wildlife Resources	Magnuson-Stevens Fishery Conservation and Management Act	National Marine Fisheries Service
	Fish and Wildlife Coordination Act report	U.S. Fish and Wildlife Service
	Migratory Bird Treaty Act	U.S. Fish and Wildlife Service
	Bald and Golden Eagle Protection Act	U.S. Fish and Wildlife Service

Table 1-2.
Compliance, Consultation, and Coordination to Be Supported by this EIS/R

Resource Applicable	Laws/Regulations/Permits	Regulating Agency/Agencies
Cultural Resources	National Historic Preservation Act – Section 106 Consultation	State Office of Historic Preservation
Levees and Floodways	Section 14 of the Rivers and Harbors Act ("Section 408") – Permission	U.S. Army Corps of Engineers
	33 Code of Federal Regulations 208.10	U.S. Army Corps of Engineers
Bridges	Section 9 of the Rivers and Harbors Act and General Bridge Act of 1946 permit	U.S. Coast Guard
Water Rights	California Water Code – Water Right Petitions (including petitions for changes to Water Right Permits 11885, 11886, and 11887)	State Water Resources Control Board
State Lands	Land Use Lease	California State Lands Commission
Air Quality	Authority to Construct, Permit to Operate	San Joaquin Valley Air Pollution Control District
State-Owned Roadways	Encroachment Permit	California Department of Transportation

1.3 Relationship to Other SJRRP NEPA and CEQA Documents

Several environmental documents have been prepared previously to facilitate early actions needed to implement the Settlement. Documents include, but are not limited to, the following:

- *Water Year 2010 Interim Flows Project Final Environmental Assessment/Finding of No Significant Impact (EA/FONSI) and Initial Study/Mitigated Negative Declaration (IS/MND)* (SJRRP 2009).
- *Interim Flows Project – Water Year 2011 Supplemental EA/FONSI* (Reclamation 2010).
- *Draft PEIS/R* (SJRRP 2011a).
- *Interim Flows Project – Water Year 2012 Final Supplemental EA/FONSI* (SJRRP 2011b).
- *Mendota Dam Sluice Gates Replacement Project, Final EA/FONSI* (SJRRP 2011c).
- *Recirculation of Recaptured Water Year 2011 San Joaquin River Restoration Program Interim Flows EA/FONSI* (Reclamation 2011).
- *Final PEIS/R* (SJRRP 2012c).

- *Invasive Vegetation Monitoring and Management Final EA/FONSI* (SJRRP 2012d).
- *PEIS/R Record of Decision* (SJRRP 2012e).
- *2014 SJRRP Juvenile Fall-Run Chinook Salmon Trap and Haul Study* (Reclamation 2014).
- *SJRRP: Salmon Conservation and Research Facility and Related Management Actions Project* (DFW 2014).

1.4 Purpose and Need for Action and Project Objectives

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action" (40 CFR 1502.13). The State CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (State CEQA Guidelines, § 15124, subd. (b)).

The purpose and objective of the Project are to implement portions of the Settlement consistent with the Act. The Act authorizes and directs the Secretary to implement the Settlement. Specifically, this Project is intended to implement Paragraphs 11(a)(1) and 11(a)(2) of the Settlement, which are authorized in Section 10004(a)(1) of the Act.

Paragraph 11(a)(1)

> *Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cfs from Reach 2B downstream to Reach 3. This improvement requires construction of a structure capable of directing flow down the bypass and allowing the Secretary to make deliveries of San Joaquin River water into Mendota Pool when necessary;*

Paragraph 11(a)(2)

> *Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass Channel;*

The Settlement specifies the need, which requires modifications to Reach 2B and construction of a bypass around Mendota Pool in support of achieving the Restoration Goal (Settlement Paragraph 2):

> *… a goal of this Settlement is to restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including*

naturally-reproducing and self-sustaining populations of salmon and other fish (the "Restoration Goal").

The purpose to provide increased capacity and floodplain and riparian habitat in Reach 2B respond to the need to restore and maintain fish populations in "good condition" by providing fish passage and rearing habitat which benefit salmon and other native fish. Without the Project in Reach 2B, restoration activities would be unlikely to achieve the Settlement goals.

1.5 Responsibilities of Lead Agencies, Responsible Agency, and Implementing Agencies

As previously described, Reclamation is the lead NEPA agency and CSLC is the lead CEQA agency in preparing this EIS/R. The actions identified in this EIS/R include actions to be undertaken by Reclamation and CSLC. The effects of these actions are identified in this EIS/R.

The Settlement identifies the Secretary as the lead Federal entity responsible for implementation and USFWS as the lead Federal agency responsible for reintroduction of spring-run and fall-run Chinook salmon. The Secretary has designated Reclamation to act as the lead Federal entity responsible for implementation of the Settlement. The Settlement also identifies the Secretary of the U.S. Department of Commerce, through NMFS, as a necessary participant to allow for permitting the reintroduction of spring-run Chinook salmon. The Settlement also anticipated involvement of the California Natural Resources Agency through DWR and DFW. Therefore, the Implementing Agencies include Reclamation, USFWS, NMFS, DWR, and DFW.

Reclamation and CSLC have coordinated with the Settling Parties and Implementing Agencies in preparation of this EIS/R. In addition, several agencies accepted the invitation to participate as cooperating agencies under NEPA, including the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (Corps), NMFS, and Central California Irrigation District. The cooperating agencies have provided input that is being considered in preparation of this EIS/R.

Additional information on responsible agencies and permit requirements is provided in Chapter 27.0, "Consultation, Coordination, and Compliance."

1.6 Project Study Area

1.6.1 Geographic Area Description

The Project study area or "Project area" includes areas that may be affected directly or indirectly by the Project alternatives. The Project footprint (township 13S, range 15E), shown in Figure 1-2, has two major components: Reach 2B and the Mendota Pool Bypass. Reach 2B generally includes the area from the San Joaquin River Control Structure near the Chowchilla Bypass downstream to Mendota Dam. Potential Project improvements in Reach 2B, which vary by alternative, extend from the Chowchilla Bifurcation Structure on the upstream end to the head of the potential Mendota Pool Bypass channel or to Mendota Dam on the downstream end. However, Reach 2B improvements may also include areas just upstream of the Chowchilla Bifurcation Structure and may continue downstream of the head of the Mendota Pool Bypass or Mendota Dam, including the Pool area, as necessary to meet Project goals and objectives. The lateral extent of potential Project Reach 2B improvements, which varies by alternative, includes lands to the north and south of the San Joaquin River in Reach 2B.

The Mendota Pool Bypass element of the Project alternatives generally includes the area from the downstream end of the Reach 2B improvements to a tie-in location in Reach 3. Improvements for the Mendota Pool Bypass, which vary by alternative, extend from the area south of Mowry Bridge over Fresno Slough to the area north of Mendota Dam where the Bypass ties into Reach 3. The Mendota Pool Bypass element of the Project alternatives also includes areas adjacent to and on the west side of Mendota Pool and Fresno Slough and areas to the south of the potential Project Reach 2B improvements. Areas indirectly affected by this Project include portions of Reach 3 downstream and Reach 2A upstream that are outside the direct Project footprint.

The Project area reflects current estimates of areas that may be affected by the Project alternatives. In this EIS/R, the area where direct and indirect effects may occur differs according to resource area; therefore, the geographic range and environmental conditions described herein vary by resource.

1.6.2 Description of Existing Conditions within the Study Area

At the upstream end of the Project, the Chowchilla Bifurcation Structure is used to control and route flood releases from Friant Dam and the upstream watershed into Reach 2B and the Chowchilla Bypass, a flood protection project on the San Joaquin River. Under no-flow conditions, plunge pools (approximately 7 feet deep and 10 feet deep, respectively) can be observed at the downstream base of the Chowchilla Bifurcation Structure in both the San Joaquin River and the Chowchilla Bypass.

Reach 2B ends on the downstream end at the Mendota Dam, which creates Mendota Pool. The Delta-Mendota Canal terminates at the Pool, which distributes water deliveries from the Delta to Exchange Contractors via the Main Canal, Helm Ditch, Columbia Canal, Main Lift Canal, and Outside Canal. The Pool is shallow with little storage volume, and the pool elevation is maintained for the purposes of hydraulic head into Fresno Slough. The Pool provides only minimal transitory storage above the operating elevation and, therefore, does not provide substantial flood control protection. During flood releases, the flashboards are removed at Mendota Dam allowing the backwatered Pool to become part of the flowing river.

Flood flows through Mendota Pool are released from Friant Dam, Pine Flat Dam, or both. Friant Dam flood control releases may be diverted into Reach 2B at the Chowchilla Bifurcation Structure, and Pine Flat Dam flood control releases may be diverted into Mendota Pool via the James Bypass and Fresno Slough. Pine Flat Dam flood control releases have priority over Friant Dam flood control releases, so depending on the available capacity in Reach 3, a portion or all of the flow from Reach 2A may be diverted into the Chowchilla Bypass. Pine Flat Dam flood control releases into Mendota Pool occur in wet years (approximately 1 in 5 years with the SJRRP). Accordingly during wet years, flow in Reach 2B may be reduced during flood control releases from Pine Flat Dam.

The Project area includes only one existing private crossing, a dip-crossing at San Mateo Avenue, consisting of a culvert to convey low flows and an earthen embankment supporting the roadbed, which is overtopped during higher flows.

The San Mateo Avenue crossing is the approximate limit of the backwater effects of the Pool. Downstream of San Mateo Avenue, the river channel is inundated as a result of the Pool water surface elevation. Upstream of the crossing, the channel is only wetted during Interim Flows or flood releases from Friant Dam. The Pool and associated river channel were drained approximately every 2 years to inspect and perform maintenance on Mendota Dam. Recent repairs at Mendota Dam have reduced this need to dewater the Pool for dam inspections.

Several water diversions (including Lone Willow Slough and the Columbia Canal), canals, lift stations, and groundwater wells exist within the Project area. Additionally, electrical and gas distribution lines and water pipelines lie within the Project area.

Existing Land Use and Habitat

A narrow corridor of riparian and aquatic habitat exists along the river corridor, levees, and at Mendota Pool; otherwise, land use within and surrounding the Project area is primarily agriculture with the exception of the water management facilities at the Pool.

The Pool backwater supports perennial riparian vegetation, predominantly willow riparian and cottonwood riparian forest communities with emergent wetland communities. Upstream of San Mateo Avenue and prior to Interim Flows, the channel exhibited a sandy substrate with little to no in-channel vegetation (Figure 1-3). Existing vegetation along the banks of the channel in these areas consists predominantly of riparian scrub and willow scrub communities.

Existing Fish Population and Habitat Conditions

Prior to the start of Interim Flows in October 2009, Reach 2B upstream of San Mateo Avenue was dry except during flood flows (approximate frequency was every 2 to 3 years), consequently there was very limited in-channel habitat features. The Pool contained mostly introduced fishes and a few native fish. The biennial dewatering of the Pool left the Pool site mostly dry, but some locations held standing water during the several week period the Pool was drained in mid-winter.

Figure 1-3.
Reach 2B Channel without Interim Flows (12/15/09)

The Reach 2B channel bed is composed of unconsolidated fine sand and, prior to Interim Flows, there was little definition of the channel bed, which is typical for sand bed systems. No pool-bar structure or bed features occurred which would typically be used in gravel bed or coarser systems to classify and evaluate fish habitat features (pools, riffles, runs) or conditions (instream cover, overhead cover, etc.). Aquatic habitat in Reach 2B upstream of San Mateo Avenue was limited because there is a long history of the channel being dry prior to the start of Interim Flows. Riparian vegetation was limited to the levees along the channel banks. In the lower portion of Reach 2B, the channel was defined where vegetation had been established along the backwatered portion from the Pool between Mendota Dam and San Mateo Avenue. The Pool was bordered by emergent, wetland and riparian vegetation including mature cottonwood trees. Aquatic habitat in this section of river was affected by the backwatering of Mendota Dam and sedimentation in the Pool.

Since the start of Interim and Restoration flows, Reach 2B has increased inundation and establishment of hydrophilic vegetation. Aquatic habitat between the Chowchilla Bifurcation Structure and San Mateo Avenue has developed into a series of low gradient riffles, flatwater glides, and mid-channel pools and the San Joaquin River arm of Mendota Pool continues to hold water year-round. With the exception of biennial dewatering, Pool elevations are maintained near capacity.

Existing Structures

Chowchilla Bifurcation Structure

The most upstream structure is the Chowchilla Bifurcation Structure (Figure 1-2 and Figure 1-4). This structure is used to route flood flows down the Chowchilla Bypass. The bifurcation has two structural components: the river control structure, which spans the

San Joaquin River, and the bypass control structure, located at the head of the Chowchilla Bypass. The bifurcation structure has wingwalls bounding four gated bays on each channel. The bays are essentially 20-foot-wide by 18-foot-high box culverts containing a trash rack on the upstream side (Figure 1-5). The four bays discharge across a row of energy dissipaters (dragons teeth) then over a concrete slab that is bounded on the downstream end by a 2-foot-high concrete weir. Immediately below the concrete weir is a row of riprap sitting against the concrete weir and above the sand bed of Reach 2B (Figure 1-6). Upstream and downstream of the structure is the sand bed of Reach 2A and 2B, respectively.

San Mateo Avenue Crossing

The present crossing of Reach 2B is a dip crossing or low-water crossing (Figure 1-7, Figure 1-8). Flows less than approximately 150 cfs are routed through a culvert beneath the road. At flows above approximately 150 cfs, the road is inundated (Houk 2009). The north (Madera County) portion of the crossing is within public right-of-way, but the south (Fresno County) portion of the crossing is on private land, essentially rendering it a private river crossing.

Mendota Dam and Mendota Pool

Mendota Dam (Figure 1-2 and Figure 1-9), at the downstream end of Reach 2B, forms a pool approximately 7 miles long to San Mateo Avenue. The downstream 2 to 3 miles of the channel is bordered by mature trees along the north bank. Typically, the Pool receives water from the Delta-Mendota Canal which supplies water to the Helm Ditch, Main Canal, Outside Canal, Main Lift Canal, Fresno Slough, and Columbia Canal. The Pool is shallow and was drained about every 2 years for dam inspection and maintenance. Recent repairs at Mendota Dam have reduced this need to dewater the Pool for dam inspections.

Figure 1-4.
View from downstream of the Chowchilla Bifurcation Structure in Reach 2B (12/15/09)

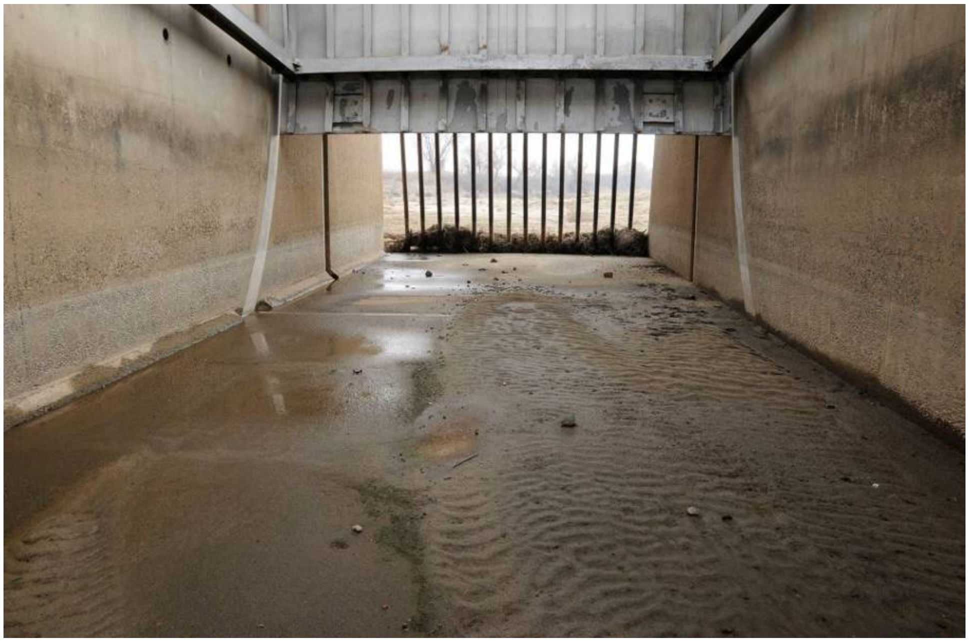


Figure 1-5.
Inside of one of the bays at the Chowchilla Bifurcation Structure[1] (12/15/09)

Figure 1-6.
Concrete sill and bordering riprap along the downstream edge of the Chowchilla Bifurcation Structure in Reach 2B[2] (12/15/09)

[1] Ponded water shown in Figure 1-5 is the remains of the 2009 fall Interim Flows.
[2] Ponded water shown in Figure 1-6 is the remains of the 2009 fall Interim Flows.

Figure 1-7.
San Mateo Avenue Crossing of Reach 2B looking from north bank to south bank (12/15/09)

Figure 1-8.
San Mateo Avenue crossing of Reach 2B showing single culvert beneath the road (12/15/09)

Figure 1-9.
Downstream face of Mendota Dam (5/28/09)

1.6.3 Description of Local Hydrology

As part of the SJRRP, Restoration Flows are released from Friant Dam based on water year type and other factors, as described in the *Restoration Flow Guidelines* (SJRRP 2013), and conveyed to Reach 2B (see Figure 1-10). Flows conveyed into or diverted from Reach 2B and the Mendota Pool include:

- Restoration (and Interim flows prior to 1/1/2014).
- Exchange Contractor deliveries to Mendota Pool from the San Joaquin River.
- Exchange Contractor deliveries to Mendota Pool from the Delta-Mendota Canal.
- Millerton Lake flood releases.
- Pine Flat Reservoir flood releases.
- Diversions to Mendota Pool via groundwater pump-ins.
- Diversions from Mendota Pool via the Columbia Canal, Mendota Dam (for Arroyo Canal in Reach 3), Helm Ditch, Main Canal, Outside Canal, Fresno County Waterworks District Canal, Fresno Slough, and Mowry pumps.
- Diversions from the river via Lone Willow Slough and other pumps for riparian rights diversions.

There are three basic flow scenarios involving Restoration Flows, flood flows, and water deliveries that would typically occur in Reach 2B:

- Restoration Flows would proceed through Reach 2B and irrigation deliveries and diversions would occur in Mendota Pool with no interaction between the Restoration Flows in Reach 2B and Mendota Pool. This would typically occur in critical-low to normal-wet water year types.
- Flood releases from Millerton Lake may be diverted from Reach 2B into the Chowchilla Bypass as well as to Mendota Pool where they can be used to fulfill water contracts or by legal water rights holders while alleviating pressure on the flood system. This would occur primarily in normal-wet to wet water year types. Some portion of these flows is anticipated to perform as Restoration Flows in Reach 2B, but the flood management agencies will have ultimate discretion in directing flood flows.
- Flood releases from Pine Flat Reservoir may be bypassed to the San Joaquin River via Fresno Slough and Mendota Pool, typically in wet water year types. Due to capacity restrictions downstream of Reach 2B, the addition of these flows further restricts the amount of flow that can enter Reach 2B, and more San Joaquin River flows will be diverted into the Chowchilla Bypass to compensate. Some portion of the San Joaquin River flows are anticipated to perform as Restoration Flows in Reach 2B, but the flood management agencies will have ultimate discretion in directing flood flows.

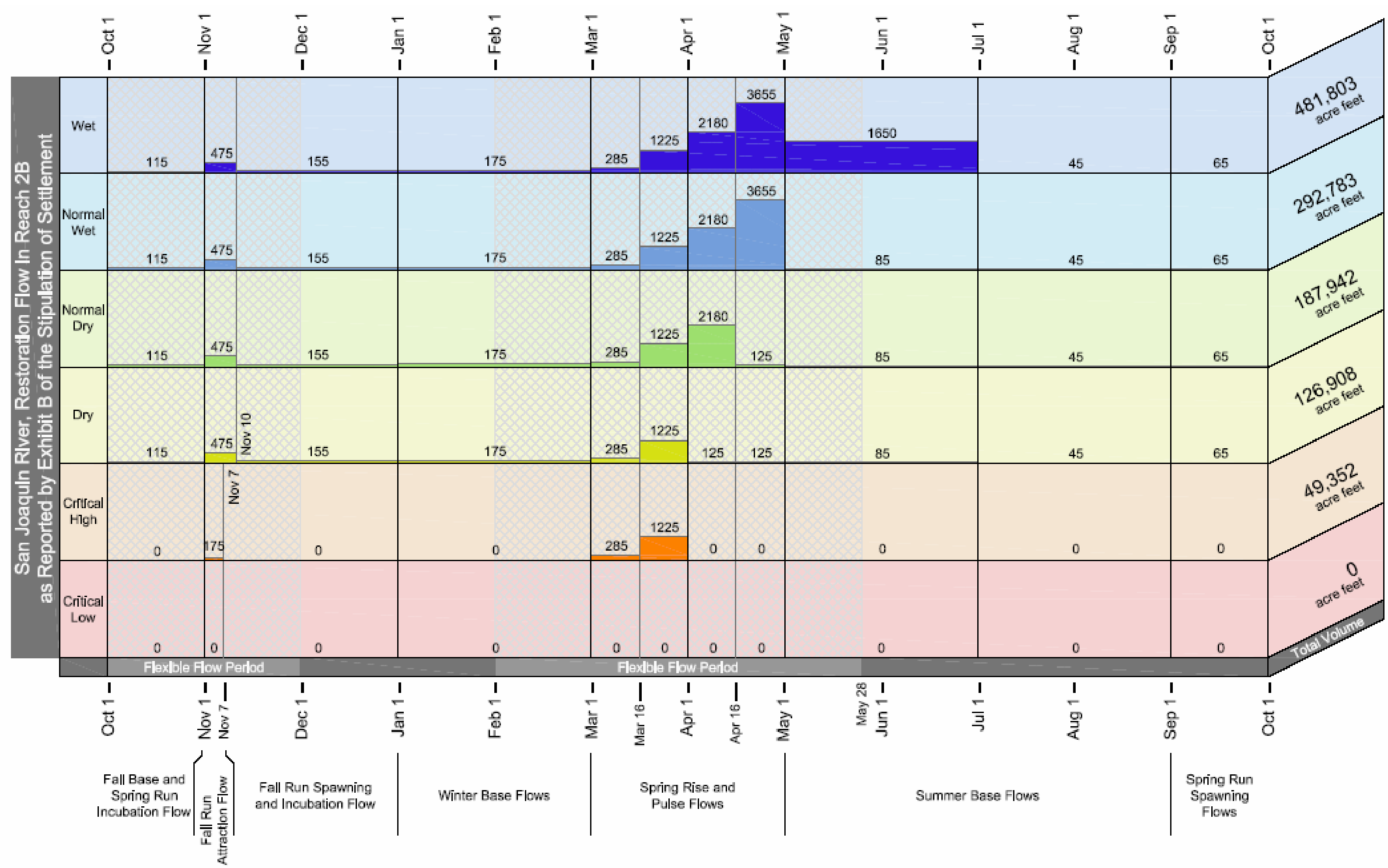
In addition to the above flow scenarios, the Restoration Administrator has the ability to manage Restoration Flows shown in Figure 1-10 to meet the Program's goals and objectives. These management strategies include reshaping the flow block by moving it earlier in the schedule, later in the schedule, compressing the flow block, or extending it consistent with the provisions in the Settlement.

1.7 Organization of this EIS/R

This EIS/R is organized as shown below.

Executive Summary presents the purpose and intended uses of this EIS/R, describes lead agencies, Project location, Project background and future actions, need for action, and Project purpose/objectives, provides an overview of the alternatives under consideration and major conclusions of the environmental analysis, documents the known areas of controversy and issues to be resolved, and summarizes in a table the environmental impacts, mitigation measures, and significance conclusions for the alternatives under consideration. It also presents a comparison of the four Action Alternatives.

Chapter 1.0, "Introduction" summarizes Project background and context, scope of this EIS/R, Project purpose and need for action and objectives, Project area, and EIS/R organization.



1 Hydrographs reflect assumptions about seepage losses and tributary inflows which are specified in the Settlement.
2 Reach 2B hydrographs are labeled as Reach 3 in Settlement Exhibit B.

Figure 1-10.
Restoration Flow hydrographs by restoration year type (Reach 2B)

Chapter 2.0, "Description of Alternatives" summarizes the process that was implemented to develop, evaluate, and select the alternatives, describes the alternatives including the No-Action/No-Project Alternative, describes options and alternatives that were considered throughout the alternatives formulation process but were eliminated from further consideration and the reasons for their elimination, and describes the State, Federal, and other agency actions (permits and approvals) required in order to implement the Project.

Chapter 3.0, "Considerations for Describing the Affected Environment and Environmental Consequences," describes the Project area, and the approach and terms used to describe the environmental and regulatory setting and environmental consequences for the resource topics presented in Chapters 4.0 through 24.0.

Chapters 4.0 through 24.0 include the environmental and regulatory settings for 21 resource topics, and discussions of methods, significance criteria, environmental impacts, and mitigation measures for potential direct and indirect impacts.

Chapter 25.0, "Cumulative Impacts," provides an analysis of overall cumulative effects of the Project alternatives, including the No-Action/No-Project Alternative, together with other past, present, and reasonably foreseeable future plans and projects to supplement information contained in the PEIS/R (SJRRP 2011a).

Chapter 26.0, "Other NEPA and CEQA Considerations," describes potential significant and unavoidable impacts, the relationship of short-term uses and long-term productivity, irreversible and irretrievable commitments of resources, and growth-inducing impacts of implementing the Project. It also describes the Preferred Alternative, compares the Action Alternatives to each other, and describes the Mitigation Monitoring and Reporting Program (MMRP).

Chapter 27.0, "Consultation, Coordination, and Compliance," summarizes public involvement activities under NEPA and CEQA; consultation and coordination with Federal, State, regional, and local agencies; agencies and organizations consulted; and areas of controversy and unresolved issues. This chapter also describes Federal and State laws and regulations that apply to project-level compliance. In addition, this chapter lists potential permits, regulatory approvals, and needed authorizations.

Chapter 28.0, "References," provides a bibliography of sources cited throughout this EIS/R.

Chapter 29.0, "List of Preparers," lists individuals who participated in preparing this EIS/R and provides qualifications for those individuals.

Chapter 30.0, "Index," lists key terms and topics discussed throughout this EIS/R, and the location of the most relevant discussion or definition of the terms and topics.

Appendices contain background information that supports this EIS/R. The appendices include technical information relevant to the resource topics described in Chapters 4.0 through 24.0.

2.0 Description of Alternatives

As part of implementation of the Stipulation of Settlement (Settlement), U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and California State Lands Commission (CSLC) have prepared this project-level Environmental Impact Statement/Environmental Impact Report (EIS/R) for the Mendota Pool Bypass and Reach 2B Improvements Project (Project). This EIS/R presents a No-Action/No-Project Alternative (hereafter called the No-Action Alternative) and four Action Alternatives to implement the Project. Of the four Action Alternatives, there are two methods of bypassing Restoration Flows around Mendota Pool, two floodplain widths, and four ways to divert water into Mendota Pool. Project alternatives include the following:

- No-Action Alternative.
- Alternative A (Compact Bypass with Narrow Floodplain and South Canal).
- Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative.
- Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal).
- Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal).

2.1 Alternatives Formulation Process

An early step in producing this EIS/R was the formulation of the alternatives that are evaluated in this document. This section presents an overview of the development of the Action Alternatives. Each of the four Action Alternatives developed for the Project consists of a floodplain width which passes 4,500 cubic feet per second (cfs), a method to bypass Restoration Flows around Mendota Pool, and a method to deliver water to Mendota Pool. These objectives are consistent with the Project's purpose and need.

2.1.1 Alternatives Development Process Overview

Alternatives development progressed through several stages. The process began with the Initial Options Technical Memorandum (TM) (San Joaquin River Restoration Program [SJRRP] 2010a) which presented initial options for meeting Project goals and objectives. Input from Program Work Groups, stakeholders, and the public was collected. Subsequently, the initial options were refined based on impact evaluations, additional engineering analyses (appraisal level design), additional data collection, screening criteria, and public input to produce initial alternatives. These initial alternatives were evaluated (SJRRP 2012, Attachment A, "Alternatives Evaluation") using a set of evaluation and screening criteria developed pursuant to National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) requirements, and developed in coordination with Project proponents, to produce the range of reasonable alternatives presented here.

Using information obtained through evaluation and refinement, the final set of bypass, floodplain, and structure options were combined to create the Action Alternatives for the EIS/R. These Project alternatives provide a range of approaches to meet the Project purpose and need, and allows for an assessment of environmental effects.

Opportunities for stakeholder involvement were integrated throughout the alternatives formulation process. Figure 2-1 presents a graphical view of the process.

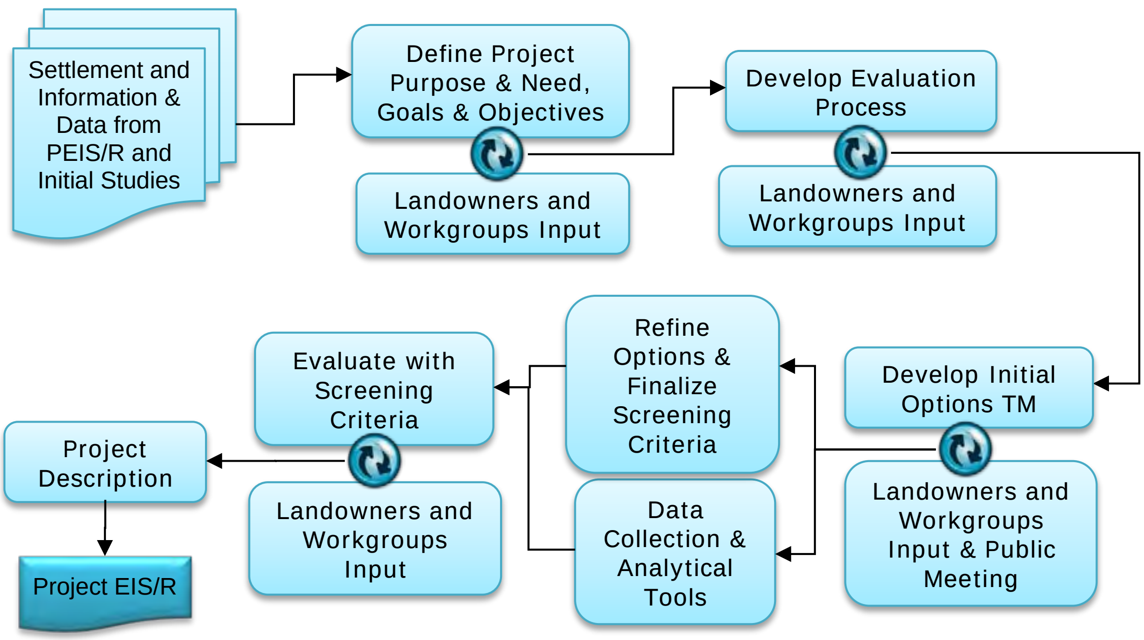


Figure 2-1.
Alternatives Formulation Process

2.1.2 Stakeholder Involvement

The alternatives development process provided opportunities for early stakeholder involvement and input. Primary stakeholders include Federal, State, and local agencies, landowners, the Technical Advisory Committee (TAC), non-governmental organizations (NGOs) and the public. The following sections describe the level of involvement of the various stakeholder groups in the alternatives formulation.

Federal, State, & Local Agencies

Federal and State Implementing Agencies involved in the SJRRP have representatives in the Technical Work Groups and Subgroups. These groups provide support for the development, evaluation, and refinement of concepts. The following groups had input during the alternatives formulation:

Fisheries Management Workgroup:

- California Department of Water Resources (DWR) presented the initial options for the Reach 2B floodplain and Mendota Pool Bypass alignment at the November 10, 2009, meeting.
- Refinement of initial options criteria and requirements related to fisheries was discussed during the December 11, 2009, Fisheries/Alternatives Subgroup.
- The design flow for fish screening was discussed on February 3, 2010.
- Further refinements to the floodplain and Mendota Pool bypass designs were presented and discussed on June 17, 2010, and passage requirements for non-salmonid native fish were also discussed.
- Passage at structures and passage design criteria were presented and discussed on August 19, 2010, and a recommendation was made to present to the Anadromous Fish Screen Program for feedback on fish screen designs.
- A special subgroup was convened twice, on October 27, 2010, and February 24, 2011, with members of the workgroup and other agency staff with expertise in fish passage structure design to discuss technical and engineering issues related to the design of the fish passage structures.
- A workshop was held on June 28, 2011, to discuss alternatives formulation.
- Criteria for fish passage at structures were discussed at a meeting on July 29, 2011.
- A meeting was held on October 25, 2011, to discuss the potential for rock ramp type fish passage facilities.
- A workshop was held on January 10, 2012, to provide an overview of the Ecosystem Diagnosis and Treatment modeling process.
- Members of the workgroup participated in several calls with the Project team to discuss technical issues, approaches to resolving issues, and on-going analyses related to fisheries management.
- The workgroup was involved in the review and comment of some Project-specific documents: the Initial Options TM, Analytical Tools TM, the Project Description TM, and this EIS/R.
- In addition, many calls and emails were exchanged with individuals in the workgroup to discuss specific issues.

Environmental Compliance and Permitting Workgroup:

- The Reach 2B consultant presented the initial options for the Reach 2B floodplain and Mendota Pool Bypass alignment at the December 1, 2009, meeting.
- The approach and use of analytical tools in the alternatives evaluation was presented and discussed at the meeting on May 18, 2010.
- DWR presented the Reach 2B draft borrow areas investigation plan at the meeting on February 15, 2011.

- The workgroup was involved in the review and comment of all Project-specific documents: the Initial Options TM, Environmental Data Needs TM, Analytical Tools TM, Environmental Survey Results TM, and this EIS/R.
- In addition, the Project team has regularly attended the workgroup's meetings to provide Project updates and answer questions.

Engineering and Design Workgroup:

- Engineering and Design Workgroup members developed pre-appraisal level structural options descriptions that addressed channel and floodplain conveyance given the site boundary conditions and a range of potential floodplain and channel characteristics.
- Coordination with the workgroup has resulted in completion of an informal technical review by Reclamation's Technical Service Center in Denver, a Design, Engineering, and Construction review, and completion of a Value Planning Study organized by Reclamation.
- In addition, the Project team has regularly attended the workgroup's weekly conference calls to provide Project updates and answer questions.

Water Management Workgroup:

- The Water Management Workgroup developed flow hydrographs for the purpose of evaluating site-specific alternatives under a range of potential flow schedules. Additionally, the group coordinated with Reclamation and other stakeholders on Program operational guidelines.

Members of all the workgroups were invited to a presentation on the alternatives evaluation to provide input on the mechanism for evaluating the alternatives at a meeting on February 18, 2011.

Fresno and Madera counties:

- Representatives from DWR spoke on the phone (July 27, 2010) and met with the Madera County Road Department (October 5, 2010) to describe the purpose of the Project and its effects on the San Mateo Avenue crossing and Drive 10 ½. DWR solicited input on the use and need for the crossing, as well as desired improvements.
- A representative of DWR spoke on the phone with the Fresno County Road Maintenance Department on July 27, 2010, to describe the purpose of the Project and its effects on the San Mateo Avenue crossing. DWR solicited input on the use and need for the crossing, as well as desired improvements, but Fresno County did not desire to provide input because the crossing is not located within their right-of-way.

Landowners

Meetings are held periodically with the landowners and representatives who have a stake in the Project or are located along the channel in the Project area to provide updates on Project status and collect input on alternatives development.

- Initial landowner consultation began prior to July 2009.
- The Reach 2B floodplain pre-appraisal level themes and Mendota Pool Bypass alignments were presented by DWR at the November 17, 2009, meeting.
- Project status updates, overview of the publically available project-specific documents, concept refinement of the San Mateo Avenue crossing design and use of Little San Joaquin Slough, and the alternatives development process were presented and discussed, and comments were accepted at the May 27, 2010, meeting.
- Project status updates, overview of new publically available project-specific documents, CSLC preliminary findings regarding sovereign and public trust lands, and DWR's land acquisitions process were presented and discussed, and comments were accepted at the March 24, 2011, meeting.
- The CSLC draft administrative sovereign and public trust land maps for Reach 2B, a brief Program update, and a Reach 2B Project update were presented at the October 3, 2011, meeting.
- The Project effects on Mendota Pool and other operations, details of Project components, and effects on infrastructure using large-scale maps were presented at the November 14, 2011, workshop.
- Overview of borrow material needs and the status of geotechnical explorations were presented during the December 16, 2011, conference call.
- Project overview, status, and a brief review of the alternatives were presented to stakeholders associated with Fresno Slough at the May 31, 2012, meeting.
- A meeting was held on January 29, 2013, to introduce the consensus-based alternative concept and approach to the adjacent landowners, canal companies, irrigation districts, levee districts, cities, and the Settling Parties. The consensus-based alternative approach gives these entities the opportunity to provide input on the Project course of action, and their input has been considered during the selection of a preferred alternative.
- Program status updates, Project EIR/S process and schedule, the landowner consensus-based alternative, flood management considerations, and geotechnical investigations techniques, strategy, and schedule were presented and discussed with stakeholders at the August 26, 2013, meeting.
- Program and Project status updates, geotechnical investigation updates, Reach 2B and Mendota Pool operations, levee and structure designs were presented and discussed with stakeholders at the December 20, 2013, workshop.
- Program and Project status updates including review of the landowner consensus-based preferred alternative, and design and field investigations were discussed with stakeholders at the October 15, 2014, meeting.

- In addition, in-person meetings were held with individual landowners and many calls and emails were exchanged with individual landowners to discuss specific issues.

Technical Advisory Committee

The TAC consists of six voting members selected by the Settling Parties to assist the Restoration Administrator regarding areas outlined in the Settlement. Coordination and information sharing between the TAC and the Implementing Agencies is ensured by two non-voting members representing the State agencies (DWR and California Department of Fish and Wildlife [DFW]) and three liaisons from the Federal agencies (Reclamation, National Marine Fisheries Service [NMFS], and U.S. Fish and Wildlife Service [USFWS]). The TAC holds regular meetings as part of its mission on many aspects for the Restoration Administrator, including some meetings that have focused on the Project.

- A meeting was held on September 22, 2010, to review the Project background, fish passage approaches, and fisheries habitat approaches.
- A meeting was held on April 14, 2011, to present the initial alternatives and alternatives evaluation results.
- A meeting was held on January 11, 2012, to present a conceptual habitat assessment approach.
- A meeting was held on January 28, 2013, to discuss the TAC's approach to evaluating the floodplain habitat in the Project alternatives.
- A meeting was held on March 20, 2013, to discuss the results of the TAC's approach to evaluating the floodplain habitat in the Project alternatives.
- A meeting was held on September 17, 2014, to discuss the preferred alternative for the Project.

Non-Governmental Organizations

Several meetings between the Program and NGOs have been held. NGOs typically in attendance at these meetings include: the San Joaquin River Partnership (Audubon California, Defenders of Wildlife, Ducks Unlimited, Natural Resources Defense Council [NRDC], Point Blue Conservation Science, Revive the San Joaquin, River Partners, Sierra Foothill Conservancy, San Joaquin River Parkway and Conservation Trust, the Bay Institute, the Nature Conservancy, the Trust for Public Land, Trout Unlimited, Tuolumne River Trust), Resources Legacy Fund, Proteus, the Environmental Opportunities Group (the Trust for Public Land, American Rivers, San Joaquin River Parkway and Conservation Trust, River Partners, the Nature Conservancy, Audubon California, NRDC, and Trout Unlimited), and others.

- A meeting was held with the San Joaquin River Partnership on March 19, 2013, to provide a status update on the Project and to present and discuss the Project alternatives.
- A meeting was held with Resources Legacy Fund, Proteus, and the Mayor of Mendota on December 10, 2013, to provide a status update on the Project and to present and discuss the Project alternatives.

- Meetings were held with the Environmental Opportunities Group on December 16, 2013, January 17, 2014, and August 14, 2014, to provide a status update on the Project and to present and discuss the Project alternatives.
- Meetings were held with the Resources Legacy Fund and Proteus on May 2, 2014, and September 30, 2014, to provide a status update on the Project and to present and discuss the Project alternatives.
- A meeting was held with Pete Dangermond (formerly with California State Parks, now under contract with the Resources Legacy Fund) and Dave Koehler (Executive Director of San Joaquin River Parkway and Conservation Trust) on August 6, 2014, to provide a status update on the Project and to present and discuss the Project alternatives.
- In addition, representatives of various NGOs attend the Program's Technical Feedback Group meetings as well as other meetings with the Program and agencies (e.g., DWR Upper San Joaquin River Regional Flood Management Plan process meetings).

Public

Reclamation and DWR held two public scoping meetings in July 2009, for the purpose of initiating the NEPA and CEQA public input processes on the Project. During the scoping meetings and throughout the public comment period, Reclamation and DWR accepted comments on the Project regarding the range of alternatives, the environmental effects, and the mitigation measures to be considered in this EIS/R. Suggestions regarding the pre-appraisal level themes were documented in the Scoping Report (SJRRP 2010b) and have been considered in this EIS/R.

The SJRRP organized and held several public outreach meetings in the form of Technical Feedback Groups. The Project proponents participated in the April 28, 2010, Restoration Goal Technical Feedback Group meeting by providing an overview and discussion of the Initial Options TM and Analytical Tools TM and in the May 17, 2012, Restoration Goal Technical Feedback Group meeting by providing a status update on the Project and an overview of technical challenges the team worked on during alternatives formulation.

The SJRRP also organized and held a Spanish-speaking community meeting on December 9, 2014. An overview of the SJRRP was presented, the Project and Project alternatives were discussed, input from the community was requested, and discussion and feedback from the community was facilitated through small group discussion.

2.1.3 Initial Options Formulation

The initial options were formulated based on existing information and data, preliminary engineering analyses and screening, as well as input from Program Work Groups, stakeholders, and the public. Individual and group landowner meetings were held to present and obtain input on the initial options presented. One of the guiding Project objectives and subsequent analyses pertain to flow conveyance. A one-dimensional hydraulic model was completed during the development of initial channel/floodplain options to examine the largest range of practical and feasible floodplain widths given a reasonable range of management and habitat restoration strategies. Initial screening involved reviewing the options for consistency with the Settlement requirements and for technical feasibility. Any option deemed technically infeasible or beyond the scope of the Settlement or contrary to its requirements were not carried forward for further consideration.

2.1.4 Alternatives Formulation

An early step in developing this EIS/R was the formulation of the Action Alternatives addressed by this document. The process diagram shown in Figure 2-2 depicts the steps in the formulation process.

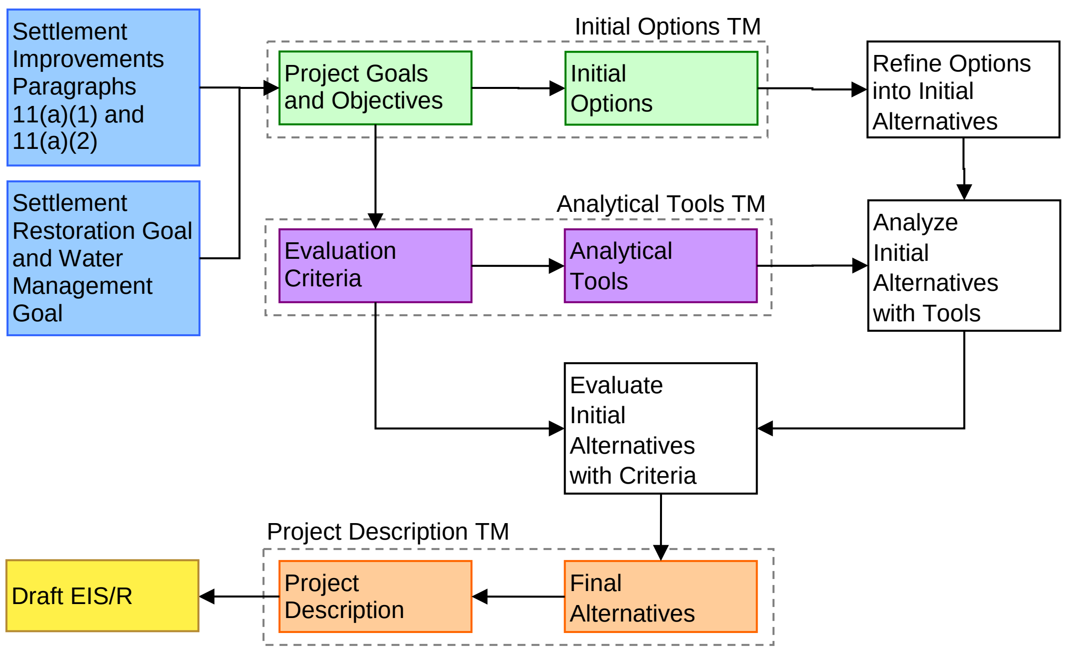


Figure 2-2.
Alternatives Formulation Process Diagram

The initial guidance for developing the Project comes from language in the Settlement, specifically the Settlement's goals and the Settlement defined improvements. These goals and improvements are consistent with the Project's purpose and need (see Section 1.4). The Settlement goals are:

The Restoration Goal (Settlement Paragraph 2):

> *… a goal of this Settlement is to restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally-reproducing and self-sustaining populations of salmon and other fish (the "Restoration Goal").*

The Water Management Goal (Settlement Paragraph 2):

> *…a goal of this Settlement is to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in this Settlement (the "Water Management Goal").*

The Mendota Pool Bypass and Reach 2B improvements defined in the Settlement are (Settlement Paragraph 11[a]):

> *(1) Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cfs from Reach 2B downstream to Reach 3. This improvement requires construction of a structure capable of directing flow down the bypass and allowing the Secretary to make deliveries of San Joaquin River water into Mendota Pool when necessary;*

> *(2) Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass channel.*

Alternatives formulation builds on the Settlement goals and project-specific improvements and progresses through three stages: initial options, initial alternatives, and final alternatives.

- Initial options represent the preliminary concepts and the basic components for project implementation. They were developed based on existing information and data, studies undertaken for the Program Environmental Impact Statement/ Environmental Impact Report (PEIS/R) process, pre-appraisal level analyses and screening, as well as input from Program Work Groups, stakeholders, and the public. The initial options are described in the Initial Options TM (SJRRP 2010a).
- The initial options were refined into initial alternatives based on additional concept refinement and engineering analyses, preliminary cost-benefit analyses, additional data collection, and input from the Program, Program Work Groups, stakeholders, and the public. The initial alternatives represent a range of feasible implementation strategies incorporating appraisal-level design and analysis.
- The initial alternatives were evaluated based on the evaluation criteria and with the tools described in the Analytical Tools TM (SJRRP 2010c). The Project Description TM Attachment A – Initial Alternatives Evaluation (SJRRP 2012) documents the methods and results of the evaluation and makes recommendations for final alternatives.

2.1.5 Summary of the Alternatives Evaluation Process

A set of evaluation criteria were proposed in the Analytical Tools TM with which to evaluate the initial alternatives on the basis of flow conveyance and operations, fish habitat and passage, habitat restoration, geomorphology and sediment, groundwater, land use, economics, and socioeconomics, and costs. The criteria were developed based on the Project goals and objectives as a means of determining whether the initial alternatives meet those goals and objectives. During the appraisal-level design, additional detail was developed for each component and structure, new and refined modeling of the river channel and floodplains was conducted, and new data from field surveys became available. The criteria were further refined based on the available data, analyses, and the level of design, and the criteria were grouped into various factors, categories, and finally implementation feasibility, benefits, and impacts perspectives.[1]

Data representing the performance of the initial alternatives according to each applicable criterion were generated and input into an evaluation matrix spreadsheet. The evaluation process leveraged concurrent data collection efforts, engineering analyses and modeling, as well as stakeholder and public input. Using the evaluation matrix, the initial alternatives were scored according to their performance at the factor, category, perspective, and overall levels allowing for an understanding of the initial alternatives with respect to the goals and objectives of the Project.

Below is a summary of the evaluation criteria. The criteria are explained in-depth in the Project Description TM, Attachment A – Initial Alternatives Evaluation, Section 6.0 (SJRRP 2012).

Objectives/Benefits Achievement

Fish Habitat and Passage

- Rearing habitat: total acres of floodplain with a depth greater than 1.0 feet at 2,500 cfs.
- Shallow Water Habitat Quality: a rating based on the proportion of very shallow water habitat (less than 0.5 feet) to the amount of rearing habitat (greater than 1.0 feet).
- Artificial structures in the migratory path: number of structures that adult salmon would need to pass. Each grade control structure, dam sill, fish passage facility (or bifurcation structure), and crossing is considered as an individual structure.
- Total number of steps at structures: the number of steps an adult salmon would need to jump or swim through. Each grade control structure, dam sill, and fish passage facility step is considered as an individual step.
- Fish screens along the migratory path: the number of fish screens with large diversion rates (greater than 100 cfs) that juvenile salmon may encounter along the migratory path.
- Potential predation sites at structures: the number of potential predation sites that juvenile salmon may encounter along the migration path. Each grade control structure, dam sill, fish passage facility (or bifurcation structure), fish screen outlet, and crossing is considered a potential predation site.

[1] Factors, categories, and perspectives are tiered groupings of the evaluation criteria. Factors are groupings of criteria, categories are groupings of factors, and perspectives are groupings of categories.

Habitat Restoration

- Wetlands and other waters of the U.S. area: the acreage of restored habitat with hydrophytic vegetation and on hydric soils.
- Sensitive vegetation alliance extent: the acreage of potential future sensitive vegetation alliances based on the Preliminary Planting Plans.
- Wildlife habitat extent: the acreage of potential future wildlife habitat types resulting from the restoration.
- Special status species habitat extent: the acreage of potential future habitat for special status wildlife species based on the wildlife habitat types.

Geomorphology

- Potential for lateral migration to impact levees: The estimated cost of providing erosion protection (revetment) on levees that may be impacted by lateral erosion.

Impacts

Groundwater

- Acres of land in which groundwater levels rise above 5-foot monitoring threshold: The acreage of land outside the proposed levee alignments that is anticipated to have shallow groundwater elevations above the 5-foot monitoring threshold and is thus subject to mitigation measures to prevent waterlogging.
- Acres of land in which groundwater levels rise above 7-foot monitoring threshold: The acreage of land outside the proposed levee alignments that is anticipated to have shallow groundwater elevations above the 7-foot monitoring threshold and is thus subject to mitigation measures to prevent waterlogging.

Land Use

- Acres of farmland removed from production: The total acres of alfalfa, almond, grapes, other row crops (grouped), palm, and pistachio that would be permanently removed from production due to the construction and long-term operation of the initial alternatives.

Socioeconomics and Economics

- Reduction in annual agricultural production values: The total production value based on unit production values and the acreage permanently removed from production due to the construction and long-term operation of the initial alternatives.

Environmental

- Wetland impacts: The estimated acreage of direct impacts to wetlands resulting from the initial alternatives.

- Sensitive vegetation alliance direct impacts: The estimated acreage of direct impacts to sensitive vegetation alliances resulting from the initial alternatives.
- Special status wildlife habitat impacts: The estimated acreage of direct impacts to special status wildlife habitat resulting from the initial alternatives.
- Historic properties potentially effected: The number of recorded historic properties identified within the extents of the initial alternatives.
- Buried deposits sensitivity: The highest buried deposits sensitivity within the extents of the initial alternatives based on the landform age scale.

2.2 Description of Alternatives

This section describes the alternatives developed for the Project. Each of the Action Alternatives consists of a floodplain width which passes 4,500 cfs, a method to bypass Restoration Flows around Mendota Pool, and a method to deliver water to Mendota Pool. Action Alternatives are considered to comply with the terms of the Settlement, substantially meet the Project goals and objectives, and have benefits potentially offsetting their impacts. Alternatives have been assessed for environmental impacts to the various resource areas (see Chapters 4.0 to 24.0).

2.2.1 NEPA and CEQA Requirements

NEPA Requirements

Reclamation, as the Project proponent and Federal lead agency, is responsible for the development of alternatives that meet NEPA requirements. For the Project alternatives, including the proposed action, NEPA requires that Federal government agencies shall (40 CFR Section 1502.14):

> *(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.*
>
> *(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.*
>
> *(c) Include reasonable alternatives not within the jurisdiction of the lead agency.*
>
> *(d) Include the alternative of no action.*
>
> *(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.*
>
> *(f) Include appropriate mitigation measures not already included in the proposed action or alternatives.*

CEQA Requirements

CSLC, as the State lead agency, is responsible for the development of alternatives that meet CEQA requirements. Section 15126.6 of the State CEQA Guidelines requires that:

- An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives. An EIR need not consider every conceivable alternative to a project. Rather, it must consider a reasonable range of potentially feasible alternatives that will foster informed decision-making and public participation. An EIR is not required to consider alternatives which are infeasible.
- The range of potential alternatives to the proposed project shall include those that could feasibly accomplish most of the basic objectives of the project and could avoid or substantially lessen one or more of the significant effects.
- The specific alternative of "no project" shall also be evaluated along with its impact.
- The EIR should briefly discuss the rationale for selecting the alternatives to be discussed. The EIR should also identify any alternatives that were considered by the lead agency but were rejected as infeasible during the scoping process and briefly explain the reasons underlying the lead agency's determination…. Among the factors that may be used to eliminate alternatives from detailed consideration in an EIR are:

  (i) Failure to meet most of the basic project objectives.
  (ii) Infeasibility.
  (iii) Inability to avoid significant environmental impacts.

This joint EIS/R is prepared in accordance with both NEPA and CEQA, with the Action Alternatives analyzed at an equal level of analysis (consistent with NEPA standards).

2.2.2 Overview of Alternatives

This EIS/R presents the No-Action Alternative and four Action Alternatives to implement the Project. Each Action Alternative includes the actions called for in the Settlement for the Mendota Pool Bypass and Reach 2B. Project alternatives include the following:

- No-Action Alternative.
- Alternative A (Compact Bypass with Narrow Floodplain and South Canal).
- Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative.
- Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal).
- Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal).

2.2.3 No-Action Alternative

The No-Action Alternative is required for the analysis of environmental effects according to NEPA and CEQA. Under this alternative, the Project would not be implemented. The No-Action Alternative is not consistent with the Settlement.

Existing conditions were developed for each resource area based on the availability of historical data and recent observations. Future conditions were based on reasonably foreseeable actions that would occur without the Project. The planning period for the future condition evaluation would vary depending on the resource area. The conditions under the No-Action Alternative are the conditions that are predicted to exist in the Project area during the planning period if the Project is not implemented.

No-Action Conditions

If the Project were not implemented, the components described in the Action Alternatives would not be implemented; however, the No Action Alternative assumes that other components of the SJRRP, as described in the 2012 Record of Decision, and other reasonably foreseeable actions consistent with current management direction expected to occur in the Project area, would be implemented.

The No-Action Alternative generally assumes no channel or structural improvements would be made in Reach 2B, and Restoration Flows would be reduced to not exceed the existing Reach 2B capacity. It is assumed for the No-Action condition that agriculture would continue and cropland would be the dominant cover type, consistent with the existing condition. The following assumptions about No-Action have been evaluated in the resource sections of the Project EIS/R.

Fisheries

In the No-Action Alternative, the maximum channel conveyance would be limited to the existing capacity. Fish passage improvements would not be provided at structures (Chowchilla Bifurcation Structure, San Mateo Avenue, and Mendota Dam). However, the remainder of the SJRRP would proceed, and salmon would be reintroduced into the San Joaquin River. Each spring during their outmigration, downstream migrating juveniles would be entrained in diversions from Mendota Pool and succumb to high rates of predation by non-native fish present in Mendota Pool. Adult salmon would be blocked on their upstream migration at Mendota Dam in all years except wet year types. Blocked adult salmon would be exposed to poaching in the river below Mendota Dam and poor water quality later in the year. There is no spawning substrate in Reach 3, downstream of the dam, so blocked adult fish would require alternative efforts (e.g., trap and haul) to reach spawning grounds or would not spawn successfully.

Habitat

Under the No-Action Alternative, habitat conditions in the Project area may change to the extent that Restoration Flows may recruit new vegetation in some areas. In this alternative, if Restoration Flows were to enter Reach 2B, the condition of the narrow strips of native riparian vegetation along the channel banks downstream of the San Mateo Avenue crossing would be maintained by the relatively stable water level held by

Mendota Dam. Upstream of San Mateo Avenue, riparian vegetation may recruit along the wetted channel banks unless vegetation removal is employed.

Seepage

The No-Action Alternative would maintain the existing levee alignments and heights and maximum conveyance would continue to be limited to the existing capacity. If Restoration Flows enter the existing Reach 2B, there would probably be a minimal increase in seepage from the river channel but since capacity would remain unchanged, this may be similar to the seepage experienced during Interim Flows under existing conditions. However, the SJRRP Seepage Management Plan would be implemented, and actions could be taken as part of that plan to reduce seepage effects from Restoration Flows.

Land Use, Agriculture, Economics & Socioeconomics

Under No-Action conditions, future land use in the area is unlikely to change. Reach 2B is in the unincorporated areas of both Fresno and Madera Counties. The nearest incorporated cities are Firebaugh and Mendota, both in Fresno County Population is expected to increase annually, compounded, by 1.1 percent and 1.3 percent in Fresno and Madera Counties, respectively, between 2010 and 2060 (California Department of Finance 2014). Most of that growth would likely occur in areas near the main cities in each of the counties. While population and economic projection data for specific unincorporated subareas of the counties are unavailable, neither agricultural nor non-agricultural activity is likely to expand substantially in the Mendota area.

If the Reach 2B Project is not implemented, future socioeconomic conditions in the pertinent Fresno and Madera County areas relative to conditions in other areas in the two counties would be expected to be similar. It is expected that the Reach 2B area would remain in agriculture and that most of the working population in the area would remain employed in agriculture and related industries.

Geomorphology

The No-Action Alternative would maintain the existing levee alignments and heights and maximum conveyance would continue to be limited to the existing capacity. If Restoration Flows enter the existing Reach 2B, sand transport would likely increase; however, recent sediment continuity studies have predicted that sand inputs from Reach 2A under Restoration Flows will likely result in net deposition in the upper segment of Reach 2B and potentially down to the Mendota Pool. The No-Action Alternative would not likely change the existing geomorphic conditions in Reach 2B.

2.2.4 Elements Common to All Action Alternatives

Action Alternatives would be designed to provide:

- Conveyance of at least 4,500 cfs in Reach 2B and through the Mendota Pool Bypass.
- Diversion of up to 2,500 cfs from Reach 2B into Mendota Pool.

Additionally, some constructed elements are also common to all Action Alternatives. Those elements are described below.

Fish Habitat and Passage

The amounts of fish habitat and the number of structures fish would need to pass vary among the Action Alternatives; however, some conditions and criteria are consistent across alternatives and warrant discussion here.

One of the primary focuses of the Action Alternatives is to provide floodplain and riparian habitat to provide benefit to migrating juvenile and adult salmonids and other native fishes. Floodplain and riparian habitats in the Action Alternatives would include a variety of native plant communities suited to the hydrology, soils, and climate of Reach 2B and the San Joaquin Valley.

The Action Alternatives also include provision of fish passage at structures for salmonids and other native fish. These structures vary by alternative but overall include fish screens, fish passage facilities, grade control structures, and bifurcation structures (under certain flows). The designs for structures with fish passage components would be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001). Specifically, the Action Alternatives would provide suitable hydraulic conditions for passage of up-migrating adult salmonids, out-migrating juvenile salmonids, and inter-reach migration of other native fish between Reach 2A and Reach 3. Suitable hydraulic conditions include those conditions which the species is physically capable of passing and do not cause undue stress on the animal. The passage features would be designed to cause no physical harm to fish. The design criteria are structured around the life stages of the target anadromous species and the timing of the runs for upstream movement of adult fall and spring run Chinook and winter steelhead and the downstream movement of juvenile life stages spawned from these runs. Recommended criteria are based on a combination of swimming ability of the fish species as reported in scientific papers and criteria in agency design guidelines. Recommended design criteria to provide for successful fish passage (depth of flow, suitable velocity ranges and jump height) are provided in Table 2-1. The design criteria for a particular species would be met over the associated flow range (minimum flow to maximum flow).

Table 2-1.
Fish Passage Design Criteria

Species	Life-stage	Migration Timeframe	Frequency	Minimum Flow	Maximum Flow	Maximum Velocity [1]	Minimum Water Depth [2]	Maximum Jump Height [3]	Minimum Pool Depth
			years	cfs	cfs	fps	feet	feet	feet
Chinook salmon	Adult	Spring and fall pulse	All years except CL	115 [4]	4,500	4.0	1.2	1.0	[5]
	Juvenile (downstream)	Nov-May	All years except CL	85 [7]	n/a	n/a	1.0	n/a	[5]
Steelhead	Adult	Spring and fall pulse	All years except CL	115 [4]	4,500	4.0	1.2	1.0	[5]
	Juvenile (downstream)	Nov-May	All years except CL	85 [7]	n/a	n/a	1.0	n/a	[5]
Sturgeon	Adult	Spring pulse	W and NW years	1,138 [8]	4,500	6.6	3.3	None – swim through	n/a
Lamprey	Adult	Spring pulse	All years except CL	125 [6]	4,500	[9]	[9]	[9]	n/a
Other native fish	Adult	Spring pulse	W, NW, and ND years	543 [10]	4,500	2.5	1.0	None – swim through	n/a

W = wet; NW = normal wet; ND = normal dry; CL = critical low

[1] Recommended maximum velocities shown are for grade control structures or structures with short longitudinal lengths based on *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001). For structures with longer lengths (e.g., culverts and bifurcation structures under certain conditions), maximum velocities would be developed based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[2] Minimum water depth criteria based on 1.5 times body depth or 1 foot depth, whichever is greater based on *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[3] Maximum jump height criteria based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[4] Based on Exhibit B lowest flow in the fall spawning period (starts Oct 1) for the desired frequency; all Spring Pulse Flows are higher.

[5] Pool depths to be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[6] Based on lowest flow within Exhibit B Spring Pulse Flow period for the desired frequency.

[7] Based on lowest flow within desired migration period for the desired frequency.

[8] Wet and normal wet years constitute 50% of years in the historical record. Based on an analysis of varying Restoration Flows management strategies (SJRRP 2010d); flows with a 50% exceedance could range from 1,138 to 4,500 cfs.

[9] Lamprey designs to be based on criteria in *Best Management Practices for Pacific Lamprey* (USFWS 2010)

[10] Wet, normal wet, and normal dry years constitute 80% of years in the historical record. Based on an analysis of varying Restoration Flows management strategies (SJRRP 2010d); flows with an 80% exceedance could range from 543 to 4,500 cfs.

The Action Alternatives include facilities that fish would encounter or need to pass to migrate between Reach 3 and Reach 2A (from downstream to upstream). The need for fish screens at diversion facilities will be further evaluated as Project planning and design continues. The following fish screens are included in the Action Alternatives in the event that they are determined necessary: the Lone Willow Slough fish screen (see Section 2.2.4), Big and Little Bertha pumps screens, and screens on other smaller diversions. Each alternative includes other facilities specific to that alternative. Each structure represents a potential stressor for adult salmon and potential predation site for juvenile salmon. However, each structure would be designed to perform according to fish passage and screening design criteria. In addition, the channel and floodplain elements of the Action Alternatives incorporate riparian areas to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to accommodate channel structure variability, all of which may help to reduce stress and predation.

During construction, impacts to fish would be minimized by including some or all of the following measures:

- Temporary bypass facilities around construction areas that meet fish passage criteria.
- Construction in the dry (i.e., not in active flows).
- Phased construction that would allow passage to continue in the channel or in the completed portions of structures while other portions are built.
- Fish rescue and relocation.

Levees

The location, length, and height of the levees vary among the Action Alternatives; however, some design criteria and features would be consistent across alternatives and warrant discussion here.

Levees would be required along the Project area to contain Restoration Flows. While the height and footprint of the levees vary according to their location along the channel and the ground elevation, the capacity, freeboard, and cross-section would be consistent. Localized backwater and redirection effects at Project structures would be considered during design of levee heights. Levees would be designed to maintain at least 3 feet of freeboard on the levees at 4,500 cfs. Levee design would be based on the U.S. Army Corps of Engineers (Corps) *Engineer Manual 1110-2-1913-Design and Construction of Levees* guidelines (Corps 2000a) and *Engineer Manual 1110-2-301 Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, & Embankment Dams* (Corps 2000b). The design includes seepage control measures, inspection trenches, maintenances roads, and drainage trenches to direct off-site drainage.

Levee alignments maintain a 300-foot buffer zone, where appropriate, between the levee and river channel to avoid impact to levees over time due to potential channel migration. In areas where a minimum 300-foot buffer zone between the main river channel and levee cannot be maintained, bank revetment would be incorporated in the design.

New levees would be designed to have sideslopes of 3 horizontal to 1 vertical (3H to 1V) on the waterside and landside. A maintenance road and surface drainage ditch would also be included. Surface drainage ditches would only be intended to capture and direct runoff; they are not intended to address groundwater seepage or through-levee seepage. By following the Corps standards, all levees would have an inspection trench. Additional data collection and analysis would be required to verify the groundwater conductivity rates of the *in situ* and borrow soils and to finalize the design of seepage control measures.

The levee alignments shown on the plan views of the Action Alternatives may be adjusted during final design. Adjustments may be made for several reasons, including to improve flow conditions on the floodplain, to improve habitat conditions on the floodplain, to reduce potential erosion, to accommodate adverse soil conditions, and to avoid existing infrastructure among others. The final levee alignments will be within the impact areas evaluated in this document.

Seepage Control Measures

Seepage of river water through or under levees is a concern for levee integrity and adjacent land uses. Through-seepage, water that seeps laterally through the levee section, would be addressed through proper levee design and construction (e.g., selection of low porosity materials and proper compaction). Under-seepage, water that seeps laterally by travelling under the levee section, is primarily controlled by the native soils beneath the levee and seepage control measures would be included where native soils do not provide sufficient control. Seepage control measures would be included, as necessary, in the Project in areas where under-seepage is likely to affect adjacent land uses. Seepage control measures could include: cut-off walls, interceptor drains or ditches, seepage wells, seepage berms, land acquisition (fee title or seepage easements) and other measures that can be implemented within the Project area.[2]

Borrow

Borrow material would primarily be required for the construction of the levees, but it may also be used in the construction of other structures for foundation or backfill material. Levees may be constructed entirely of local borrow material, a mix of local and imported borrow material, or just imported borrow material. Borrow locations will be determined after a geotechnical exploration of the local borrow areas is complete; the exploration will determine the suitability of local soils for use as borrow material. Until the exploration can be complete, it is assumed that all levee fill will come from local borrow sites. Investigation and analysis of potential borrow sites is ongoing by SJRRP, and the borrow area information will be updated as new information becomes available.

[2] A cut-off wall is a construction technique to reinforce areas of soft earth that are near open water or a high groundwater table with a mixture of soil, bentonite, and cement. Interceptor drains are buried perforated pipes and interceptor ditches are surface ditches, both of which intercept groundwater and redirect it to a discharge point. Because the drains and ditches have lower resistance to flow, the groundwater table can be kept artificially low in areas near the pipe or ditch. The discharge point could include a lift pump to move drained water over the levees, or it could be discharged directly to a surface water body (e.g., agricultural canal). Seepage wells are groundwater wells that are used to pump and draw down the water table where seepage is occurring. Seepage berms are berms placed on the landside of a levee to add additional weight and width to the levee to counteract seepage.

Topsoil from local borrow areas would be stockpiled for reuse at the borrow site or within the Project area.

The locations of borrow areas are dependent on the locations of suitable materials. To the extent that suitable materials and the locations for floodplain grading coincide, borrow from those areas may be preferred. Borrow from within the Project levees will be designed to be compatible with native fish habitat and uses by either reconnecting to the river channel or by restoring to an appropriate elevation to prevent stranding.

It is estimated that up to 350 acres of land total will be needed for borrow areas. This includes borrow locations inside and outside the Project levees (identified as Potential Borrow Area on Figure 1-2). Borrow areas will avoid sensitive biological resources to the extent practicable.

Levee and Structure Protection

Action Alternatives generally provide a minimum 300-foot buffer between the existing channel and the proposed levee, where appropriate and feasible. For locations where the 300-foot buffer was not included, erosion protection for the levee in the form of revetment would be included. The revetment would be riprap material covered by soil and then planted to provide a vegetated surface. However, softer approaches, such as bioengineering or dense planting, may be considered during design depending on velocities and scour potential. Locations that require revetment include areas where the 300-foot buffer was not included due to the proximity of existing infrastructure, near the proposed structures, and along river bends less than 300 feet from the levee in areas that have the potential to erode, as determined in the design process.

Channel Bank Protection

Action Alternatives could include riparian vegetation, rock vanes, woody materials, revetment, or other measures designed to protect channel banks from erosion. Bank protection measures would be installed in locations susceptible to and likely to experience bank erosion.

Removal of Existing Levees

Removal of portions of the existing levees is included and designed to expand the inundation area of the floodplain out to the proposed levees and improve connectivity between the river channel and proposed floodplain. The locations of existing levee removal would be based upon the hydraulic performance of the channel and floodplain. In certain locations, however, highly desirable existing vegetation (native and sensitive vegetation communities that can serve as seed banks for future vegetation communities) can be found on the existing levees. Where hydraulic performance and connectivity of the floodplain would not be negatively affected, portions of the existing levees with highly desirable vegetation would remain in place. Materials that are removed from the existing levees would likely be reused within the Project area.

Floodplain and Channel Grading

Floodplain and channel grading would be included with the Action Alternatives. Floodplain and channel grading would include any or all of the following at locations to be determined during design:

- Creating high-flow channels through the floodplain to increase the inundation extent at lower flows.
- Connecting low-lying areas on the floodplain to the river to prevent stranding.
- Removing high areas where flow connectivity would be impeded (e.g., farm road grades).
- Excavating floodplain benches adjacent to the river channel to increase the frequency of inundation.
- Creating greater inundation depth diversity on the floodplain.
- Excavating channels in portions of the Project area to tie into existing elevations upstream and downstream of the Project or to create desirable sediment transport conditions.

Floodplain and channel grading can provide benefits to salmon and other native fish by allowing inundation to occur at lower flows, by distributing suitable rearing habitats further into the floodplain, by connecting rearing habitat to primary production areas (shallow water habitat), by providing escape routes during receding flows, and by confining flows to a deeper, narrower channel to limit temperature increases.

Figure 2-3 provides an example of how various floodplain grading approaches can be used to expand inundation on the floodplain. The Existing Channel graphic shows an example of how inundation would occur without floodplain grading. The Lowered Floodplain example shows an example of how floodplain benches, lowered areas to either side of the channel, could be used to inundate floodplain areas at lesser flows. This graphic also shows how lowered floodplains could affect inundation at moderate flows. The High Flow Channels graphic shows an example of how high flow channels, side channels that initiate at larger flows than the main channel, could be used to expand floodplain inundation.

Lone Willow Slough Fish and Riparian Diversions Screens

Lone Willow Slough connects to the river at approximately River Mile (RM) 215.9 just downstream of the Chowchilla Bifurcation Structure. Some Action Alternatives include construction of a fish screen at this diversion, if determined necessary. During flood control releases from Friant Dam and when the Exchange Contractors are exercising their water rights on the San Joaquin River, in lieu of taking substitute water from the Delta-Mendota Canal, up to 125 cfs of water may be diverted for irrigation from Reach 2B into the Lone Willow Slough. A screen would prevent fish from entering the canal when flows are being diverted. The fish screen structure would consist of a 15-foot by 21-foot concrete hollow box, with the river side of the box open to river flows and the back of the box fitted with a board guide to control diversion into the irrigation canal. The opening at the riverside would include an automated cleaner system, trash rack and a fish screen to prevent migrating fish from entering the intake. The screen would be designed to meet *Anadromous Salmonid Passage Facility Design* (NMFS 2008) criteria.

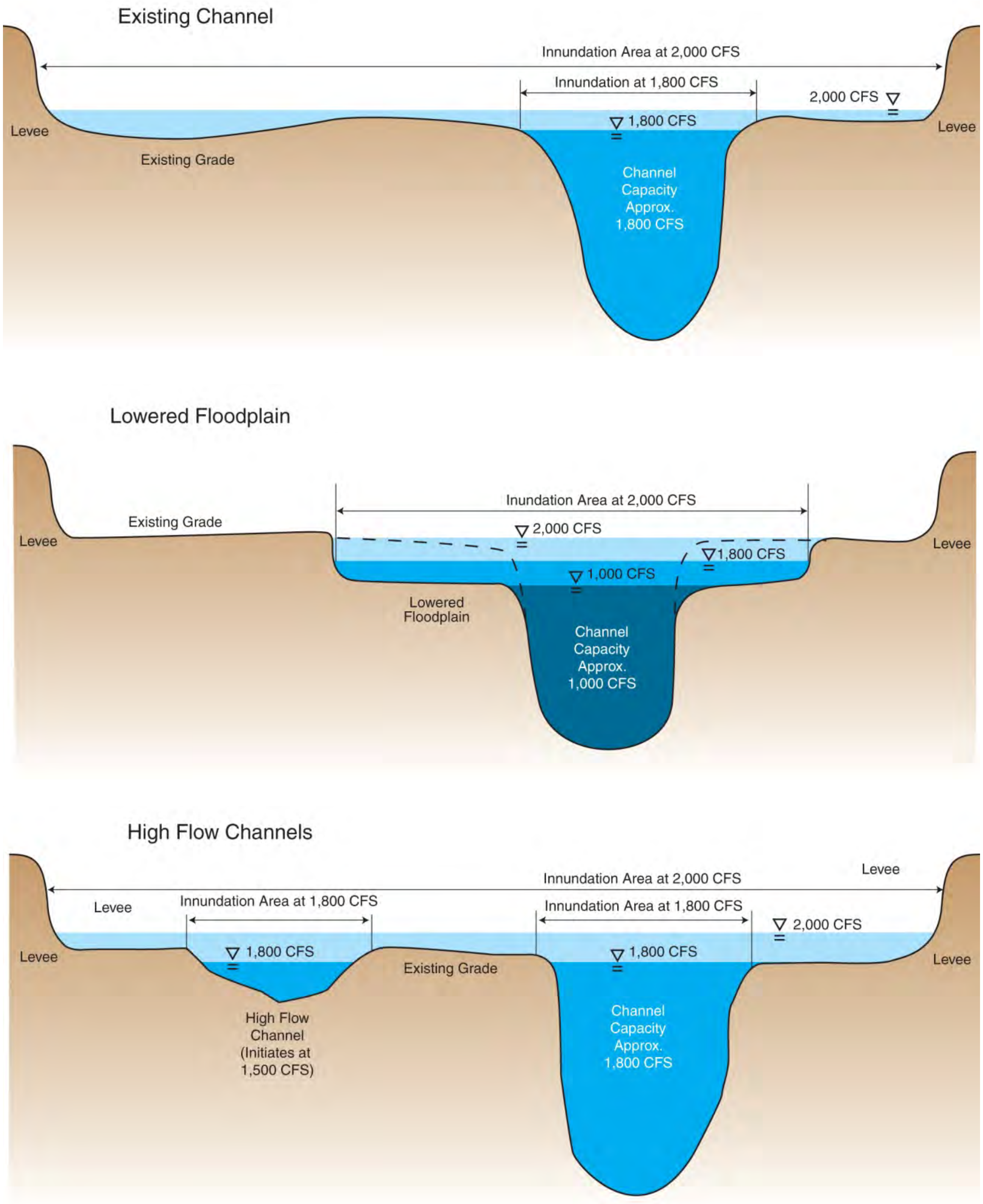


Figure 2-3.
Example Floodplain Grading Approaches

There are existing diversion pumps located along Reach 2B (e.g., Big and Little Bertha pumps). These pumps would be retrofitted with fish screens, where required, to prevent migrating fish from entering the intakes. The screens would be designed to meet *Anadromous Salmonid Passage Facility Design* (NMFS 2008) criteria.

Infrastructure for Fish Monitoring

The designs for control structures, fish passage facilities, and fish screens include security fences and gates, mounting hardware, and electrical supply in order to conduct fish monitoring activities. Construction, operations, and maintenance of the fish monitoring infrastructure are included as part of this Project. The fish monitoring activities themselves are not included in this Project, and will be addressed in subsequent environmental analysis, as appropriate.

Existing Infrastructure Relocations or Floodproofing

Existing infrastructure (see Figure 2-4) such as groundwater wells, pumps, electrical and gas distribution lines, water pipelines, and canals is located in the Project area and would require relocation, retrofitting, or floodproofing to protect the structures from future Restoration Flows and increased floodplain area. Although the relocations, retrofits, and floodproofing would be included as part of the Project; the actual relocation, retrofit, or floodproofing work may be performed by others. As a result of the Project, some existing infrastructure may be unnecessary in the future (e.g., power lines that service pumps relocated to outside the Project area). In these cases, infrastructure may be demolished or abandoned in place.

Electrical and Gas Distribution

The length of electrical and gas distribution line identified for possible relocation was evaluated for the Action Alternatives. Information from Pacific Gas & Electric (PG&E) was available for portions of the area in GIS shapefile format and was supplemented by field data. At the current level of design, it was assumed that the length of existing electrical and gas distribution line found within the Project area would need to be replaced.

Canals and Drains

The length of canals identified for possible relocation was evaluated for the Action Alternatives. On-farm canals and drains visible on the LiDAR imagery (Central Valley Floodplain Evaluation and Delineation [CVFED] 2009) and identified during on-site field meetings with landowners were quantified. No canal and drains outside the Project footprint have yet been identified for redesign. Some portions of canals and drains could be discontinued in the future; the extent of discontinued and replaced canals will be considered during landowner negotiations. No subsurface drains were able to be quantified; however, some are believed to exist within the area.

Lift Pumps

The number of lift pumps identified for possible relocation was evaluated for the Action Alternatives. Lift pumps visible on the LiDAR imagery (CVFED 2009) or noted in the CalFish Passage Assessment Database (CalFish 2014) were assumed to require relocation to new facilities on the edge of the proposed levees. A pilot channel dug from the low flow river channel to the intake of the relocated pumps was also assumed. Locations in the CalFish Passage Assessment database were confirmed using the LiDAR imagery when possible.

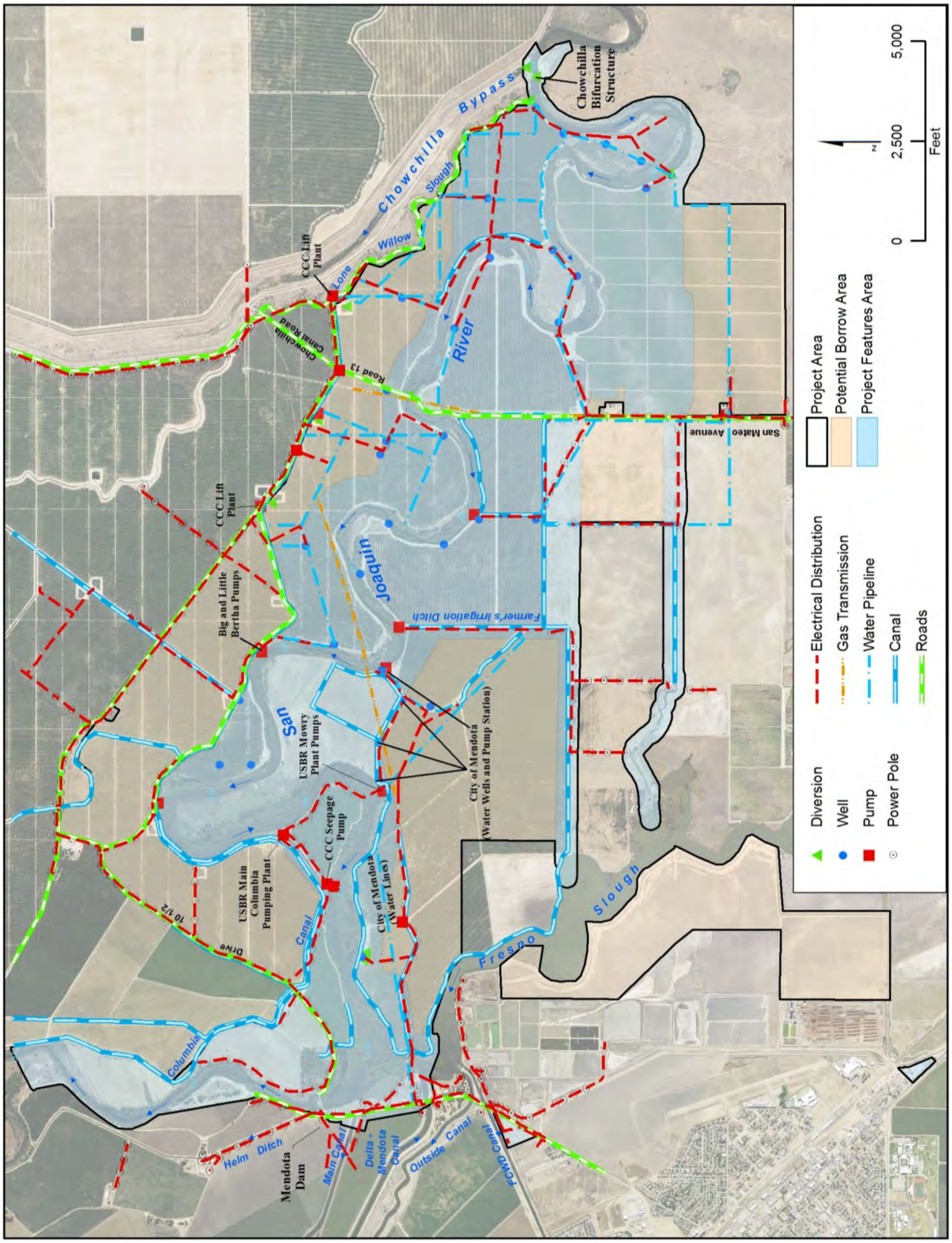


Figure 2-4.
Existing Infrastructure in the Project Area

Groundwater Wells

The number of existing wells identified for possible floodproofing or relocation, including the city of Mendota groundwater wells, was evaluated for the Action Alternatives. Wells were identified within the area using aerial photography. During design, the DWR wells database would be consulted for an estimate of abandoned wells that have not been destroyed, so that these old wells would not be conduits for flood waters to the groundwater. A formal well canvas would also be conducted. Floodproofed wells would be provided with year-round vehicular access via a raised roadbed across the floodplain. The roadbed could include multiple culverts to support floodplain connectivity, depending on the length of the access road and its effect on floodplain flows. Wells relocated by the Project would provide equal utility. Wells taken out of service by the Project would be abandoned in accordance with U.S. Environmental Protection Agency (EPA), DWR and/or local regulations.

Regulating Reservoirs

The number of irrigation regulating reservoirs identified for possible relocation was evaluated for the Action Alternatives. Reservoirs were assumed to be a typical size, contain one lift pump, and half of the reservoir located below the surrounding grade and half above the surrounding grade.

Oil and Gas Wells

Two closed or active oil and gas wells have been identified within the Project area for potential closure, relocation, or buyout. If active oil and gas wells cannot be avoided, the destruction or closure of those wells would be conducted in accordance with the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) regulations.

Other Utilities

Other infrastructure was identified within the impacted areas. Other facilities include: high voltage transmission lines, gas lines, and water pipelines. High voltage transmission lines are assumed to be high enough to not be impacted. Gas lines are typically attached to bridges or buried below the river when crossing the river and were assumed not to require relocation. Water pipelines were quantified from existing maps and discussions with landowners. Water pipelines may be relocated or abandoned depending on their future use requirements. Service line crossings (e.g., gas, water, electrical) would be considered during levee design.

Construction Access

Access for vehicles carrying materials, equipment, and personnel to and from the construction area would be provided via several existing roadways in the Project vicinity (see Figure 2-5). Improvements may be required to upgrade roadways, pavements, and crossings for anticipated construction traffic and loads, provide adequate turning radii and site distances, and to control dust on non-paved roads. Anticipated improvements include:

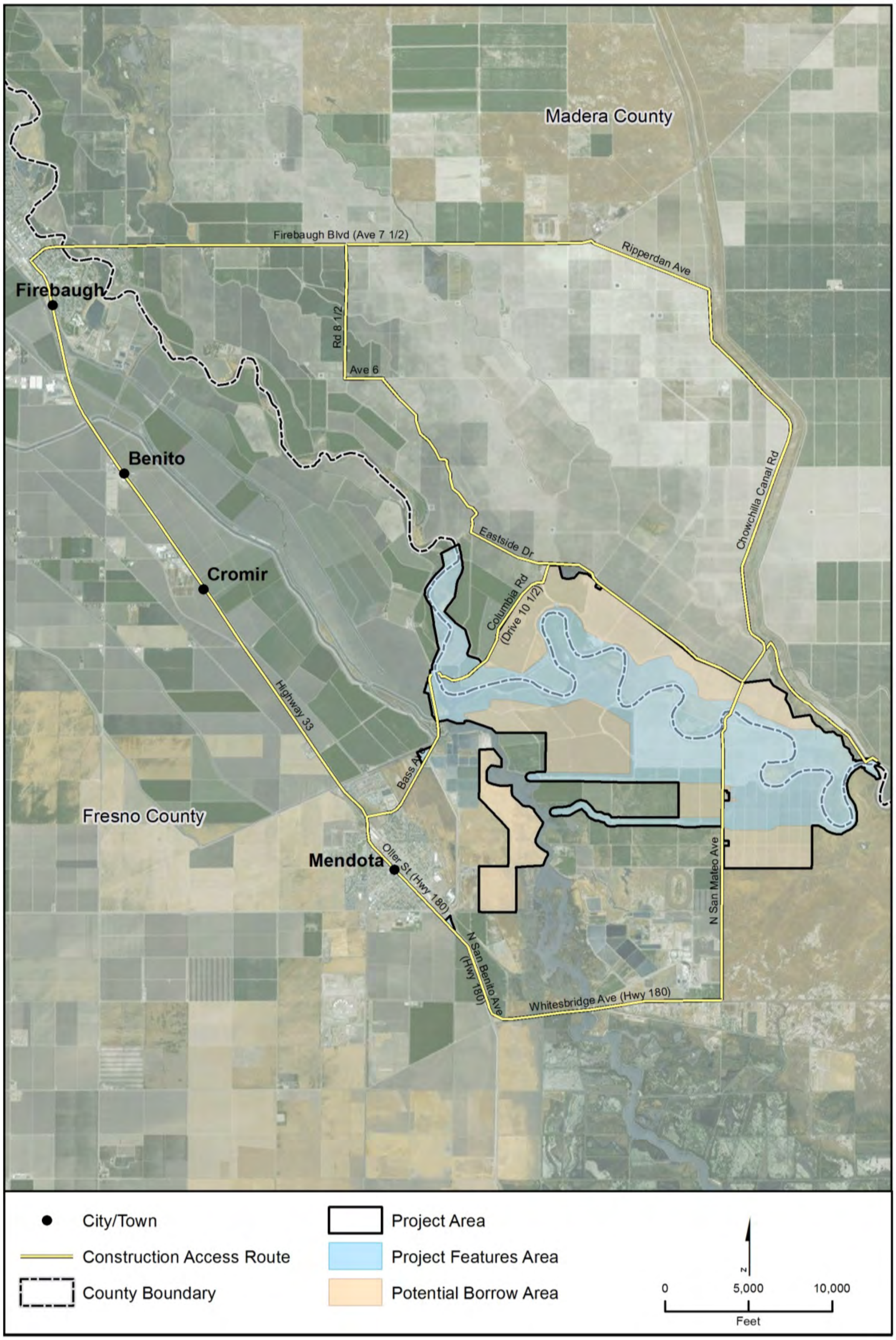


Figure 2-5.
Construction Access Routes

- Eastside Drive – Approximately 0.6 mile of dirt road starting at Road 10 ½ will likely require overlaying, and the implementation of dust control measures.
- Chowchilla Canal Road/Road 13 – Approximately 0.3 mile of road starting at Eastside Drive will likely require some overlaying and the implementation of dust control measures.
- San Mateo Avenue – Approximately 0.5 mile of gravel and 1.5 miles of oil-dirt road starting at the existing San Joaquin River levees will likely require some overlying and the implementation of dust control measures.
- Bass Avenue Canal Crossings – These crossings may need additional bracing and shoring to ensure that they will be able to support the load of the construction equipment and activities. All the construction equipment on Bass Avenue will be within the legal loads (see note below). This crossing is on the Fresno County replacement list.
- Delta-Mendota Canal Crossing – This crossing may need additional bracing and supports to ensure that it will be able to support the load of the construction equipment activities.

Dust control measures for non-paved roads could include the use of water trucks or dust palliative for dust control or gravel placement where necessary. Legal loads would be used on all roads, and once construction is completed, the roads would be returned to the same condition as they were prior to the Project.

Revegetation of Temporary Disturbance Areas

Areas temporarily disturbed during construction would be restored to their previous contours, if feasible, and then seeded with a native vegetation seed mixture to prevent soil erosion. Some areas, such as borrow areas, may not be feasible to restore previous contours, but these areas would be smoothed and seeded.

Operations and Maintenance

The Project includes long-term operations and maintenance of the proposed facilities and features as described below.

Maintenance

Levees will require maintenance for vegetation management, access roads, levee inspections, levee restoration, rodent control, minor structures, encroachment removal, levee patrolling during flood events, and equipment. Levee vegetation management includes equipment to drag or mow the levee banks or aquatic-safe herbicide applications. Maintenance of access roads includes replacing gravel or scraping and filling of ruts to keep the roads in good condition. Levee restoration includes restoring areas with erosion or settlement problems or adding armor. Rodent control includes setting traps with bait and periodically checking the traps. Minor structures maintenance includes repair or replacement of gates, locks or fences. Encroachment removal involves removing illegally dumped materials.

Floodplain maintenance includes vegetation management for invasive species, periodic floodplain and channel shaping to retain capacity and prevent fish stranding, and other floodplain maintenance activities such as debris removal and repair of channel banks and bank protection measures.

San Mateo Avenue maintenance includes maintenance when flows overtop the road and annual maintenance to keep the crossing functional and ensure that it can meet fish passage requirements. These maintenance activities include cleaning the culverts of debris or sediment, clearing any debris from the roadway prior to opening after flows have receded, repairing the road sub-base, base, and gravel surfacing, and repairing or replacing minor structures. Minor structures maintenance includes replacing gate locks, painting gates, replacing lost or damaged signage, and lubricating gates.

Control structures and Fresno Slough Dam maintenance includes annual operating maintenance for control gates, lubricating the fittings, greasing and inspecting the motors, replacing parts and equipment, in-channel sediment removal in the structure vicinity, and cleaning the trash rack. Work needed for the radial gates includes inspection of gates and seals and periodic replacement of seals. Work needed for the trash rack includes periodic repair or replacement of components, inspecting for operation, and greasing and inspecting the motors.

Fish screen maintenance is needed to ensure that screens are functioning to NMFS standards and capable of diverting the required flow. Fish screens maintenance includes removing the screens for cleaning, replacing screens when needed, periodic repair or replacement of brush cleaning system components, periodic repair or replacement of trash rack components, inspection for operation, greasing and inspecting motors, and in-channel sediment removal in the structure vicinity.

Fish barrier maintenance is needed to ensure that the barrier is functioning to NMFS standards and capable of passing the required flow. Fish barrier maintenance includes periodic repair or replacement of screens, in-channel sediment removal in the structure vicinity, and debris removal.

Fish passage facility maintenance is needed to ensure that the passage facility is functioning to NMFS standards. Depending on the type of fish passage facility built, fish passage facility maintenance could include removing sediment and debris from the facility, in-channel sediment removal in the structure vicinity, inspection of gates and seals and periodic replacement of seals, periodic repair or replacement of weir gates, periodic repair or replacement of supplementary water system components, inspection for operation, greasing and inspecting motors, and replacement of riprap, grouting, boulders, large woody debris, or other “natural” features of the fish passage facility.

Seepage control measure maintenance is dependent on the type of measures implemented but could include activities such as periodic sediment removal and channel re-shaping for interceptor ditches, cleaning or flushing of interceptor drains, repair and replacement of pump parts for seepage wells and lift pumps, and vegetation management, berm restoration, and rodent control for seepage berms.

Levee and structure protection maintenance includes repair restoration of protection measures due to erosion or degradation and vegetation management.

Water diversion canal maintenance includes sediment removal and channel re-shaping.

Mendota Dam maintenance includes periodic minor upstream sediment removal in order to operate the Short Canal only.

Maintenance Schedule

All maintenance activities, when possible, would be timed to minimize the impacts to fish. Access and safety concerns are the main driver for timing of the maintenance activities, but can be scheduled around fish migration. Ultimately, the schedule may be impacted by compliance with the clearance to conduct the work and timing of flows.

Maintenance of levees and floodplains with aquatic-safe herbicide treatment would occur sometime between spring and fall and would depend on the plant species that are being treated. Typically the herbicide would be administered prior to the plant going to seed and may need to be sprayed more than once. Disking for vegetation management usually occurs twice within the year; once in early spring after the rainfall season and then again in late summer prior to plants going to seed. Access road and levee restoration work would likely be done in the summer after the rainfall season, and timing and projects would be dependent on environmental clearance for small mammals, nesting birds or burrowing owls, and other wildlife species. Rodent control would likely be done by a pest control advisor and would likely be done in the spring through fall and not during the rainfall season. All levee and floodplain work can be impacted by the presence of nesting birds, so in some areas work may not begin until the nesting birds have fledged or if there is some other biological reason to believe that the maintenance activities would not impact the nesting birds.

Timing of the maintenance of structures within the waterways would depend on the flow hydrograph and forecasted flows, but can typically be expected in the summer/fall after high spring flows have receded. Cleaning of the in-channel structures would typically occur when flows are low enough to allow crews and equipment to enter the river safely to access the structures. San Mateo Avenue may be cleared or repaired earlier for access as soon as flows recede and are not likely to increase for the remainder of the water year. If earlier, this work would only be for road access and would not be located in the channel itself.

Debris that collects on trash racks, screens, ladders, or other fish passage structures will need to be periodically removed but will likely be scheduled based on the operation permits for these structures. Annual maintenance cleaning would be expected after the fish migration, but will need to be timed when flows have receded.

Lubing and annual gate maintenance would likely be in the late summer or early fall prior to winter and spring flows to make sure the structures are operating properly and to provide time for repairs and ordering parts if needed.

For the Short Canal Option, the boards would be placed back into Mendota Dam. This could occur at any time, but would likely occur during the irrigation season (typically March through October). The fish passage structure at the dam would allow for fish passage when the boards are in-place.

Water diversion canals that require maintenance could be isolated from the river system by closing the headgates at the canals which will not impact fish migration.

Operations

There are no operations for levees, floodplains, or levee and structure protection.

San Mateo Avenue operations include closing the gates to the crossing during high flows and reopening once flows have receded.

Control structures and Fresno Slough Dam operations include operating the motors for the control gates, inspecting and assessing the gates, adjusting the gates for various stages of flows, and running the automatic trash sweep.

Fish screen operations could occur every day when diversions are occurring. Operations include visually inspecting screens, verifying flow, clearing obstructions and debris, adjusting the baffles, permitting and regulatory compliance measures, estimating performance (i.e., velocity measurements), powering the screen, running the pumps for the sediment removal system, running automatic brush cleaning and trash rake motors, and running pumps for the fish diversion pipe. Operations also could include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes) and may include the addition of juvenile and/or adult fish traps.

Fish barrier operations could occur every day during salmon upmigration for spawning. Operations include visually inspecting screens, verifying flow, clearing obstructions and debris, installing and removing barrier screens, and permitting and regulatory compliance measures.

Fish passage facility operations could occur every day during fish migration. Operations include visually inspecting the facility, verifying flow, clearing obstructions and debris, adjusting the weirs, permitting and regulatory compliance measures, estimating performance (i.e., velocity measurements), powering mechanically controlled weirs.

Seepage control measure operations are primarily passive, but seepage well operations would include running the pumps to lower the water table, and interceptor drain and ditch operations could involve running lift pumps.

There are no operations for the water diversion canal. Operation of the canal headworks is covered under control structures above.

Mendota Dam operations include placing and removing stop logs in order to operate the Short Canal (only applies to Alternative C [Fresno Slough Dam with Narrow Floodplain and Short Canal]; see Section 2.2.7).

Monitoring Activities

Monitoring activities would include physical and nonphysical activities within the Project area. Several monitoring components would be covered by the Program's *Physical Monitoring and Management Plan* (PEIS/R pages 2-49 to 2-52, and Appendix D.1, SJRRP 2011a), which provides guidelines for observing conditions as well as adjusting to changes in physical conditions within the Project area. The Program's *Physical Monitoring and Management Plan* consists of multiple component plans, addressing physical conditions such as flow, groundwater seepage, channel capacity, and propagation of native vegetation. Each component plan identifies objectives for the physical conditions within the Project area, and provides guidelines for the monitoring and management of those conditions. The component plans identify potential actions that could be taken to further enhance the achievement of the objectives. Finally, the Plan includes a description of monitoring activities which apply to one or more of the component plans. The component plans include the following monitoring objectives, all of which are identified in the Program's *Physical Monitoring and Management Plan*:

- **Flow –** To ensure compliance with the hydrograph releases in Exhibit B of the Settlement and any other applicable flow releases (e.g., buffer flows) (detail is provided in the Program's *Restoration Flow Guidelines*).
- **Seepage –** To reduce or avoid adverse or undesirable seepage impacts (detail is provided in the Program's *Seepage Management Plan*).
- **Channel capacity –** To maintain flood conveyance capacity (detail is provided in the Program's *Channel Capacity Report*).
- **Native vegetation –** To establish and maintain native riparian habitat.

Project specific components of the monitoring will include addressing effectiveness monitoring of fish screens and fish passage at structures within the Project area. The monitoring objective is the following:

- **Passage and screening effectiveness –** To maintain effective fish passage and fish screening at structures and diversions.

Monitoring activities, as they are described in the Program's *Physical Monitoring and Management Plan*, are guidelines for monitoring and could change during Project implementation. Monitoring activities in Reach 2B could include the following Program-level activities:

- **Flow monitoring –** Flow, cross sections, and surface water stage at gaging stations, and at additional locations during high-flow events.
- **Groundwater level monitoring –** Groundwater elevation in monitoring wells (detail is provided in the Program's *Seepage Management Plan*).
- **Aerial and topographic surveys –** True color aerial photographs and topographic surveys to assess river stage, hydraulic roughness, river width, bed elevation, and vegetation conditions.

- **Vegetation surveys –** Surveys of seed dispersal start and peak times, and native riparian vegetation establishment.
- **Sediment mobilization monitoring –** Sediment mobilization, bar formation, and bank erosion through aerial and topographic surveys of areas with elevated erosion potential (detail is provided in the Program's *Sediment Management Plan*).

Project specific monitoring activities will include the following:

- **Passage and screening effectiveness –** Flow, cross-sections, water surface, and velocity measurements near and within structures that provide passage or screening. Fish counting devices and rotary screw traps to count and measure fish passage and fish size.

Structure Design and Subsidence

All design work would be completed in general accordance with Reclamation Design Standards, applicable design codes, and commonly accepted industry standards. Where design criteria are missing for a specific project element, either Reclamation would be consulted for design specifications or standard engineering practice methods would be employed.

In addition, ground subsidence effects are anticipated to be experienced in the Project area. During the design process, causes of the observed subsidence, data from previously conducted studies, subsidence locations expected to require special design considerations, anticipated subsidence rates, and methods to mitigate the anticipated ground subsidence would be identified and incorporated into the design.

Land Acquisition

The approximate amount of additional lands to be acquired to accommodate the floodplain, levees, bypass channel, structures, and borrow was quantified based on parcel data in GIS shapefile format from Fresno and Madera counties. Since remaining portions of parcels that fall outside the Project area may not be as easily utilized by the land owners, the entire parcels were considered, where appropriate. The amount of land acquisition varies with alternative (approximately 2,450 to 3,300 acres).

Phased Implementation

The Project may utilize a phased approach to implementation of the selected alternative. Phased implementation would involve building selected components of the Project in separate construction phases, allowing Project funding to be secured over time. For example, the bypass channel and bifurcation structure could be built in a first phase, fish passage facilities in a second phase, and fish screens and levees and floodplain construction in a third phase. Exact phasing would be developed during the detailed design phase of the selected alternative.

2.2.5 Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A (Compact Bypass with Narrow Floodplain and South Canal) includes:

- Building levees capable of conveying flows up to 4,500 cfs with 3 feet of freeboard.
- Restoring floodplain habitat an average of approximately 3,000 feet wide to provide benefit to salmonids and other native fishes.
- Constructing a channel and structures capable of conveying up to 4,500 cfs of Restoration Flows around the Mendota Pool.
- Constructing the South Canal and structures capable of conveying up to 2,500 cfs from Reach 2B to Mendota Pool.
- Providing upstream and downstream fish passage for adult salmonids and other native fishes, and downstream fish passage for juvenile salmonids, between Reach 2A and Reach 3.

This alternative would construct a channel between Reach 2B and Reach 3, the Compact Bypass channel, in order to bypass the Mendota Pool. Restoration Flows would enter Reach 2B, flow through the reach, then downstream to Reach 3 via the Compact Bypass channel. A canal to convey San Joaquin River water deliveries to Mendota Pool, the South Canal, would be built. The San Joaquin River control structure at the Chowchilla Bifurcation Structure would be removed, and a bifurcation structure would be built at the head of the South Canal to control flood diversions into the Chowchilla Bypass and water delivery diversions into Mendota Pool. Fish passage facilities and a fish screen would be built at the South Canal bifurcation structure to provide passage around the structure and prevent fish being entrained in the diversion. A fish barrier would be built in Reach 3 to direct up-migrating fish into the Compact Bypass channel. A new crossing would be built at the San Mateo Avenue crossing. These features are described in further detail in the sections below. See Figure 2-6 and Figure 2-7 for a plan view of the alternative's features.

Compact Bypass Channel

The bypass channel would convey 4,500 cfs around the Mendota Pool by constructing a channel just southwest of the existing Columbia Canal alignment. Once constructed, the bypass channel would become the new river channel. This alternative includes excavating the bypass channel, constructing levees and in-channel structures, removing existing levees, relocating or modifying existing infrastructure, and acquiring land. The in-channel structures may include bifurcation control structures, grade control structures, fish screen(s), fish passage facility(ies), fish barrier(s), Columbia Canal Siphon, as well as the Drive 10 ½ realignment and are discussed under Structures. The bypass channel and associated structures would provide downstream passage of juvenile Chinook salmon and upstream passage of adult Chinook salmon, as well as passage for other native fishes, while isolating Mendota Pool from Restoration Flows.

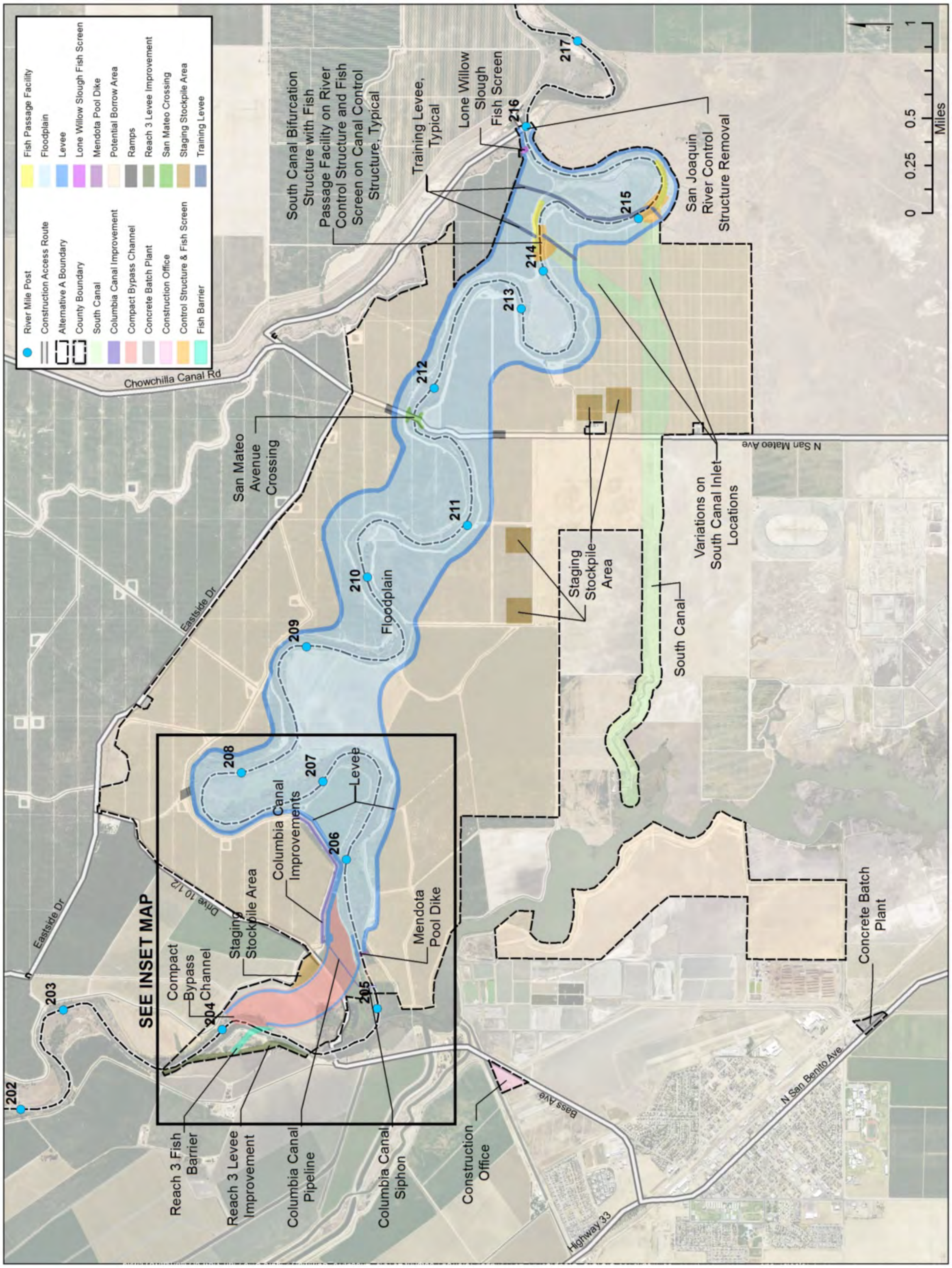


Figure 2-6.
Plan View of Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

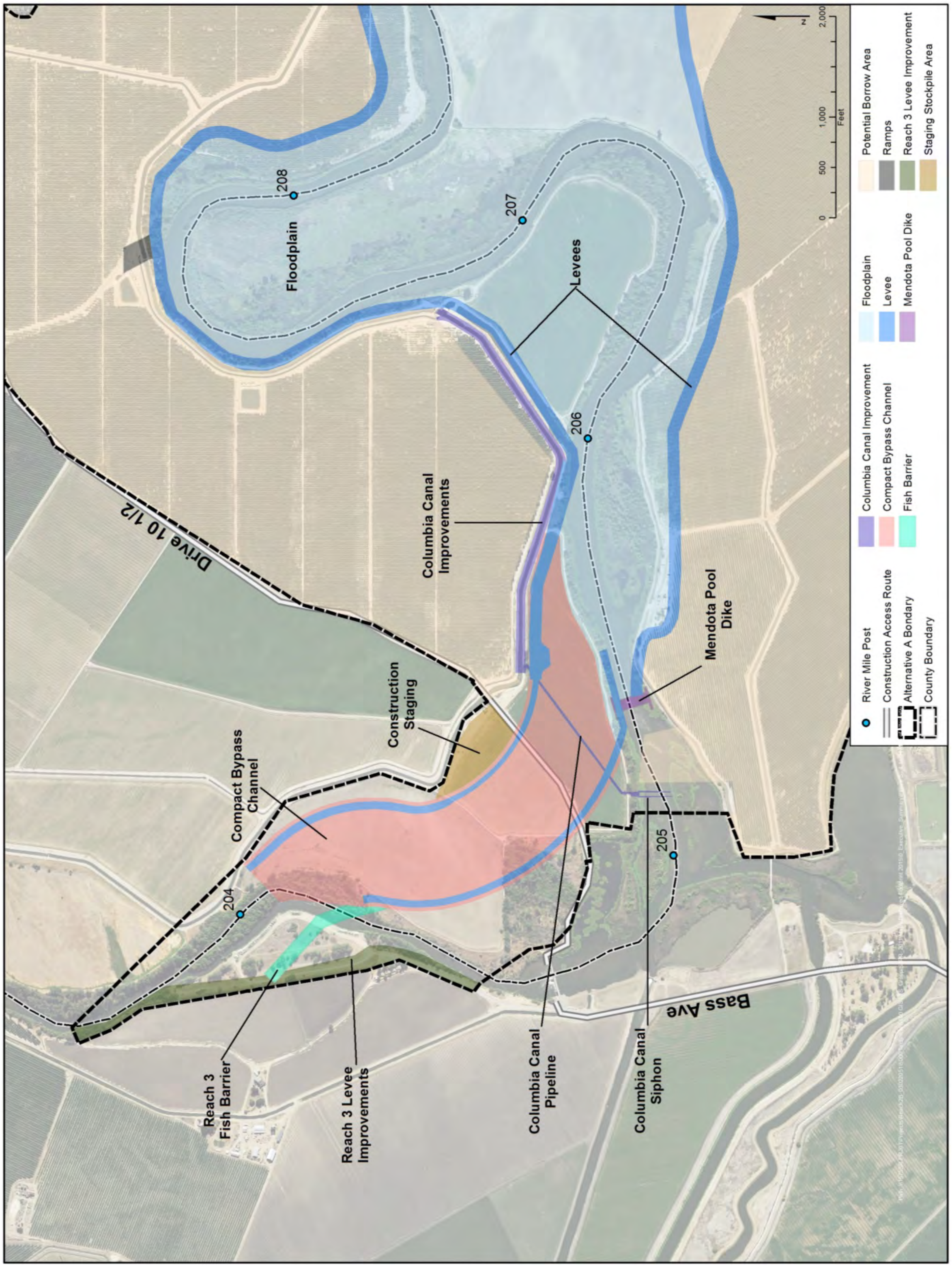


Figure 2-7.
Inset Map of Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

The bypass channel would connect to Reach 3 approximately 0.6 mile downstream from Mendota Dam (approximately RM 204), bypass the Mendota Pool to the north, and connect to Reach 2B approximately 0.9 mile upstream from Mendota Dam (approximately RM 205.5). The bypass channel would have a total length of approximately 0.9 mile. A siphon under the bypass channel would be constructed to connect the Columbia Canal to the Mendota Pool.

The bypass channel would be a multi-stage channel designed to facilitate fish passage at low flows, channel stability at moderate flows, and contain high flows. The low-flow channel would be designed for a capacity of around 200 cfs and would have a topwidth of approximately 110 feet and a depth of approximately 2 feet. The main channel would be designed for a capacity of around 1,860 cfs (approximately the 2-year annual peak Restoration Flow in Reach 2B) and would have an average topwidth of approximately 320 feet and total depth of approximately 6 feet. The floodplain bench would be designed with a shallow cross-slope (approximately 1 percent slope) to allow variable floodplain depths at flows between 1,860 cfs and 4,500 cfs. The channel design will be further refined during the final design process.

The channel, designed as an unlined earthen channel, would be approximately 5,300 feet long with a total corridor width of approximately 950 feet. The average slope of the channel between grade control structures would be approximately 0.0004 (approximately 2.1 feet/mile), while the total elevation drop would be approximately 12 feet including grade control structures. A series of grade-control structures would be included to achieve the necessary elevation change (see Grade Control Structures).

South Canal

The South Canal would deliver up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. The South Canal could connect to the river at various locations, ideally on a straight section of the river or on the outside of bend. Two optional locations for the junction with the San Joaquin River are shown in Figure 2-6 at approximately RM 214.2 and RM 215. The South Canal would discharge into Fresno Slough via the Little San Joaquin Slough approximately 2.3 river miles south of Mendota Dam.

Water deliveries would be controlled at the upstream end of the South Canal by a bifurcation structure. The river control structure would have a fish passage facility for fish passage, and the canal control structure would have a fish screen to prevent entrainment. The control structures, fish screen, and fish passage facilities are discussed under Structures.

The South Canal could be concrete-lined or unlined. The unlined design would include maintained grasses in the channel. Either design would have a trapezoidal cross-section. The lined South Canal would have a top-width of approximately 90 feet, a total corridor width of approximately 180 feet (including levees and maintenance roads), and 2H to 1V side slopes on the canal banks and levees. The unlined South Canal would have a top-width of approximately 270 feet, total corridor width of approximately 490 feet (including levees and maintenance roads), and 3H to 1V side slopes on the canal banks and levees.

Levee heights would be based on a flow of 2,500 cfs and 3 feet of freeboard. Seepage control measures and erosion protection would be included as necessary to minimize seepage impacts and reduce erosion and scour in the canal. However, seepage is assumed to not be an issue for a lined canal, so seepage control measures would not be provided for the lined canal.

The South Canal would cross San Mateo Avenue, so a bridge crossing would be provided to maintain access. The bridge would include concrete deck, reinforcing steel, piles, and pile extensions, railing, excavation, and backfill.

Structures

The structures described below would be required to provide the operational flexibility to divert water to the Mendota Pool, provide fish passage, allow maintenance access to Mendota Dam, prevent fish entrainment and straying, and provide controlled elevation drop between Reach 2B and Reach 3.

San Joaquin River Control Structure at Chowchilla Bifurcation Structure Removal

The existing Chowchilla Bifurcation Structure consists of two control structures: one at the head of the Chowchilla Bypass and one across the San Joaquin River at RM 216. With the inclusion of a bifurcation structure at the head of the South Canal, a new control structure would be built across the San Joaquin River at the head of the canal. The new control structure would alleviate the need for the San Joaquin River control structure at the Chowchilla Bifurcation Structure because all diversions into the Chowchilla Bypass could be controlled from the new control structure at the head of the South Canal. As part of this alternative, the San Joaquin River control structure at the Chowchilla Bifurcation Structure would be demolished.

South Canal Bifurcation Structure

A bifurcation structure would be constructed at the upstream end of the South Canal. The bifurcation structure consists of two control structures: one across the path of Restoration Flows (San Joaquin River) and one across the path of water deliveries to Mendota Pool (South Canal).

The control structure across the path of the Restoration Flows would be designed to accommodate up to 4,500 cfs and consists of six 20-foot-wide bays for a structure length of approximately 140 feet. Conditions in this control structure would be designed based on NMFS 2001 and NMFS 2008 fish passage criteria. The control structure across the path of the water deliveries would be designed to accommodate up to 2,500 cfs and consists of four 20-foot-wide bays for a structure length of approximately 100 feet. Flow through each bay would be controlled by a gate (e.g., radial (Tainter) or inflatable Obermeyer). In the final design, the number and size of the gates may be modified. The size of the gates would be determined by the design maximum flow.

The Restoration Flow path structure includes a fish passage facility on the side of the structure, and the water deliveries flow path structure includes a fish screen upstream of the structure. Each control structure would be placed in the middle of the channel and has earthen embankments connecting the structure to the proposed levees. The connector embankments would be similar in height to the surrounding San Joaquin River levees. The connector embankments may include culverts, gates, weirs, inflatable bladder dams, or other features to improve flow and fish passage on the floodplain when water deliveries are not occurring. A 16-foot-wide roadway and 20-foot-wide maintenance/operations platform would be provided over each control structure.

The bifurcation structure would be used to control flow to the river, to the canal providing water deliveries to Mendota Pool (South Canal), and to the Chowchilla Bypass. Flow would be backwatered in the upper portion of Reach 2B above the canal bifurcation structure to operate the Chowchilla Bypass. Therefore, San Joaquin River levee heights would be increased over that segment of Reach 2B, particularly near the canal bifurcation structure.

South Canal Fish Passage Facility

The South Canal bifurcation structure would include a fish passage facility on the side of the control structure across the Restoration Flow path. The fish passage facility would be necessary to provide passage during water deliveries and for Restoration Flows where passage conditions through the control structure may not be ideal.

Passage Facility Design

The design of the fish passage facility would be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008). The size and geometry of the fish passage facility would be dictated by the flow requirements for juvenile and adult fish in Table 2-1. Several types of fish passage facility may be considered in detailed design: vertical slot weir ladder design was included for its ability to accommodate a greater range of water depths (hydraulic head at the upstream and downstream ends), but the design may also consider ice-harbor, pool and chute, rock ramp fishway or other passage facility designs.

A roadway would need to be built over the fish passage facility to connect the maintenance road atop the river control structure with the levee road on the south side of the river. The roadway would be supported by the vertical concrete walls of the fish passage facility or other structural features.

Attraction Flows

The attraction flow magnitude will be 5 to 10 percent of the total flow through the control structure over the path of Restoration Flows. The Project requires conveyance of at least 4,500 cfs, so the attraction flow at the passage facility entrance could be as high as 450 cfs. The passage facility itself may have a design flow rate less than the maximum attraction flow. In this case, the balance of attraction flows could be provided at the passage facility entrance (downstream side) through supplementary water, described below.

Supplementary Water

Supplementary water, if incorporated into the facility, is water already in the river and which is piped to the fish passage facility entrance to augment attraction flows. No additional water supply beyond what would be flowing in the river is required. The supplementary water allows the passage facility to operate under a wider range of river flows by supplying additional attraction flow when the need exceeds the design flow rate through the passage facility. Supplementary water would also be used to control the hydraulic head at the passage facility entrance.

Supplementary flow would be collected by a water delivery intake structure located upstream from the fish passage facility (see Figure 2-8). The intake structure would include an automated cleaning system, trash rack and a fish screen to prevent migrating fish from entering the intake. River water would enter the intake structure, and travel downriver through pipes to the passage facility entrance.

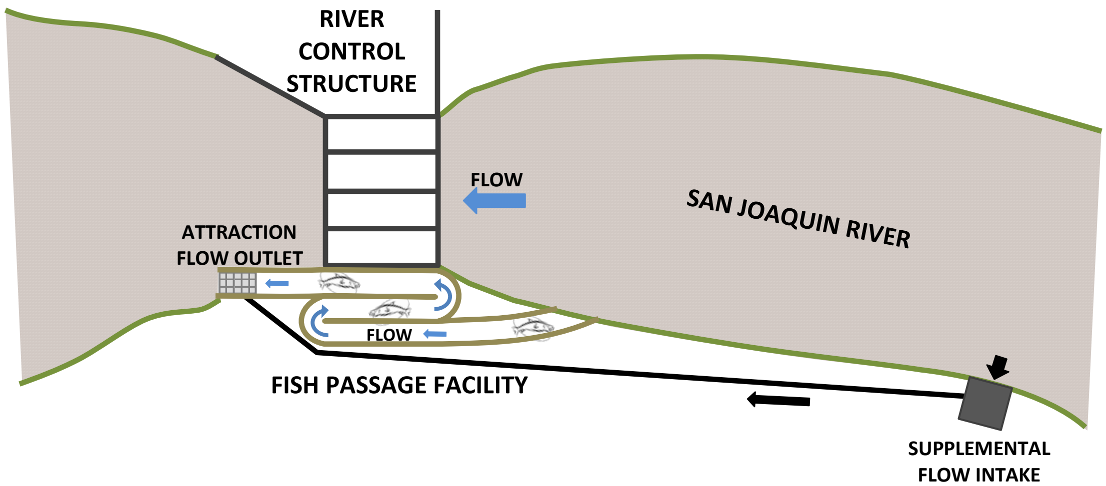


Figure 2-8.
Supplementary flow system plan-view diagram

South Canal Fish Screen

A fish screen would be included at the head of the South Canal where water deliveries would be diverted from the river toward Mendota Pool. The fish screen would be necessary to keep or return out-migrating juvenile salmon to the San Joaquin River (the path of Restoration Flows) during water deliveries.

The screen would be designed to pass flow up to 2,500 cfs. The type of fish screen could be a fixed flat plate in “V” configuration, vertical flat plate, inclined flat plate, cone, or cylindrical screens. Depending on the design type, the fish screen facility may include trash racks, stainless steel wedge wire fish screens, flow control baffle systems behind the screens, screen cleaning systems for the trash racks and screens, bypass flow control weirs, fish-friendly pumps, and/or fish bypass pressure pipelines. The trash racks would be installed at the entrance to the screen structures to protect screens from trash, logs, and other large debris.

Approach, sweeping, and bypass entrance velocities would be kept within established fish screen criteria (NMFS 2008). Flow through the fish screens may be controlled by baffles behind the fish screens. Cleaning of the screens would be accomplished using an automated brush system. Electric power would be needed for fish friendly pumps, if included, and screen cleaning systems. Operation of the fish screens would include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes).

San Mateo Avenue Crossing Replacement

The San Mateo Avenue crossing is an existing river crossing located within a public right-of-way in Madera County and on private land in Fresno County at approximately RM 211.8. The crossing transitions from public right-of-way to private land at the center of the river. In order to maintain vehicular access, accommodate increased flow magnitudes associated with Restoration Flows, and provide fish passage, an improved crossing would be included with this alternative. The crossing would accommodate the increased flows in the river by maintaining the required velocities for proper fish passage for flows up to 4,500 cfs. The crossing would be designed to meet NMFS 2001 and NMFS 2008 passage criteria. When flow is within the capacity of the culverts (e.g., less than 1,500 cfs), fish passage would occur in the culvert. The crossing would be overtopped during higher flows.

The proposed San Mateo Avenue crossing includes installing a low flow or dip crossing with multiple, counter-sunk concrete box culverts designed for highway loading. The structure includes armoring along the entrance and exit of the structure as well as along the channel banks in the immediate vicinity of the structure. The armoring would be necessary to protect the structure during overtopping flows. Culverts would be embedded below the existing channel bed. Grouted riprap would be placed in the culvert below the existing channel bed to prevent channel scour reaching the floor of the culvert and to create a roughened boundary layer for fish passage. Native bed material would be placed above the grouted riprap up to the existing channel bed elevation to provide passage conditions similar to that which exists in the adjacent natural stream.

Mendota Pool Dike

Adjacent to the head of the Compact Bypass, a dike across the existing river channel would be needed to prevent water in Mendota Pool from flowing into the Compact Bypass. The dike would be of similar design as the levees in Section 2.2.4 including seepage control measures to prevent seepage from the Pool into the Compact Bypass. The dike would run from the proposed Reach 2B levee on the south side of the river, across the river, to proposed left-bank levee of the Compact Bypass. This structure would likely be regulated by DWR Division of Safety of Dams (DSOD).

Drive 10 ½

The Compact Bypass would cross existing Drive 10 ½, which provides access to the east side of Mendota Dam. With this alternative, the road would end at east side of the bypass channel and would not continue to Mendota Dam.

Reach 3 Fish Barrier

A fish exclusion barrier would be included in Reach 3 near the downstream end of the Compact Bypass to prevent adult fish from migrating beyond the bypass channel up to the base of Mendota Dam, which during most flows out of Mendota Pool, would be a dead end for fish passage. This would lead to delays in adult salmon migration or potentially death. Although out-migrating fish would not be expected to be present downstream from Mendota Dam, the fish barrier would allow juveniles to pass the structure.

The exclusion barrier design would be a high-flow picket barrier, which is a flow-through structure of closely spaced bars (i.e., pickets) that prevent adult fish from traveling upstream in the river to Mendota Dam at flows up to a combined discharge of 4,500 cfs (Mendota Dam and the Compact Bypass). The design accounts for a range of flow options from routing the entire 4,500-cfs flow through the structure (flood flows from the James Bypass), to routing a 600-cfs irrigation delivery through the structure with up to 3,900 cfs being routed down the Compact Bypass, to routing no flow through the structure with up to 4,500 cfs down the Compact Bypass.

The total length of the structure would be approximately 1,410 feet, with 260 feet across the main channel and 1,150 feet across the overbanks. The base of the structure would consist of a concrete sill connected to concrete piles, which extend into clay layers. The structure would be approximately 20 feet high in the main channel and 9 feet high in the overbanks. Riprap would be placed 2 feet thick at the entrance and exit of the sill to prevent erosion. The fish barrier meets the average through-velocity criteria of 1.0 foot per second (fps) in *Anadromous Salmonid Passage Facility Design* (NMFS 2008).

In order to meet velocity criteria for the structure, some floodplain grading between the existing Reach 3 levees would be required to provide even flow-through conditions. In addition, approximately 4,200 linear feet of improvements to the Reach 3 left-bank levee are included to ensure that backwater conditions at the structure do not affect adjacent property. The improved Reach 3 levee would have the same alignment as the existing levee.

Grade Control Structures

A series of several (10 to 18), approximately 0.5-foot-high grade-control structures would be included within the bypass channel to achieve the necessary elevation change between Reach 2B and Reach 3. The grade control could be provided by structures such as sheet pile weirs or constructed rock riffles.

Rock riffles have benefits for native fish migration, but they present construction challenges in the sandy substrate of the Reach 2B and Reach 3 area. The flow over constructed rock riffles may reduce the disorienting effects on juveniles from rapidly changing hydraulics otherwise created at weir structures, and they are more favorable to sturgeon, which do not jump. Constructed rock riffles may be less favorable to predators which can hold in the quiescent pools below weir structures. However, placing rock in sandy substrate requires engineered foundation materials (layers of rock in gradually decreasing sizes) to prevent undermining the structure. Further analysis during design will determine which type of grade control structure will be selected.

Sheet pile weirs would be constructed with capped and anchored sheet piles. Caps on the sheet piles would be used to avoid injuring fish and can be surfaced with natural materials (i.e., grouted rock) to emulate natural conditions which fish may be exposed to in non-manmade portions of the San Joaquin River.

Each grade control structure would extend across the main channel and key into the overbanks to protect against flanking, resulting in a total structure width of about 420 feet.

Vegetated revetment would be included along both channel banks within the portion of the bypass containing the grade control structures to provide additional protection against flanking. It is assumed that the revetment would consist of buried riprap covered with topsoil, erosion control fabric, and native woody vegetation, so that fish would experience natural channel banks. Native woody vegetation directly upstream, downstream, and adjacent to the grade control structures would provide shading and opportunities for juveniles to hide from predators.

Fish Habitat and Passage

The purpose of the floodplain would be to provide riparian and floodplain habitat and support the migration and seasonal rearing of salmonids and other native fishes in Reach 2B. The floodplain has an average width of approximately 3,000 feet and an inundated area of approximately 850 acres at 2,500 cfs.

This alternative provides floodplain habitat resulting in approximately 450 acres of shallow water habitat for primary production[3] as well as approximately 400 acres of habitat that supports direct rearing[4] at 2,500 cfs. Approximately 55 percent of the floodplain in this alternative would inundate less than 1 foot deep at 2,500 cfs. This alternative also retains approximately 200 acres of shallow water habitat at flows up to 4,500 cfs.

Figure 2-9 below presents conceptual inundation areas for primary production and rearing habitats as they vary by flow. Inundation acreages may change during the design process.

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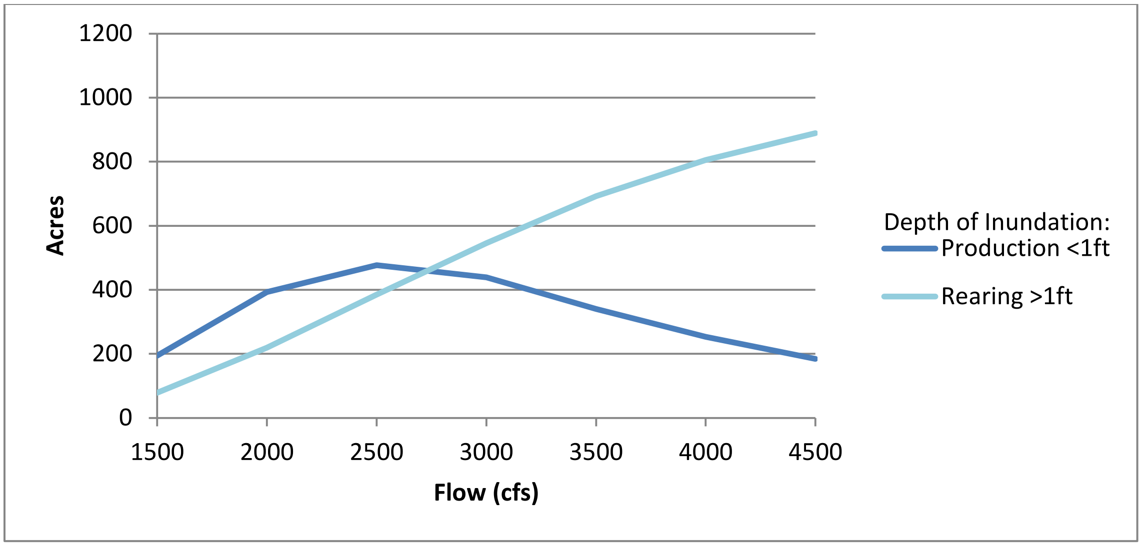
[3] Primary production is defined as the production of organic compounds from atmospheric or aquatic carbon dioxide, principally through the process of photosynthesis. The organisms responsible for primary production are known as primary producers or autotrophs, and form the base of the food chain (e.g., algae). Primary production also includes aquatic invertebrate species that feed on algae and are a food source for fish.

[4] Rearing habitat is defined as those areas with characteristics that support growth and maturation of juvenile salmonids prior to their outmigration as smolts. For the purpose of analysis, juvenile salmon direct rearing habitat is the area with water greater than 1.0 feet deep at 2,300 cfs, a flow which will occur in approximately one out of every 2 years for a sustained period of at least 20 days in the period March 15 to May 15 (see further discussion in the Project Description TM Attachment A – Alternatives Evaluation, Section 6.2.2 (SJRRP 2012). The modeled flow of 2,500 cfs is used as a surrogate for 2,300 cfs.



Source: Tetra Tech 2012

Figure 2-9.
Potential Inundation Acreage by Flow for Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

In the Compact Bypass channel, floodplain benches with an approximate average width of 300 feet on each side the main flow portion of the bypass channel are included (see section "Compact Bypass Channel.") Riparian and floodplain habitat would develop on the benches in the bypass channel to benefit migrating fish and promote a stable channel and sediment transport from Reach 2B to Reach 3.

This alternative includes several facilities that fish may encounter or need to pass to migrate between Reach 3 and Reach 2B (from downstream to upstream):

- A fish barrier near the downstream end of the Compact Bypass.
- Several (10 to 18) in-channel grade control structures in the Compact Bypass.
- The San Mateo Avenue crossing.
- Four fish screen return outlets from the South Canal fish screen.
- A bifurcation control structure at the South Canal with fish passage facility.
- A fish screen near the upstream end of the South Canal.
- Fish screens at Lone Willow Slough, Big and Little Bertha pumps, and other smaller diversions (these screens are discussed in Section 2.2.4).

Each structure would be designed to perform according to the fish passage design criteria (see Section 2.2.4). In addition, the channel and floodplain incorporate riparian plantings to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to incorporate channel structure variability during detailed design, all of which may help to reduce stress and predation.

This alternative includes a fish barrier at the downstream end of the bypass channel to keep fish from migrating into false migration pathways. Without the barrier, a false migration pathway up to the base of Mendota Dam would be available to fish in all years, and a false migration pathway into Mendota Pool and Fresno Slough (potentially into the King River system) would occur in about one in five years, when the boards are taken out of Mendota Dam to pass Pine Flat flood releases into Reach 3. However, with the barrier, which would be designed to accommodate flows up to 4,500 cfs, fish would not be able to migrate to Mendota Dam or enter Mendota Pool, but they would be guided into the bypass channel and Reach 2B.

Floodplain and Riparian Habitat

This alternative includes passive riparian habitat restoration and compatible agricultural activities in the floodplain. It is assumed that over time wetland communities (obligate, facultative-wet, and facultative species) would develop within the main channel and that a dense riparian scrubland would develop along the main river channel banks. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) could occur.[5] The Restoration Flows would be used to recruit new vegetation along the channel. This alternative relies upon existing seed banks (upstream of the Project and on portions of existing Reach 2B levees to remain) and Restoration Flows for vegetation recruitment, and no supplemental water supply is required. Invasive, non-native species would be removed from the channel and riparian areas during or following construction, and the Project would include long-term management for invasive plants.

Several native vegetation alliances may develop in the riparian areas, such as saltgrass flats, sandbar willow thickets, California mugwort brush, black willow thickets, riparian bank herbs, California bulrush marsh, buttonwillow thickets, Oregon ash groves, creeping rye grasslands, and Fremont cottonwood forests.

Existing Native Vegetation Protection

The existing native vegetation in the Project area designated to remain would be temporarily fenced with orange snow fencing (or equivalent) to prevent entry, driving, parking, or storing equipment or material within these areas during construction. Existing vegetation would be left in place or only minimally trimmed to facilitate access and work at the site. The existing soil is an ideal growing medium for all the desired native plants. In order to maximize plant growth and planting success, existing soil and topsoil would be preserved unless the soil contains invasive non-native seed or fragmented stems and rhizomes, in which case it should not be preserved. Disturbance during construction would be minimized to the maximum practicable extent.

Invasive Species Control

Invasive, non-native species would be removed from the Project area during the construction phase. Invasive species management would consist of removal of the most invasive non-native species within the reach such as giant reed grass (*Arundo donax*),

[5] Rearing on floodplains with agricultural practices has been shown to be compatible with salmon rearing, and provide faster salmon growth rates compared to in-channel rearing alone (Sommer et al. 2001).

perennial pepperweed (*Lepidium latifolium*) and poison hemlock (*Conium maculatum*). Invasive species management would also include removal of other invasive species that are currently found in upstream reaches and may eventually colonize in the Project area such as red sesbania (*Sesbania punicea*), salt cedar (*Tamarix* species), and Chinese tallow (*Sapium sebiferum*). Invasive plant removal techniques may include mechanical removal, root excavation, hand pulling, mowing, disking, controlled burning, grazing, aquatic-safe herbicides, or a combination of techniques as appropriate.

Long-Term Management

While it is not anticipated that major management actions would be needed, the key objective of long-term management would be to monitor and identify any environmental issues that arise, and use adaptive management to determine what actions would be most appropriate to correct these issues.

The general management approach to the long-term maintenance of the floodplain areas would be to maintain quality habitat for each natural resource, on-going monitoring and maintenance of key environmental characteristics of the entire floodplain area within the reach. An adaptive management approach would be used to incorporate changes to management practices, including corrective actions as determined to be appropriate by Reclamation and/or CSLC. Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, etc.

The expected long-term management needs and activities necessary to maintain any on-site mitigation sites would be resource specific long-term maintenance activities and other general maintenance activities such as exotic species elimination, grazing management, clean-up and trash removal, infrastructure management such as gate, fence, road, culvert, signage and drainage-feature repair, and other maintenance activities necessary to maintain the riparian and floodplain habitat quality.

Water Deliveries

This alternative includes the South Canal for making up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. Water deliveries to the Pool would include diversion of Friant Dam releases that are meant to satisfy the Exchange Contract as well as diversion of San Joaquin River flood flows if there is demand in Mendota Pool.

When water deliveries occur, the gates at the South Canal bifurcation structure would be manipulated to control flows into the downstream river channel and allow flows into the South Canal. To create sufficient hydraulic head to allow water to flow into the canal, operation of the gates would include backwatering a small portion of the San Joaquin River upstream of the South Canal bifurcation structure. The extent of the backwater is anticipated to be small and dependent on the design slope of the canal. Up-migrating fish passage along Reach 2B would occur through the South Canal fish passage facility during water deliveries. The South Canal fish screen would capture out-migrating fish entering the diversion and return them to the river. Some flow in the downstream river channel would be maintained during water delivery operations during fish migration periods.

Construction Considerations

The total construction timeline for this alternative is estimated to range approximately from 102 to 132 months (8.5 to 11 years); opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process.

Soil improvements for possible liquefiable soils may be required to protect proposed structures from damage or failure during an earthquake. All proposed structures would be designed to account for potential liquefaction. Soil improvements could include removing and replacing soils with adequate materials, injecting soil-cement slurry, vibrofloatation, dynamic compaction, structural foundation piles (stone or reinforced concrete), and other techniques.[6]

Flow in the San Joaquin River, operations at the existing Mendota Dam, and operation of the existing Columbia Canal must be maintained during construction. The majority of the Compact Bypass channel would likely be constructed without interruption to the San Joaquin River flow or the Columbia Canal.

The construction of the control structure across the existing river channel would require removable cofferdams in three phases to facilitate the construction without blocking the flow. If flow is present in the river during the construction period, flow would be diverted around the work area via a temporary diversion pipe or canal and fish passage would be provided. Cofferdams include two rows of braced sheet piling filled with dirt for stability and seepage control. The total height of the cofferdam is assumed to be 24 feet of which 12 feet would be above the channel bed. The control structures to be constructed on dry land (e.g., head of the South Canal) would not require cofferdams.

Stone slope protection (riprap) would be provided on the upstream and downstream slopes of the control structure embankment including some portions of the side slopes of the channel itself to prevent scouring. Riprap would be placed on bedding over geotextile fabric.

Construction of the fish screen and return/bypass fish pipes would take place in the dry using conventional construction methods and must be coordinated with construction of the water delivery canal. The exception to this is the outlet for the fish return pipes, which would require a cofferdam. All fish facility structures and pipes with surfaces exposed to fish require additional attention to surface-smoothness.

For construction of the control structures and fish passage facilities, it would be desirable to maintain a minimum flow during construction; the amount or range of flows during construction has not yet been identified. A sheet pile cofferdam would be provided for the river control structure and/or the canal control structure and the water diverted away from the construction. Additional sheet piling would be provided to divert flows through the new bifurcation structure while the fish passage facility is constructed.

[6] Vibrofloatation uses a vibrating probe that penetrates the soil and causes the grain structure to collapse and increase the density of the soil. Dynamic compaction involves dropping a heavy weight onto soil to compact it.

Cofferdams would likely be required around portions of the construction site at the San Mateo Avenue crossing. Since a portion of the existing crossing is private (not a public road), it was assumed that access could be closed during construction. Construction would be timed so that the lesser Restoration Flows (5 to 195 cfs) can be routed around the structure during construction. At high flows water would flow over the structure, in addition to through the proposed culverts. To protect the structure during high flows, the proposed fill would be enclosed in concrete and cutoff walls and riprap would be included to prevent damage to the structure during over topping flows.

Summary

Table 2-2 summarizes the levees, relocations, land acquisition, and construction schedule associated with Alternative A (Compact Bypass with Narrow Floodplain and South Canal) based on design, field, and evaluation criteria data prepared for the EIS/R.

Table 2-2.
Alternative A (Compact Bypass with Narrow Floodplain and South Canal)
Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee	
Levee Length	8.7 miles	7.1 miles	
Average Levee Height	5.8 feet	5.4 feet	
Fill Volume	345,200 cubic yards	269,700 cubic yards	
Relocations			
Electrical Distribution	43,500 feet	Barn/Shed	1
Gas Transmission	10,000 feet	Facility	1
Water Pipeline	31,000 feet	Groundwater Well	26
Canal	32,500 feet	Lift Pump	10
Culvert	1	Power Pole	144
Diversion	3	Dwelling	2
Land Acquisition and Construction Schedule			
Land Acquisition[1]	2,700 acres		
Time to Build[2]	132 months		

[1] Total acreage includes areas that are sovereign and public trust lands.
[2] Construction timeline does not include the time that would also be needed to complete the NEPA/CEQA documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.2.6 Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) includes:

- Building levees capable of conveying flows up to 4,500 cfs with 3 feet of freeboard.
- Restoring floodplain habitat an average of approximately 4,200 feet wide to provide benefit to salmonids and other native fishes.

- Constructing a channel and structures capable of conveying up to 4,500 cfs of Restoration Flows around the Mendota Pool.
- Constructing structures capable of conveying up to 2,500 cfs from Reach 2B to Mendota Pool.
- Providing upstream and downstream fish passage for adult salmonids and other native fishes, and downstream fish passage for juvenile salmonids, between Reach 2A and Reach 3.

This alternative would construct a channel between Reach 2B and Reach 3, the Compact Bypass channel, in order to bypass the Mendota Pool. Restoration Flows would enter Reach 2B at the Chowchilla Bifurcation Structure, flow through Reach 2B, then downstream to Reach 3 via the Compact Bypass channel. The existing Chowchilla Bifurcation Structure would continue to divert San Joaquin River flows into the Chowchilla Bypass during flood operations, and a fish passage facility and control structure modifications would be included at the San Joaquin River control structure at the Chowchilla Bifurcation Structure. A bifurcation structure would be built at the head of the Compact Bypass channel to control diversions into Mendota Pool. Fish passage facilities would be built at the Compact Bypass bifurcation structure to provide passage around the structure. The existing crossing at the San Mateo Avenue would be removed. These features are described in further detail in the sections below. See Figure 2-10 and Figure 2-11 for a plan view of the alternative's features. Elements that are common to all alternatives (described in Section 2.2.3) would be implemented under Alternative B.

Compact Bypass Channel

The bypass channel would convey 4,500 cfs around the Mendota Pool by constructing a channel just southwest of the existing Columbia Canal alignment. Once constructed, the bypass channel would become the new river channel. This alternative includes excavating the bypass channel, constructing levees and in-channel structures, removing existing levees, relocating or modifying existing infrastructure, and acquiring land. The in-channel structures include the bifurcation control structure, grade control structures, fish screen, fish passage facility, Columbia Canal Siphon, as well as the Drive 10 ½ realignment and are discussed under Structures. The bypass channel and associated structures provide downstream passage of juvenile Chinook salmon and upstream passage of adult Chinook salmon, as well as passage for other native fishes, while isolating Mendota Pool from Restoration Flows.

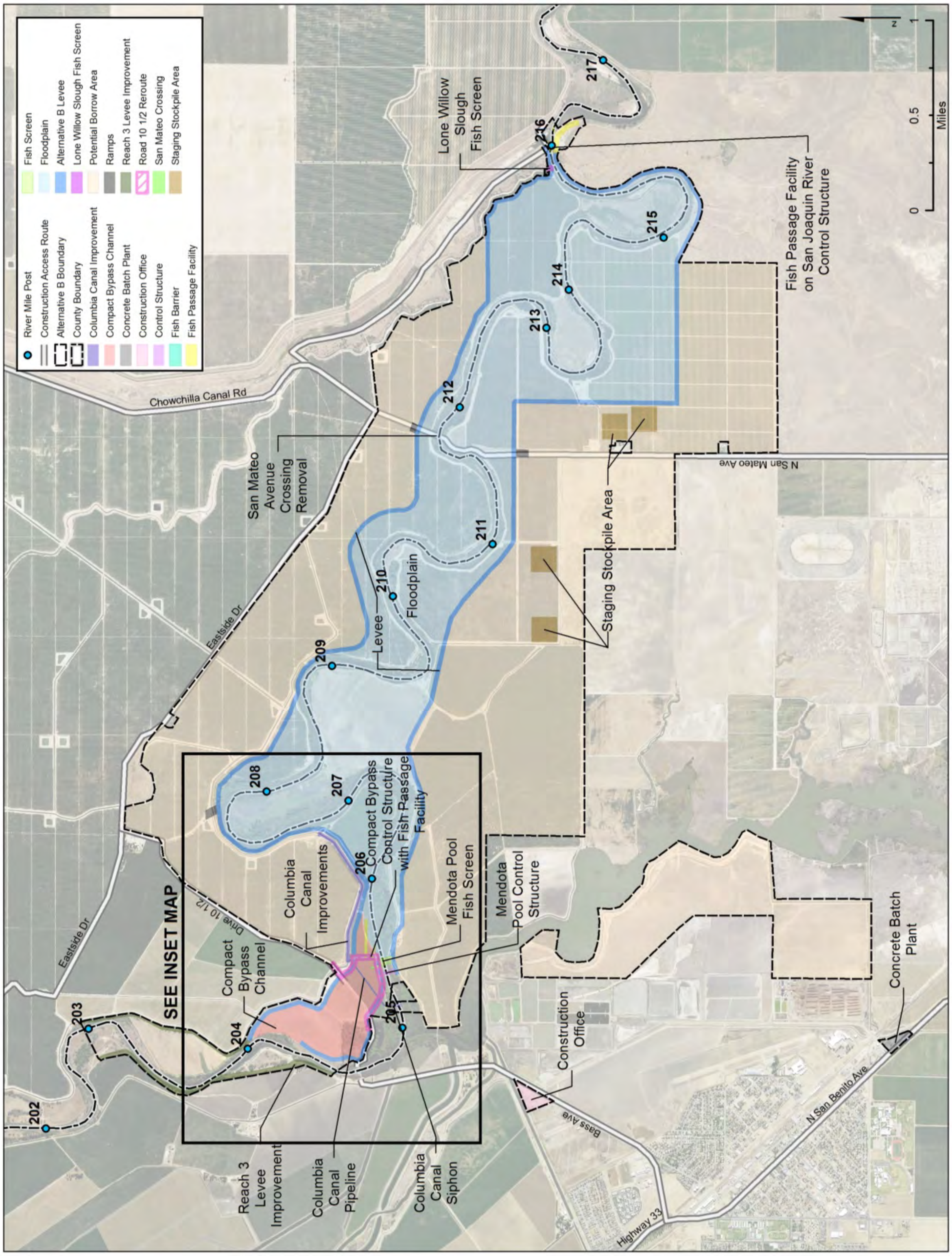


Figure 2-10.
Plan View of Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure)

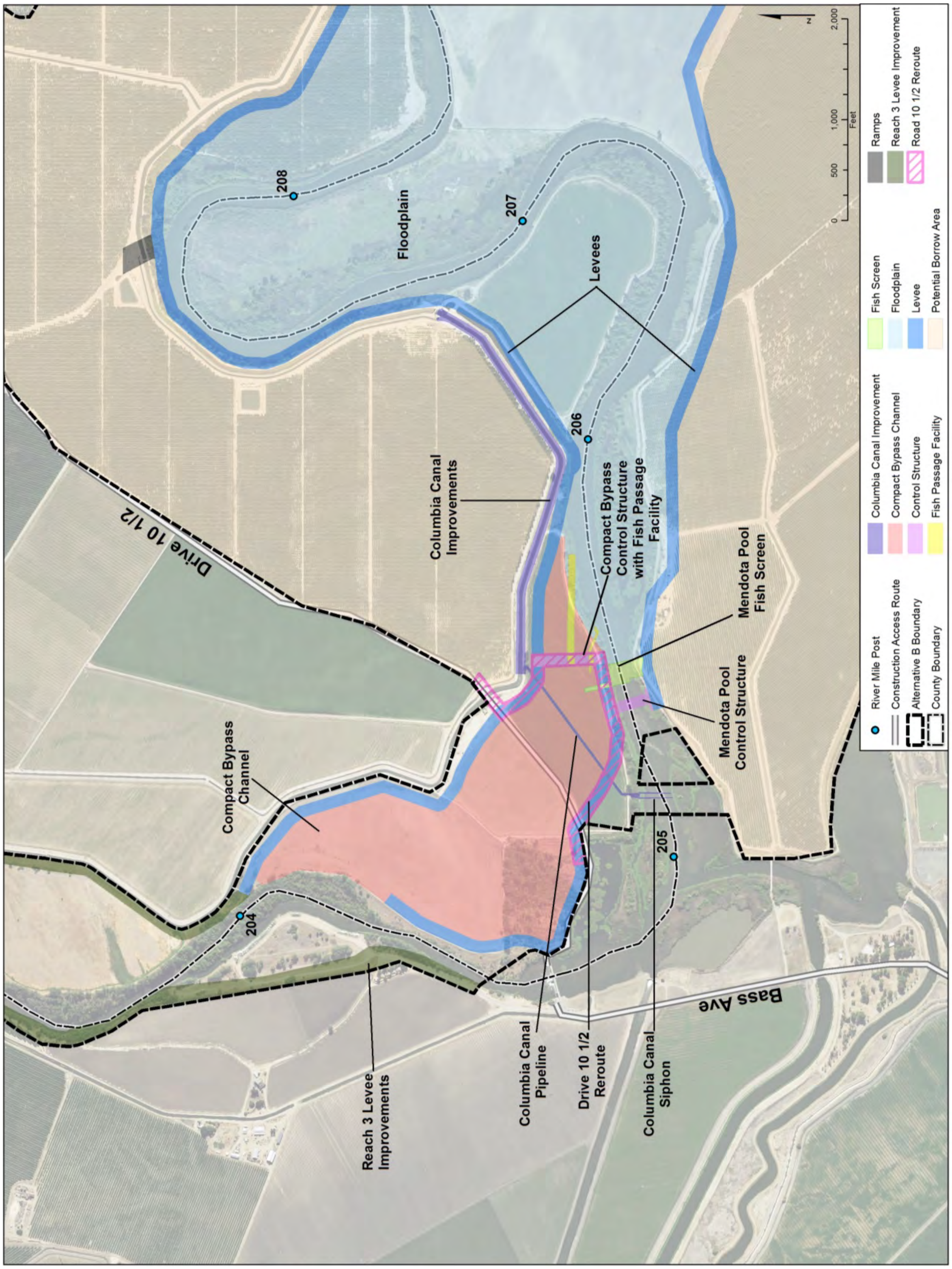


Figure 2-11.
Inset Map of Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure)

The bypass channel would connect to Reach 3 approximately 0.6 mile downstream from Mendota Dam (approximately RM 204), bypass the Mendota Pool to the north, and connect to Reach 2B approximately 0.9 mile upstream from Mendota Dam (approximately RM 205.5). The bypass channel would have a total length of approximately 0.9 mile. A siphon under the bypass channel would be constructed to connect the Columbia Canal to the Mendota Pool.

The bypass channel would be a multi-stage channel designed to facilitate fish passage at low flows, channel stability at moderate flows, and contain high flows. The low-flow channel would be designed for a capacity of around 75 cfs and would have a topwidth of approximately 50 feet and a depth of approximately 1 to 2 feet. The base flow channel would be designed for a capacity of around 200 cfs and would have a topwidth of approximately 70 feet and a depth of approximately 3 feet. The main channel would be designed for a capacity of around 1,500 cfs and would have an average topwidth of approximately 190 feet and total depth of approximately 5 feet. The floodplain bench would be approximately 150 feet wide on average on both sides of the main channel and designed with a shallow cross-slope (approximately 1 percent slope) to allow variable floodplain depths at flows between 1,500 cfs and 4,500 cfs.

The channel, designed as an unlined earthen channel, would be approximately 5,300 feet long with an average total corridor width of approximately 1,150 feet. The total elevation drop would be approximately 3 to 7 feet including grade control structures. A series of grade-control structures would be included to achieve the necessary elevation change (see Grade Control Structures). Channel complexity will be incorporated as appropriate per the Rearing Habitat Design Objectives.

Structures

The structures described below would be required to provide the operational flexibility to divert water to the Mendota Pool, provide fish passage, allow maintenance access to Mendota Dam, prevent fish entrainment and straying, and provide controlled elevation drop between Reach 2B and Reach 3.

Fish Passage Facility on the San Joaquin River Control Structure at the Chowchilla Bifurcation Structure

The existing San Joaquin River control structure at the Chowchilla Bifurcation Structure would not be passable by up-migrating salmon and native fish for all flows and flow splits between the river and the Chowchilla Bypass. The undershot gates, sill across the downstream side of the structure, and trash rack on the upstream side contribute to upstream passage difficulties at high, low, and all flows, respectively. A fish passage facility would be required for upmigrating salmon and other native fish to swim into Reach 2A from Reach 2B under most conditions.

Passage Facility Design

The design of the fish passage facility would be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008). The size and geometry of the fish passage facility would be dictated by the flow requirements for juvenile and adult fish (see Table 2-1). Several types of fish passage facility may be considered in detailed design: vertical slot weir ladder design was included for its ability to accommodate a greater range of water depths (hydraulic head at the upstream and downstream ends), but the design may also consider ice-harbor, pool and chute, rock ramp fishway or other passage facility designs.

Attraction Flows

The attraction flow magnitude will be 5 to 10 percent of the total flow through the control structure over the path of Restoration Flows. The Project requires conveyance of at least 4,500 cfs, so the attraction flow at the passage facility entrance could be as high as 450 cfs. The passage facility itself may have a design flow rate less than the maximum attraction flow. In this case, the balance of attraction flows could be provided at the passage facility entrance (downstream side) through supplementary water, described below.

Supplementary Water

Supplementary water, if incorporated into the facility, is water already in the river and which is piped to the fish passage facility entrance to augment attraction flows (see Figure 2-8). No additional water supply beyond what would be flowing in the river is required. The supplementary water allows the passage facility to operate under a wider range of river flows by supplying additional attraction flow when the need exceeds the design flow rate through the passage facility. Supplementary water would also be used to control the hydraulic head at the passage facility entrance. Supplementary flow would be collected by a water delivery intake structure located upstream from the fish passage facility. The intake structure would include an automated cleaning system, trash rack and a fish screen to prevent migrating fish from entering the intake. River water would enter the intake structure, and travel downriver through pipes to the passage facility entrance.

San Joaquin River Control Structure at the Chowchilla Bifurcation Structure Modifications

In addition to the passage facility, the San Joaquin River control structure at the Chowchilla Bifurcation Structure would be modified to improve fish passage through the control structure itself or to improve operations of the passage facility. Fish passage through the modified river control structure may meet passage criteria only for certain flows, so the fish passage facility described above would still be required.

Improvements to the river control structure could include removing the trash racks, replacing one or more radial gates with over-shot gates (e.g., inflatable Obermeyer weir gates), notching or removal of the baffle wall or weir, removing the dragon’s teeth, and replacing or modifying the scour protection. Improvements would be designed based on NMFS 2001 and NMFS 2008 passage criteria. Improvements would not affect the ability of the structure to divert flood water into the Chowchilla Bypass.

San Mateo Avenue Crossing Removal

The San Mateo Avenue crossing is an existing river crossing located within a public right-of-way in Madera County and on private land in Fresno County at approximately RM 211.8. The crossing transitions from public right-of-way to private land at the center of the river. The crossing consists of a low flow or dip crossing with a single culvert. As part of this alternative, the culvert and road embankments would be demolished, and no river crossing would be provided at this location.

Compact Bypass Bifurcation Structure

A bifurcation structure would be constructed at the upstream end of the Compact Bypass. The bifurcation structure consists of two control structures: one across the path of Restoration Flows (Compact Bypass) and one across the path of water deliveries to Mendota Pool (San Joaquin River). Since this structure will be retaining the Pool, it would likely be regulated by DSOD if owned by a State or local entity.

The control structure across the Compact Bypass would be designed to accommodate up to 4,500 cfs and consists of six 20-foot-wide bays for a structure length of approximately 140 feet. Conditions in this control structure would be designed based on NMFS 2001 and NMFS 2008 fish passage criteria. The control structure across the San Joaquin River (the path of the water deliveries) would be designed to accommodate up to 2,500 cfs and consists of four 20-foot-wide bays for a structure length of approximately 100 feet. Flow through each bay would be controlled by a gate (e.g., radial [Tainter] or inflatable Obermeyer). In the final design, the number and size of the gates may be modified. The size of the gates would be determined by the design maximum flow.

The Compact Bypass control structure includes a fish passage facility on the side of the structure (i.e., the Compact Bypass Fish Passage Facility), and the San Joaquin River (water deliveries flow path) control structure includes a fish screen upstream of the structure (i.e., the Mendota Pool Fish Screen), if appropriate. Each control structure would be placed in the middle of the channel and has earthen embankments connecting the structure to the proposed levees. The connector embankments may include culverts, gates, weirs, inflatable bladder dams, or other features to improve flow and fish passage on the floodplain when water deliveries are not occurring. A 16-foot-wide roadway and 20-foot-wide maintenance/operations platform would be provided over each control structure.

Compact Bypass Fish Passage Facility

The Compact Bypass control structure (across the Restoration Flow path) includes a fish passage facility. The fish passage facility would be necessary to provide passage during water deliveries and for Restoration Flows where passage conditions in the control structure may not be ideal. The design of the fish passage facility is the same as that presented above for the fish passage facility at San Joaquin River control structure at the Chowchilla Bifurcation Structure.

Drive 10 ½ Crossing

The Compact Bypass would cross existing Drive 10 ½, which provides access for the operations and maintenance of Mendota Dam. To continue the current level of access, the road would be rerouted along the bypass channel levees and cross the head of the bypass channel at the proposed Compact Bypass bifurcation structure. A road deck would also be provided over the fish passage facility adjacent to the bifurcation structure. The road would be designed for HS-20 loading (e.g., sufficient to allow transport of a 25-ton maintenance crane to Mendota Dam).

Mendota Pool Fish Screen

A fish screen would be included adjacent to the head of the Compact Bypass where water deliveries would be diverted from the river to Mendota Pool, if appropriate.[7] The fish screen would keep or return out-migrating juvenile salmon to the Compact Bypass (the path of Restoration Flows) during water deliveries. The Compact Bypass Bifurcation Structure is only operated for Exchange Contractor diversions in summer months in highly infrequent dry years or during flood flow deliveries, when flows split several times before entering Mendota Pool and fish survival through the bypasses is high. The Mendota Pool fish screen is the same as described for the South Canal in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

The screen would be designed to pass flow up to 2,500 cfs. The type of fish screen could be a fixed flat plate in “V” configuration, vertical flat plate, inclined flat plate, cone, or cylindrical screens. Depending on the design type, the fish screen facility may include trash racks, stainless steel wedge wire fish screens, flow control baffle systems behind the screens, screen cleaning systems for the trash racks and screens, bypass flow control weirs, fish-friendly pumps, and/or fish bypass pressure pipelines. The trash racks would be installed at the entrance to the screen structures to protect screens from trash, logs, and other large debris.

Approach, sweeping, and bypass entrance velocities would be kept within established fish screen criteria (NMFS 2008). Flow through the fish screens may be controlled by baffles behind the fish screens. Cleaning of the screens would be accomplished using an automated brush system. Electric power would be needed for fish friendly pumps, if included, and screen cleaning systems. Operation of the fish screens would include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes).

Grade Control Structures

A series of several (2 to 6), approximately 1.0-foot-high grade-control structures could be included within the bypass channel to achieve the necessary elevation change between Reach 2B and Reach 3, if necessary. The grade control could be provided by constructed rock riffle structures stabilized with sheet piles.

Rock riffles have benefits for native fish migration, but they present construction challenges in the sandy substrate of the Reach 2B and Reach 3 area. The flow over constructed rock riffles may reduce the disorienting effects on juveniles from rapidly changing hydraulics otherwise created at weir structures, and they are more favorable to sturgeon, which do not jump. Constructed rock riffles may be less favorable to predators which can hold in the quiescent pools below weir structures. However, placing rock in sandy substrate requires engineered foundation materials (layers of rock in gradually decreasing sizes) to prevent undermining the structure. Further analysis during design will determine the rock sizes and riffle slopes.

[7] The need for the Mendota Pool fish screen will be further evaluated as Project planning and design continues. This screen is included in Alternative B in the event that it is determined necessary.

Sheet piles would be installed on the upstream side of each rock riffle. Caps on the sheet piles would be used to avoid injuring fish and can be surfaced with natural materials (i.e., grouted rock) to emulate natural conditions which fish may be exposed to in non-manmade portions of the San Joaquin River.

Each grade control structure would extend across the main channel and key into the overbanks to protect against flanking, resulting in a total structure width of about 220 feet.

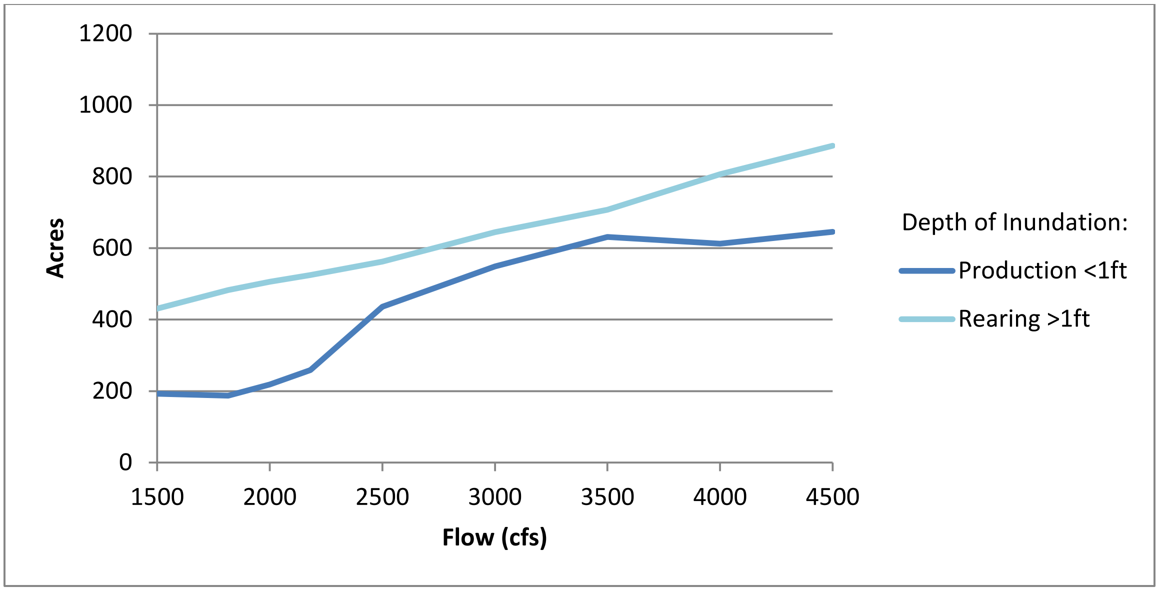
Bank protection measures would be incorporated into the bypass. Bank protection measures could include: vegetated revetment, rock vanes, large woody material structures, bioengineering techniques, and riparian vegetation. Bank protection could be included in the channel, along one channel bank, or along both channel banks. It is assumed that the vegetated revetment would consist of buried riprap covered with topsoil, erosion control fabric, and native woody vegetation, so that fish would experience natural channel banks. Rock vanes would be constructed to only interact with the flow if erosion occurs (i.e., the top of the vane will be level with the constructed overbank surface). Large woody material structures are assumed to be anchored engineered logjams or other similar anchored wood structures that are built into the channel banks. Bioengineering techniques could include vegetated geogrids, fabric encapsulated soil banks, brush mattresses, and root wads. Native woody vegetation directly upstream, downstream, and adjacent to the grade control structures would provide shading and opportunities for juveniles to hide from predators.

Fish Habitat and Passage

The purpose of the floodplain would be to provide riparian and floodplain habitat and support the migration and seasonal rearing of salmonids and other native fishes in Reach 2B. Floodplains would be developed in accordance with the Rearing Habitat Design Objectives. The floodplain has an average width of approximately 4,200 feet and an inundated area of approximately 1,000 acres at 2,500 cfs.

This alternative provides floodplain habitat resulting in approximately 440 acres of shallow water habitat for primary production as well as approximately 560 acres of habitat that supports direct rearing at 2,500 cfs. Approximately 44 percent of the floodplain in this alternative would inundate less than 1 foot deep at 2,500 cfs. This alternative also retains approximately 650 acres of shallow water habitat at flows of 4,500 cfs. Figure 2-12 below presents conceptual inundation areas for primary production and rearing habitats as they vary by flow. Inundation acreages may change during the design process.

In the Compact Bypass channel, floodplain benches with an approximate average width of 150 feet on each side the main flow portion of the bypass channel are included (see section “Compact Bypass Channel.”) Riparian and floodplain habitat would be planted and developed on the benches in the bypass channel to benefit migrating fish and promote a stable channel and sediment transport from Reach 2B to Reach 3.



Source: Reclamation 2015

Figure 2-12.
Potential Inundation Acreage by Flow for Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure)

This alternative includes several facilities that fish may encounter or need to pass to migrate between Reach 3 and Reach 2B (from downstream to upstream):

- Several (2 to 6) in-channel grade control structures in the Compact Bypass.
- Four fish screen return outlets from the Mendota Pool fish screen.
- A bifurcation control structure at the upstream end of the Compact Bypass with fish passage facility.
- The Mendota Pool fish screen adjacent to the upstream end of the Compact Bypass.
- Fish screens at Lone Willow Slough, Big and Little Bertha pumps, and other smaller diversions, if determined necessary (these screens are discussed in Section 2.2.4).
- The San Joaquin River control structure at the Chowchilla Bifurcation Structure with a fish passage facility.

Each structure would be designed to perform according to the fish passage design criteria (see Section 2.2.4). In addition, the channel and floodplain incorporate riparian plantings to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to incorporate channel structure variability during detailed design, all of which may help to reduce stress and predation.

This alternative does not include a fish barrier at the downstream end of the Compact Bypass to keep fish from migrating upstream of the Compact Bypass in Reach 3 toward the base of Mendota Dam.

Floodplain and Riparian Habitat

This alternative includes a mixture of active and passive riparian and floodplain habitat restoration (in contrast to the passive restoration included in Alternative A) and compatible agricultural activities in the floodplain. Active restoration planting of native riparian species would occur along both banks of the low flow channel of the river up to 450 feet from the bank. In accordance with the Rearing Habitat Design Objectives, it would include native species that would provide shade and reduce air temperatures to help minimize water temperatures, provide large woody debris and organic matter needed to provide habitat and food, and help stabilize the low-flow channel. Some areas may be passively revegetated by creating riparian establishment areas that provide a riparian seed bank of native species. The remaining areas would be seeded with native grasses and forbs to minimize erosion and to help control invasive species. Active revegetation activities would likely include a combination of seeding, transplanting, and pole/live stake plantings. Plantings may be designed as either clusters of trees and shrubs with larger areas of seeded grasses and forbs or as dense forests. Spacing and alignment of plantings would take into account species growth patterns, potential equipment access needs for monitoring and maintenance, and desired future stand development. Passive restoration would occur in areas that rely on Restoration Flows for additional vegetation recruitment. Natural riparian recruitment (passive restoration) would promote continual habitat succession, particularly in areas where sediment is deposited or vegetation is removed by natural processes.

Table 2-3 lists the species that are likely to be planted or seeded during active restoration, and is draft and subject to change. Emergent wetlands and water tolerant woody species of riparian scrub would be selected for development within the main channel, woody shrubs and trees with an herbaceous understory would be selected for development along the main river channel banks, and bands of other habitat types (e.g., grasses) would be selected for development at higher elevations along the channel corridor. Active vegetation restoration would occur following construction and these areas would be irrigated and managed as necessary during the establishment period. Phased implementation of active vegetation restoration at strategic locations could occur concurrently with phased implementation of construction and physical infrastructure.

Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) could occur on the floodplain in previous agricultural areas outside of State-owned and public trust lands. Growers would be required to leave cover on the ground and would be required to develop and implement a Water Quality Plan, approved by the Reclamation, to meet current water quality standards for aquatic resources and coldwater fisheries, as well as meeting the specific needs for anadromous fishes in adjacent and downstream areas.

Table 2-3.
Potential Species for Revegetation

Common Name	Scientific Name	Vegetation Type
Riparian Shrub and Wetland Areas (0 to 2 feet above summer baseflow elevations)		
Gooding's willow	*Salix gooddingii*	tree
common buttonbrush	*Cephalanthus occidentalis*	shrub
narrowleaf willow	*Salix exigua*	shrub
redroot flatsedge	*Cyperus erythrorhizos*	annual sedge
baltic rush	*Juncus balticus*	perennial rush
dwarf barley	*Hordeum depressum*	annual grass
spike bentgrass	*Agrostis exarata*	perennial grass
meadow barley	*Hordeum brachyantherum*	perennial grass
distant phacelia	*Phacelia distans*	annual forb
seep monkeyflower	*Mimulus guttatus*	annual/perennial forb
yerba mansa	*Anemopsis californica*	perennial forb
Douglas' sagewort	*Artemisia douglasiana*	perennial forb
Dense Riparian Areas (2 to 8 feet above summer baseflow elevations)		
white alder	*Alnus rhombifolia*	tree
Oregon ash	*Fraxinus latifolia*	tree
California sycamore	*Platanus racemosa*	tree
Fremont cottonwood	*Populus fremontii*	tree
Gooding's willow	*Salix gooddingii*	tree
mule-fat	*Baccharis salicifolia*	shrub
California wildrose	*Rosa californica*	shrub
narrowleaf willow	*Salix exigua*	shrub
dwarf barley	*Hordeum depressum*	annual grass
spike bentgrass	*Agrostis exarata*	perennial grass
meadow barley	*Hordeum brachyantherum*	perennial grass
Douglas' sagewort	*Artemisia douglasiana*	perennial forb
Upland Areas (greater than 8 feet above summer baseflow elevations)		
cattle saltbush	*Atriplex polycarpa*	shrub
California wildrose	*Rosa californica*	shrub
Saltgrass	*Distichlis spicata*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
beardless wildrye	*Leymus triticodes*	perennial grass
California goldfields	*Lasthenia californica*	annual forb
bull clover	*Trifolium fucatum*	annual forb

Existing Native Vegetation Protection

The existing native vegetation in the Project area designated to remain would be temporarily fenced with orange snow fencing (or equivalent) to prevent entry, driving, parking, or storing equipment or material within these areas during construction. Existing vegetation would be left in place or only minimally trimmed to facilitate access and work at the site. The existing soil is an ideal growing medium for all the desired native plants. In order to maximize plant growth and planting success, existing soil and topsoil would be preserved unless the soil contains invasive non-native seed or fragmented stems and rhizomes, in which case it should not be preserved, and disturbance during construction would be minimized to the maximum practicable extent.

Invasive Species Control

Invasive, non-native species would be removed from the Project area during the installation, plant establishment and maintenance periods. Invasive species management would consist of removal of the most invasive non-native species within the reach such as giant reed grass (*Arundo donax*), perennial pepperweed (*Lepidium latifolium*) and poison hemlock (*Conium maculatum*). Invasive species management would also include removal of other invasive species that are currently found in upstream reaches and may eventually colonize in the Project area such as red sesbania (*Sesbania punicea*), salt cedar (*Tamarix species*), and Chinese tallow (*Sapium sebiferum*). Invasive plant removal techniques may include mechanical removal, root excavation, hand pulling, mowing, disking, controlled burning, grazing, aquatic-safe herbicides, or a combination of techniques as appropriate.

Temporary Irrigation System and Water Supply

Proposed plantings that are wetland species or borderline wetland species would need regular aboveground irrigation (typically April through October) during their establishment period (typically 3 to 5 years depending on rainfall conditions and the plants’ growth rates and vigor). The amount of water needed is estimated to be approximately 2.4 acre feet per year. An extensive temporary aboveground irrigation system, such as aerial spray or drip irrigation, would provide water for the plants several times a week during the hot months of the year. If an aerial spray irrigation system is installed, the irrigation distribution piping would be installed aboveground and anchored to the ground so that it would not be damaged during high flows inundating the floodplain. If an aerial spray system is used, sprinkler heads would likely be installed on braced standpipes so that their irrigation stream would not be blocked or diverted by growing vegetation. The irrigation system would be disassembled and removed at the end of the establishment period.

The Program would pursue options for irrigation water supply, including groundwater wells or water pumped from the river with portable, skid-mounted, diesel- or gas-powered pumps and stored in tanks. Additionally, purchases from willing sellers may be required to withdraw water from the river or other nearby water sources (e.g., Mendota Pool). If water is pumped from the river, the amount of water diverted will be controlled so that river water temperatures do not increase and passage for salmonids is not impaired. The diversion from the river would also be screened if necessary to prevent entraining juvenile salmonids.

Maintenance and Monitoring

Maintenance and monitoring would be conducted following revegetation. Monitoring activities include monitoring of the installed plants for drought stress and overwatering, identification of competitive, invasive, non-native species for removal, identification of diseased, dead and washed-out plants, irrigation system function, and identification of trash and debris for removal. Maintenance activities would include controlling invasive plant species, mitigating animal damage, irrigation, replacement of diseased, dead, or washed-out plants, irrigation system maintenance, and removal of trash and debris. Management of invasive species would ensure that the desirable vegetation dominates the landscape and provides habitat diversity, productivity, and sustainability. Animal damage to newly planted or germinated vegetation could be alleviated with screens, aquatic-safe chemical deterrents, or other exclusion methods.

Temporary irrigation of wetland and riparian areas during establishment, especially if precipitation is below normal, would facilitate root system development into the alluvium groundwater. Irrigation infrastructure would need to be installed and remain in place for at least 3 years. The irrigation system would be used each year on a biweekly to daily basis during the hot part of the growing season. The landscape contractor would be required to regularly check the integrity of the system and make sure that system is not clogged or damaged. Upland areas would be seeded in the fall before the winter precipitation season, and it is likely that these areas would become established to an acceptable level after one season of normal precipitation. (There may be more than one active revegetation effort required to establish a dense riparian corridor necessary to naturally stabilize the Compact Bypass channel.) Removal of trash and debris from the restoration areas on both sides of the river would be performed on an as-needed basis for the duration of the entire monitoring period.

Long-Term Management

While it is not anticipated that major management actions would be needed, the key objective of management would be to monitor and identify any environmental issues that arise, and use adaptive management to determine what actions would be most appropriate to correct these issues.

The general management approach to the long-term maintenance of the floodplain areas would be to maintain quality habitat for each natural resource, on-going monitoring and maintenance of key environmental characteristics of the entire floodplain area within the reach. An adaptive management approach would be used to incorporate changes to management practices, including corrective actions as determined to be appropriate by Reclamation and/or CSLC. Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, etc.

The expected long-term management needs and activities necessary to maintain any on-site mitigation sites would be resource specific long-term maintenance activities and other general maintenance activities such as exotic species elimination, grazing management, clean-up and trash removal, infrastructure management such as gate, fence, road, culvert, signage and drainage-feature repair, and other maintenance activities necessary to maintain the riparian and floodplain habitat quality.

Water Deliveries

This alternative includes a diversion at the head of the Compact Bypass for making up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. This diversion would directly deliver water from the river to Mendota Pool without the need for a canal. Water deliveries to the Pool would include diversion of Friant Dam releases that are meant to satisfy the Exchange Contract as well as diversion of San Joaquin River flood flows up to 2,500 cfs if there is demand in Mendota Pool.

When water deliveries occur, the gates at the Compact Bypass bifurcation structure would be manipulated to control flows into the Compact Bypass and allow flows into Mendota Pool. Since the Mendota Pool operating elevation is several feet higher than the bottom of the Compact Bypass channel, operation of the gates would include backwatering a portion of the San Joaquin River upstream of the Compact Bypass bifurcation structure. The extent of the backwater is anticipated to be similar to the extent of the Mendota Pool backwater under existing conditions (i.e., upstream to approximately the existing San Mateo Avenue crossing). Up-migrating fish passage from the Compact Bypass into Reach 2B would occur through the Compact Bypass fish passage facility during water deliveries. The Mendota Pool fish screen would capture out-migrating fish entering the diversion and return them to the Compact Bypass. Sufficient flow to support adult and juvenile fish passage through the Compact Bypass would be maintained during water delivery operations during fish migration periods.

Construction Considerations

The total construction timeline for this alternative is currently estimated to range approximately from 106 to 157 months (9 to 13 years); opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process.

Soil improvements for possible liquefiable soils may be required to protect proposed structures from damage or failure during an earthquake. All proposed structures would be designed to account for potential liquefaction. Soil improvements could include removing and replacing soils with adequate materials, injecting soil-cement slurry, vibrofloatation, dynamic compaction, structural foundation piles (stone or reinforced concrete), and other techniques.[8]

Flow in the San Joaquin River, operations at the existing Mendota Dam, operations at the Chowchilla Bifurcation Structure, and operation of the existing Columbia Canal must be maintained during construction. The majority of the Compact Bypass channel would likely be constructed without interruption to the San Joaquin River flow or the Columbia Canal.

The construction of the Mendota Pool control structure across the existing river channel would require removable cofferdams in three phases to facilitate the construction without blocking the flow. If flow is present in the river during the construction period, flow would be diverted around the work area via a temporary diversion pipe or canal and fish passage would be provided. Cofferdams include two rows of braced sheet piling filled with dirt for stability and seepage control. The total height of the cofferdam is assumed to be 24 feet of which 12 feet would be above the channel bed. The control structures to be

[8] Vibrofloatation uses a vibrating probe that penetrates the soil and causes the grain structure to collapse and increase the density of the soil. Dynamic compaction involves dropping a heavy weight onto soil to compact it.

constructed on dry land (e.g., the Compact Bypass control structure) would not require cofferdams.

Stone slope protection (riprap) would be provided on the upstream and downstream slopes of the control structure embankment including some portions of the side slopes of the channel itself to prevent scouring. Riprap would be placed on bedding over geotextile fabric.

Construction of the fish screen, which is located in the San Joaquin River, would require removable cofferdams in three phases to facilitate the construction without blocking the flow. The exception to this is the return/bypass fish pipes and outlet, which would take place in the dry using conventional construction methods. All fish facility structures and pipes with surfaces exposed to fish require additional attention to surface-smoothness.

For construction of the control structures and fish passage facilities, it would be desirable to maintain a minimum flow during construction; the amount or range of flows during construction has not yet been identified. For construction at the bifurcation, it was assumed that construction would first be done away from the fish passage facility. A sheet pile cofferdam would be provided for the Mendota Pool control structure and/or the Compact Bypass control structure, if needed, and the water diverted away from the construction. Additional sheet piling would be provided to divert flows through the new bifurcation structure while the fish passage facility is constructed.

Demolition of the San Mateo Avenue crossing would be timed so that the lesser Restoration Flows (5 to 195 cfs) can be routed around the structure during demolition.

Summary

Table 2-4 summarizes the levees, relocations, land acquisition, and construction schedule associated with Alterative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) based on design, field, and evaluation criteria data prepared for the EIS/R.

Table 2-4.
Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure)
Levees, Relocations, and Land Acquisition

	Left Levee	**Right Levee**
Levee Length	8.1 miles	6.8 miles
Average Levee Height	5.6 feet	4.7 feet
Fill Volume	328,600 cubic yards	226,900 cubic yards

Relocations			
Electrical Distribution	48,500 feet	Barn/Shed	1
Gas Transmission	11,000 feet	Facility	1
Water Pipeline	41,000 feet	Groundwater Well	32
Canal	31,500 feet	Lift Pump	10

Table 2-4.
Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure)
Levees, Relocations, and Land Acquisition

Culvert	1	Power Pole	162
Diversion	3	Dwelling	2
Land Acquisition and Construction Schedule			
Land Acquisition[1]	2,900 acres		
Time to Build[2]	157 months		

[1] Total acreage includes areas that are sovereign and public trust lands.
[2] Construction timeline does not include the time that would also be needed to complete the NEPA and CEQA documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.2.7 Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) includes:

- Building levees capable of conveying flows up to 4,500 cfs with 3 feet of freeboard.
- Restoring floodplain habitat an average of approximately 3,000 feet wide to provide benefit to salmonids and other native fishes.
- Constructing a dam capable of containing Mendota Pool within Fresno Slough so that 4,500 cfs of Restoration Flows can be conveyed around the Mendota Pool.
- Constructing the Short Canal and structures capable of conveying up to 2,500 cfs from Reach 2B to Mendota Pool.
- Providing upstream and downstream fish passage for adult salmonids and other native fishes, and downstream fish passage for juvenile salmonids, between Reach 2A and Reach 3.

This alternative would build a dam across Fresno Slough, the Fresno Slough Dam, to contain the Mendota Pool, and it would utilize the existing river channel in order to bypass the Mendota Pool. Restoration Flows would enter Reach 2B at the Chowchilla Bifurcation Structure, flow through Reach 2B, then downstream to Reach 3 over the sill at Mendota Dam. Mendota Pool would be contained south of the Fresno Slough Dam. The existing Chowchilla Bifurcation Structure would continue to divert San Joaquin River flows into the Chowchilla Bypass during flood operations, and a fish passage facility and control structure modifications would be included at the San Joaquin River control structure at the Chowchilla Bifurcation Structure. A canal to convey San Joaquin River water deliveries to Mendota Pool, the Short Canal, would be built adjacent to the Fresno Slough Dam. The Mendota Dam along with a control structure built at the head of the Short Canal would be used to control diversions into Mendota Pool through the Short Canal. Fish passage facilities at Mendota Dam and a fish screen on the Short Canal would be built to provide passage around Mendota Dam and prevent fish from being entrained in the diversion. A fish barrier would be built downstream of the Fresno Slough Dam to keep up-migrating fish in Reach 2B. A new crossing would be built at the San Mateo Avenue crossing. These features are described in further detail in the sections below. See Figure 2-13 and Figure 2-14 for a plan view of the alternative's features.

Short Canal

The Short Canal would deliver up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. The Short Canal could connect to the river either on the east or west side of the Fresno Slough Dam. Additionally, the west-side configuration could be combined with the Main Canal and Helm Ditch Relocations or be constructed independent of those relocations. The Short Canal would discharge into Fresno Slough approximately 0.8 river mile south of Mendota Dam.

Water deliveries would be controlled by a control structure at the north end of the Short Canal and Mendota Dam. The canal control structure would have a fish screen to prevent entrainment and Mendota Dam would be retrofitted with fish passage facilities. The control structures, fish screen, and fish passage facilities are discussed under Structures.

The Short Canal would be concrete-lined with a trapezoidal cross-section. The Short Canal would have a top-width of approximately 70 feet, a total corridor width of approximately 180 feet (including levees and maintenance roads), and 2H to 1V side slopes on the canal banks and 3H to 1V side slopes on the levees. Levee heights would be based on a flow of 2,500 cfs and 3 feet of freeboard.

Structures

The structures described below would be required to provide the operational flexibility to divert water to the Mendota Pool, provide fish passage, prevent fish entrainment and straying, and provide controlled elevation drop between Reach 2B and Reach 3.

Fish Passage Facility on the San Joaquin River Control Structure at the Chowchilla Bifurcation Structure

The fish passage facility is the same as that in Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) in Section 2.2.6.

San Joaquin River Control Structure at the Chowchilla Bifurcation Structure Modifications

The San Joaquin River control structure at the Chowchilla Bifurcation Structure modifications is the same as described in Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure) in Section 2.2.6.

San Mateo Avenue Crossing Replacement

The existing river crossing at San Mateo Avenue would be replaced with a new culverted crossing. The crossing is the same as described in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

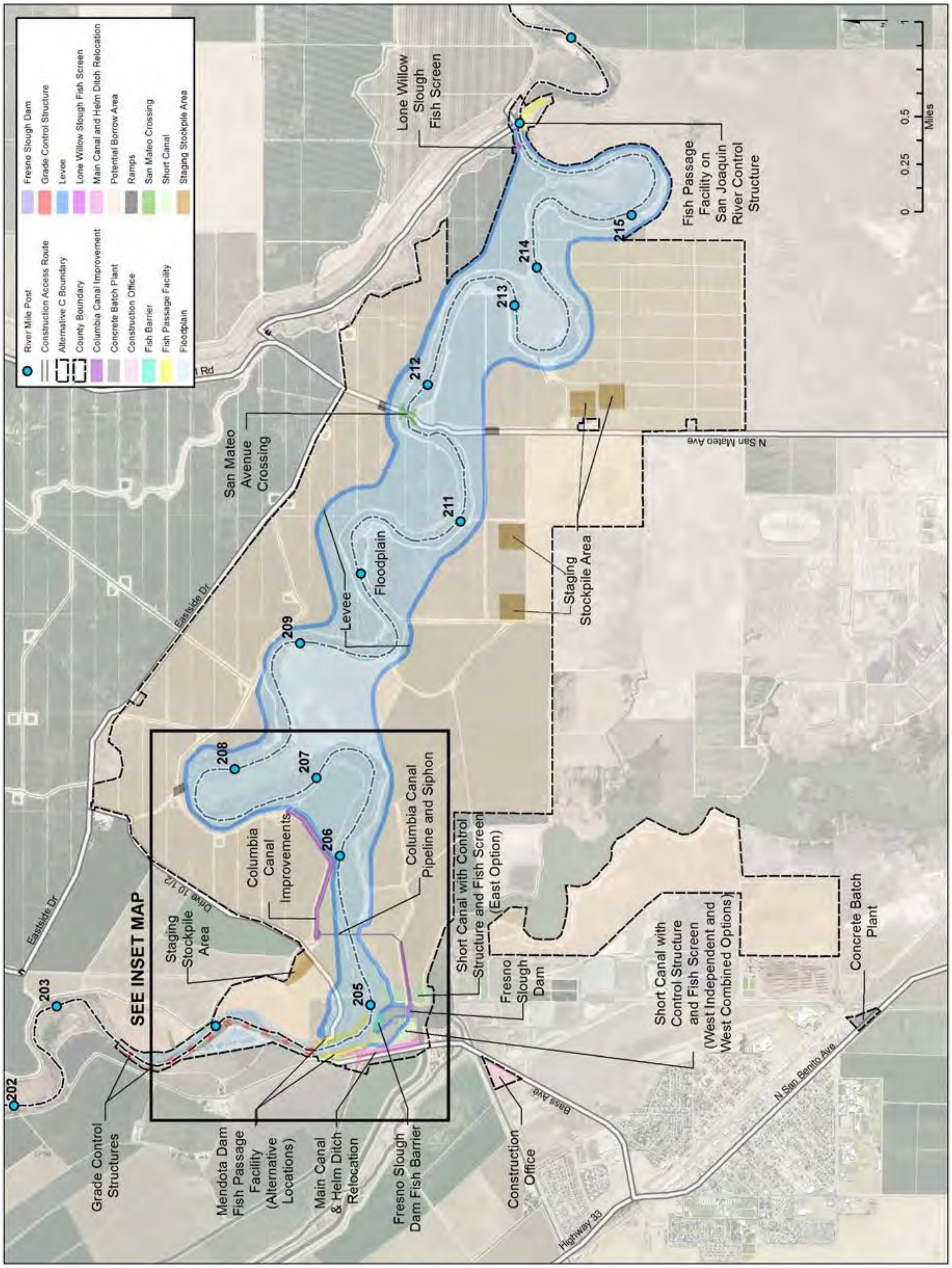


Figure 2-13.
Plan View of Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

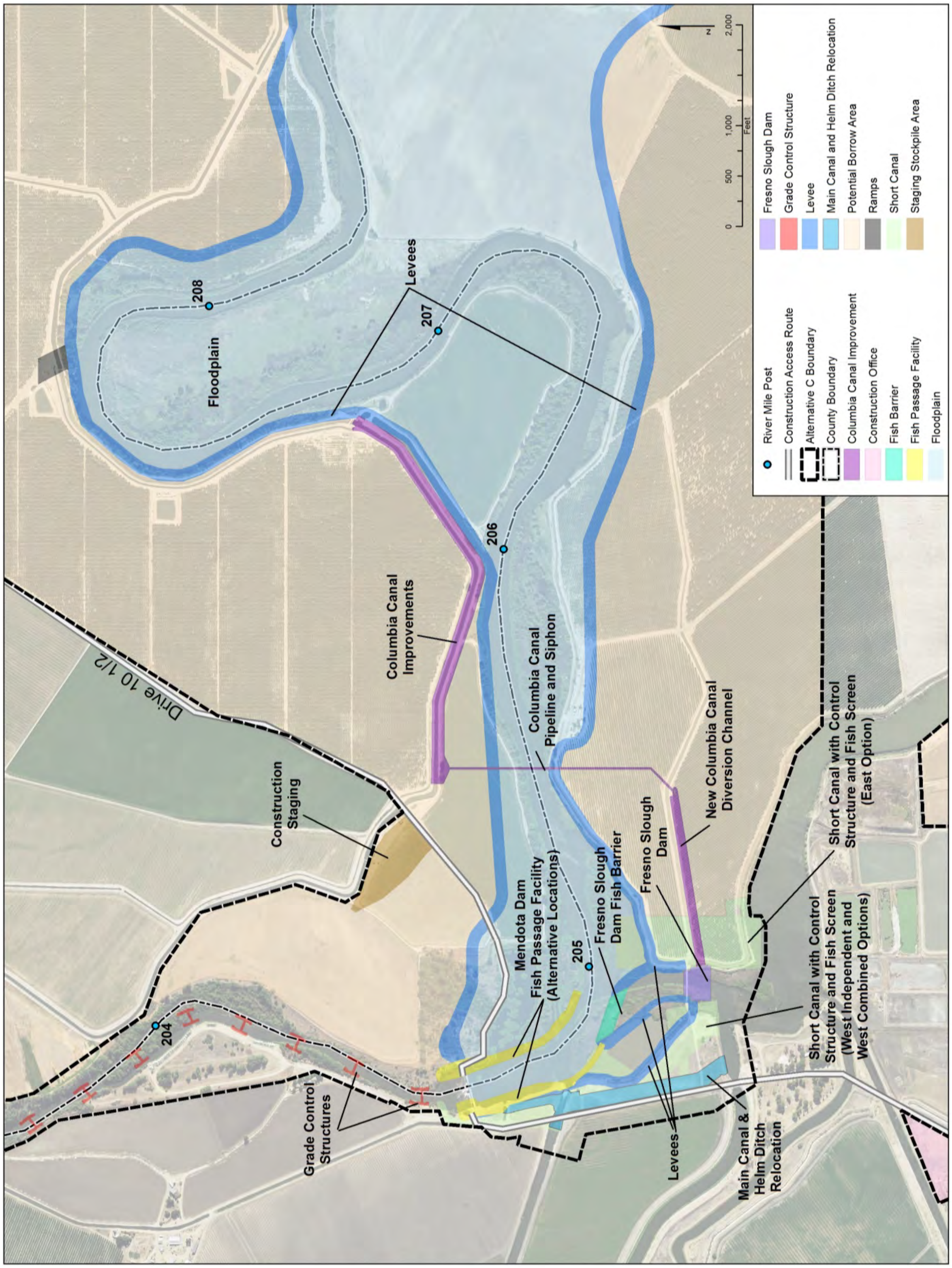


Figure 2-14.
Inset Map of Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Short Canal Control Structure

A control structure would be constructed at the upstream end of the Short Canal. The control structure would be across the path of water deliveries to Mendota Pool. Since this structure will be retaining the Pool, it would likely be regulated by DSOD if owned by a State or local entity. The Short Canal control structure is the same as the control structure across the path of water deliveries described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Short Canal Fish Screen

A fish screen would be included at the head of the Short Canal where water deliveries would be diverted from the river. The fish screen would be necessary to keep or return out-migrating juvenile salmon to the San Joaquin River (the path of Restoration Flows) during water deliveries. The Short Canal fish screen is the same as described for the South Canal in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Fresno Slough Dam

The Fresno Slough Dam would be constructed approximately 0.5 mile south of the Mendota Dam, in the existing Fresno Slough. In addition, the dam structure would be located just south of the existing Mowry Bridge that crosses the Fresno Slough. The dam would serve to limit the extent of Mendota Pool so it no longer occupies portions of the San Joaquin River. This pool would feed the five existing irrigation canals (Main Canal, Helm Ditch, Columbia Canal, Outside Canal, and Main Lift Canal). A screened water diversion canal would enable water deliveries from the San Joaquin River to the Mendota Pool. Since inputs into the Mendota Pool would be screened, Fresno Slough Dam does not require provisions for fish passage. Since this structure will be retaining the Pool, it would likely be regulated by DSOD if owned by a State or local entity.

The dam structure would be designed to accommodate a maximum water elevation of 156 feet. This water elevation corresponds to a pool depth of 16 feet above the top of the concrete floor.

The Fresno Slough Dam would have a reinforced concrete spillway. The spillway would likely not require the support of piles. The spillway would include a concrete cutoff wall at the upstream end of the spillway to limit the hydrostatic uplift pressures and reduce the effects of scour. Baffle blocks and riprap would be included at the downstream end of the concrete spillway to limit the effects of scour and erosion.

Directly adjacent to the upstream and downstream ends of the concrete dam structure, a total of four concrete retaining walls form the walls of the spillway, and retain the sides of the earthen embankment portion of the dam. The spillway structure would be comprised of multiple gates, which serve to control the flow of water from the Mendota Pool to the San Joaquin River.

Over the dam, a concrete roadway, concrete maintenance platform, and a hoist operation platform span the full width of the structure. A series of vertical stoplog slots would be included in the concrete abutment walls. The stoplog slots allow the placement of stoplogs directly upstream of the gates, to facilitate local dewatering of the gates for maintenance operations.

Some excavation of existing channel sediments upstream of the dam will be required to improve flow conditions through the dam during Kings River floods.

Fresno Slough Dam Fish Barrier

A fish exclusion barrier would be included north of the Fresno Slough Dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases through the Fresno Slough Dam. Levees would be constructed to delineate a channel between the Fresno Slough Dam and the fish barrier, and sediments in the San Joaquin River would be excavated to allow proper structure placement and acceptable sweeping velocities.

The design of the fish barrier is the same as the Reach 3 fish barrier described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Mendota Dam Modifications

This alternative includes using the San Joaquin River channel as a means of bypassing Mendota Pool. Since the Mendota Dam crosses the San Joaquin River, the structure will need to be modified to provide run-of-the-river conditions during Restoration Flows. The concrete portions of structure of Mendota Dam would remain in place, and the flash boards currently used to close the bays and back up water would be removed during non-water delivery operations using the Short Canal. The sill of the dam may be notched in one or more bays to improve fish passage conditions, and the notch would be designed to accommodate flash boards similar to the current bays. When the Short Canal is in operation, the flash boards would be placed in the notch(es) and bays to back up water for water deliveries.

Mendota Dam Fish Passage Facilities

Fish passage facilities are provided at Mendota Dam for two conditions: when the boards are out and when the boards are in. Most of the time, the flash boards at Mendota Dam will be out, and Restoration Flows will pass unimpeded over the sill at Mendota Dam. When water deliveries from the river to Mendota Pool are occurring, the flash boards at Mendota Dam will be installed to create an impoundment. Due to the variation in conditions, different fish passage facilities are required for each condition.

Boards-Out Conditions (no water deliveries occurring)

Passage for boards-out conditions could be accomplished with either grade-control structures, dam notching, a fish passage facility, or a combination of these.

A series of approximately 0.5-foot-high grade control structures could be installed downstream of Mendota Dam to increase the water surface elevation during low flows of around 100 cfs to allow fish passage over the sill when the boards are out at Mendota Dam. The structures would be located several hundred feet apart. Each structure would raise the water surface incrementally on the downstream side of the dam so that salmonids would be able to migrate over the sill. Other aspects of the grade control structures are the same as those described for those in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

The sill of the dam could also be notched to provide suitable low flow passage conditions when the boards are out. Notching the dam would involve removing portions of the existing concrete sill and potentially reinforcing the remaining concrete. The notch(es) would be designed to accommodate flash boards so that water delivery operations could occur. Notching could be utilized in combination with the grade control structures to reduce the overall number of structures needed to incrementally raise the water surface on the downstream side of the dam.

Alternatively, a fish passage facility could be installed at Mendota Dam to provide passage when the boards are out. The boards-out fish passage facility could be combined with the boards-in fish passage facility (described below) by including multiple entrances and exits on the facility. Otherwise, an independent fish passage facility for boards-out conditions could be constructed. The design of the boards-out fish passage facility is the same as described for the South Canal fish passage facility in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Boards-In Conditions (during water deliveries)

For the Short Canal to operate, the boards at Mendota Dam would be replaced to raise the water surface in the river and back up water into the Mendota Pool. A proposed fish passage facility enables fish to pass over Mendota Dam when the boards are in. The passage facility transitions from the minimum San Joaquin River water surface elevation in Reach 3 (occurring during low flow/base flow conditions) to the normal pool water surface elevation above Mendota Dam. The boards-in fish passage facility could be combined with the boards-out fish passage facility (described above) by including multiple entrances and exits on the facility. Otherwise, an independent fish passage facility for boards-in conditions would be constructed. The design of the boards-in fish passage facility is the same as described for the South Canal fish passage facility in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Main Canal and Helm Ditch Relocations

The Fresno Slough Dam requires the headworks of the Central California Irrigation District's (CCID) Main Canal and Helm Ditch to be reconfigured to divert water from the upstream (south) side of the Fresno Slough Dam. This would allow the District to continue to receive their water supply from the Delta-Mendota Canal and flows from the Fresno Slough without requiring screening of those diversions.

To provide water to the CCID's Main Canal and Helm Ditch, an inlet canal is proposed that would take water from the upstream side of the proposed Fresno Slough Dam, run north adjacent to the west side of the San Joaquin River, and connect to the Main Canal and Helm Ditch just west of their current intakes. This canal would be capable of conveying the full flow of both the Main Canal and the Helm Ditch combined (1,550 cfs).

The inlet canal would be designed to pass the design flow at anticipated low water levels in the Pool, but it would still provide 2 feet of freeboard at the anticipated high water level. The water elevation in the inlet canal would essentially float with the Mendota Pool. A bridge over the inlet canal would be required to maintain access to Mowry Bridge and the future Fresno Slough Dam. Currently, there is a 20-inch drinking water pipeline for the city of Mendota that crosses the Mowry Bridge. This pipeline would need to be modified so that it crosses the proposed inlet canal on the proposed bridge.

The inlet canal would be concrete lined in locations where erosion is likely to be a concern (i.e., at bends and transitions), and riprap would be placed at the transition from the Pool to the inlet channel.

A concrete control structure would control the water from the inlet canal. It would function to control flows to both the Main Canal and the Helm Ditch. Controlling the flow to the Main Canal would be accomplished with control gates. Upstream of the gates on the eastern wall, a pipeline would deliver water to the relocated head of the Helm Ditch. The concrete pipe, equipped with a canal gate, would serve to control the flow rate as well as shutoff point. It is assumed that existing headworks and telemetry for both the Main Canal and Helm Ditch would be removed from the site, and new telemetry would be installed.

The upstream side of the Main Canal structure would have a cutoff wall to prevent undermining the structure. Downstream of the control structure, the Main Canal would transition both vertically and horizontally into the existing Main Canal alignment and cross-section. The extension of Helm Ditch would be designed to match the cross-section of the existing Helm Ditch downstream.

Removal of River Sediments

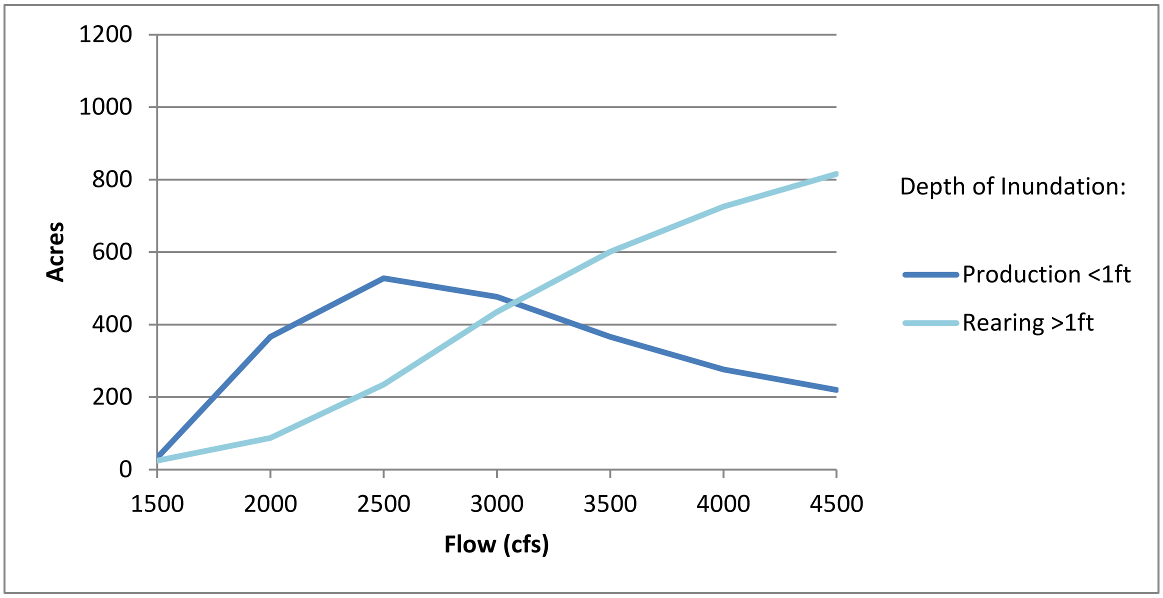
This alternative would make use of the existing river channel from the Chowchilla Bifurcation Structure (approximately RM 216) down to Mendota Dam (approximately RM 204.6) in order to convey Restoration Flows. Since a portion of this river segment is currently impounded by Mendota Dam, sediment has filled in the pre-Mendota Dam channel. This alternative assumes that the sediment would be excavated from portions of the former Pool impoundment area to establish a new equilibrium channel slope. If sediments meet on-site disposal criteria, they may be used to backfill soil borrow areas or to grade low areas on the floodplain.

Fish Habitat and Passage

The purpose of the floodplain would be to provide riparian and floodplain habitat and support the migration and seasonal rearing of salmonids and other native fishes in Reach 2B. The floodplain has an average width of approximately 3,000 feet and an inundated area of approximately 750 acres at 2,500 cfs.

This alternative provides floodplain habitat resulting in approximately 500 acres of shallow water habitat for primary production as well as approximately 250 acres of habitat that supports direct rearing at 2,500 cfs. For this alternative, approximately 65 percent of the floodplain would inundate less than 1 foot deep at 2,500 cfs. This alternative also retains approximately 200 acres of shallow water habitat at flows up to 4,500 cfs.

Figure 2-15 below presents conceptual inundation areas for primary production and rearing habitats as they vary by flow. Inundation acreages may change during the design process.



Source: Tetra Tech 2012

Figure 2-15.
Potential Inundation Acreage by Flow for Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

This alternative includes several facilities that fish may encounter or need to pass to migrate between Reach 3 and Reach 2B (from downstream to upstream):

- An estimated two to four in-channel grade control structures below Mendota Dam.
- The sill of Mendota Dam (when boards are out) or a fish passage facility at Mendota Dam (when boards are in).
- Four fish screen return outlets from the Short Canal fish screen.
- A fish barrier north of the Fresno Slough Dam.
- A fish screen near the upstream end of the Short Canal.
- The San Mateo Avenue crossing.

- Fish screens at Lone Willow Slough, Big and Little Bertha pumps, and other smaller diversions (these screens are discussed in Section 2.2.4).
- A bifurcation control structure at the Chowchilla Bypass with fish passage facility.

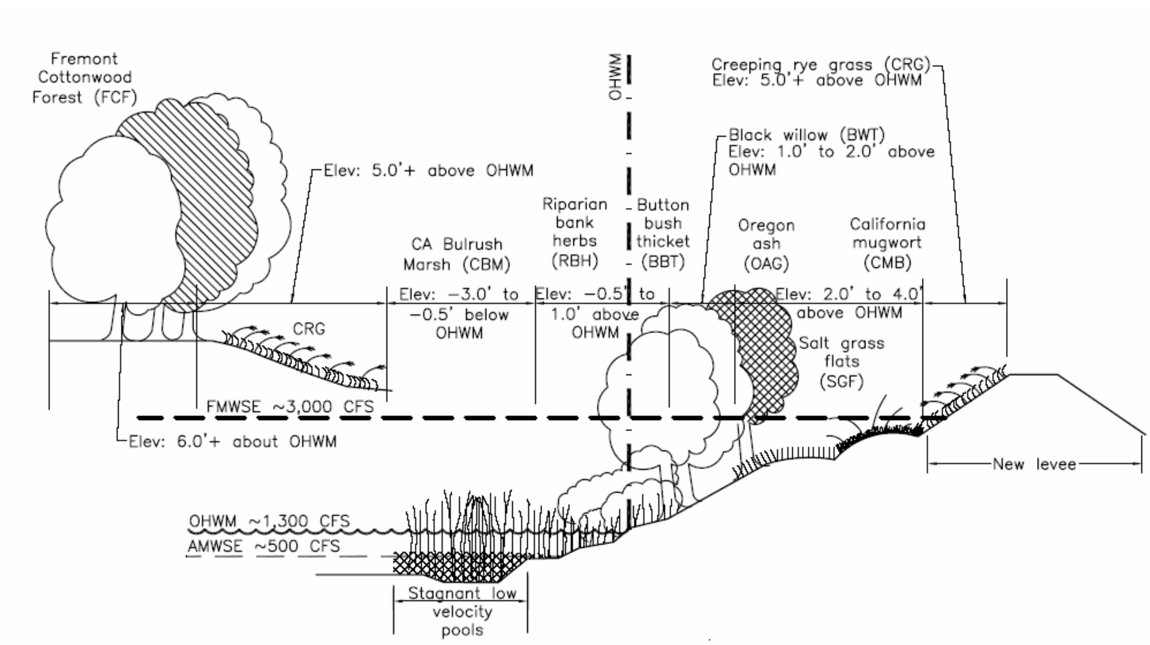
Each structure would be designed to perform according to the fish passage design criteria (see Section 2.2.4). In addition, the channel and floodplain incorporate riparian plantings to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to incorporate channel structure variability during detailed design, all of which may help to reduce stress and predation.

Floodplain and Riparian Habitat

This alternative includes active riparian and floodplain habitat restoration (in contrast to the passive restoration included in Alternative A). It is assumed that wetland communities (obligate, facultative-wet, and facultative species) would develop within the main channel, that a dense riparian scrubland would develop along the main river channel banks, and that bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the channel corridor. The wetland, floodplain, and riparian areas would be planted following construction and then irrigated and managed as necessary during the establishment period. Invasive, non-native species would be removed from the Project area during or following construction, and the Project would include long-term management for invasive species. Phased implementation of active vegetation restoration at strategic locations could occur concurrently with phased implementation of construction and physical infrastructure.

Several native vegetation alliances could be incorporated into the floodplain and habitat planting design (Figure 2-16). The grass-dominated vegetation alliances, which produce the maximum food benefits for salmon, could be more than twice as large as those that would develop with the narrow floodplain alternatives. All of the elevated areas of the meander loops could be maintained or restored to saltgrass flats. The adjacent existing wetland areas within the loops could be preserved or enhanced by additional wetland species plantings and removal of numerous invasive species. The lower lying portions of the reach could be planted with the buttonwillow thicket vegetation alliance. Because of the expanded floodplain and the slowly moving water, the extent of this vegetation alliance could almost quadruple compared to what might develop in the narrow floodplain alternatives.

The extent of black willow thicket and California mugwort brush could also increase over what might develop in the narrow floodplain alternatives. Additional restoration work could focus on the re-establishment of the riparian bank herbs, California bulrush marsh, Oregon ash groves, creeping rye grasslands, and Fremont cottonwood forests. Because of the fast growth and its soft and brittle wood, the cottonwood is considered to be a good source of large woody debris and organic matter within the riverine channel. The riverside levee banks would be planted with native grass species such as those in the creeping rye grassland alliance. Since creeping wild rye (*Leymus triticoides*) is a facultative wetland species that thrives in the upper parts of riparian areas, the extent of creeping rye grassland could more than double compared to the narrow floodplain alternatives.



Notes: The figure provides an abridged cross-section of the river and floodplain. The upper left-hand portion of the figure shows typical vegetation alliances that would occur on higher ground (above the 3,000 cfs waterline). The left levee would be on the outside, but it is not shown here for brevity purposes. The lower, right-hand portion of the figure shows the range of vegetation alliances that would occur on the levee and on lower ground down to the bottom of the river channel (below the 3,000 cfs waterline).

OHWM – ordinary high water mark; AMWSE = annual mean water surface elevation.

Figure 2-16.
Typical distribution of vegetation alliances along a restored Reach 2B riparian bank section

This alternative would provide potential habitat for greater sandhill crane and Swainson's hawk. The larger floodplains provide increasingly more potential habitat.

Existing Native Vegetation Protection

Existing native vegetation protection would be conducted as described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Invasive Species Control

Invasive, non-native species would be removed from the Project area during the installation, plant establishment and maintenance periods. Maintenance and invasive species control would be conducted as described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Temporary Irrigation System and Water Supply

Proposed plantings that are wetland species or borderline wetland species would need regular aboveground irrigation (typically April through October) during their establishment period (typically 3 to 5 years depending on rainfall conditions and the plants' growth rates and vigor). The amount of water needed is estimated to be approximately 2.4 acre feet per year. An extensive temporary aboveground irrigation system, such as aerial spray or drip irrigation, would provide water for the plants several times a week during the hot months of the year. If an aerial spray irrigation system is installed, the irrigation distribution piping would be installed aboveground and anchored to the ground so that it would not be damaged during high flows inundating the floodplain. If an aerial spray system is used, sprinkler heads would likely be installed on braced standpipes so that their irrigation stream would not be blocked or diverted by growing vegetation. The irrigation system would be disassembled and removed at the end of the establishment period.

The Program would pursue options for irrigation water supply, including groundwater wells or water pumped from the river with portable, skid-mounted, diesel- or gas-powered pumps and stored in tanks. Additionally, purchases from willing sellers may be required to withdraw water from the river or other nearby water sources (e.g., Mendota Pool). If water is pumped from the river, the amount of water diverted will be controlled so that river water temperatures do not increase and passage for salmonids is not impaired. The diversion from the river would also be screened to prevent entraining juvenile salmonids.

Maintenance and Monitoring

The key maintenance and monitoring activities include close monitoring of the installed plants for drought stress and overwatering, removal of competitive, invasive, non-native species, replacement of diseased and dead plants, irrigation system maintenance, and removal of trash and debris.

Close monitoring of the installed plants for both drought stress and overwatering would be performed because the proposed plants are native wetland species that can be quickly damaged by lack of irrigation.

For irrigation system maintenance, the system would be used intensively each year on a biweekly to daily basis during the hot part of the growing season. The landscape contractor would be required to regularly check the integrity of the system and make sure that none of the sprinkler heads are clogged or damaged.

Long-Term Management

Long-term management would be conducted as described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Water Deliveries

This alternative includes the Short Canal for making up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. Water deliveries to the Pool would include diversion of Friant Dam releases that are meant to satisfy the Exchange Contract as well as diversion of San Joaquin River flood flows if there is demand in Mendota Pool.

When water deliveries need to occur, the normal pool elevation in Mendota Pool may be higher than the water surface in the river at Fresno Slough Dam. In order for the Short

Canal to be able to deliver water into Mendota Pool, the flash boards of Mendota Dam would be installed, and the water surface in the river would be raised until water could flow from the river south into Mendota Pool via the Short Canal. A fish screen would be included at the Short Canal, and fish passage facilities would be included at Mendota Dam when the boards are in and the diversion is operating.

Construction Considerations

The total construction timeline for this alternative is currently estimated to range approximately from 91 to 133 months (7.5 to 11 years); opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process.

Soil improvements for possible liquefiable soils may be required to protect proposed structures from damage or failure during an earthquake. All proposed structures would be designed to account for potential liquefaction. Soil improvements could include removing and replacing soils with adequate materials, injecting soil-cement slurry, vibrofloatation, dynamic compaction, structural foundation piles (stone or reinforced concrete), and other techniques.[9]

Construction of the Fresno Slough Dam must not interrupt water deliveries. To accomplish this, the construction of the dam would require removable cofferdams in three phases to facilitate the construction without blocking the flow. If flow is present in the slough during the construction period, flow would be diverted around the work area via a temporary diversion pipe or canal and fish passage would be provided.

Stone slope protection (riprap) would be provided on the upstream and downstream slopes of the control structure embankment including some portions of the side slopes of the channel itself to prevent scouring. Riprap would be placed on bedding over geotextile fabric.

Construction of the fish screen and return/bypass fish pipes would take place in the dry using conventional construction methods and must be coordinated with construction of the water delivery canal. The exception to this is the outlet for the fish return pipes, which would require a cofferdam. All fish facility structures and pipes with surfaces exposed to fish require additional attention to surface-smoothness.

For construction of the control structures and fish passage facilities, a minimum flow must be maintained during construction; the amount or range of flows has not yet been identified. For construction at the bifurcation structure, it was assumed that construction would first be done away from the fish passage facility. A sheet pile cofferdam would be provided for the river control structure and/or the canal control structure and the water diverted away from the construction. Additional sheet piling would be provided to divert flows through the new bifurcation structure while the fish passage facility is constructed.

[9] Vibrofloatation uses a vibrating probe that penetrates the soil and causes the grain structure to collapse and increase the density of the soil. Dynamic compaction involves dropping a heavy weight onto soil to compact it.

Summary

Table 2-5 summarizes the levees, relocations, land acquisition, and construction schedule associated with Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) based on design, field, and evaluation criteria data prepared for the EIS/R.

Table 2-5.
Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)
Levees, Relocations, and Land Acquisition

	Left Levee		**Right Levee**
Levee Length	7.7 miles		6.9 miles
Average Levee Height	5.6 feet		5.2 feet
Fill Volume	317,500 cubic yards		224,500 cubic yards
Relocations			
Electrical Distribution	48,000 feet	Barn/Shed	1
Gas Transmission	9,000 feet	Facility	1
Water Pipeline	33,000 feet	Groundwater Well	25
Canal	32,500 feet	Lift Pump	10
Culvert	1	Power Pole	166
Diversion	3	Dwelling	2
Land Acquisition and Construction Schedule			
Land Acquisition[1]	2,450 acres		
Time to Build[2]	133 months		

[1] Total acreage includes areas that are sovereign and public trust lands.
[2] Construction timeline does not include the time that would also be needed to complete the NEPA and CEQA documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.2.8 Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) includes:

- Building levees capable of conveying flows up to 4,500 cfs with 3 feet of freeboard.
- Restoring floodplain habitat an average of approximately 4,200 feet wide to provide benefit to salmonids and other native fishes.
- Constructing a dam capable of containing Mendota Pool within Fresno Slough so that 4,500 cfs of Restoration Flows can be conveyed around the Mendota Pool.
- Constructing the North Canal and structures capable of conveying up to 2,500 cfs from Reach 2B to Mendota Pool.
- Providing upstream and downstream fish passage for adult salmonids and other native fishes, and downstream fish passage for juvenile salmonids, between Reach 2A and Reach 3.

This alternative would build a dam across Fresno Slough, the Fresno Slough Dam, to contain the Mendota Pool, and it would utilize the existing river channel in order to bypass the Mendota Pool. Restoration Flows would enter Reach 2B, flow through the reach, then downstream to Reach 3 over the sill at Mendota Dam. Mendota Pool would be contained south of the Fresno Slough Dam. A canal to convey San Joaquin River water deliveries to Mendota Pool, the North Canal, would be built. The San Joaquin River control structure at the Chowchilla Bifurcation Structure would be removed, and a bifurcation structure would be built at the head of the North Canal to control flood diversions into the Chowchilla Bypass and water delivery diversions into Mendota Pool. Fish passage facilities and a fish screen would be built at the North Canal bifurcation structure to provide passage around the structure and prevent fish being entrained in the diversion. A fish barrier would be built downstream of the Fresno Slough Dam to keep up-migrating fish in Reach 2B. The existing San Mateo Avenue crossing would be removed. These features are described in further detail in the sections below. See Figure 2-17 and Figure 2-18 for a plan view of the alternative's features.

North Canal

The North Canal would deliver up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. The North Canal could connect to the river at various locations, ideally on a straight section of the river or on the outside of bend. Three optional locations for the junction with the San Joaquin River are shown in Figure 2-17 at approximately RM 209.8, RM 213.4, and RM 214.2. The North Canal would discharge into Fresno Slough approximately 1.8 river miles south of Mendota Dam.

Other aspects of the North Canal are the same as those described for the South Canal in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

Structures

The structures described below would be required to provide the operational flexibility to divert water to the Mendota Pool, provide fish passage, prevent fish entrainment and straying, and provide controlled elevation drop between Reach 2B and Reach 3.

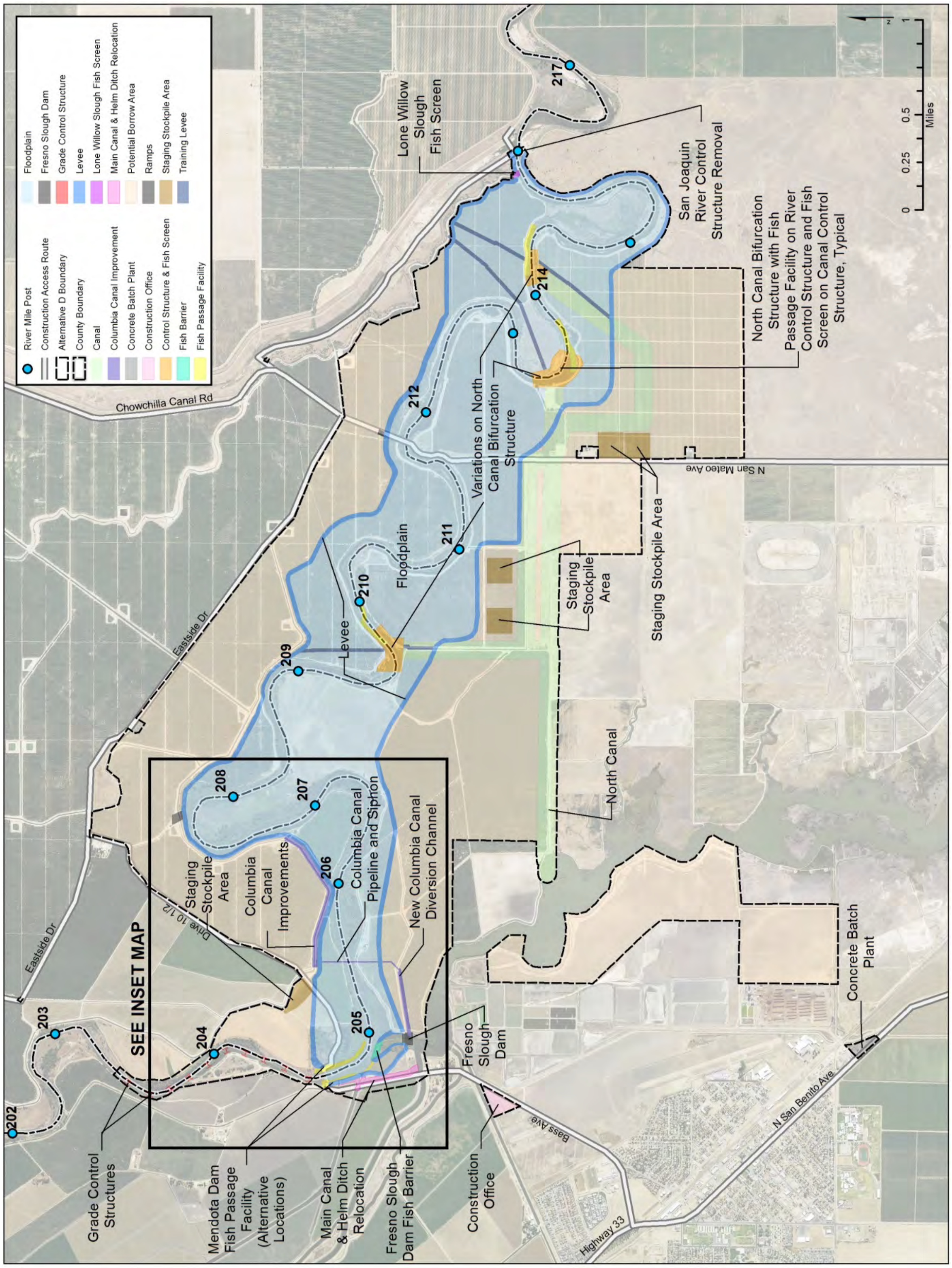


Figure 2-17.
Plan View of Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

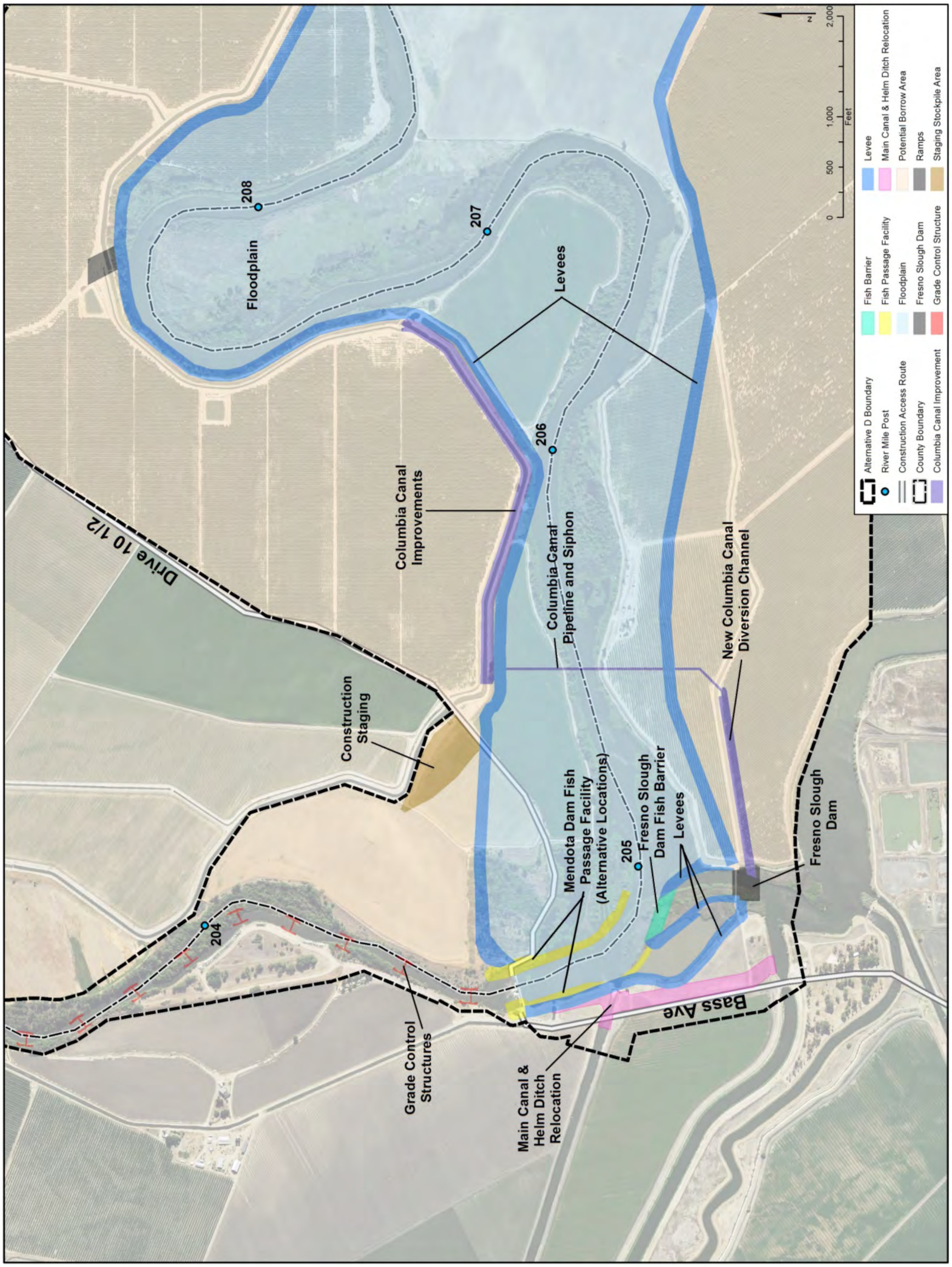


Figure 2-18.
Inset Map of Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

San Joaquin River Control Structure at the Chowchilla Bifurcation Structure Removal

The Chowchilla Bifurcation Structure consists of two control structures: one at the head of the Chowchilla Bypass and one across the San Joaquin River at RM 216. With the inclusion of a bifurcation structure at the head of the North Canal, a new control structure would be built across the San Joaquin River at the head of the canal. The new control structure would alleviate the need for the San Joaquin River control structure at the Chowchilla Bifurcation Structure because all diversions into the Chowchilla Bypass could be controlled from the new control structure at the head of the North Canal. As part of this alternative, the San Joaquin River control structure at the Chowchilla Bifurcation Structure would be demolished.

North Canal Bifurcation Structure

A bifurcation structure would be constructed at the upstream end of the North Canal. The bifurcation structure consists of two control structures: one across the path of Restoration Flows (San Joaquin River) and one across the path of water deliveries to Mendota Pool (North Canal). The North Canal bifurcation structure is the same as described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

North Canal Fish Passage Facility

The North Canal bifurcation structure would include a fish passage facility on the side of the control structure across the Restoration Flow path. The fish passage facility would be necessary to provide passage during water deliveries and for Restoration Flows where passage conditions through the control structure may not be ideal. The design of the fish passage facility is the same as that presented for the South Canal fish passage facility in Section 2.2.5.

North Canal Fish Screen

A fish screen would be included at the head of the North Canal where water deliveries would be diverted from the river. The fish screen would be necessary to keep or return out-migrating juvenile salmon to the San Joaquin River (the path of Restoration Flows) during water deliveries. The North Canal fish screen is the same as described for the South Canal in Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5.

San Mateo Avenue Crossing Removal

The San Mateo Avenue crossing is an existing river crossing located within a public right-of-way in Madera County and on private land in Fresno County at approximately RM 211.8. The crossing transitions from public right-of-way to private land at the center of the river. The crossing consists of a low flow or dip crossing with a single culvert. As part of this alternative, the culvert and road embankments would be demolished, and no river crossing would be provided at this location.

Fresno Slough Dam

The Fresno Slough Dam is the same as that described in Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) in Section 2.2.7.

Fresno Slough Dam Fish Barrier

The Fresno Slough Dam fish barrier is the same as that described in Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) in Section 2.2.7.

Mendota Dam Fish Passage Facilities

The Mendota Dam fish passage facilities are the same as described for the boards-out condition in Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) in Section 2.2.7.

Main Canal and Helm Ditch Relocations

The Main Canal and Helm Ditch relocations are the same as described in Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) in Section 2.2.7.

Removal of River Sediments

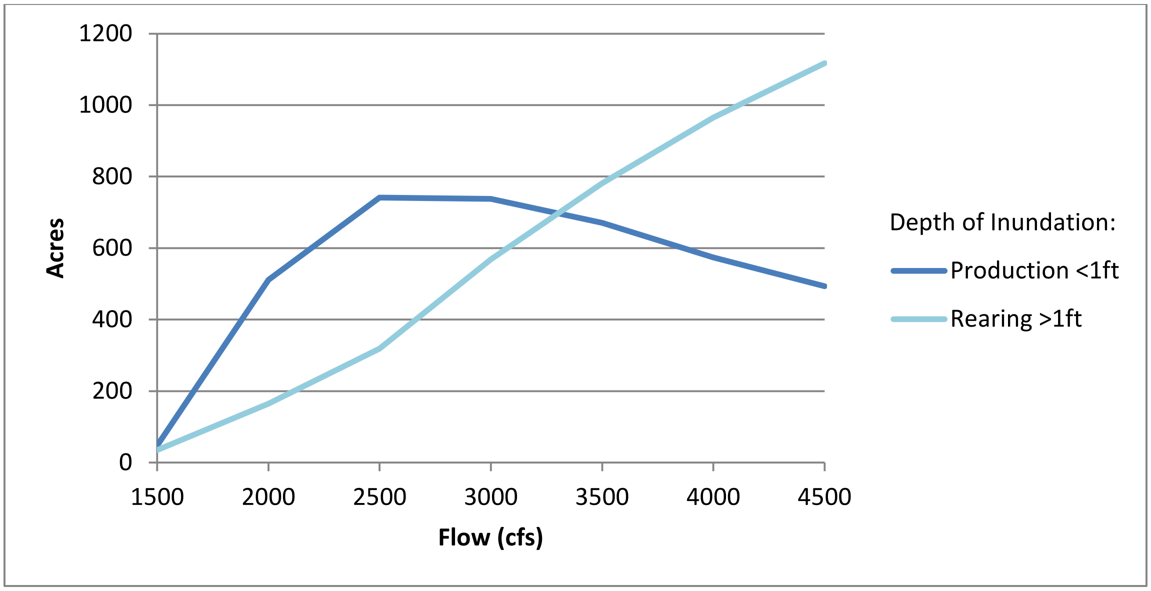
The removal of river sediment is the same as described in Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) in Section 2.2.7.

Fish Habitat and Passage

The purpose of the floodplain would be to provide riparian and floodplain habitat and support the migration and seasonal rearing of salmonids and other native fishes in Reach 2B. The floodplain has an average width of approximately 4,200 feet and an inundated area of approximately 1,050 acres at 2,500 cfs.

This alternative provides floodplain habitat resulting in approximately 750 acres of shallow water habitat for primary production as well as approximately 300 acres of habitat that supports direct rearing at 2,500 cfs. Approximately 70 percent of the floodplain in this alternative would inundate less than 1 foot deep at 2,500 cfs. This alternative also retains approximately 500 acres of shallow water habitat at flows up to 4,500 cfs.

Figure 2-19 below presents conceptual inundation areas for primary production and rearing habitats as they vary by flow. Inundation acreages may change during the design process.



Source: Tetra Tech 2012

Figure 2-19.
Potential Inundation Acreage by Flow for Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

This alternative includes several facilities that fish may encounter or need to pass to migrate between Reach 3 and Reach 2B (from downstream to upstream):

- An estimated two to four in-channel grade control structures below Mendota Dam.
- The sill of Mendota Dam.
- A fish barrier north of the Fresno Slough Dam.
- Four fish screen return outlets from the North Canal fish screen.
- A bifurcation control structure at the North Canal with fish passage facility.
- A fish screen near the upstream end of the North Canal.
- Fish screens at Lone Willow Slough, Big and Little Bertha pumps, and other smaller diversions (these screens are discussed in Section 2.2.4).

Each structure represents a potential stressor for adult salmon and potential predation site for juvenile salmon. However, each structure would be designed to perform according to the fish passage design criteria (see Section 2.2.4). In addition, the channel and floodplain incorporate riparian plantings to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to incorporate channel structure variability during detailed design, all of which may help to reduce stress and predation.

Floodplain and Riparian Habitat

Floodplain and riparian habitat restoration actions are similar to those described for Alternative A (Compact Bypass with Narrow Floodplain and South Canal) in Section 2.2.5 would be included in this alternative.

Water Deliveries

This alternative includes the North Canal for making up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. Water deliveries to the Pool would include diversion of Friant Dam releases that are meant to satisfy the Exchange Contract as well as diversion of San Joaquin River flood flows if there is demand in Mendota Pool.

When water deliveries occur, the gates at the North Canal bifurcation structure would be manipulated to control flows into the downstream river channel and allow flows into the North Canal. To create sufficient hydraulic head to allow water to flow into the canal, operation of the gates would include backwatering a small portion of the San Joaquin River upstream of the North Canal bifurcation structure. The extent of the backwater is anticipated to be small and dependent on the design slope of the canal. Up-migrating fish passage along Reach 2B would occur through the North Canal fish passage facility during water deliveries. The North Canal fish screen would capture out-migrating fish entering the diversion and return them to the river. Some flow in the downstream river channel would be maintained during water delivery operations during fish migration periods.

Construction Considerations

The total construction timeline for this alternative is currently estimated to range approximately from 97 to 158 months (8 to 13 years); opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process. The construction considerations are the same as described for Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal) in Section 2.2.7.

Summary

Table 2-6 summarizes the levees, relocations, land acquisition, and construction schedule associated with Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal) based on design, field, and evaluation criteria data prepared for the EIS/R.

Table 2-6.
Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)
Levees, Relocations, and Land Acquisition

	Left Levee		Right Levee
Levee Length	7.2 miles		6.6 miles
Average Levee Height	5.2 feet		4.2 feet
Fill Volume	272,000 cubic yards		188,250 cubic yards
Relocations			
Electrical Distribution	68,000 feet	Barn/Shed	1
Gas Transmission	11,500 feet	Facility	1
Water Pipeline	50,000 feet	Groundwater Well	32
Canal	56,000 feet	Lift Pump	10
Culvert	1	Power Pole	239
Diversion	3	Dwelling	2
Land Acquisition and Construction Schedule			
Land Acquisition[1]	3,300 acres		
Time to Build[2]	158 months		

[1] Total acreage includes areas that are sovereign and public trust lands.

[2] Construction timeline does not include the time that would also be needed to complete the NEPA and CEQA documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.2.9 Alternatives Comparison Tables

The table below (Table 2-7) combines the summary tables from Sections 2.2.5, 2.2.6, 2.2.7, and 2.2.8 in order to allow easy cross-comparison of the Action Alternatives.

Table 2-7.
Levees, Relocations, and Land Acquisition

	Alternative A	Alternative B	Alternative C	Alternative D
Levees				
Left Levee Length	8.7 miles	8.1 miles	7.7 miles	7.2 miles
Left Average Levee Height	5.8 feet	5.6 feet	5.6 feet	5.2 feet
Left Fill Volume	345,200 cubic yards	328,600 cubic yards	317,500 cubic yards	272,000 cubic yards
Right Levee Length	7.1 miles	6.8 miles	6.9 miles	6.6 miles
Right Average Levee Height	5.4 feet	4.7 feet	5.2 feet	4.2 feet
Right Fill Volume	269,700 cubic yards	226,900 cubic yards	224,500 cubic yards	188,250 cubic yards

Table 2-7.
Levees, Relocations, and Land Acquisition

	Alternative A	Alternative B	Alternative C	Alternative D
Relocations				
Electrical Distribution	43,500 feet	48,500 feet	48,000 feet	68,000 feet
Gas Transmission	10,000 feet	11,000 feet	9,000 feet	11,500 feet
Water Pipeline	31,000 feet	41,000 feet	33,000 feet	50,000 feet
Canal	32,500 feet	31,500 feet	32,500 feet	56,000 feet
Culvert	1	1	1	1
Diversion	3	3	3	3
Barn/Shed	1	1	1	1
Facility	1	1	1	1
Groundwater Well	26	32	25	32
Lift Pump	10	10	10	10
Power Pole	144	162	166	239
Dwelling	2	2	2	2
Land Acquisition and Construction Schedule				
Land Acquisition[1]	2,700 acres	2,900 acres	2,450 acres	3,300 acres
Time to Build[2]	132 months	157 months	133 months	158 months

[1] Total acreage includes areas that are sovereign and public trust lands.
[2] Construction timeline does not include the time that would also be needed to complete the NEPA and CEQA documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.2.10 Environmental Commitments

Environmental commitments are measures or practices adopted by a project proponent to reduce or avoid adverse effects that could otherwise result from project construction or operations. The following section describes additional environmental commitments that would be implemented with the Action Alternatives to avoid potentially adverse environmental consequences. These commitments are consistent with those commitments provided in the PEIS/R.

Conservation Strategy

As part of Program implementation, a comprehensive strategy for the conservation of listed and sensitive species and habitats has been prepared, and will be implemented in coordination with USFWS, NMFS, and DFW. The strategy's purpose is to serve as a tool built into the project description to minimize and avoid potential impacts to sensitive species and habitats. This Conservation Strategy guides development and implementation of specific conservation measures for project-level actions. The Conservation Strategy includes conservation goals and measures for species and communities (such as avoidance, minimization, monitoring, and management measures) consistent with adopted recovery plans, as described below. If avoidance and minimization measures are impractical or infeasible, then adaptive management measures would be pursued and developed in coordination with the appropriate regulatory agency.

To achieve the Restoration Goal, a number of actions that are proposed to be implemented may substantially alter not only the aquatic ecosystem of the San Joaquin River, but also the river's riparian and wetland ecosystems, and some adjacent upland ecosystems. Riparian, wetland, and upland ecosystems of the Central Valley, such as those along the San Joaquin River, provide habitat for a large number of species, including several Federally-listed and State-listed species. Therefore, the Action Alternatives include the Program's Conservation Strategy, which would be implemented in a manner that is consistent with adopted conservation plans for sensitive species, and for wetland and riparian ecosystems of the Restoration Area.

The Conservation Strategy consists of management actions that would result in a net benefit for riparian and wetland habitats in the Project area, to avoid reducing the long-term viability of sensitive species, and to be consistent with adopted conservation plans. The goals of the strategy are described below:

- **Conserve riparian vegetation and waters of the United States, including wetlands –** Project implementation would likely result in a net increase in the acreage of riparian and wetland vegetation in the Project area. However, several Project actions may disturb or eliminate riparian vegetation or waters of the United States (including wetlands). If impacts to waters of the United States (including wetlands), navigable waters, or the Federal levee system cannot be avoided, a Corps Section 404, Section 408, and/or Section 10 permit and Central Valley Regional Water Quality Control Board (RWQCB) Section 401 water quality certification would be obtained. Increased acreage of wetlands resulting from Interim and Restoration flows may be considered a means of replacing, restoring, or enhancing wetlands. However, the acreage, location, and methods of replacing, restoring, or enhancing wetlands would be determined during these permitting processes. The SJRRP has been actively working with resource agencies to further develop the Program's *Riparian Habitat Monitoring, Mitigation, and Management Plan*.
- **Control and manage invasive species –** Because of their adverse effects on aquatic and riparian ecosystems, the spread of invasive plant species as a result of Project would be controlled and managed. For each invasive plant species with known infestations, thresholds for management responses and specific management responses would be established and implemented (including species-specific control methods).
- **Conserve special-status species –** Populations of special-status species would benefit from restoring and sustaining riparian and wetland habitat, and controlling invasive species, as described previously. However, during construction-related activities, a variety of special-status species of upland, wetland, and riparian habitats could experience adverse effects. Therefore, the Conservation Strategy includes measures to prevent or reduce impacts that could result from loss of habitat within the Project footprint or from impacts on adjacent habitat or species.

In addition, this strategy includes coordination with appropriate regulatory agencies to provide mitigation or compensation, consistent with applicable conservation plans, to avoid or minimize effects when actions would result in a net loss of habitat or other substantial adverse effects, if the implementation of avoidance and minimization measures is infeasible or impractical.

These measures address all potentially affected Federally-listed and/or State-listed species, and all other species identified by USFWS, NMFS, or DFW as candidates, sensitive, or special-status in local or regional plans, policies, or regulations. For individual actions under each of the Action Alternatives, the applicable, feasible measures would guide development of action-specific conservation strategies. Table 2-8 presents the elements of the Program's Conservation Strategy as applicable to the Project. The measures presented here are the same as those presented in the PEIS/R (SJRRP 2011a, pages 2-55 to 2-79).

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
VELB		
VELB-1. Avoid and Minimize Effects to Species	If elderberry shrubs and valley elderberry longhorn beetle are anticipated within the project area, within 1 year before the commencement of ground-disturbing activities, a qualified biologist shall identify any elderberry shrubs in the project footprint. Qualified biologist(s) will survey potentially affected shrubs for valley elderberry longhorn beetle exit holes in stems greater than 1 inch in diameter. If elderberry shrubs are found on or adjacent to the construction project site, if feasible, a 100-foot-wide avoidance buffer – measured from the dripline of the plant – will be established around elderberry shrubs with stems greater than 1 inch in diameter at ground level and will be clearly identified in the field by staking, flagging, or fencing. No activities will occur within the buffer areas and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	USFWS
VELB -2. Compensate for Temporary or Permanent Loss of Habitat	The project proponent will consult with USFWS to determine appropriate compensation ratios. Compensatory mitigation measures will be consistent with the *Conservation Guidelines for Valley Elderberry Longhorn Beetle* (USFWS 1999a), or current guidance. Compensatory mitigation for adverse effects may include transplanting elderberry shrubs during the dormant season (November 1 to February 15), if feasible, to an area protected in perpetuity, as well as required additional elderberry and associated native plantings and approved by USFWS. If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the	USFWS

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	preservation of long-term viable populations.	
BNLL	**Blunt-Nosed Leopard Lizard**	
BNLL-1. Avoid and Minimize Effects to Species	Three areas have been identified as having potential blunt-nosed leopard lizard habitat based on aerial maps. These areas include approximately 2,460 acres along the southwest side of the San Joaquin River in Reach 2, approximately 490 acres in a portion of the Eastside Bypass and adjacent lands near Reach 4A of the San Joaquin River, and approximately 2,938 acres encompassing the northern side of the Mariposa Bypass and parcels north of the Mariposa Bypass and west of the Eastside Bypass. Within 1 year before the commencement of the proposed project, focused site visits and habitat assessment will be conducted on these lands. Based on focused assessment, and discussions with the USFWS and DFW, protocol-level surveys may be conducted. If blunt-nosed leopard lizard are detected within or adjacent to the project site, measures that will avoid direct take of this species will be developed in cooperation with USFWS and DFW and implemented before ground disturbing activities.	USFWS DFW
BNLL-2. Compensate for Temporary or Permanent Loss of Habitat or Species	Compensation for impacts to the species, if needed, will be determined in coordination with USFWS and DFW, as appropriate.	USFWS DFW
PLANTS	**Other Special-Status Plants**	
PLANTS-1. Avoid and Minimize Effects to Special-Status Plants	Within 1 year before the commencement of ground-disturbing activities, habitat assessment surveys for the special-status plants listed in Table 1 of Appendix L of the PEIS/R, “Biological Resources – Vegetation and Wildlife,” that are applicable to Reach 2B will be conducted by a qualified botanist, in accordance with the most recent USFWS and DFW guidelines and at the appropriate time of year when the target species would be in flower or otherwise clearly identifiable. Locations of special-status plant populations will be clearly identified in the field by staking, flagging, or fencing a minimum 100-foot-wide buffer around them before the commencement of activities that may cause disturbance. No activity shall occur within the buffer area, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. Some special-status plant species are annual plants, meaning that a plant completes its entire life cycle in one growing season. Other special-status plant species are perennial plants that return year after year until they reach full maturity. Because of the differences in plant life histories, all general conservation measures will be developed on a case-by-case basis and will include strategies that are species- and site-specific to avoid impacts to special-status plants.	USFWS DFW
GGS	**Giant Garter Snake**	
GGS-1. Avoid and Minimize Loss of Habitat	If giant garter snake habitat is anticipated to be present within the project area, preconstruction surveys will be completed by a qualified biologist approved by USFWS and DFW within a 24-hour period before	Reclamation USFWS DFW

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
for Giant Garter Snake	any ground disturbance of potential giant garter snake habitat. If construction activities stop on the project site for a period of 2 weeks or more, a new giant garter snake survey will be completed no more than 24 hours before the restart of construction activities. Avoidance of suitable giant garter snake habitat, as defined by USFWS (USFWS 1993) and DFW, will occur by demarcating and maintaining a 300-foot-wide buffer around these areas. For projects within potential giant garter snake habitat, all activity involving disturbance of potential giant garter snake habitat will be restricted to the period between May 1 and October 1, the active season for giant garter snakes. The construction site shall be re-inspected if a lapse in construction activity of 2 weeks or greater has occurred. Clearing will be confined to the minimal area necessary to facilitate construction activities. Giant garter snake habitat within or adjacent to the project will be flagged, staked, or fenced and designated as an Environmentally Sensitive Area. No activity shall occur within this area, and USFWS-approved worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. Construction activities shall be minimized within 200 feet of the banks of giant garter snake habitat. Movement of heavy equipment will be confined to existing roadways to minimize habitat disturbance. Vegetation shall be hand-cleared in areas where giant garter snakes are suspected to occur. Exclusionary fencing with one-way exit funnels shall be installed at least 1 month before activities to allow the species to passively leave the area and to prevent reentry into work zones, per USFWS and/or DFW guidance. If a giant garter snake is found during construction activities, USFWS, DFW, and the project's biological monitor will immediately be notified. The biological monitor, or his/her assignee, will stop construction in the vicinity of the find and allow the snake to leave on its own. The monitor will remain in the area for the remainder of the work day to ensure the snake is not harmed. Escape routes for giant garter snake should be determined in advance of construction and snakes will be allowed to leave on their own. If a giant garter snake does not leave on its own within 1 working day, USFWS and DFW will be consulted. All construction-related holes shall be covered to prevent entrapment of individuals. Where applicable, construction areas shall be dewatered 2 weeks before the start of activities to allow giant garter snakes and their prey to move out of the area before any disturbance.	
GGS-2. Compensate for Temporary or Permanent Loss of Habitat	Temporarily affected giant garter snake aquatic habitat will be restored in accordance with criteria listed in the USFWS Mitigation Criteria for Restoration and/or Replacement of Giant Garter Snake Habitat (Appendix A to *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake Within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California* (USFWS 1997)), or the most current criteria from USFWS or DFW. Permanent loss of giant garter snake habitat will be compensated at a	USFWS DFW

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	ratio and in a manner consulted on with USFWS and DFW. Compensation may include preservation and enhancement of existing populations, restoration or creation of suitable habitat, or purchase of credits at a regulatory-agency-approved mitigation bank in sufficient quantity to compensate for the effect. Credit purchases, land preservation, or land enhancement to minimize effects to giant garter snakes should occur geographically close to the impact area. If off-site compensation is chosen, it shall include dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, and the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	
WPT	**Western Pond Turtle**	
WPT-1. Avoid and Minimize Loss of Individuals	A qualified biologist will conduct surveys in aquatic habitats to be dewatered and/or filled during project construction. Surveys will be conducted immediately after dewatering and before fill of aquatic habitat suitable for western pond turtles. If western pond turtles are found, the biologist will capture them and move them to nearby USFWS- and/or DFW-approved areas of suitable habitat that will not be disturbed by project construction.	DFW
EAGLE	**Bald Eagle and Golden Eagle**	
EAGLE-1. Avoid and Minimize Effects to Bald and Golden Eagles (as Defined in the Bald and Golden Eagle Protection Act)	Surveys for bald and golden eagle nests will be conducted within 2 miles of any proposed project within areas supporting suitable nesting habitat and important eagle roost sites and foraging areas. These surveys will be conducted in accordance with the USFWS *Protocol for Evaluating Bald Eagle Habitat and Populations in California* and DFW *Bald Eagle Breeding Survey Instructions* or current guidance (*USFWS Draft Project Design Criteria and Guidance for Bald and Golden Eagles*). If an active eagle's nest is found, project disturbance will not occur within ½-mile of the active nest site during the breeding season (typically December 30 to July 1) or any project disturbance if it is shown to disturb the nesting birds. A no-disturbance buffer will be established around the nest site for construction activities in consultation with USFWS and DFW, and will depend on ecological factors, including topography, surrounding vegetation, nest height, and distance to foraging habitat, as well as the type and magnitude of disturbance. Project activity will not occur within the ½-mile-buffer areas, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	USFWS DFW
SWH	**Swainson's Hawk**	
SWH-1. Avoid and Minimize Impacts to Swainson's	Preconstruction surveys for active Swainson's hawk nests will be conducted in and around all potential nest trees within ½-mile of project-related disturbance (including construction-related traffic). These surveys will be conducted in accordance with *the Recommended*	DFW

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
Hawk	*Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley* (Swainson's Hawk Technical Advisory Committee 2000) or current guidance. If known or active nests are identified through preconstruction surveys or other means, a ½-mile no-disturbance buffer shall be established around all active nest sites if construction cannot be limited to occur outside the nesting season (February 15 through September 15). Worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	
SWH-2. Compensate for Loss of Nest Trees and Foraging Habitat	If foraging habitat for Swainson's hawk is removed in association with project implementation, foraging habitat compensation will occur in coordination with DFW. Foraging habitat mitigation may consist of planting and establishing alfalfa, row crops, pasture, or fallow fields. If potential nesting trees are to be removed during construction activities, removal will take place outside of Swainson's hawk nesting season, and the project proponent will develop a plan to replace known Swainson's hawk nest trees with a number of equivalent native trees that were previously determined to be impacts through consultation with DFW. Compensation shall include dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, and the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	DFW
RAPTOR	**Other Nesting Raptors**	
RAPTOR-1. Avoid and Minimize Loss of Individual Raptors	Construction activity, including vegetation removal, will only occur outside the typical breeding season for raptors (September 16 to December 31), if raptors are determined to be present. Preconstruction surveys will be conducted by a qualified biologist in areas of suitable habitat to identify active nests in the project footprint. If active nests are located in the project footprint, a no-disturbance buffer will be established until a qualified biologist determines that the nest is no longer active. The size of the buffer shall be established by a qualified biologist in coordination with DFW based on the sensitivity of the resource, the type of disturbance activity, and nesting stage. No activity shall occur within the buffer area, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	DFW
RAPTOR-2. Compensate for Loss of Nest Trees	Native trees removed during project activities will be replaced with an appropriate number of native trees, in coordination with DFW.	DFW
RNB	**Riparian Nesting Birds: Least Bell's Vireo**	
RNB-1. Avoid Effects to Species	If least Bell's vireo is anticipated within a project area, a qualified biologist shall make an initial site visit to determine if suitable habitat for the species may exist within the project footprint. Where suitable habitat may be present, reconnaissance-level surveys	USFWS DFW

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	would be conducted by biologists adhering to guidance offered in *Least Bell's Vireo Survey Guidelines*, USFWS, January 19, 2001.	
RNB-2. Avoid, Minimize, and Compensate for Effects to Species	If least Bell's vireo is detected or suspected to be present in the project footprint, information would be collected according to the guidelines stated in RNB-1. USFWS and DFW would be contacted to determine the approach for avoidance, minimization, or compensation.	USFWS DFW
MBTA	**Other Birds Protected by the Migratory Bird Treaty Act**	
MBTA-1. Avoid and Minimize Effects to Species	Native nesting birds will be avoided by not conducting project activity, including vegetation removal, during the typical breeding season (February 1 to September 1), if species covered under the Migratory Bird Treaty Act and Fish and Game Code sections 3503, 3503.5, and 3513 are determined to be present. An Avian Protection Plan shall be established in coordination with USFWS and DFW. Any overhead utility companies within the project area, whose lines, poles, or towers may be moved in association with the project, will also be consulted as part of the Avian Protection Plan.	USFWS DFW
BRO	**Burrowing Owl**	
BRO-1. Avoid Loss of Species	Preconstruction surveys for burrowing owls will be conducted in areas supporting potentially suitable habitat and within 30 days before the start of construction activities. If ground-disturbing activities are delayed or suspended for more than 30 days after the preconstruction survey, the site should be resurveyed. These surveys and mitigation will be conducted in accordance with the *Burrowing Owl Survey Protocol and Mitigation Guidelines* (The California Burrowing Owl Consortium 1993), or current guidance. Occupied burrows shall not be disturbed during the breeding season (February 1 through August 31). A minimum 160-foot-wide buffer shall be placed around occupied burrows during the nonbreeding season (September 1 through January 31), and a 250-foot-wide buffer shall be placed around occupied burrows during the breeding season. Ground-disturbing activities shall not occur within the designated buffers.	DFW
BRO-2. Minimize Impacts to Species	If a DFW-approved biologist can verify through noninvasive methods that owls have not begun egg-laying and incubation, or that juveniles from occupied burrows are foraging independently and are capable of independent survival, a plan shall be coordinated with DFW to offset burrow habitat and foraging areas on the project site if burrows and foraging areas are taken by SJRRP actions. Mitigation measures will be consistent with the *Staff Report on Burrowing Owl Mitigation* (DFW 2012), or current guidance. If destruction of occupied burrows occurs, existing unsuitable burrows should be enhanced (enlarged or cleared of debris) or new burrows created. This should be done in consultation with DFW. Passive owl relocation techniques must be implemented. Owls should be excluded from burrows in the immediate impact zone within a 160-foot-wide buffer zone by installing one-way doors in burrow entrances. These doors shall be in place at least 48 hours before excavation to insure the owls have departed. The project area shall be monitored daily for 1 week to confirm owl	DFW

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	departure from burrows before any ground-disturbing activities. Where possible, burrows should be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe should be inserted into the tunnels during excavation to maintain an escape route for any animals inside the burrow.	
BAT	**Special-Status Bats**	
BAT-1. Avoid and Minimize Loss of Species	If suitable roosting habitat for special-status bats will be affected by project construction (e.g., removal of buildings, modification of bridges), surveys for roosting bats on the project site will be conducted by a qualified biologist. The type of survey will depend on the condition of the potential roosting habitat and may include visual surveys or use of acoustic detectors. Visual surveys may consist of a daytime pedestrian survey for evidence of bat use (e.g., guano) and/or an evening emergence survey for the presence or absence of bats and will include trees within ¼-mile of project construction activities. The type of survey will depend on the condition of the potential roosting habitat. If no bat roosts are found, then no further study is required. If evidence of bat use is observed, the number and species of bats using the roost will be determined. Bat detectors may be used to supplement survey efforts. If roosts are determined to be present and must be removed, the bats will be excluded from the roosting site before the facility is removed. A mitigation program addressing compensation, exclusion methods, and roost removal procedures will be developed in consultation with DFW before implementation. Exclusion methods may include use of one-way doors at roost entrances (bats may leave, but not reenter), or sealing roost entrances when a site can be confirmed to contain no bats. Exclusion efforts may be restricted during periods of sensitive activity (e.g., during hibernation or while females in maternity colonies are nursing young).	DFW
BAT-2. Compensate for Loss of Habitat	The loss of each roost will be replaced, in consultation with DFW, and may include construction and installation of bat boxes suitable to the bat species and colony size excluded from the original roosting site. Roost replacement will be implemented before bats are excluded from the original roost sites. Once the replacement roosts are constructed and it is confirmed that bats are not present in the original roost sites, the structure may be removed.	DFW
FKR	**Fresno Kangaroo Rat**	
FKR-1. Avoid and Minimize Effects to Species	Preconstruction surveys will be conducted by a qualified biologist per USFWS and DFW survey methodology to determine if potential burrows for Fresno kangaroo rat are present in the project footprint. Surveys will be conducted within 30 days before ground-disturbing activities. The biologist will conduct burrow searches by systematically walking transects, which shall be adjusted based on vegetation height and topography, and in coordination with USFWS and DFW. Transects shall be used to identify the presence of kangaroo rat burrows. When burrows are found within 100 feet of the Project footprint, focused live trapping surveys shall be conducted by a qualified and permitted biologist, following a methodology approved in advance by USFWS and	USFWS DFW

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	DFW. Additional conservation measures may be developed pending the results of surveys, and in consultation with USFWS and DFW. Construction activities shall be conducted when they are least likely to affect the species (i.e., after the normal breeding season of December through September (Ahlborn 1999)). This timing shall be coordinated with USFWS and DFW.	
FKR-3. Compensate for Temporary or Permanent Loss of Habitat or Species	Compensation for impacts to the species, if needed, will be determined in coordination with DFW and USFWS, as appropriate.	USFWS DFW
SJKF	**San Joaquin Kit Fox**	
SJKF-1. Avoid and Minimize Effects to Species	A qualified biologist will conduct preconstruction surveys no less than 14 days and no more than 30 days before the commencement of activities to identify potential dens more than 5 inches in diameter. The project proponent shall implement USFWS' (1999b) *Standardized Recommendations for Protection of San Joaquin Kit Fox Prior to or During Ground Disturbance.* The project proponent will notify USFWS and DFW in writing of the results of the preconstruction survey within 30 days after these activities are completed. If dens are located within the proposed work area, and cannot be avoided during construction activities, a USFWS-approved biologist will determine if the dens are occupied. If occupied dens are present within the proposed work, their disturbance and destruction shall be avoided. Exclusion zones will be implemented following the latest USFWS procedures (currently USFWS 1999b). The project proponent will notify USFWS and DFW immediately if a natal or pupping den is found in the survey area. The project proponent will present the results of preactivity den searches within 5 days after these activities are completed and before the start of construction activities in the area. Construction activities shall be conducted when they are least likely to affect the species (i.e., after the normal breeding season of December–April (Ahlborn 2000)). This timing shall be coordinated with USFWS and DFW.	USFWS DFW
PL	**Pacific Lamprey**	
PL-1. Avoid and Minimize Effects to Species	A qualified biologist will conduct preconstruction surveys as outlined in Attachment A of USFWS' *Best Management Practices to Minimize Adverse Effects to Pacific Lamprey* (*Entosphenus tridentatus*) (2010). Work in documented areas of Pacific lamprey presence will be timed to avoid in-channel work during typical lamprey spawning (March 1 to July 1). If temporary dewatering in documented areas of lamprey presence is required for instream channel work, salvage methods shall be	USFWS

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	implemented to capture and move ammocoetes to a safe area, in consultation with USFWS.	
RHSNC	**Riparian Habitat and Other Sensitive Natural Communities**	
RHSNC-1. Avoid and Minimize Loss of Riparian Habitat and Other Sensitive Natural Communities	Biological surveys will be conducted to identify, map, and quantify riparian and other sensitive habitats in potential construction areas. Construction activities will be avoided in areas containing sensitive natural communities, as appropriate.	DFW
RHSNC-2. Compensate for Loss of Riparian Habitat and Other Sensitive Natural Communities	The Riparian Habitat Mitigation and Monitoring Plan for the SJRRP will be developed and implemented in coordination with DFW. Credits for increased acreage or improved ecological function or riparian and wetland habitats resulting from the implementation of SJRRP actions will be applied as compensatory mitigation before additional compensatory measures are required. If losses of other sensitive natural communities (e.g., recognized as sensitive by CNDDB, but not protected under other regulations or policies) would not be offset by the benefits of the SJRRP, then additional compensation will be provided through creating, restoring, or preserving in perpetuity in-kind communities at a sufficient ratio for no net loss of habitat function or acreage. The appropriate ratio will be determined in consultation with USFWS or DFW, depending on agency jurisdiction.	DFW
WUS	**Waters of the United States/Waters of the State**	
WUS-1. Identify and Quantify Wetlands and Other Waters of the United States	Before SJRRP actions that may affect waters of the United States or waters of the State, Reclamation will map the distribution of wetlands (including vernal pools and other seasonal wetlands) in the Eastside and Mariposa bypasses. The project proponent will determine, based on the mapped distribution of these wetlands and hydraulic modeling and field observation, the acreage of effects, if any, on waters of the United States. If it is determined that vernal pools or other seasonal wetlands will be affected by the SJRRP, the project proponent will conduct a delineation of waters of the United States, and submit the delineation to the Corps for verification. The delineation will be conducted according to methods established in the Corps *Wetlands Delineation Manual* and *Arid West Supplement* (Corps Environmental Laboratory 1987, 2008). Construction and modification of road crossings, control structures, fish barriers, fish passages, and other structures will be designed to minimize effects on waters of the United States and waters of the State, and will employ BMPs to avoid indirect effects on water quality.	Corps
WUS-2. Obtain Permits and Compensate for Any Loss of Wetlands and Other Waters of	The project proponent, in coordination with the Corps, will determine the acreage of effects on waters of the United States and waters of the State that will result from implementation of the SJRRP. The project proponent will adhere to a "no net loss" basis for the acreage of wetlands and other waters of the United States and waters of the State that will be removed and/or degraded. Wetland habitat will	Corps

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
the United States/Waters of the State	be restored, enhanced, and/or replaced at acreages and locations and by methods agreed on by the Corps and the Central Valley RWQCB, and DFW, as appropriate, depending on agency jurisdiction. The project proponent will obtain Section 404 and Section 401 permits and comply with all permit terms. The acreage, location, and methods for compensation will be determined during the Section 401 and Section 404 permitting processes. The compensation will be consistent with recommendations in the Fish and Wildlife Coordination Act Report (Appendix F of the PEIS/R).	
INV	**Invasive Plants**	
INV-1. Implement the Invasive Vegetation Monitoring and Management Plan	Reclamation will implement the Invasive Vegetation Monitoring and Management Plan for the SJRRP (Appendix L of the PEIS/R), which includes measures to monitor, control, and where possible eradicate, invasive plant infestations during flow releases and construction activities. The implementation of the Invasive Vegetation Monitoring and Management Plan (Appendix L of the PEIS/R) will include monitoring procedures, thresholds for management responses, success criteria, and adaptive management measures for controlling invasive plant species. The control of invasive weeds and other recommended actions in the Invasive Vegetation Monitoring and Management Plan (Appendix L of the PEIS/R) will be consistent with recommendations in the Fish and Wildlife Coordination Act Report (Appendix F of the PEIS/R).	Reclamation
CP	**Conservation Plans**	
CP-1. Remain Consistent with Approved Conservation Plans	Facility siting and construction activities will be conducted in a manner consistent with the goals and strategies of adopted habitat conservation plans, natural community conservation plans, or other approved local, regional, or State habitat conservation plans to the extent feasible. Coordination shall occur with USFWS and/or DFW, as appropriate.	USFWS DFW
CP-2. Compensate Effects Consistent with Approved Conservation Plans	The project proponent shall compensate effects consistent with applicable conservation plans and implement all applicable measures required by the plans.	USFWS DFW
GS	**Southern Distinct Population Segment of North American Green Sturgeon**	
GS-1. Avoid and Minimize Loss of Habitat And Individuals	The SJRRP will be operated in such a way that actions affecting green sturgeon habitat shall be done in accordance with existing operating criteria of the CVP and SWP, and prevailing and relevant laws, regulations, BOs, and court orders in place when the action(s) are performed.	NMFS
CVS	**Central Valley Steelhead**	
CVS-1. Avoid Loss of Habitat and Risk of	Impacts to habitat conditions (i.e., changes in flows potentially resulting in decreased flows in the tributaries, increases in temperature, increases in pollutant concentration, change in recirculation/recapture	NMFS

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
Take of Species	rates and methods, decrease in floodplain connectivity, removal of riparian vegetation, decreased in quality rearing habitat, etc.) must be analyzed in consultation with NMFS. The Hills Ferry Barrier will be operated and maintained to exclude Central Valley steelhead from the Restoration Area during construction activities and until suitable habitat conditions are restored. Maintenance of conservation measures will be conducted to the extent necessary to ensure that the overall long-term habitat effects of the project are positive. Before implementation of site-specific actions, the action agency shall conduct an education program for all agency and contracted employees relative to the Federally listed species that may be encountered within the study area of the action, and required practices for their avoidance and protection. A NMFS-appointed representative shall be identified to employees and contractors to ensure that questions regarding avoidance and protection measures are addressed in a timely manner. Disturbance of riparian vegetation will be avoided to the greatest extent practicable. A spill prevention plan will be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. In addition to a spill prevention plan, a cleanup protocol will be developed before construction begins and shall be implemented in case of a spill. Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, shall be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas. A qualified biological monitor will be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during construction initiation, midway through construction, and at the close of construction, to monitor implementation of conservation measures and water quality. The San Joaquin River channel shall be designed to decrease or eliminate predator holding habitat, in coordination with NMFS.	
CVS-2. Minimize Loss of Habitat and Risk of Take of Species	In-channel construction activities that could affect designated critical habitat for Central Valley steelhead will be limited to the low-flow period between June 1 and October 1 to minimize potential for adversely affecting Federally listed anadromous salmonids during their emigration period. In-channel construction activities that could affect designated critical habitat for Central Valley steelhead will be limited to daylight hours during weekdays, leaving a nighttime and weekend period of passage for Federally listed fish species. Construction BMPs for off-channel staging, and storage of equipment and vehicles, will be implemented to minimize the risk of contaminating the waters of the San Joaquin River by spilled materials. BMPs will also include minimization of erosion and stormwater runoff, as appropriate. Riparian vegetation removed or damaged will be replaced at a ratio, coordinated with NMFS, within the immediate area of the disturbance to	NMFS

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	maintain habitat quality. If individuals of listed species are observed present within a project area, NMFS must be notified. NMFS personnel shall have access to construction sites during construction, and following completion, to evaluate species presence and condition and/or habitat conditions. If bank stabilization activities should be necessary, then such stabilization shall be constructed to minimize predator habitat, minimize erosion potential, and contain material suitable for supporting riparian vegetation.	
SRCS	**Central Valley Spring-Run Chinook Salmon**	
SRCS-1. Avoid and Minimize Loss of Habitat and Individuals	The SJRRP will be operated in such a way that actions in the vicinity of spring-run Chinook salmon habitat shall be done in accordance with existing operating criteria of the CVP and SWP, and prevailing and relevant laws, regulations, BOs, and court orders in place at the time the actions are performed. SJRRP actions shall be performed in accordance with the Experimental Population 4(d) rule, as it is developed, and where applicable.	NMFS DFW
EFH	**Essential Fish Habitat (Pacific Salmonids)**	
EFH-1. Avoid Loss of Habitat and Risk of Take of Species	Impacts to habitat conditions (e.g., changes in flows potentially resulting in decreased flows in the tributaries, increases in temperature, increases in pollutant concentration, change in recirculation/recapture rates and methods, decrease in floodplain connectivity, removal of riparian vegetation, decreased in quality rearing habitat) must be analyzed in consultation with NMFS. The Hills Ferry Barrier will be operated and maintained to exclude Pacific salmonids from the Restoration Area during construction activities, and until suitable habitat conditions are restored. Under historical operations, the Hills Ferry Barrier is operated September through mid-December. The period of operation under this measure may vary from historical operations. Maintenance of conservation measures will be conducted to the extent necessary to ensure that the overall long-term habitat effects of the project are positive. Before implementation of site-specific actions, the action agency shall conduct an education program for all agency and contracted employees relative to the Federally listed species that may be encountered within the study area of the action, and required practices for their avoidance and protection. A NMFS-appointed representative shall be identified to employees and contractors to ensure that questions regarding avoidance and protection measures are addressed in a timely manner. Disturbance of riparian vegetation will be avoided to the greatest extent practicable. A spill prevention plan will be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. In addition to a spill prevention plan, a cleanup protocol will be developed before construction begins and shall	NMFS

Table 2-8.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	be implemented in case of a spill. Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, shall be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas. A qualified biological monitor will be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during construction initiation, midway through construction, and at the close of construction to monitor implementation of conservation measures and water quality. The bottom topography of the San Joaquin River channel will be designed to decrease or eliminate predator holding habitat.	
EFH-2. Minimize Loss of Habitat and Risk of Take from Implementation of Construction Activities	In-channel construction activities that could affect habitat for will be limited to the low-flow period between June 1 and October 1 to minimize potential for adversely affecting Federally listed anadromous salmonids during their emigration period. In-channel construction activities that could affect habitat for Pacific salmonids will be limited to daylight hours during weekdays, leaving a nighttime and weekend period of passage for Federally listed fish species. Construction BMPs for off-channel staging and storage of equipment and vehicles will be implemented to minimize the risk of contaminating the waters of the San Joaquin River by spilled materials. BMPs will also include minimization of erosion and stormwater runoff, as appropriate. Riparian vegetation removed or damaged will be replaced, as applicable, in accordance with the Riparian Habitat Monitoring Management and Mitigation Plan, and will be coordinated with the USFWS and NMFS and/or other agencies as appropriate. If individuals of listed species are observed present within a project area, NMFS must be notified. NMFS personnel shall have access to construction sites during construction and following completion to evaluate species presence and condition and/or habitat conditions. If bank stabilization activities should be necessary, then such stabilization shall be constructed to minimize predator habitat, minimize erosion potential, and contain material suitable for supporting riparian vegetation.	NMFS

Acronyms:
°C = degrees Celsius
°F = degrees Fahrenheit
BMP = best management practice
BO = Biological Opinion
CFR = Code of Federal Regulations
cfs = cubic feet per second
CNDDB = California Natural Diversity Database
Corps = U.S. Army Corps of Engineers
CVP = Central Valley Project
DFW = California Department of Fish and Wildlife
DWR = California Department of Water Resources
EPA = Federal Environmental Protection Agency
NMFS = National Marine Fisheries Service
PEIS/R = Program Environmental Impacts Statement/Report
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RWQCB = Regional Water Quality Control Board
Settlement = Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.*
SJRRP = San Joaquin River Restoration Program
State = State of California
SWP = State Water Project
USFWS = U.S. Fish and Wildlife Service

Minimize Flood Risk from Restoration Flows

The Program's strategy for minimizing flood risk is to limit the maximum downstream extent and rate of Restoration Flows for the given reach to then-existing channel capacities. This strategy is incorporated by reference from the PEIS/R (SJRRP 2011a, pages 2-22 through 2-28) and summarized here. These Program-wide commitments are documented in the PEIS/R Record of Decision (ROD). No new Project-level actions to minimize flood risk from Restoration Flows are being proposed.

Throughout Settlement implementation, the maximum downstream extent and rate of Restoration Flows to be released through a reach will be maintained at or below then-existing channel capacities. As channel or structure modifications are completed, maximum Restoration Flow releases will be correspondingly increased in accordance with then-existing channel capacities and with the release schedule. Consistent with the San Joaquin River Restoration Settlement Act, Interim Flows (2009-2014) were reduced, as needed, to address material seepage impacts, as identified through the monitoring program (see the Program's *Physical Monitoring and Management Plan* and *Seepage Management Plan* (PEIS/R Appendices D.1 and D.2, SJRRP 2011a)). If release of water from Friant Dam is required for flood control purposes, concurrent Restoration Flows will be reduced by an amount equivalent to the required flood control release. If flood control releases from Friant exceed the concurrent scheduled Restoration Flows, no additional releases above those required for flood control will be made for SJRRP purposes.

Then-existing channel capacities within the Restoration Area correspond to flows that would not significantly increase flood risk from Interim and Restoration flows in the Restoration Area (see the *Channel Capacity Report* (SJRRP 2015)). The action to release Restoration Flows includes measures that would achieve the following objectives: (1) commit Reclamation to implementing actions that would meet performance standards that minimize increases in flood risk as a result of Restoration Flows, (2) limit the release and conveyance of Restoration Flows to those flows that would remain in-channel until adequate data are available to apply the performance standards and until the performance standards are satisfied, and (3) enable the Settlement to be implemented in coordination with other ongoing and future actions outside of the Settlement that could address channel capacity issues identified in the Settlement or through the SJRRP or other programs. Implementation of measures that achieve these objectives will allow for the safe release and conveyance of Restoration Flows throughout the duration of Settlement implementation.

Reclamation will continue to implement the following three integrated measures that collectively minimize increases in flood risk as a result of Restoration Flows during Settlement implementation:

- **Establish a Channel Capacity Advisory Group and Determine and Update Estimates of Then-Existing Channel Capacities as Needed –** The establishment and administration of a Channel Capacity Advisory Group to provide independent review of estimated then-existing channel capacities, monitoring results, and management actions to address vegetation and sediment transport within the system as identified by Reclamation.

- **Maintain Restoration Flows at or Below Estimates of Then-Existing Channel Capacities –** The process for limiting Restoration Flows to reduce the risk of levee failure due to underseepage, through-seepage, and associated levee stability issues to less-than-significant levels.
- **Closely Monitor Erosion and Perform Maintenance and/or Reduce Restoration Flows as Necessary to Avoid Erosion-Related Impacts –** The commitment by Reclamation to implement erosion monitoring and management, including monitoring potential erosion sites, reducing Restoration Flows as necessary, and reporting ongoing results of monitoring and management actions to the Channel Capacity Advisory Group.

Only limited data are currently available on San Joaquin River channel capacities and levee conditions. The levee design criteria developed by the Corps and presented in *Design and Construction of Levees Engineering and Design Manual* (Manual No. 1110-2-1913) (Corps 2000a), *Slope Stability* (Manual No. 1110-2-1902) (Corps 2003), and *Design Guidance for Levee Underseepage* (Engineering Technical Letter No. 1110-2-569) (Corps 2005) will be applied throughout the Restoration Area to identify the Restoration Flows that would not cause the levee slope stability Factor of Safety to be reduced below 1.4, or the underseepage Factor of Safety to be reduced below the value corresponding to an exit gradient at the toe of the levee of 0.5. The levee slope stability Factor of Safety is defined as the ratio of available shear strength of the top stratum of the levee slope to the necessary shear strength to keep the slope stable (Corps 2003), and minimum levee slope stability factors of safety are given by the Corps levee criteria shown in Table 2-9. The application of the levee slope stability Factor of Safety of 1.4 is required for federally authorized flood control projects. Through-seepage is calculated as part of the slope stability analysis and does not have a separate Factor of Safety. The underseepage Factor of Safety is defined as a ratio of the critical hydraulic gradient to the actual exit gradient of seepage on the levee. Corps design guidance recommends that the allowable underseepage factor of safety for use in evaluations and/or design of seepage control measures should correspond to an exit gradient at the toe of the levee of 0.5 (in general, this would provide a Factor of Safety of 1.6), but states that deviation from recommended design guidance is acceptable when based and documented on sound engineering judgment and experience (Corps 2005).

Until adequate data are available to determine the Factor of Safety, Reclamation would limit the release of Interim and Restoration flows to those which would remain in-channel. In-channel flows are flows that maintain a water surface elevation at or below the elevation of the landside levee toe (i.e., the base of the levee). When sufficient data are available to determine the Factor of Safety, Reclamation will limit Restoration Flows to levels that would correspond to a Factor of Safety of 1.4 or higher and an underseepage Factor of Safety corresponding to an exit gradient at the toe of the levee of 0.5 or lower at all times. Observation of levee erosion, seepage, boils, impaired emergency levee access, or other indications of increased flood risk identified through ongoing monitoring at potential erosion sites would indicate that the minimum Factor of

Safety is not met and would trigger immediate reductions in Restoration Flows at the site. Such observations would supersede channel capacity estimates, and Restoration Flows will be reduced in areas where these conditions occur.

Table 2-9.
Minimum Factors of Safety - Levee Slope Stability

Type of Slope	Applicable Stability Conditions and Required Factors of Safety			
	End-of-Construction	Long-Term (Steady Seepage)	Rapid Drawdown[a]	Earthquake[b]
New Levees	1.3	1.4	1.0 to 1.2	(see below)
Existing Levees	--	1.4[c]	1.0 to 1.2	(see below)
Other Embankments and Dikes[d]	1.3[e,f]	1.4[c,f]	1.0 to 1.2[f]	(see below)

Source: U.S. Army Corps of Engineers 2000a. Design and Construction of Levees Engineering and Design Manual. Manual No. 1110-2-1913. April. Table 6-1b, page 6-5.

Notes:

[a] Sudden drawdown analyses. F. S. = 1.0 applies to pool levels prior to drawdown for conditions where these water levels are unlikely to persist for long periods preceding drawdown. F. S. = 1.2 applies to pool level, likely to persist for long periods prior to drawdown.

[b] See ER 1110-2-1806 for guidance. An EM for seismic stability analysis is under preparation.

[c] For existing slopes where either sliding or large deformation have occurred previously and back analyses have been performed to establish design shear strengths lower factors of safety may be used. In such cases probabilistic analyses may be useful in supporting the use of lower factors of safety for design.

[d] Includes slopes which are part of cofferdams, retention dikes, stockpiles, navigation channels, breakwater, river banks, and excavation slopes.

[e] Temporary excavated slopes are sometimes designed for only short-term stability with the knowledge that long-term stability is not adequate. In such cases higher factors of safety may be required for end-of-construction to ensure stability during the time the excavation is to remain open. Special care is required in design of temporary slopes, which do not have adequate stability for the long-term (steady seepage) condition.

[f] Lower factors of safety may be appropriate when the consequences of failure in terms of safety, environmental damage and economic losses are small.

Other Environmental Commitments

The Project proponents will implement the following measures to avoid potentially adverse environmental consequences. Many of these measures are consistent with those specified in the PEIS/R ROD.

Air Quality

- The Project proponents will comply with San Joaquin Valley Air Pollution Control District (SJVAPCD) Regulation VIII. Control measures will be implemented to reduce emissions of particulate matter (predominantly dust/dirt) generated by Project activities, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations. Control measures include phasing work to reduce the amount of surface area disturbed at any one time, applying water to the construction site to limit visual dust emissions, limiting the speed vehicles travel on unpaved access/haul roads, storing and handling bulk materials in such a manner that minimizes visual dust emissions, minimizing carryout and trackout of soils from unpaved surfaces to paved surfaces, and preparing and implementing a Dust Control Plan.

- The Project proponents will comply with SJVAPCD Rule 9510, “Indirect Source Review,” which requires on-site emission reducing design elements and/or the payment of fees that would be used to fund off-site emissions reduction projects. Construction emissions would be reduced onsite by using add-on controls, cleaner fuels, and/or newer lower-emissions equipment, as described in Chapter 4, “Air Quality.”
- The Project proponents will implement Mitigation Measures AQ-1A, AQ-1B, AQ-1C, AQ-2, AQ-3A, and AQ-3B, as described in Chapter 4.0, “Air Quality.” Implementation of these measures will reduce criteria exhaust emissions from construction equipment, reduce criteria exhaust emissions from material hauling vehicles, offset Project construction emissions through a SJVAPCD voluntary emission reduction agreement, reduce or offset Project emissions, reduce diesel particulate matter emissions from construction equipment, and reduce diesel particulate matter emissions from material hauling vehicles.

Cultural Resources

- The Project proponents will implement Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, CUL-1E, and CUL-2, as described in Chapter 9.0, “Cultural Resources.” With implementation of these measures, the Project proponents will comply with Section 106 of the NHPA or equivalent, conduct subsurface testing and/or archaeological monitoring in proximity to identified sites or areas of sensitivity, halt work in the event of an archaeological discovery, plan an intentional site burial preservation in place (where applicable), avoid soil borrowing in the vicinity of known archaeological resources, and follow the Secretary of the Interior’s standards for the treatment of historic properties.

Geology and Soils

- Site-specific geotechnical exploration, testing, and analysis will be conducted prior to final design to allow for the characterization of site soils and appropriate design of proposed structures with respect to potentially corrosive soils or subsidence conditions.
- Project proponents will prepare and implement a stormwater pollution prevention plan that complies with applicable Federal regulations concerning construction activities. (This measure is the same as GRW-1A and SQW-1.)
- Excavation of borrow materials will be done in accordance with Reclamation design standards, and comply with provisions of the Clean Water Act Section 402 and the National Pollutant Discharge Elimination System Construction General Permit.

Hydrology – Groundwater

- The Project proponents will implement Mitigation Measures GRW-1A and GRW-1B, as described in Chapter 13.0, “Hydrology – Groundwater.” With implementation of these measures, the Project proponents will prepare and implement a stormwater pollution prevention plan and a construction groundwater management plan.

Hydrology – Surface Water Resources and Water Quality

- The Project proponents will implement Mitigation Measures SWQ-1 and SWQ-3, as described in Chapter 14.0, “Hydrology – Surface Water Resources and Water Quality.” With implementation of these measures, the Project proponents will develop and implement a stormwater pollution prevention plan and minimize the use of pesticide and herbicide contaminated soil.

Land Use Planning and Agricultural Resources

- The Project proponents will implement Mitigation Measures LU-1, LU-2, LU-3, and LU-5, as described in Chapter 16.0, “Land Use Planning and Agricultural Resources.” With implementation of these measures, the Project proponents will preserve agricultural productivity of designated farmland to the extent possible, and notify County planning agencies of general plan and zoning ordinance inconsistencies.

Noise and Vibration

- The Project proponents will implement Mitigation Measures NOI-1, NOI-2, and NOI-3, as described in Chapter 17.0, “Noise and Vibration.” Implementation of these measures will reduce temporary and short-term noise levels from construction-related equipment near sensitive receptors, minimize vibration-related effects, and reduce temporary noise levels from construction-related traffic increases near sensitive receptors.

Paleontological Resources

- The Project proponents will implement Mitigation Measures PAL-1, as described in Chapter 18.0, “Paleontological Resources.” With implementation of these measures, the Project proponents will stop work if paleontological resources are encountered during earthmoving activities and implement a recovery plan.

Public Health and Hazardous Materials

- The Project proponents will comply with the California Environmental Protection Agency’s (Cal/EPA’s) Unified Program.
- The Project proponents will comply with Federal, State, and local hazardous materials regulations, as applicable, monitored by the State (e.g., California

Occupational Safety and Health Administration [Cal/OSHA], Department of Toxic Substances Control, California Highway Patrol) and/or local jurisdictions.

- Project proponents will adopt reasonable wildland fire safety strategies and have the firefighting equipment required by Cal/OSHA during all phases of construction.
- The Project proponents will implement Mitigation Measures HAZ-2A, HAZ-2B, HAZ-2C, HAZ-2D, HAZ-2E, HAZ-3, HAZ-4, HAZ-5, and HAZ-6, as described in Chapter 19.0, “Public Health and Hazardous Materials.” With implementation of these measures, the Project proponents will follow general hazardous materials guidelines, properly dispose of hazardous building components, properly dispose of pesticides, properly manage discolored or odiferous soils, properly remove underground storage tanks, minimize disturbance to known hazardous material sites, minimize use of pesticide and herbicide contaminated soil, minimize exposure to potential West Nile Virus carrying vectors, minimize exposure to potential Hantavirus vectors, minimize exposure to Valley Fever, and minimize the disturbance of idle or abandoned wells.

Recreation

- The Project proponents will implement Mitigation Measures REC-1 and REC-2, as described in Chapter 20.0, “Recreation.” With implementation of these measures, the Project proponents will minimize construction effects on recreation uses and establish boat portage facilities around Project facilities.

Transportation and Traffic

- The Project proponents will comply with Department of Motor Vehicles codes by requiring contractors and employees to be properly licensed and endorsed when operating commercial vehicles.
- The Project proponents will comply with California Vehicle Code section 35551 by enforcing compliance with weight restrictions on vehicles traveling on freeways and highways and by requiring heavy haulers to obtain permits, if required, prior to delivery of any heavy haul load.
- The Project proponents will comply with California Vehicle Code section 35780 by requiring heavy haulers to obtain a Single-Trip Transportation Permit prior to delivery of any oversized load.
- The Project proponents will coordinate with the California Department of Transportation (Caltrans) for relocation of any structures or fixtures necessary to telegraph, telephone, or electric power lines or of any ditches, pipes, drains, sewers, or underground structures located in the public rights-of-way.
- As required by the PEIS/R ROD, Project proponents will prepare and implement a traffic management plan that identifies the number of truck trips, time of day for arrival and departure of trucks, limits on number of truck trips, and traffic circulation control measures. Control measures typically include advertising planned lane closures, warning signage, a flag person to direct traffic flows when

needed, and methods for maintaining continued access by emergency vehicles. During project construction, access to existing land uses will be maintained at all times, with detours used as necessary during road closures. The traffic management plan will be submitted to the appropriate county public works, fire, police, and sheriff departments for comments.

- The Project proponents will implement Mitigation Measures TRA-4A and TRA-4B, as described in Chapter 22.0, "Transportation and Traffic." With implementation of these measures, the Project proponents will provide a temporary roadway and crossing at San Mateo Avenue and use construction sequencing to provide continuous emergency access at Drive 10 ½, where applicable.

Utilities and Service Systems

- As required by the PEIS/R ROD to minimize and avoid disruption of subsurface utilities from ground disturbing activities, Project proponents will (1) confirm the location of existing underground utilities, (2) coordinate with the owners of transmission lines and pipelines, (3) design restoration actions to avoid affecting underground facilities, if feasible, and (4) coordinate with the utility owner to shut off and relocate the utilities, as necessary.
- The location of public utilities will be confirmed and appropriate notifications will be made by contacting utility providers (e.g., power and communication utility service, and irrigation district service) who operate, maintain or own utilities in the Project area.
- Construction contractors will request an underground service alert from Underground Service Alert North in advance of earthmoving activities to locate and avoid underground utilities.
- Solid waste removed from the Project area will be disposed of in a permitted landfill. The operator of the recycling/disposal location will be notified and Project proponents will obtain approval for the type and amount of solid waste that will be generated.

Visual Resources

- The Project proponents will implement Mitigation Measures VIS-1 and VIS-6, as described in Chapter 24.0, "Visual Resources." With implementation of these measures, the Project proponents will minimize visual disruption from construction activities and conform to lighting standards, where applicable.

Permitting

Reclamation will obtain all necessary permits, as required by law. Implementation of the Project may require the permits and approvals described in Table 2-10. In general, Federal and State actions (permit issuance) will require a signed ROD (NEPA) and findings, EIR certification, and Notice of Determination (NOD) documents (CEQA). Additional information on permit acquisition procedures, submittal package requirements, critical issues, timing, and permit fees is discussed in the Project's Regulatory Compliance TM (SJRRP 2011b).

Table 2-10.
Summary of Permits and Approvals that May be Required for the Project

Agency and Associated Permit or Approval	Lead Agency for Submittal
Corps Clean Water Act Section 404 Individual Permit Rivers and Harbors Act Section 10 Permit Rivers and Harbors Act Section 14 Permit (Section 408) 33 Code of Federal Regulations 208.10	Reclamation
USFWS/NMFS Endangered Species Act Section 7 Consultation Magnuson-Stevens Fisheries Conservation and Management Act	Reclamation
USFWS Fish and Wildlife Coordination Act Report	USFWS/NMFS
SHPO/ACHP National Historic Preservation Act, Section 106	Reclamation
U.S. Coast Guard General Bridge Act and Rivers and Harbors Act Section 9	Reclamation
Central Valley RWQCB Clean Water Act Section 401 Water Quality Certification	Reclamation
SWRCB/Central Valley RWQCB Clean Water Act Section 402 Construction General Permit	Reclamation
SWRCB Amended water rights	Reclamation
CSLC Land Use Lease	Reclamation
SJVAPCD Air Impact Analysis Regulation VIII Dust Control Plan Federal Clean Air Act	Reclamation
Fresno/Madera Counties Williamson Act Contracts Land Use/Zoning	Reclamation

Key:
ACHP = Advisory Council on Historic Preservation
Central Valley RWQCB = Central Valley Regional Water Quality Control Board
Corps = U.S. Army Corps of Engineers
CSLC = California State Lands Commission
NMFS = National Marine Fisheries Service
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SHPO = State Historic Preservation Officer
SJVAPCD = San Joaquin Valley Air Pollution Control District
SWRCB = State Water Resources Control Board
USFWS = U.S. Fish and Wildlife Service

2.3 Alternatives Considered and Eliminated from Further Consideration

Formulation of a range of Project alternatives for inclusion in this EIS/R began with a review of Settlement provisions for achieving the Restoration and Water Management goals and the Settlement provisions for the Reach 2B and Mendota Pool Bypass components. This was followed by preparing the purpose, need, and objectives; developing criteria for including actions in the Project alternatives; defining planning and implementation constraints; and identifying related projects and opportunities associated with achieving the purpose and need. These steps were applied to actions identified in Settlement provisions and to comments received during the public scoping process to identify a range of alternatives to be addressed. As a result of this process, several potential actions were eliminated from consideration, and the reasonable range of initial alternatives was identified. This process and the alternatives eliminated from consideration are summarized here and described in greater detail in the Project Description TM, Attachment A – Initial Alternatives Evaluation (SJRRP 2012).

2.3.1 Pre-Initial Options Analysis

Pre-initial options analysis included concepts suggested during the Project scoping meetings and other concepts suggested within the Project team.

Some actions suggested during the scoping process and considered by the Project Team were retained for inclusion in the Project initial options, while others were not retained for inclusion because they would not meet the Project purposes, needs, goals, and objectives. The actions suggested during the scoping process, and associated screening information, are summarized below.

- Mitigation for flood impacts: No alterations to flood management operations or to the service level of existing flood control facilities (such as design capacity and levee stability) are included in the Project. Mitigation of flood risks not generated by the Project would be beyond the scope of the Project. Local flooding conditions would be improved through increased capacity within the channel and floodplain and improved levees. Alterations to existing flood control facilities (such as the Chowchilla Bifurcation Structure) would provide at least the same level of service as the existing features and would require no changes to operations.
- Evaluation and redesign of the Columbia-Mowry Distribution System including facility access, operations and maintenance, pumps, pipelines, and power: Modifications to existing canals, pumps, pipelines, access, and power are limited to those relocations necessary to construct the Project. The Project would not include evaluation or redesign of system components outside of those potentially impacted by the Project.
- No interruption of water deliveries: The Project goals and objectives include providing water deliveries up to 2,500 cfs within Reach 2B from the San Joaquin River to the Mendota Pool; however, the availability to provide the contracted water amounts from any particular source is beyond the scope of the Project.
- Acquire land to support recreation, tourism, flora, fauna, and groundwater recharge: The purpose of the Project does not include independently supporting recreation, tourism, flora (other than riparian habitat), fauna (other than salmon and other native fishes), or groundwater recharge, so land would not be acquired solely for these purposes. However, opportunities may exist to support these functions in conjunction with or incidental to implementation of the Project, and

land acquired to meet the Project purposes, needs, goals, and objectives may also benefit recreation, tourism, flora, fauna, and groundwater recharge.

- Shortening channel distance to reduce levee length and reduce maintenance costs: Shortening of the river channel or the bypass alignments would not meet the purpose and need of the Project and may cause considerable negative effects to habitat, geomorphology, and sediment continuity in the reach that would result from shortening, or straightening, the channel.
- Installing a cutoff channel before the river bends just downstream of the Chowchilla Bifurcation Structure to reduce flooding toward Hwy 180: No alterations to flood management operations are included in the Project, and mitigation for flood risks not generated by the Project would be beyond the scope of the Project. Local flooding conditions could be improved through increased capacity within the channel and floodplain and improved levees.
- Installing a wall across the river in Reach 3 just below Mendota Dam and diverting water to Mendota Pool: This action would not meet the purpose and need of the Settlement as it would not provide a bypass around the Pool.
- Allow salmon in the Pool and Chowchilla Bypass: The extent to which fish would enter or be screened out of the Chowchilla Bypass would be beyond the scope of the Project but will be considered as part of other Program actions. Fish screening upstream of Reach 2B diversions to Mendota Pool was included.
- Include provisions to allow for Mendota Dam maintenance: Maintenance of Mendota Dam as it relates to operating the Project is included (e.g., removing sediment to operate the Short Canal); however, general maintenance of the structure and its equipment is beyond the purpose, need, and scope of the Project.
- Avoid bifurcation of future flows (require all flows from Reach 2A to be conveyed to Reach 3): The Settlement requires Restoration Flows in Reach 2B and in downstream reaches, but it does not require flood conveyance in Reach 2B, and diversion of flood flows into the Chowchilla Bypass is required to meet existing flood operation guidelines. The flexibility to divert flows to Mendota Pool is also required to meet potential Exchange Contract water deliveries.
- Fish screens in Mendota Pool (instead of bypassing the Pool): This action would not meet the purpose and need of the Settlement as it would not provide a bypass around the Pool. In addition, the maintenance, reliability of fish screens for all Pool connections would not perform as well as other alternatives.
- Evaluate all alternatives that avoid impacts to wetlands: The extent of impact to existing wetlands was considered in the alternatives evaluation process.
- Avoid dredging or filling in waters of the United States: Filling in waters of the United States would be minimized to the extent possible and was considered in the alternatives evaluation process.
- Address effects of the Project on Milburn Pond: The Project does not affect Milburn Pond.

- Do not reintroduce salmon in order to protect existing riparian habitat: Existing riparian habitat was considered in the alternatives evaluation process. Not reintroducing salmon would be contrary to the Settlement.

Some additional options exist that were not part of the scoping process, but were also considered by the Project Team and not retained for inclusion in the Project initial options because they would not meet the Project purposes, needs, goals, and objectives. These include the following:

- Construction of levees to withstand a 200-year flood: Eliminated because existing levees in the Project area are not part of the Lower San Joaquin River Flood Control Project and providing 200-year flood protection is beyond the scope of the Project and would create secondary flood impacts upstream and downstream of the Project area.

2.3.2 Pre-Evaluation Screening

During the concept refinement phase of the Project, some of the initial options were revised, refined, or eliminated from further consideration. The concepts considered and eliminated from further consideration prior to the alternatives evaluation are described below. Many concepts were refined or revised during appraisal-level design before moving into the alternatives evaluation; those refinements are described in the Project Description TM Attachment A – Alternatives Evaluation Section 5.2 (SJRRP 2012).

Bottomless Arch Culverts

Bottomless arch culverts were considered in the Initial Options TM as a potential method of improving the crossing at San Mateo Avenue. However, based upon further consideration, bottomless arch culverts were found to be too difficult to implement in the sand bed channel of Reach 2B because the culverts would require substantial undercut for foundation work, the culverts would potentially require a concrete floor to stabilize the structures during high flows, and could have an unacceptable failure rate. In addition, less expensive and equally beneficial options are available (i.e., concrete box culverts).

Corrugated Metal Pipe Culverts

Corrugated metal pipe culverts were considered in the Initial Options TM as a potential method of improving the crossing at San Mateo Avenue. However, based upon further consideration, corrugated metal pipe culverts were found to be difficult to design for the fish passage requirements and they may have a shortened lifespan due to the corrosive nature of the soils in the Project area.

Bridge

A bridge was considered in the Initial Options TM as a potential type of crossing for the San Mateo Avenue crossing. However, based upon further consideration, both a box culvert crossing and a bridge crossing were found to be capable of meeting the fish passage requirements, but the bridge is significantly more expensive. Therefore, the bridge crossing was eliminated from further consideration.

Floodplain Vegetation Types

In the Initial Options TM, several floodplain vegetation types were considered: fully grassed floodplain, forested riparian fringe along the river with a grassed floodplain, and fully forested floodplain. Based upon further review during concept refinement, the floodplain vegetation concept used in the hydraulics modeling was revised to a mosaic type floodplain habitat including a forested riparian fringe along the river and a mixture of grasslands, scrub, and trees on the floodplain. The mosaic floodplain habitat was more typically found along the river historically and can be found in other parts of the San Joaquin Valley today.

Floodplain Recontouring

As part of the Initial Options development, recontouring of the entire floodplain to allow inundation of large areas at lower flows was considered. Based upon further review during concept refinement, this concept provided less or similar benefit as the select floodplain grading included in the Project alternatives. Wholesale recontouring would not increase the habitat diversity on the floodplain and thus would not provide increased benefits to fish. However, it would require excavation of much larger quantities of material and thus would increase costs. Wholesale recontouring also has the potential to decrease the area of inundation and cause erosion along the channel. Wholesale floodplain recontouring was therefore eliminated from further consideration.

Older Levee Setbacks

During concept refinement, the levee alignments presented in the Initial Options TM were refined and revised and one alignment was eliminated: Initial Option FP-1. Initial Option FP-1 was found to not sufficiently meet the Settlement requirements to provide floodplain and riparian habitat in Reach 2B. The other levee alignments were modified to account for property lines, field lines, infrastructure, flow and sediment continuity purposes, and to add a minimum 300-foot buffer, where appropriate, between the channel and levee to protect the levee from lateral channel migration and erosion.

Mendota Dam Removal

The Fisheries Management Workgroup asked the lead agencies to consider removing Mendota Dam as part of the Fresno Slough Dam Initial Alternative. Based upon further consideration and analysis, the lead agencies decided not to remove the dam because it provides a grade control point between Reach 3 and Reach 2B. Without the dam, the channel base level would be lowered and incision could migrate upstream through Reach 2B (Tetra Tech 2011). This could jeopardize passage conditions at the structures in the Project area such as at San Mateo Avenue and Chowchilla Bifurcation Structure where channel grades would potentially be lowered by up to approximately 4.7 feet and 1.9 feet, respectively, effectively relocating the grade-control point. Lowering the base-level would also eliminate overbank flow during all but the highest flows (Tetra Tech 2011). Furthermore, structural stability of existing and proposed structures could be compromised by the decreased bed elevations and resulting scour.

Floating Picket Weir

A floating picket weir was considered in the Initial Options TM as a potential method of providing a fish exclusion barrier at the downstream end of the Mendota Pool Bypass

Channel to direct fish into the Bypass. Based upon further consideration, this option was eliminated due to the magnitude of flows expected to be seen at the barrier location and this type of weir not being appropriate for such high flows.

Behavioral Barrier

Behavioral fish barriers were investigated during the appraisal-level design as a means of providing an exclusion/directional barrier at the downstream end of the Mendota Pool Bypass Channel to direct upmigrating adult salmon into the bypass channel and away from the base of Mendota Dam. A system to reroute irrigation flows from Mendota Dam to downstream of the barrier would be included with this concept, leaving slack water between the end of the bypass channel and the Dam. Behavioral barrier systems are a developing technology, but two main types of barriers have been implemented on other rivers: electric barriers and acoustic barriers. Both types of barriers have significant draw-backs for implementation in the Project.

Electric barriers generate an electric current through the water across a channel in order to deter fish. Based on existing and previous installations, electric barriers were found to present potential unavoidable electric shock hazards for fish (target and non-target species), other animals, people, and watercraft. Often target fish species either made it past the barrier or were killed. Velocities and depths need to be consistent for the barrier to be effective; something that has proven difficult on reaches with moveable beds and those with variable flows. Velocities also need to be sufficient to sweep stunned fish out of the barrier, which may be difficult in the low slope, low velocity Reach 3. Some programs are considering replacing their electric barriers with different technologies. For all these reasons, the electric barrier is not recommended.

Acoustic barriers use a sound signal contained in a bubble curtain of air to deter fish; acoustic barriers may also incorporate the use of strobes and lights to deter fish. There are few existing installations of acoustic barriers, but they have been found to be most effective on juvenile fish with minimal effectiveness on adult fish. Effectiveness has also been found to decrease with increasing flows. Acoustic barrier technology is not capable of functioning during high flows such as flood releases from Pine Flat routed down Fresno Slough into Reach 3 (typically at 4,500 cfs or reach capacity). These high flows occur on an average annual frequency of 1 in 5 years, typically in wet years. Since the purpose of the Mendota Pool Bypass Barrier is to direct adult migrating salmon into the bypass at all flows, including flood flows, the acoustic barrier is not recommended.

Velocity Barrier

Based on design and hydraulic analyses, a velocity barrier at the downstream end of the Mendota Pool Bypass Channel was eliminated from further consideration because the resulting barrier would be higher than Mendota Dam, would increase the elevation in Mendota Pool between 4 and 5 feet, and would necessitate improvements to all levees on Mendota Pool and Fresno Slough.

Other Types of Fish Screens

During the appraisal-level design several types of fish screens were reviewed for their applicability to the Project for screening fish from the 2,500 cfs diversion to Mendota

Pool. The following screen design types were eliminated from further consideration due to design constraints. Horizontal flat plate screens (patented by Farmers Irrigation District in Oregon) were eliminated because they are intended for use with smaller diversions (less than 100 cfs); there are no physical model studies or field applications demonstrating that this design is capable of handling larger diversions. Traveling screens were eliminated because maintenance is a significant problem, and there are no known field applications for diversions of the Project's size. Box screens were eliminated because, while they can be sized for larger applications, they function very similarly to cylindrical screens which were considered further. Pump screens were eliminated because they are only applicable to very small diversions (less than 10 cfs).

Pump Diversion to Mendota Pool

All the proposed alternatives divert water to Mendota Pool via gravity. During the appraisal-level design, a pump diversion was also considered and preliminary costs were developed. The pump diversion was eliminated from further consideration because the capital improvement costs are nearly four times the cost of the gravity diversions. In addition, the pump diversion would rely on Mendota Dam or another barrier to form a backwatered pool, so the pump diversion would not be able to eliminate the need for a fish passage structure.

2.3.3 Initial Alternatives Screening

Two floodplain initial alternatives and two bypass initial alternatives were included in the Project description based on their comparatively better performance in the alternatives evaluation. The included alternatives were FP-2 (now called the narrow floodplain), FP-4 (now called the wide floodplain), Compact Bypass, and Fresno Slough Dam. The results of the alternatives evaluation and the initial alternatives recommended for elimination are described in the Project Description TM Attachment A – Alternatives Evaluation Section 8.0 (SJRRP 2012).

Three initial alternatives were eliminated from consideration based on the evaluation results: FP-1, FP-5, and the Settlement Alignment. These initial alternatives were eliminated because they perform relatively poorly when compared to the other initial alternatives. The remaining initial alternatives (FP-2, FP-3, FP-4, Compact Alignment, and Fresno Slough Dam) provide a better balance between benefits and impacts.

FP-1 would result in a confined channel system with high velocities and scour along the corridor requiring expensive bank revetment. Vegetation could be difficult to establish, and water depths would often be too deep to provide effective floodplain rearing and primary production benefits. Based on the results of the evaluation, FP-1 performs poorly for several reasons:

- Relatively low amounts of rearing habitat.
- Poor quality shallow water habitat.
- Relatively high capital improvement costs.
- Relatively low amounts of restoration area.

- Relatively greater risk of channel instability.
- Relatively larger nuisance seepage impacts.

FP-5 would result in large areas too shallow and dry to provide effective floodplain rearing and primary production benefits. Based on the results of the evaluation, FP-5 performs poorly for several reasons:

- Poor quality shallow water habitat.
- Relatively high restoration and land costs.
- Relatively greater land removed from production.
- Limited additional fish habitat and passage benefits for the added costs.
- Potential for fish strandings.

The Settlement Alignment provides less habitat than the Compact Alignment but with higher costs and larger land requirements. Based on the results of the evaluation, the Settlement Alignment performs poorly for several reasons:

- No additional shallow water or rearing habitat.
- Relatively high capital improvement costs.
- Relatively less restoration area.
- Relatively greater risk of channel instability.
- Relatively greater land removed from production.

One option was recommended for elimination from consideration based on the evaluation results: Bend 10 Columbia Canal Relocation. This option was recommended for elimination because it performs relatively poorly when compared to the Bend 10 levee revetment, which provides a better balance between benefits and impacts.

Based on the results of the evaluation, the Bend 10 Columbia Canal Relocation option performs poorly for several reasons:

- Additional land acquisition is required.
- More land removed from production.
- Relatively greater environmental impacts.

3.0 Considerations for Describing the Affected Environment and Environmental Consequences

The Project study area is broadly defined to ensure evaluation of potential direct, indirect, and cumulative effects. The areas where direct, indirect, and cumulative effects may occur differ according to resource area; therefore, the geographic range described varies by resource. Resources are generally described in relatively more detail where direct effects may occur and in relatively less detail where indirect effects are anticipated. The information in this chapter was obtained from technical studies prepared by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation). Additional information was obtained from published environmental and planning documents, books, journals articles, websites, field surveys, and communications with technical experts. Descriptions of the affected environment are organized geographically.

3.1 Study Area

The study area for this Environmental Impact Statement/Report (EIS/R) includes areas that may be affected directly, indirectly, or cumulatively by implementing Project alternatives. The study area has been broadly defined to ensure evaluation of potential effects within the following geographic subareas:

- Upstream reaches (e.g., Reach 2A).
- Reach 2B, Downstream reaches (e.g., Reach 3).
- Chowchilla Bypass.
- Delta-Mendota Canal.
- Mendota Pool.
- Fresno Slough.

Operational impacts could result in these geographic subareas under the Project alternatives. Construction-related impacts would result in the Project area under the Project alternatives. Construction-related impacts would not result in other geographic subareas. The geographic subareas are described briefly below.

3.1.1 Reach 2

Reach 2 begins at Gravelly Ford and extends approximately 24 miles downstream to the Mendota Pool, continuing the boundary between Fresno and Madera counties. This reach is a meandering, low-gradient channel. Reach 2 is subdivided at the Chowchilla Bifurcation Structure into two subreaches, Reach 2A (upstream) and Reach 2B (downstream). Except for the area backwatered by Mendota Dam, prior to Interim Flows, both Reach 2A and Reach 2B were dry in most months. Reach 2A is subject to extensive seepage losses. Reach 2B is a sandy channel with limited conveyance capacity.

3.1.2 Reach 3

Reach 3 begins at Mendota Dam and extends approximately 23 miles downstream to Sack Dam. Reach 3 conveys flows of up to 800 cubic feet per second (cfs) from the Mendota Pool for diversion to the Arroyo Canal at Sack Dam, maintaining year-round flow in a meandering channel with a sandy bed. Flood flows from the Kings River are conveyed to Reach 3 via Fresno Slough and Mendota Dam. This reach continues the boundary between Fresno and Madera counties. The sandy channel meanders through a predominantly agricultural area, and diversion structures are common in this reach.

3.1.3 Chowchilla Bypass

The Chowchilla Bifurcation Structure at the head of Reach 2B regulates the flow split between the San Joaquin River and the Chowchilla Bypass. The Chowchilla Bifurcation Structure consists of two control structures: one at the head of the Chowchilla Bypass and one across the San Joaquin River at RM 216 (see Figure 3-1). The structure is operated depending on flows in the San Joaquin River, flows from the Kings River system via Fresno Slough, water demands in Mendota Pool, and seasonality. Tributaries to the Chowchilla Bypass include the Fresno River and Berenda Slough. The Chowchilla Bypass extends to the confluence of Ash Slough, which marks the beginning of the Eastside Bypass.

3.1.4 Delta-Mendota Canal

The Delta-Mendota Canal conveys water from the Jones Pumping Plant in the south Delta to agricultural lands in the San Joaquin Valley. Water not delivered directly from the Delta-Mendota Canal is diverted at the O’Neill Pumping Plant and O’Neill Forebay for delivery via the San Luis Canal to Central Valley Project (CVP) contractors in the San Joaquin Valley, or to storage in San Luis Reservoir for later use. Most of the rest of the water continues to the south Central Valley, with some water diverted to Santa Clara County.

3.1.5 Mendota Pool

Mendota Pool is the reservoir created by Mendota Dam and has both a San Joaquin River arm and a Fresno Slough arm (see Figure 3-2). The San Joaquin arm of Mendota Pool is the portion of Reach 2B that extends from Mendota Dam to the San Mateo Avenue crossing. The Fresno Slough arm of Mendota Pool extends several miles south of the San Joaquin River. The pool serves as a distribution point for irrigation water supplies delivered by the Delta-Mendota Canal and for refuge water supply to the Mendota Wildlife Area. Mendota Pool provides no long-term storage for water supply operations or flood management.

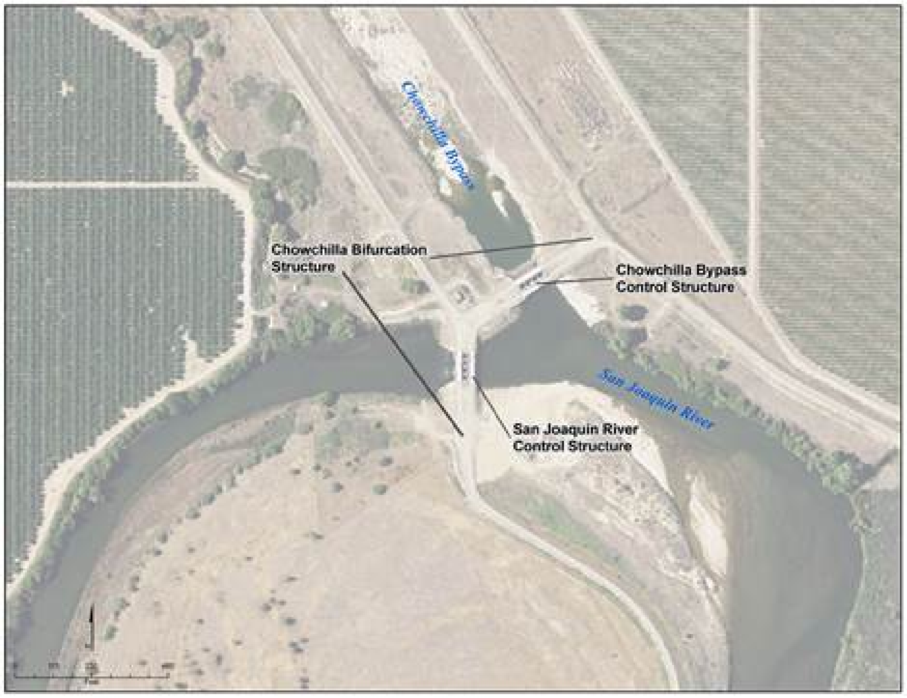


Figure 3-1.
Chowchilla Bifurcation Structure

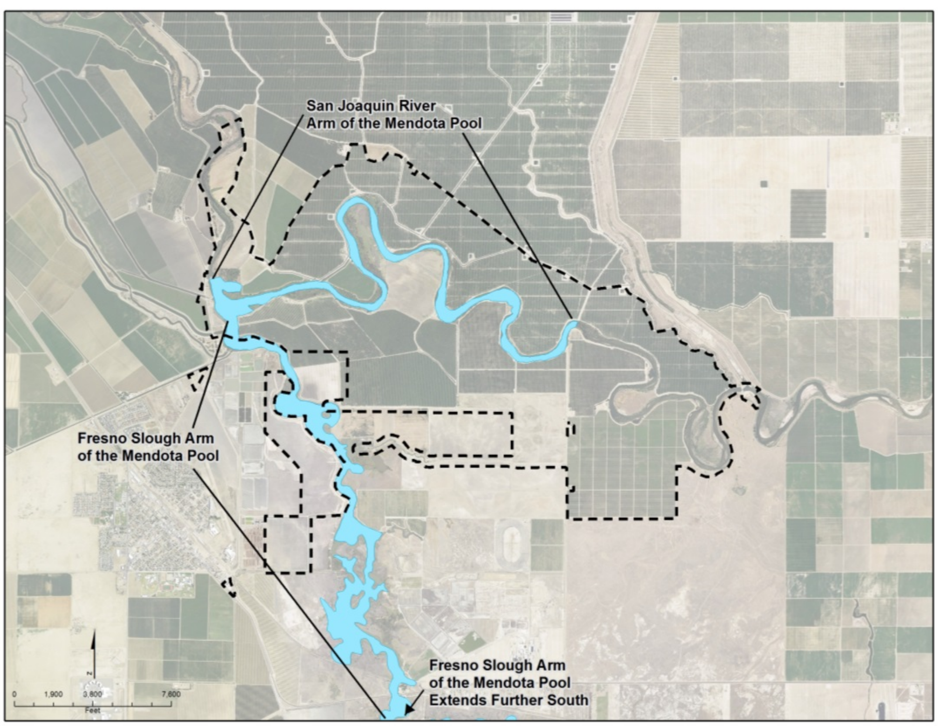


Figure 3-2.
Mendota Pool

Mendota Pool delivers water to the San Joaquin River Exchange Contractors Water Authority, other CVP contractors, wildlife refuges and management areas, and State water contractors. Water delivered to Mendota Pool from the Delta-Mendota Canal is withdrawn at seven canal or pump locations in the pool, leaving about 500 cfs to be discharged down the San Joaquin River for delivery to the Arroyo Canal, which is located about 23 miles downstream from Mendota Dam.

3.1.6 Fresno Slough

Fresno Slough is a distributary of the North Fork of the Kings River and is an intermittent stream that flows northwesterly to the San Joaquin River. James Bypass is a constructed channel that bypasses a portion of Fresno Slough. Flows in the North Fork of the Kings River consist primarily of flood releases from Pine Flat Dam located about 55 miles to the east of the confluence of Fresno Slough and the San Joaquin River. Kings River flood flows can enter Mendota Pool via Fresno Slough/James Bypass. Flows from the Kings River are regulated by Pine Flat Dam releases and the Crescent Weir.

3.2 Chapter Contents and Definition of Terms

Chapters 4.0 through 24.0 include the environmental and regulatory setting for 21 resource topics, as well as discussions of methods, significance criteria, environmental impacts, and mitigation measures for direct and indirect impacts, organized by resource topic. Chapter 25.0 discusses cumulative effects, Chapter 26.0 discusses other disclosures required by National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), including the Mitigation Monitoring and Reporting Program (MMRP). The NEPA/CEQA requirements are summarized in the following subsection, followed by an overview of the content of Chapters 4.0 through 24.0.

3.2.1 NEPA and CEQA Requirements

The NEPA/CEQA requirements for the environmental setting and consequences sections are similar, but not identical. These requirements are summarized below. This section also presents the organization and general assumptions used in the environmental analysis contained in this EIS/R. The reader is referred to the individual technical sections regarding specific assumptions, methodology, and significance criteria (thresholds of significance) used in the analyses.

Environmental Setting

Council on Environmental Quality (CEQ) Regulations specify that an Environmental Impact Statement (EIS) “shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of an impact, with less important material summarized, consolidated, or simply referenced” (40 Code of Federal Regulations [CFR] 1502.15).

Section 15125, subdivision (a) of the State CEQA Guidelines states an Environmental Impact Report (EIR) “must include a description of the physical environment conditions in the vicinity of the project, as they exist at the time that the notice of preparation is published, or if no notice of preparation is published, at the time the environmental analysis is commenced, from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which the lead agency determines whether an impact is significant. The description of the environmental setting shall be no longer than is necessary to an understanding of the significant effects of the proposed project and its alternatives."

Environmental Consequences

The CEQ Regulations specify that a Federal agency preparing an EIS must consider the effects of the proposed action and alternatives on the environment; these include effects on ecological, aesthetic, historical, and cultural resources and economic, social, and health effects. Environmental effects are categorized as direct, indirect, and cumulative effects (defined below in Section 3.3.3). An EIS must also discuss possible conflicts with the objectives of Federal, State, regional, and local land use plans, policies, and controls for the area concerned; energy requirements and conservation potential; urban quality; the relationship between short-term uses of the environment and long-term productivity; and irreversible or irretrievable commitments of resources. An EIS must identify relevant, reasonable mitigation measures that are not already included in the proposed action or alternatives to the proposed action that could avoid, minimize, rectify, reduce, eliminate, or compensate for the project's adverse environmental effects (40 CFR 1502.14, 1502.16, 1508.8).

The State CEQA Guidelines explain that the environmental analysis for an EIR must evaluate impacts associated with the project and identify mitigation for any potentially significant impacts. All phases of a proposed project, including development and operation, are evaluated in the analysis. Section 15126.2, subdivision a, of the State CEQA Guidelines states in part:

> *An EIR shall identify and focus on the significant environmental effects of the proposed project. In assessing the impact of a proposed project on the environment, the Lead Agency should normally limit its examination to changes in the existing physical conditions in the affected area as they exist at the time the notice of preparation is published, or where no notice of preparation is published, at the time environmental analysis is commenced. Direct and indirect significant effects of the project on the environment shall be clearly identified and described, giving due consideration to both the short-term and long-term effects. The discussion should include relevant specifics of the area, the resources involved, physical changes, alterations to ecological systems, and changes induced in population distribution, population concentration, the human use of the land (including commercial and residential development), health and safety problems caused by the physical changes, and other aspects of the resource base such as water, historical resources, scenic quality, and public services. The EIR shall also analyze any significant environmental effects the*

project might cause by bringing development and people into the area affected…

An EIR must also discuss inconsistencies between the proposed project and applicable general plans, specific plans, and regional plans (State CEQA Guidelines, § 15125, subd. (d)). An EIR must describe feasible measures that could minimize significant adverse impacts, and the measures must be fully enforceable through permit conditions, agreements, or other legally-binding instruments (State CEQA Guidelines, § 15126.4, subds. (a)(1) & (a)(2)). Mitigation measures are not required for effects that are found to be less than significant (State CEQA Guidelines, § 15126.4, subd. (a)(3)); however, this does not preclude a CEQA lead agency from adopting such mitigation measures as long as the mitigation measures are consistent with all applicable constitutional requirements as specified in State CEQA Guidelines section 15126.4, subdivision (a)(4). Mitigation measures related to historic resources and greenhouse gas (GHG) emissions are discussed in State CEQA Guidelines section 15126.4, subdivisions (b) and (c), respectively.

For Chapters 4.0 through 24.0, an "Impact Assessment Methodology" subsection is provided. This subsection describes the methods, processes, procedures, and/or assumptions used to formulate and conduct the impact analysis for each specific resource topic.

3.2.2 Significance Criteria

Significance criteria (or "thresholds of significance") are used to define the level at which an impact would be considered significant in accordance with CEQA. The thresholds applied in this joint NEPA/CEQA document encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and intensity of its effects, and also meet the more specific requirements of CEQA for significance thresholds.

Thresholds may be quantitative or qualitative; they may be based on agency or professional standards or on legislative or regulatory requirements that are relevant to the impact analysis. Generally, however, thresholds of significance are derived from Appendix G of the State CEQA Guidelines, as amended, and NEPA, where defined. Significance criteria used in this EIS/R are based on the checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, regional, and local agencies. These thresholds also include the factors taken into account under NEPA to determine the significance of the action in terms of the context and the intensity of its effects.

An environmental document prepared to comply with CEQA must identify the significance of the environmental effects of a proposed project. Therefore, for each effect (impact), a conclusion is provided regarding its significance. A "'significant effect on the environment' means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project…" (State CEQA Guidelines, § 15382).

3.2.3 Impact Comparisons and Definitions

Under CEQA, the environmental analysis compares the alternatives under consideration, including the No-Project Alternative (referred to in this EIS/R as the No-Action Alternative), to existing conditions, defined at the time when the Notice of Preparation was published (July 13, 2009). Under NEPA, the effects of the alternatives under consideration, including the No-Action Alternative, are determined by comparing effects between alternatives and against effects from the No-Action Alternative. Consequently, baseline conditions differ between NEPA and CEQA. Under NEPA, the No-Action Alternative (i.e., expected future conditions without the project) is the baseline to which the Action Alternatives are compared, and the No-Action Alternative is compared to existing conditions. Under CEQA, existing conditions are the baseline to which all alternatives are compared.

Project impacts fall into the following categories:

- A **temporary impact** would occur only during construction. The environmental analysis addresses potentially significant impacts from the direct impact of construction at the project site, direct impact associated with site development, and indirect construction impacts associated with fill and wetland construction activities, construction traffic, etc.
- A **short-term impact** would last from the time construction ceases to within 3 years following construction.
- A **long-term impact** would last longer than 3 years following construction. In some cases, a long-term impact could be considered a permanent impact.
- A **direct impact** is an impact that would be caused by an action and would occur at the same time and place as the action.
- An **indirect impact** is an impact that would be caused by an action but would occur later in time, or at a distance that is removed from the project area (e.g., growth-inducing effects and other changes related to changes in land use patterns, and related effects on the physical environment), yet is reasonably foreseeable in the future.
- A **residual impact** is an impact that would remain after the application of mitigation.
- A **cumulative impact** is an impact taken together with other past, present, and probable future projects producing related impacts, or when two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. A cumulative impact occurs from the change in the environment which results from the incremental impact of a project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time. Cumulative impacts are discussed in Chapter 25.0, "Cumulative Impacts."

Impacts (and associated mitigation measures as necessary) are listed numerically and sequentially throughout each section. A statement summarizing the impact precedes the discussion of each impact. The discussion that follows the summary statement includes the analysis on which a conclusion is based regarding the significance of the impact. If the discussion is succinct, it is included in its entirety in the summary statement, and is not provided separately.

3.2.4 Impact Levels

This EIS/R uses the following terminology based on CEQA to denote the significance of each environmental effect (impact), and includes consideration of the "context" of the action and the "intensity" (severity) of its effects in accordance with NEPA guidance (40 CFR 1508.27) (CEQ Regulations for implementing NEPA do not require significance determinations):

- **No impact** indicates that the construction, operation, and maintenance of the action alternatives would not have any direct or indirect impacts on the environment. It means that no change from existing conditions would result. This impact level does not require mitigation.
- A **beneficial effect** is one that would result in a beneficial change in the physical environment. This impact level does not require mitigation.
- **A less-than-significant impact** is one that would not result in a substantial or potentially substantial adverse change in the physical environment. This impact level does not require mitigation, even if applicable measures are available, under CEQA.
- A **significant impact** is defined by CEQA as one that would cause "a substantial, or potentially substantial, adverse change in the environment" (Pub. Resources Code, § 21068). Levels of significance can vary by alternative, based on the setting and the nature of the change in the existing physical condition. Under CEQA, mitigation measures or alternatives to the proposed action must be provided, where applicable, to avoid or reduce the magnitude of significant impacts.
- A **potentially significant impact** is one that, if it were to occur, would be considered a significant impact as described above; however, the occurrence of the impact cannot be immediately determined with certainty. For CEQA purposes, a potentially significant impact is treated as if it were a significant impact. Therefore, under CEQA, mitigation measures or alternatives to the proposed action must be provided, where necessary and applicable, to avoid or reduce the magnitude of significant impacts.
- An impact may have a level of significance that is too uncertain to be reasonably determined, which would be designated **too speculative for evaluation**, in accordance with State CEQA Guidelines section 15145. Where some degree of evidence points to the reasonable potential for a significant effect, the EIS/R may explain that a determination of significance is uncertain, but is still assumed to be "potentially significant," as described above. In other circumstances, after thorough investigation, the determination of significance may still be too

speculative to be meaningful. This is an effect for which the degree of significance cannot be determined for specific reasons, such as because aspects of the impact itself are either unpredictable or the severity of consequences cannot be known at this time.

3.2.5 Mitigation Measures

Mitigation measures are presented, where feasible, to avoid, minimize, rectify, reduce, or compensate for significant and potentially significant impacts of the Action Alternatives, in accordance with the State CEQA Guidelines section 15126.4 and NEPA regulations (40 CFR 1508.20). Mitigation measures are not required for impacts identified under the No-Action Alternative because approving agencies would not be required to obtain permits or agreements if the agencies chose not to approve the project. For these reasons, mitigation measures are not provided for the No-Action Alternative even if significant impacts may result. Furthermore, no mitigation measures are proposed when an impact conclusion is "**less than significant**," "**no impact**," or "**beneficial**."

Mitigation measures are identified for project-level actions. Mitigation measures are presented in their entirety for significant and potentially significant project-level impacts and, in accordance with section 15126.4 of the State CEQA Guidelines, are fully enforceable through permit conditions, agreements, or other legally-binding instruments.

Section 15370 of the State CEQA Guidelines defines mitigation as follows:

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensating for the impact by replacing or providing substitute resources or environments.

In accordance with Public Resources Code section 21081.6, subdivision (a), if a State agency approves the project actions, that agency would adopt a reporting or monitoring program at the time that it makes its CEQA findings. The purpose of the MMRP (see Chapter 26.0) is to ensure that the mitigation measures adopted as part of project approval would be complied with during project construction and implementation. The MMRP would identify each of the mitigation measures for project-level actions, and describe the party responsible for monitoring (Reclamation, California State Lands Commission, or other, as appropriate), the time frame for implementation, and the program for monitoring compliance.

3.2.6 Significance After Mitigation

For each significant and potentially significant impact, following the presentation of proposed mitigation measures, the significance of the impact after mitigation is stated.

Where sufficient feasible mitigation is not available to reduce impacts to a less-than-significant level, the impacts are identified as “significant and unavoidable.” Under State CEQA Guidelines section 15091, subdivision (a), a public agency cannot approve or carry out a project for which an EIR has been certified which identifies one or more significant environmental effects of the project unless the public agency makes one or more written findings for each of those significant effects, accompanied by a brief explanation of the rationale for each finding. In accordance with State CEQA Guidelines section 15093, when an agency approves a project which will result in the occurrence of significant effects which are identified in the Final EIR but are not avoided or substantially lessened, the agency shall make a “statement of overriding considerations” supported by substantial evidence in the record that states in writing the specific reasons to support its action based on the final EIR and/or other information in the record.

For the No-Action and Action Alternatives, significant and unavoidable impacts are also summarized in Chapter 27.0, “Other NEPA and CEQA Considerations.”

3.2.7 Relationship between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

NEPA requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. For the No-Action and Action Alternatives, this discussion is provided in Chapter 26.0, “Other NEPA and CEQA Considerations.”

3.2.8 Irreversible and Irretrievable Commitments of Resources

NEPA requires that an EIS include a discussion of the irreversible and irretrievable commitments of resources that may be involved if the project is implemented. Similarly, the State CEQA Guidelines requires the identification and analysis of significant irreversible environmental changes that would be involved if the project is implemented. For joint CEQA/NEPA documents, the EIS/R must analyze and justify the extent to which the Project will commit nonrenewable resources to uses that future generations will probably be unable to reverse (Pub. Resources Code, § 21100(a); State CEQA Guidelines, §§ 15126, Subd. (c), 15126.2, Subd. (c), and 15127).

The irreversible and irretrievable commitment of resources is the permanent loss of resources for future or alternative purposes. Irreversible and irretrievable commitments of resources occur when resources cannot be recovered or recycled or when resources are consumed or reduced to unrecoverable forms. For the No-Action and Action Alternatives, irreversible and irretrievable commitments of resources are discussed in Section 26.3, “Irreversible and Irretrievable Commitments of Resources.”

3.3 Resources Eliminated from Further Analysis

CEQA and the State CEQA Guidelines provide for the identification and elimination from detailed study the issues that are not significant or that have been covered by prior environmental review (Pub. Resources Code, § 21002.1, State CEQA Guidelines, § 15143). The CEQ Regulations provide similar provisions (40 CFR 1501.7(a)(3)).

During initial scoping with the public and governmental agencies, and based on information obtained through literature review, agency correspondence, consultations, and field data collection, it was determined that Indian Trust Assets could be eliminated from detailed study because Indian Trust Assets are not found in the Project area. Therefore, with the exception of Indian Trust Assets, all other resource areas covered by NEPA and CEQA are addressed in this EIS/R.

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4.0 Air Quality

This chapter describes the environmental and regulatory setting for air quality, as well as environmental consequences and mitigation, as they pertain to implementation of the Project alternatives. Greenhouse gas emissions are discussed in Chapter 8.0, "Climate Change and Greenhouse Gas Emissions." The discussion of existing conditions and the potential impacts of the Project alternatives on air quality encompass Reach 2B, Fresno and Madera counties, and the San Joaquin Valley Air Basin (SJVAB).

4.1 Environmental Setting

The Project area and vicinity are located in Fresno and Madera counties, which are part of the SJVAB. The SJVAB also comprises all of Merced, Kings, San Joaquin, Stanislaus, and Tulare counties and the valley portion of Kern County.

4.1.1 Ambient Air Quality

Ambient concentrations of air pollutants, contaminants, and odors are determined by the amount of emissions released by sources and the atmosphere's ability to transport and dilute such emissions. Natural factors which affect transport and dilution include terrain, wind, atmospheric stability, and the presence of sunlight. Therefore, existing air quality conditions in the area are determined by such natural factors as topography, meteorology, and climate, in addition to the amount of emissions released by existing sources, as discussed separately below.

Climate, Meteorology, and Topography

The SJVAB, which occupies the southern half of the Central Valley, is approximately 250 miles long and, on average, 35 miles wide. The SJVAB is a well-defined climatic region with distinct topographic features on three sides. The Coast Range is located on the western border of the SJVAB. The San Emigdio Mountains, which are part of the Coast Range, and the Tehachapi Mountains, which are part of the Sierra Nevada, are both located on the south side of the SJVAB. The Sierra Nevada forms the eastern border of the SJVAB. The northernmost portion of the SJVAB is San Joaquin County. There is no topographic feature delineating the northern edge of the basin. The SJVAB can be considered a "bowl" open only to the north.

The SJVAB is basically flat with a downward gradient in terrain to the northwest. Air flows into the SJVAB through the Carquinez Strait, the only breach in the western mountain barrier, and moves across the Sacramento–San Joaquin Delta from the San Francisco Bay area. The mountains surrounding the SJVAB create a barrier to airflow, which leads to the entrapment of air pollutants when meteorological conditions are unfavorable for transport and dilution. As a result, the SJVAB is highly susceptible to pollutant accumulation over time.

The inland Mediterranean climate type of the SJVAB is characterized by hot, dry summers and cool, rainy winters. The climate is a result of the topography and the strength and location of a semi-permanent, subtropical high-pressure cell. During summer, the Pacific high-pressure cell is centered over the northeastern Pacific Ocean resulting in stable meteorological conditions and a steady northwesterly wind flow. Cold ocean water upwells from below to the surface because of the northwesterly flow, producing a band of cold water off the California coast.

Daily summer high temperatures often exceed 100 degrees Fahrenheit (°F), averaging in the low 90s in the north and high 90s in the south. In the entire SJVAB, daily summer high temperatures average 95ºF. Over the last 30 years, temperatures in the SJVAB averaged 90°F or higher for 106 days a year, and 100°F or higher for 40 days a year. The daily summer temperature variation can be as high as 30°F (San Joaquin Valley Air Pollution Control District [SJVAPCD] 2002). In winter, the Pacific high-pressure cell weakens and shifts southward, resulting in wind flow offshore and allowing storm systems to move in from the Pacific Ocean. Average high temperatures in the winter are in the 50s, but lows in the 30s and 40s can occur on days with persistent fog and low cloudiness. The average daily low temperature in the winter is 45°F (SJVAPCD 2002).

A majority of the precipitation in the SJVAB occurs as rainfall during winter storms. The rare occurrence of precipitation during the summer is in the form of convective rain showers. The amount of precipitation in the SJVAB decreases from north to south primarily because the Pacific storm track often passes through the northern portion of the SJVAB, while the southern portion remains protected by the Pacific high-pressure cell. Stockton, in the north, receives about 20 inches of precipitation per year, while Fresno, in the center, receives about 10 inches per year, and Bakersfield, at the southern end of the valley, receives less than 6 inches per year. Average annual rainfall for the entire SJVAB is approximately 9.25 inches on the valley floor (SJVAPCD 2002).

The winds and unstable atmospheric conditions associated with the passage of winter storms result in periods of low air pollution and excellent visibility. Precipitation and fog tend to reduce or limit some pollutant concentrations. For instance, clouds and fog block sunlight, which is required to fuel photochemical reactions that form ozone. Because carbon monoxide (CO) is partially water-soluble, precipitation and fog also tend to reduce concentrations in the atmosphere. In addition, respirable particulate matter with an aerodynamic diameter of 10 micrometers or less (PM_{10}) can be washed from the atmosphere through wet deposition processes (e.g., rain). However, between winter storms, high pressure and light winds lead to the creation of low-level temperature inversions and stable atmospheric conditions resulting in the concentration of air pollutants (e.g., CO and PM_{10}).

Summer is considered the ozone season in the SJVAB. This season is characterized by poor air movement in the mornings and by longer daylight hours, which provide a plentiful amount of sunlight to fuel photochemical reactions between reactive organic gases (ROG) and nitrogen oxides (NO_X), which result in ozone formation. During the summer, wind speed and direction data indicate that summer wind usually originates at the north end of the San Joaquin Valley and flows in a south-southeasterly direction through Tehachapi Pass and into the Southeast Desert Air Basin (SJVAPCD 2002).

Criteria Air Pollutants

Concentrations of ozone, CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), PM_{10}, fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less ($PM_{2.5}$), and lead are used as indicators of ambient air quality conditions. Because these are the most prevalent air pollutants known to be deleterious to human health, and because there is extensive documentation available on health-effects criteria for these pollutants, they are commonly referred to as "criteria air pollutants."

A brief description of each criteria air pollutant, including source types, health effects, and future trends, is provided below along with the most current attainment area designations and monitoring data for the Project area and vicinity.

Ozone

Ozone is a photochemical oxidant, a substance whose oxygen combines chemically with another substance in the presence of sunlight, and the primary component of smog. Ozone is not directly emitted into the air, but is formed through complex chemical reactions between precursor emissions of ROG and NO_X in the presence of sunlight. ROG are volatile organic compounds that are photochemically reactive. ROG emissions result primarily from incomplete combustion and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that results from the combustion of fuels. As a highly reactive molecule, ozone readily combines with many different components of the atmosphere. Consequently, high levels of ozone tend to exist only while high ROG and NO_X levels are present to sustain the ozone formation process. Once the precursors have been depleted, ozone levels rapidly decline. Because these reactions occur on a regional scale, ozone is a regional pollutant.

Ozone located in the upper atmosphere (stratosphere) acts in a beneficial manner by shielding the earth from harmful ultraviolet radiation that is emitted by the sun. However, ozone located in the lower atmosphere (troposphere) is a major health and environmental concern. Meteorology and terrain play a major role in ozone formation. Generally, low wind speeds or stagnant air coupled with warm temperatures and clear skies provide the optimum conditions for ozone formation. As a result, summer is generally the peak ozone season. Because of the reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. In general, ozone concentrations over or near urban and rural areas reflect an interplay of emissions of ozone precursors, transport, meteorology, and atmospheric chemistry.

The adverse health effects associated with exposure to ozone impact primarily the respiratory system. Scientific evidence indicates that ambient levels of ozone affect not only sensitive receptors, such as asthmatics and children, but healthy adults as well. Exposure to ambient levels of ozone ranging from 0.10 to 0.40 parts per million (ppm) for 1 to 2 hours has been found to significantly alter lung functions by increasing respiratory rates and pulmonary resistance, decreasing tidal volumes (the amount of air inhaled and exhaled), and impairing respiratory mechanics. Ambient levels of ozone above 0.12 ppm are linked to symptomatic responses that include such symptoms as throat dryness, chest tightness, headache, and nausea. In addition to the above adverse health effects, evidence also exists relating ozone exposure to an increase in permeability of respiratory epithelia; such increased permeability leads to an increased response of the respiratory system to challenges and a decrease in the immune system's ability to defend against infection.

Although ozone problem in the SJVAB ranks among the most severe in the State, the ozone precursor emissions of ROG and NO_X have decreased over the past several years because of more stringent motor vehicle standards and cleaner burning fuels. From 1992 to 2012, the maximum peak 8-hour indicator decreased by 6 percent. The number of national 8-hour exceedance days has declined by 32 percent (California Air Resources Board [ARB] 2014).

Carbon Monoxide

CO is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon in fuels, primarily from mobile (transportation) sources. In fact, 86 percent of the nationwide CO emissions are from mobile sources; the other 14 percent consists of CO emissions from wood-burning stoves, incinerators, and industrial sources (U.S. Environmental Protection Agency [EPA] 2013a).

CO enters the bloodstream through the lungs by combining with hemoglobin, which normally supplies oxygen to the cells. However, CO combines with hemoglobin much more readily than oxygen does, resulting in a drastic reduction in the amount of oxygen available to the cells. Adverse health effects associated with exposure to CO concentrations include such symptoms as dizziness, headaches, and fatigue. CO exposure is especially harmful to individuals who suffer from cardiovascular and respiratory diseases (EPA 2014).

The highest concentrations are generally associated with cold, stagnant weather conditions that occur during the winter. In contrast to problems caused by ozone, which tends to be a regional pollutant, CO problems tend to be localized.

Nitrogen Dioxide

NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines. Combustion devices emit primarily nitric oxide (NO), which reacts through oxidation in the atmosphere to form NO_2 (EPA 2014). The combined emissions of NO and NO_2 are referred to as NO_X and reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with ozone, the NO_2 concentration in a particular geographical area may not be representative of the local NO_X emission sources.

Inhalation is the most common route of exposure to NO_2. Because NO_2 has relatively low solubility in water, the principal site of toxicity is in the lower respiratory tract. The severity of the adverse health effects depends primarily on the concentration inhaled rather than the duration of exposure. An individual may experience a variety of acute symptoms, including coughing, difficulty with breathing, vomiting, headache, and eye irritation during or shortly after exposure. After a period of approximately 4 to 12 hours, an exposed individual may experience chemical pneumonitis or pulmonary edema with breathing abnormalities, cough, cyanosis, chest pain and rapid heartbeat. Severe, symptomatic NO_2 intoxication after acute exposure has been linked on occasion with prolonged respiratory impairment with such symptoms as chronic bronchitis and decreased lung functions (EPA 2014).

Sulfur Dioxide

SO_2 is produced by such stationary sources as coal and oil combustion, steel mills, refineries, and pulp and paper mills. The major adverse health effects associated with SO_2 exposure pertain to the upper respiratory tract. SO_2 is a respiratory irritant with constriction of the bronchioles occurring with inhalation of SO_2 at 5 ppm or more. On contact with the moist, mucous membranes, SO_2 produces sulfurous acid (H_2SO_3), which is a direct irritant. Concentration, rather than duration of the exposure, is an important determinant of respiratory effects. Exposure to high SO_2 concentrations may result in edema of the lungs or glottis and respiratory paralysis.

Particulate Matter

Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. PM_{10} consists of particulate matter emitted directly into the air, such as fugitive dust, soot and smoke from mobile and stationary sources, construction operations, fires and natural windblown dust, and particulate matter formed in the atmosphere by condensation and/or transformation of SO_2 and ROG (EPA 2014). $PM_{2.5}$ is a subgroup of PM_{10}, consisting of smaller particles that have an aerodynamic diameter of 2.5 micrometers or less.

PM_{10} emissions in the SJVAB are dominated by emissions from area-wide sources, primarily fugitive dust from vehicle travel on unpaved and paved roads, waste burning, and residential fuel combustion. The adverse health effects associated with PM_{10} depend on the specific composition of the particulate matter. For example, health effects may be associated with metals, polycyclic aromatic hydrocarbons and other toxic substances adsorbed onto fine particulate matter (referred to as the “piggybacking effect”), or with fine dust particles of silica or asbestos. Generally, adverse health effects associated with PM_{10} may result from both short-term and long-term exposure to elevated concentrations and may include breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular diseases, alterations to the immune system, carcinogenesis, and premature death (EPA 2014). $PM_{2.5}$ poses an increased health risk because the particles can deposit deep in the lungs and may contain substances that are particularly harmful to human health.

Direct emissions of $PM_{2.5}$ remained relatively unchanged between 2000 and 2005, was reduced to current levels by 2010, and are projected by the ARB to remain unchanged through 2035 (ARB 2014). Annual average $PM_{2.5}$ concentrations in the SJVAB show a definite downward trend from 1999 through 2011. Annual average concentrations have dropped 26 percent between 1999 and 2011 (ARB 2014). $PM_{2.5}$ emissions in the SJVAB are dominated by emissions from the same area-wide sources as PM_{10}.

Lead

Lead is a metal found naturally in the environment, as well as in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, as discussed in detail below, metal processing is currently the primary source of lead emissions. The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities and lead-acid battery manufacturers.

Twenty years ago, mobile sources were the main contributor to ambient lead concentrations in the air. In the early 1970s, the EPA set national regulations to gradually reduce the lead content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. The EPA banned the use of leaded gasoline in highway vehicles in December 1995 (EPA 2014).

As a result of the EPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector have declined dramatically (95 percent between 1980 and 1999) and levels of lead in the air decreased by 94 percent between 1980 and 1999. The major sources of lead emissions to the air are ore and metals processing and piston-engine aircraft operating on leaded aviation gasoline (EPA 2014). The National Health and Nutrition Examination Survey have found a steady decrease in the levels of lead in people's blood since 1976. This decline has been attributed to the move from leaded to unleaded gasoline (EPA 2013b).

The decrease in lead emissions and ambient lead concentrations over the past 25 years is California's most dramatic success story with regard to air quality management. The rapid decrease in lead concentrations can be attributed primarily to phasing out the lead in gasoline. This phase-out began during the 1970s, and subsequent ARB regulations have virtually eliminated all lead from gasoline now sold in California. All areas of the State are currently designated as attainment for the State lead standard (the EPA does not designate areas for the national lead standard). Although the ambient lead standards are no longer violated, lead emissions from stationary sources still pose "hot spot" problems in some areas. As a result, the ARB identified lead as a toxic air contaminant.

Emission Sources

With respect to the emissions of criteria air pollutants within Fresno and Madera counties, mobile sources are the largest contributor to the estimated annual average levels of CO and NO_X accounting for approximately 68 percent and 83 percent, respectively, of the total emissions. Area-wide sources account for approximately 22 percent, 90 percent, and 73 percent of ROG, PM_{10} and $PM_{2.5}$ emissions, respectively, in the two counties (Fresno and Madera) (ARB 2013a). Table 4-1 shows the estimated annual average emissions for the SJVAB in 2012.

Table 4-1.
2012 Estimated Annual Average Emissions for the SJVAB (tons per day)

Source Category	TOG	ROG	CO	NO_x	SO_x	PM	PM_{10}	$PM_{2.5}$
Stationary Sources								
Fuel Combustion	18.8	3.6	23.8	29.2	4.3	6.0	5.5	5.3
Waste Disposal	457.4	21.0	0.5	0.3	0.1	0.6	0.2	0.1
Cleaning and Surface Coatings	23.3	20.3	0.0	-	-	0.1	0.1	0.1
Petroleum Production and Marketing	130.9	33.6	0.6	0.3	0.1	0.2	0.2	0.1
Industrial Processes	16.7	15.7	0.8	6.7	3.4	16.5	8.0	3.2
Total Stationary Sources	647.1	94.2	25.7	36.4	7.9	23.4	14.0	8.8
Stationary Sources Percentage of Total	31.6	15.7	1.9	11.1	63.7	4.1	4.3	8.0
Area-wide Sources								
Solvent Evaporation	53.1	47.6	-	-	-	-	-	-
Miscellaneous Processes	969.0	128.6	186.8	13.2	1.3	488.4	250.2	54.0
Total Area-wide Sources	1022.1	176.2	186.8	13.2	1.3	488.4	250.2	54.0
Area-wide Sources Percentage of Total	50.0	29.4	13.9	4.0	10.5	85.6	77.7	49.1
Mobile Sources								
On-road Motor Vehicles	53.2	48.5	437.6	177.9	0.7	10.8	10.8	6.7
Other Mobile Sources	41.6	39.0	252.5	97.6	0.5	5.9	6.6	6.1
Total Mobile Sources	94.8	87.5	690.1	275.5	1.2	16.7	17.4	12.8
Mobile Sources Percentage of Total	4.6	14.6	51.3	84.3	9.7	2.9	5.4	11.6
Natural (Non-anthropogenic) Sources								
Natural Sources	282.0	242.0	442.7	1.7	2.0	42.2	40.5	34.3
Total Natural (Non-anthropogenic Sources)	282.0	242.0	442.7	1.7	2.0	42.2	40.5	34.3
Natural Sources Percentage of Total	13.8	40.3	32.9	0.5	16.1	7.4	12.6	31.2
Grand Total	2046.1	599.9	1345.2	326.8	12.4	570.6	322.1	110.0

Source: ARB 2013a

Key:

CO = carbon monoxide

NOx = nitrogen oxides

PM = particulate matter

PM_{10} = particulate matter smaller than or equal to 10 microns in diameter

$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter

ROG = reactive organic gas

SO_x = sulfur oxides

SJVAB = San Joaquin Valley Air Basin

TOG = total organic gas

Similar to most agricultural areas of the Central Valley, the Project area and vicinity have existing air quality emissions of PM, NO_X, and ROG due, in part, to active agricultural land use. Agricultural field operations, such as tilling, planting, weeding, fertilizing, harvesting, and spreading of manure or compost can produce air pollution emissions. These emissions can be directly emitted from the action of wheels and machinery on soil or from engine operation and fuel combustion. For example, wind erosion can transport dust after tillage (increasing PM_{10}) and fertilizer used for crops release ammonia to the atmosphere, which mixes with other emissions to form microscopic airborne particles (increasing $PM_{2.5}$).

Monitoring Station Data and Attainment Area Designations

Criteria air pollutant concentrations are measured at several monitoring stations in the SJVAB. There are two stations within proximity to the Project area. The closest is the Pump Yard station, approximately 15 miles east of the project site in Madera County, which measures ozone and $NO_{X.}$ The next closest is the North Villa Avenue station in the town of Clovis, approximately 30 miles east of the Project area in Fresno County. The North Villa Avenue station measures ozone, CO, PM_{10}, $PM_{2.5}$, and NO_2. These monitoring stations are at elevations similar to the Project site, as they are located on the valley floor. Table 4-2 summarizes the air quality data from these stations for 2008 through 2012. The North Villa Avenue station concentrations are not necessarily representative of Project area concentrations because of the distance from the monitoring station to the site, but give approximate emissions levels that would be similar to the Project vicinity. Figure 4-1 shows the locations of the monitoring stations.

Both the ARB and the EPA use this type of monitoring data in relation to applicable standards to designate area attainment status for criteria air pollutants. The purpose of these designations is to identify those areas with air quality problems and thereby initiate planning efforts for improvement. The basic designation categories are nonattainment, maintenance, attainment, and unclassified. A pollutant is designated nonattainment if there was at least one violation of a Federal or State standard for that pollutant in the area, and a pollutant is designated attainment if the Federal or State standard for that pollutant was not violated at any site in the area during a three-year period. A maintenance area is an area that was previously classified as nonattainment and has subsequently demonstrated compliance with the standards. Unclassified is used in an area that cannot be classified on the basis of available information as meeting or not meeting the standards. In addition, the California designations include a subcategory of the nonattainment designation, called nonattainment-transitional. The nonattainment-transitional designation is given to nonattainment areas that are progressing and nearing attainment. The most current attainment designations for the portion of the SJVAB in the Project area and vicinity are shown in Table 4-3 for each criteria air pollutant.

The SJVAB is designated as being in nonattainment for (see Table 4-3):

- The State 1-hour ozone standard and the Federal and State 8-hour ozone standard.
- The State 24-hour and annual PM_{10} standards.
- The State annual $PM_{2.5}$ standard and the Federal 24-hour and annual $PM_{2.5}$ standards.

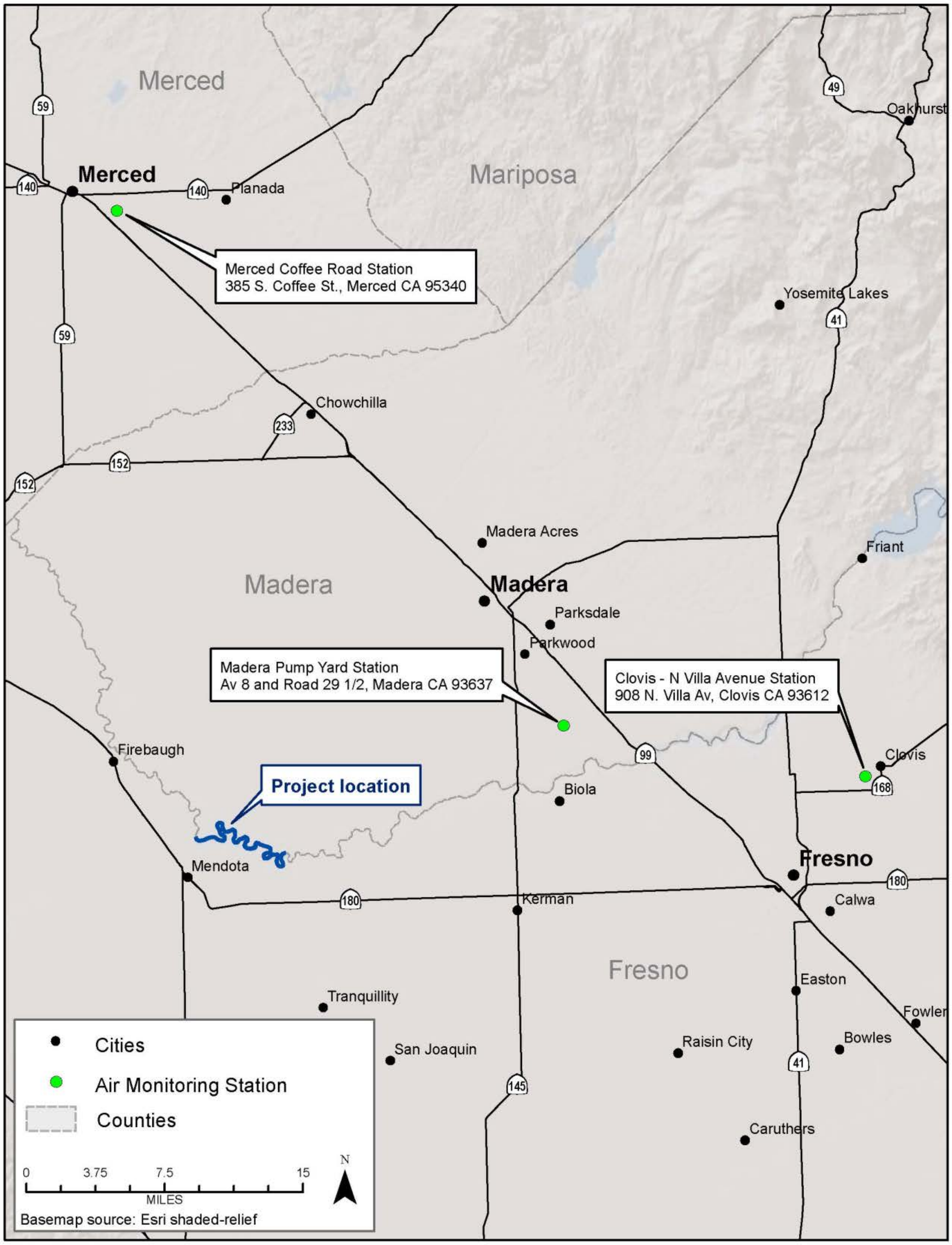

Figure 4-1. Location of Ambient Air Quality Monitoring Stations

Table 4-2.
Summary of Annual Ambient Air Quality Data (2008–2012)

	2008		2009		2010		2011		2012	
	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]
Ozone										
Maximum concentration (1-hr, ppm)	0.120	0.157	0.111	0.121	0.110	0.139	0.098	0.134	0.107	0.135
Maximum concentration (8-hr, ppm)	0.107	0.128	0.096	0.105	0.096	0.106	0.085	0.103	0.092	0.109
Number of days State standard exceeded (1-hr)	9	52	6	42	3	27	2	42	1	46
Number of days State standard exceeded (8-hr)	46	60	27	64	12	58	19	72	21	93
Number of days national standard exceeded (8-hr)	24	44	13	48	8	39	8	49	7	57
Nitrogen Dioxide (NO2)										
Maximum concentration (1-hr, ppm)	0.053	0.067	0.046	0.061	0.048	0.055	0.043	0.050	0.048	0.055
Number of days State standard exceeded (1-hr)	0	0	0	0	0	0	0	0	0	0
Annual Average (ppm)	0.009	0.012	0.009	0.011	0.008	0.010	0.008	0.010	0.008	0.010
Fine Particulate Matter ($PM_{2.5}$)										
Maximum daily concentration (μg/m^3) National/(California)[3]	-	(95.3)	-	71.0	-	75.2	-	76.4	-	80.8
Number of days national standard exceeded (measured[4])	-	17	-	26	-	19	-	38	-	24
National annual average (μg/m^3)	-	16.1	-	18.2	-	14.6	-	17.9	-	15.3
Respirable Particulate Matter (PM_{10})										
Maximum concentration (μg/m^3), National/(California)[3]	-	80.5	-	(65.2)	-	62.8	-	(77.0)	-	(78.3)

Table 4-2.
Summary of Annual Ambient Air Quality Data (2008–2012)

	2008		2009		2010		2011		2012	
	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]	Madera[1]	Fresno[2]
Number of days national standard exceeded (Measured/Calculated[4])	-	0/0	-	0/0	-	0/0	-	0/0	-	0/0
Number of days State standard exceeded (Measured[4])	-	13	-	5	-	8	-	9	-	9
Carbon Monoxide (CO)										
Maximum concentration (1-hr/8-hr [National (California[3])] , ppm)[5]	-	2.8/2.1	-	2.9/2.0	-	2.9/2.0	-	3/2.2	-	3.2/2.1
Number of days State standard exceeded (8-hr)	-	0	-	0	-	0	-	0	-	0
Number of days national standard exceeded (1-hr/8-hr)	-	0/0	-	0/0	-	0/0	-	0/0	-	0/0

Sources: ARB 2013b, EPA 2013c.

Notes:

[1] Measurements from the Pump Yard station (Madera County).

[2] Measurements from the North Villa Avenue station in the town of Clovis (Fresno County).

[3] State and national statistics may differ for the following reasons: State statistics are based on California approved samplers, whereas national statistics are based on samplers using Federal reference or equivalent methods. State and national statistics may therefore be based on different samplers. State statistics are based on local conditions National statistics are based on standard conditions. State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria

[4] Measured days are those days that an actual measurement was greater than the level of the State daily standard or the national daily standard. Measurements are typically collected every 6 days. The number of days above the standard is not necessarily the number of violations of the standard for the year.

[5] National and California 8-hr CO maximum concentrations were the same for these 3 years.

Key:

hr = hour

ppm = parts per million

μg/m^3 = micrograms per cubic meter

\- = data not available

Table 4-3.
Summary of Attainment Status Designations and Ambient Air Quality Standards in the Project Area and Vicinity

Pollutant	Averaging Time	California		National Standards[1]		
		Standards [2,3]	Attainment Status [4]	Primary [3,5]	Secondary [3,6]	Attainment Status [7]
Ozone	1-hour	0.09 ppm (180 μg/m^3)	N (Severe)	-	-	-
	8-hour	0.07 ppm (137 μg/m^3)	N	0.075 ppm (147 μg/m^3)	Same as Primary Standard	N (Extreme)
Carbon Monoxide (CO)	1-hour	20 ppm (23 mg/m^3)	A (Fresno) U (Madera, Modesto)	35 ppm (40 mg/m^3)	–	U/A
	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)		
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 μg/m^3)	–	0.053 ppm (100 μg/m^3)	Same as Primary Standard	U/A
	1-hour	0.18 ppm (339 μg/m^3)	A	0.10 ppm (188 μg/m^3)	-	–
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	–	–	0.030 ppm (80 μg/m^3)	–	U/A
	24-hour	0.04 ppm (105 μg/m^3)	A	0.14 ppm (365 μg/m^3)	–	
	3-hour	–	–	–	0.5 ppm (1300 μg/m^3)	
	1-hour	0.25 ppm (655 μg/m^3)	A	0.075 ppm	–	–
Respirable Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 μg/m^3	–	–	Same as Primary Standard	–
	24-hour	50 μg/m^3	N	150 μg/m^3		A
Fine Particulate Matter ($PM_{2.5}$) [9]	Annual Arithmetic Mean	12 μg/m^3	N	12 μg/m^3	Same as Primary Standard	N (Moderate)
	24-hour	–	–	35 μg/m^3		
Lead[8]	30-day Average	1.5 μg/m^3	A	–	–	–
	Calendar Quarter	–	–	1.5 μg/m^3	Same as Primary Standard	U/A
	Rolling 3 Month Average	–	–	0.15 μg/m^3	Same as Primary Standard	U/A
Sulfates	24-hour	25 μg/m^3	A	No National Standards		
Hydrogen Sulfide	1-hour	0.03 ppm (42 μg/m^3)	U	No National Standards		
Vinyl Chloride[8]	24-hour	0.01 ppm (26 μg/m^3)	A	No National Standards		

Table 4-3.
Summary of Attainment Status Designations and Ambient Air Quality Standards in the Project Area and Vicinity

Pollutant	Averaging Time	California		National Standards[1]		
		Standards [2,3]	Attainment Status [4]	Primary [3,5]	Secondary [3,6]	Attainment Status [7]
Visibility-Reducing Particle Matter	8-hour	Extinction coefficient of 0.23 per kilometer —visibility of 10 miles or more (0.07—30 miles or more for Lake Tahoe) because of particles when the relative humidity is less than 70 percent.	U	No National Standards		

Sources: ARB 2011a, 2011b; EPA 2013d; SJVAPCD 2011.

Notes:

[1] National standards (other than ozone, PM, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The PM_{10} 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The $PM_{2.5}$ 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the EPA for further clarification and current Federal policies.

[2] California standards for ozone, CO (except Lake Tahoe), SO_2 (1- and 24-hour), NO_2, PM, and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. California Ambient Air Quality Standards (CAAQS) are listed in the Table of Standards in California Code of Regulations, Title 17, section 70200.

[3] Concentration expressed first in units in which it was promulgated [i.e., parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$)]. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[4] Unclassified (U): a pollutant is designated unclassified if the data are incomplete and do not support a designation of attainment or nonattainment.
Attainment (A): a pollutant is designated attainment if the State standard for that pollutant was not violated at any site in the area during a 3-year period.
Nonattainment (N): a pollutant is designated nonattainment if there was a least one violation of a State standard for that pollutant in the area.
Nonattainment/Transitional (NT): is a subcategory of the nonattainment designation. An area is designated nonattainment/transitional to signify that the area is close to attaining the standard for that pollutant.

[5] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[6] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[7] Nonattainment (N): any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.
Attainment (A): any area that meets the national primary or secondary ambient air quality standard for the pollutant.
Unclassifiable (U): any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

[8] ARB has identified lead and vinyl chloride as toxic air contaminants with no threshold of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

[9.] On December 14, 2012, the EPA revised the annual $PM_{2.5}$ ambient air quality standard. The value was changed from 15 ug/m3 to 12 ug/m3. Attainment designations would not be available until December 2014.

Toxic Air Contaminants

Concentrations of toxic air contaminants, or in Federal parlance hazardous air pollutants (HAPs), are also used as indicators of ambient air quality conditions. A toxic air contaminant is defined as an air pollutant that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. Toxic air contaminants are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations.

According to the *California Almanac of Emissions and Air Quality* (ARB 2007a), the majority of the estimated health risk from toxic air contaminants can be attributed to relatively few compounds, the most important being particulate matter from diesel-fueled engines (diesel particulate matter). Diesel particulate matter differs from other toxic air contaminants in that it is not a single substance, but rather a complex mixture of hundreds of substances. Although diesel particulate matter is emitted by diesel-fueled internal combustion engines, the composition of the emissions varies depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present.

Unlike the other toxic air contaminants, no ambient monitoring data are available for diesel particulate matter because no routine measurement method currently exists. However, the ARB has made preliminary concentration estimates based on a particulate matter exposure method. This method uses the ARB emissions inventory's PM_{10} database, ambient PM_{10} monitoring data and the results from several studies to estimate concentrations of diesel particulate matter. In addition to diesel particulate matter, the toxic air contaminants for which data are available that pose the greatest existing ambient risk in California are benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethene.

Diesel particulate matter poses the greatest health risk among these 10 toxic air contaminants. Based on receptor modeling techniques, the ARB estimated the diesel particulate matter health risk within the SJVAB in 2000 to be 390 excess cancer cases per million people. Since 1990, the health risk of diesel particulate matter in the SJVAB has been reduced by 50 percent. Overall, levels of most toxic air contaminants have gone down since 1990 except for *para*-dichlorobenzene and formaldehyde (ARB 2007a).

According to the ARB Community Health Air Pollution Information System, there are five major existing stationary sources of toxic air contaminants within 3 miles of the Project area (ARB 2011c). In addition, vehicles on State Route 140, 165, 99, 41, and 152 are sources of diesel particulate matter and other mobile source air toxics.

Odors

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache).

With respect to odors, the human nose is the sole sensing device. The ability to detect odors varies considerably among the population and overall is quite subjective. Some individuals have the ability to smell very minute quantities of specific substances; others may not have the same sensitivity, but may have sensitivities to odors of other substances. In addition, people may have different reactions to the same odor; an odor that is offensive to one person may be perfectly acceptable to another (e.g., fast food restaurant). An unfamiliar odor is also more likely to be detected and cause complaints than a familiar one. This is due to the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition only occurs with an alteration in the intensity.

Quality and intensity are two properties present in any odor. The quality of an odor indicates the nature of the smell experience. For instance, if a person describes an odor as flowery or sweet, then the person is describing the quality of the odor. Intensity refers to the strength of the odor. For example, a person may use the word strong to describe the intensity of an odor. Odor intensity depends on the odorant concentration in the air. When an odorous sample is progressively diluted, the odorant concentration decreases. As this occurs, the odor intensity weakens and eventually becomes so low that the detection or recognition of the odor is quite difficult. At some point during dilution, the concentration of the odorant reaches a detection threshold. An odorant concentration below the detection threshold means that the concentration in the air is not detectable by the average human.

Potential existing sources of odor include various agricultural activities in the vicinity of the Project area (e.g., dairy operations, livestock operations, and fertilizer use).

4.1.2 Sensitive Receptors

Sensitive receptors are considered those with increased exposure or risk to air pollutants and include schools, daycare facilities, elderly care establishments, medical facilities, and other areas that are populated with people considered more vulnerable to the effects of poor air quality. There are some residences located within a 1,000-foot radius of the Project footprint (Figure 4-2). Sensitive receptors shown on Figure 4-2 are single residences or a group of residences. Since this Project mostly consists of construction activities, the receptors would not be exposed to toxic air contaminants or HAPs for a long period of time.

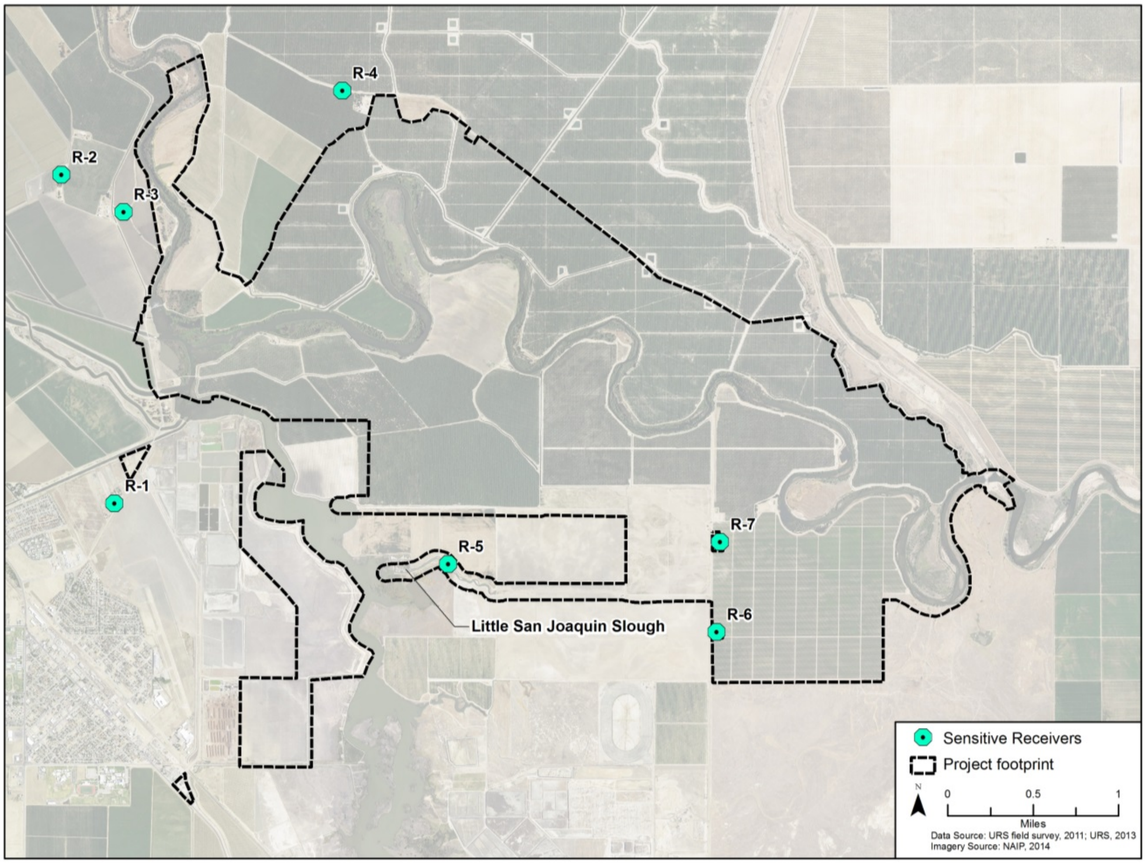

Figure 4-2.
Location of Existing Sensitive Receptors

4.2 Regulatory Setting

Air quality within the Project area and vicinity is regulated by the EPA, the ARB, the SJVAPCD, Fresno and Madera counties, and the cities of Fresno and Firebaugh. Each of these agencies develops rules, regulations, policies, and/or goals to comply with applicable legislation. Although EPA regulations may not be superseded, both State and local regulations may be more stringent.

4.2.1 Federal

Federal laws and regulations pertaining to air quality are discussed below.

Federal Clean Air Act

The Federal Clean Air Act (CAA) was enacted in 1970 to protect and enhance the Nation’s air quality to promote public health and welfare and the productive capacity of the Nation’s population. The CAA requires an evaluation of any Federal action to determine its potential impact on air quality in the project region. California has a corresponding law, which also must be considered during the preparation of this

Environmental Impact Statement/Report (EIS/R). Most regulatory responsibilities under the CAA are delegated to State, regional, or local government bodies.

The CAA requires areas with unhealthy levels of ozone, CO, NO_2, SO_2, and inhalable particulate matter to develop State Implementation Plans (SIPs) to comply with the national ambient air quality standards (42 United States Code [USC] §7410 et seq.). Federal agencies must conform to SIPs, meaning they must ensure that federally supported activities will not cause or contribute to a new violation, increase the severity of an existing violation, or delay timely attainment of any standard in any area (42 USC §7506(c)(1)(B)).

Proponents of specific projects must demonstrate that the actions will conform to the CAA and the SIP. A Federal action conforms with an applicable SIP if (1) the total of direct and indirect emissions from the action are compliant and consistent with the requirements of the SIP, and (2) one of a list of enumerated, pollutant-specific requirements is satisfied (such as accounting for the Federal action's projected emission of any criteria pollutant in the SIP, or offsetting ozone or NO_2 emissions within the nonattainment area) (42 Code of Federal Regulations [CFR] 93.158(a)). Ultimately, a conformity analysis may require revising a SIP, implementing mitigation measures to bring the Federal action's emissions levels down, or altering the action, possibly by reducing the magnitude of the action, to reduce emissions to levels within the budgets established by the SIP for specific pollutants.

Section 176 of the CAA prohibits Federal agencies from engaging in or supporting an action or activity that does not conform to an applicable SIP. Actions and activities must conform to a SIP's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards, and in attaining those standards expeditiously.

Any Federal agency providing financial assistance, issuing a license or permit, or approving or supporting in any way a proposed project located in a nonattainment or maintenance area for a criteria air pollutant is required to issue a conformity analysis. The conformity analysis must certify that the federally permitted project is consistent with the SIP developed pursuant to the CAA. A conformity analysis is required unless the proposed action's emissions are below the federally established *de minimis* emissions thresholds, and the proposed action's emissions do not reach the level of 10 percent or more of the regional emissions budget for any given pollutant in the nonattainment area. This is also applicable to short-term, construction-related emissions, and therefore applies to the Project.

Criteria Air Pollutants

At the Federal level, the EPA has been charged with implementing national air quality programs. EPA's air quality mandates are drawn primarily from the CAA. The most recent major amendments made by Congress were in 1990.

The CAA required the EPA to establish national ambient air quality standards (NAAQS). As shown in Table 4-3, the EPA has established primary and secondary NAAQS for the following criteria air pollutants: ozone, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$ and lead. The primary standards protect the public health and the secondary standards protect public welfare. The CAA also required each State to prepare an air quality control plan or SIP. The Federal Clean Air Act Amendments of 1990 (CAAA) added requirements for States with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. The EPA must review all State SIPs to determine whether they conform to the mandates of the CAA and the amendments thereof, and to determine whether implementing them would achieve air quality goals. If the EPA determines a SIP to be inadequate, a Federal Implementation Plan that imposes additional control measures may be prepared for the nonattainment area. Failure to submit an approvable SIP or to implement the plan within the mandated time frame may cause sanctions to be applied to transportation funding and stationary air pollution sources in the air basin.

Toxic Air Contaminants

The EPA has programs for identifying and regulating toxic air contaminants (HAPs in the Federal parlance). Title III of the CAAA directed the EPA to promulgate national emissions standards for HAPs. The standards may differ for major sources than for area sources of HAPs. Major sources are defined as stationary sources with potential to emit more than 10 tons per year of any HAP or more than 25 tons per year of any combination of HAPs; all other sources are considered area sources. The CAAA called on the EPA to promulgate emissions standards in two phases. In the first phase (1992–2000), the EPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring Maximum Achievable Control Technology. For area sources, the standards may be different based on generally available control technology. In the second phase (2001–2008), the EPA was required to promulgate health risk–based emissions standards where deemed necessary to address risks remaining after implementation of the technology-based national emissions standards for HAPs.

The CAAA also required the EPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions including benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, Section 219 of the CAAA required the use of reformulated gasoline in selected areas with the most severe ozone nonattainment conditions to further reduce mobile-source emissions.

Odors

There are no Federal laws, regulations, or policies pertaining to odors.

General Conformity

To determine whether projects are subject to the general conformity determination requirements, the EPA has established general conformity threshold values (in tons per calendar year) for each of the criteria pollutants for each type of federally designated nonattainment and maintenance areas. If the emissions generated by construction or operation of a project (on an area-wide basis) are less than these threshold values, the

General Conformity Rule is not applicable and no additional analyses are required. If the emissions are greater than these values, compliance with the General Conformity Rule must be demonstrated.

General conformity requirements apply only to federally designated maintenance and nonattainment areas. The Project area is in an area federally designated as an extreme nonattainment area for the 8-hour ozone standard, a nonattainment area for $PM_{2.5}$, and a maintenance area for PM_{10}. The applicability threshold values for this area, according to 40 CFR Part 93, are 10 tons per year for volatile organic compounds, 10 tons per year for NO_X, and 100 tons per year for $PM_{2.5}$ and PM_{10}.

As such, the Project must demonstrate compliance with the General Conformity Rule before construction begins. Compliance with the General Conformity Rule can be demonstrated in one or more of the following ways:

- By reducing construction-phase emissions to below the general conformity *de minimis* thresholds.
- By showing that the construction-phase emissions are included in the area's emission budget for the SIP.
- By demonstrating that the State agrees to include the emission increases in the area's SIP without exceeding emission budgets.
- By offsetting the Project's construction-phase emissions in each year that the thresholds are exceeded.
- Through an air quality modeling analysis demonstrating that the Project would not cause or exacerbate a NAAQS violation (however, this cannot be used for ozone precursors in ozone nonattainment areas).

4.2.2 State of California

State laws and regulations pertaining to air quality are discussed below.

California Clean Air Act

The California Clean Air Act (CCAA) of 1988 requires nonattainment areas, such as the SJVAB, to achieve and maintain State ambient air quality standards by the earliest practicable date. The CCAA also requires local air districts to develop plans for attaining State ozone, CO, NO_2, and SO_2 standards. The SJVAPCD has the authority to issue permits and ensure compliance with air quality regulations in the Project area.

The SJVAPCD is required by the CCAA to develop "indirect source" control programs in its attainment plans. The SJVAPCD is committed to reducing PM_{10} and nitrous oxides (N_2O) emissions from indirect sources in the 2003 PM_{10} Plan and the 2004 Extreme Ozone Attainment Demonstration Plan. The SJVAPCD's Governing Board adopted District Rule 9510 as a result of this commitment. In accordance with SJVAPCD Rule 9510, Indirect Source Review, applicants must mitigate project impacts through the incorporation of on-site emission reducing design elements and/or the payment of fees that would be used to fund off-site emissions reduction projects.

In accordance with SJVAPCD Rule 8021 – Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities, the owner or operator of a construction project is required to submit a Dust Control Plan to the SJVAPCD if at any time the project would involve:

- Residential developments of 10 or more acres of disturbed surface area.
- Nonresidential developments of 5 or more acres of disturbed surface area.
- Moving, depositing, or relocating of more than 2,500 cubic yards per day of bulk materials on at least three days of the project.

A Dust Control Plan identifies the fugitive dust sources at the construction site and describes all of the dust control measures to be implemented before, during, and after any dust-generating activity for the duration of the project. The owner or operator is required to comply with all requirements of the applicable rules under Regulation VIII and the SJVAPCD's Rules and Regulations at all times.

Criteria Air Pollutants

The ARB is the agency responsible for coordination and oversight of State and local air pollution control programs in California and for implementing the CCAA. The CCAA, which was adopted in 1988, required the ARB to establish California ambient air quality standards (CAAQS) (Table 4-3). The ARB has established CAAQS for sulfates, hydrogen sulfide, vinyl chloride, visibility-reducing particulate matter, and the above-mentioned criteria air pollutants. In most cases the CAAQS are more stringent than the NAAQS. Differences in the standards are generally explained by the health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the CAAQS incorporate a margin of safety to protect sensitive individuals.

The CCAA requires that all local air districts in the State endeavor to achieve and maintain the CAAQS by the earliest practical date. The act specifies that local air districts should focus particular attention on reducing the emissions from transportation and area-wide emission sources, and provides districts with the authority to regulate indirect sources.

Among the ARB's other responsibilities are overseeing local air district compliance with California and Federal laws, approving local air quality plans, submitting SIPs to the EPA, monitoring air quality, determining and updating area designations and maps, and setting emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels. In California, there are 15 nonattainment areas for the national ozone standard and two nonattainment areas for the $PM_{2.5}$ standard (EPA 2013d). The ozone SIP and $PM_{2.5}$ SIP were adopted and sent to the EPA on 2007 and 2012, respectively. The SIP must show how each area would attain the Federal standards. To do this, the SIP identifies the amount of pollution emissions that must be reduced in each area to meet the standard and the emission controls needed to reduce the necessary emissions.

Toxic Air Contaminants

Toxic air contaminants in California are primarily regulated through the Tanner Air Toxics Act (Assembly Bill [AB] 1807) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588). AB 1807 sets forth a formal procedure for the ARB to designate substances as toxic air contaminants. Research, public participation, and scientific peer review must occur before the ARB can designate a substance as a toxic air contaminant. To date, the ARB has identified more than 21 toxic air contaminants and adopted the EPA's list of HAPs as toxic air contaminants. Most recently, diesel particulate matter was added to the ARB list of toxic air contaminants.

Once a toxic air contaminant is identified, the ARB then adopts an Airborne Toxics Control Measure for sources that emit that particular toxic air contaminant. If there is a safe threshold for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If there is no safe threshold, the measure must incorporate best available control technology (BACT) to minimize emissions (e.g., the airborne toxics control measure limits truck idling to 5 minutes [Cal. Code Regs., tit. 13, Ch. 10, § 2485]).

The Hot Spots Act requires that existing facilities that emit toxic substances above a specified level prepare a toxic-emission inventory, prepare a risk assessment if emissions are significant, notify the public of significant risk levels, and prepare and implement risk reduction measures.

The ARB has adopted diesel-exhaust control measures and more stringent emission standards for various on-road mobile sources of emissions, including transit buses and off-road diesel equipment (e.g., tractors, generators). In February 2000, the ARB adopted a new public-transit bus fleet rule and emission standards for new urban buses. These new rules and standards provide for (1) more stringent emission standards for some new urban bus engines, beginning with 2002 model year engines; (2) zero-emission bus demonstration and purchase requirements applicable to transit agencies; and (3) reporting requirements, under which transit agencies must demonstrate compliance with the public-transit bus fleet rule. Current milestones include the low-sulfur diesel fuel requirement and tighter emission standards for heavy-duty diesel trucks (2007) and off-road diesel equipment (2011) nationwide. Over time, the replacement of older vehicles would result in a vehicle fleet that produces substantially lower levels of toxic air contaminants than under current conditions. Mobile-source emissions of toxic air contaminants (e.g., benzene, 1,3-butadiene, diesel particulate matter) have been reduced significantly over the last decade, and would be reduced further in California through a progression of regulatory measures (e.g., Low Emission Vehicle/Clean Fuels and Phase II reformulated gasoline regulations) and control technologies. With implementation of ARB's Risk Reduction Plan, it is expected that diesel particulate matter concentrations would be reduced by 85 percent in 2020 from the estimated year-2000 level. Adopted regulations are also expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. As emissions are reduced, it is expected that risks associated with exposure to the emissions would also be reduced.

The ARB (2005) published the *Air Quality and Land Use Handbook: A Community Health Perspective*, which provides guidance concerning land use compatibility with toxic air contaminant sources. While not a law or adopted policy, the handbook offers advisory recommendations for the siting of sensitive receptors near uses associated with toxic air contaminants, such as freeways and high-traffic roads, commercial distribution centers, rail yards, ports, refineries dry cleaners, gasoline stations, and industrial facilities.

Odors

There are no State laws, regulations, or policies pertaining to odors.

4.2.3 Regional and Local

Regional and local plans and policies pertaining to air quality are discussed below. The Project area is located within the SJVAB which is regulated by the SJVAPCD.

Criteria Air Pollutants

San Joaquin Valley Air Pollution Control District Regulations

The SJVAPCD seeks to improve air quality conditions in the SJVAB through a comprehensive program of planning, regulation, enforcement, technical innovation and promotion of the understanding of air quality issues. The clean air strategy of the SJVAPCD includes preparing plans and programs for the attainment of ambient air quality standards (AAQS), adopting and enforcing rules and regulations, and issuing permits for stationary sources. The SJVAPCD also inspects stationary sources, responds to citizen complaints, monitors ambient air quality and meteorological conditions, and implements other programs and regulations required by the CAA, CAAA, and CCAA.

Guide for Assessing and Mitigating Air Quality Impacts. In January 2002, the SJVAPCD released a revision to the previously adopted guidelines document. This revised *Guide for Assessing and Mitigating Air Quality Impacts* (GAMAQI) (SJVAPCD 2002) is an advisory document that provides lead agencies, consultants, and project applicants with uniform procedures for addressing air quality in environmental documents. The guide contains the following applicable components:

- Criteria and thresholds for determining whether a project may have a significant adverse air quality impact.
- Specific procedures and modeling protocols for quantifying and analyzing air quality impacts.
- Methods available to mitigate air quality impacts.
- Information for use in air quality assessments that is updated frequently such as air quality data, regulatory setting, climate and topography.

The SJVAPCD prepared an updated Draft GAMAQI in 2012 and a subsequent update to the Draft GAMAQI in July 2014. The Draft 2012 GAMAQI and 2014 GAMAQI contain similar thresholds of significance with additional clarification on criteria mass emissions. They also update and clarify the methodologies and basis for thresholds.

Air Quality Attainment Plans. The SJVAPCD prepares and submits Air Quality Attainment Plans in compliance with the requirements set forth in the CCAA. The CCAA also requires a triennial assessment of the extent of air quality improvements and emission reductions achieved through the use of control measures. As part of the assessment, the attainment plans must be reviewed and, if necessary, revised to correct for deficiencies in progress and to incorporate new data or projections. As a nonattainment area, the region is also required to submit rate-of-progress milestone evaluations in accordance with the CAAA. These milestone reports include compliance demonstrations if requirements are being met in the nonattainment area. The air quality attainment plans and reports present comprehensive strategies to reduce emissions of ROG, NO_X, and PM_{10}/$PM_{2.5}$ from stationary, area, mobile and indirect sources. Such strategies include the adoption of rules and regulations; enhancement of California Environmental Quality Act (CEQA) participation; implementation of a new and modified indirect-source review program; adoption of local air quality plans; and stationary-, mobile-, and indirect-source control measures. Table 4-4 summarizes the SJVAPCD's current Air Quality Attainment Plans.

Rules and Regulations. As mentioned above, the SJVAPCD adopts rules and regulations. All projects are subject to the SJVAPCD's rules and regulations in effect at the time of construction. Specific rules applicable to the construction of the Project may include, but are not limited to:

Regulation VIII—Fugitive Dust PM_{10} Prohibitions: Rules 8011 to 8081 are designed to reduce PM_{10} emissions (predominantly dust/dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations. Compliance with Regulation VIII is mandatory. If a nonresidential project is 5 or more acres in area, a Dust Control Plan must be submitted as specified in Section 6.3.1 of Rule 8021 and construction activities are not allowed to commence until the SJVAPCD has approved the plan.

Rule 2010—Permits Required: This rule applies to any person who plans to or does operate, construct, alter, or replace any source operation which may emit air contaminants or may reduce the emission of air contaminants. This Project, or portions thereof, may be subject to SJVAPCD permitting requirements.

Rule 2201—New and Modified Stationary Source Review Rule: This rule applies to all new stationary sources and all modifications of existing stationary sources. They are subject to SJVAPCD permit requirements if, after construction, they emit or may emit one or more affected pollutant.

Rule 3135—Dust Control Plan Fee: This rule requires the applicant to submit a fee in addition to a Dust Control Plan. The purpose of this fee is to recover the SJVAPCD's cost for reviewing such plans and conducting compliance inspections.

Table 4-4.
Summary of San Joaquin Valley Air Pollution Control District Air Quality Plans

Pollutant	Plan Title	Date	Status
Ozone	*Extreme Ozone Attainment Demonstration Plan, San Joaquin Valley Air Basin Plan Demonstrating Attainment of Federal 1-Hour Ozone Standards*	October 2004, Amended October 2005	Adopted by SJVAPCD and ARB in October 2004. Submitted to EPA in November 2004.[1]
	2013 Plan for the Revoked 1-Hour Ozone Standard	September 2013	Adopted by SJVAPCD on September 19, 2013.
	Draft Staff Report, 8-Hour Ozone Reasonably Available Control Technology—State Implementation Plan Analysis	April 2006	Adopted by SJVAPCD in August 17, 2006.
	8-Hour Ozone Attainment Demonstration Plan for the San Joaquin Valley	April 2007	Adopted by SJVAPCD in April 2007. Approved by ARB in June 2007. EPA approved the SJVAPCD 8-hour plan (revised in 2008 and 2011) on March 1, 2012
Carbon Monoxide (CO)	*2004 Revision to the California State Implementation Plan for Carbon Monoxide Updated Maintenance Plan for the Federal Planning Areas*	July 2004	Adopted by ARB July 2004. Approved by EPA on November 30, 2005
Respirable and Fine Particulate Matter (PM_{10} and $PM_{2.5}$)	*$PM_{2.5}$ Plan*	December 2012	Adopted by SJVAPCD in December 2012. Adopted by ARB January 2013 and submitted to the EPA.
	Natural Events Action Plan for High Wind Events in the San Joaquin Valley	August 2008	Adopted by SJVAPCD August 2008. Final Version submitted to ARB and EPA on August 7, 2008.

Sources: ARB 2008, 2011d; SJVAPCD 2005, 2011, 2013.

Notes:

[1] Effective June 15, 2005, EPA revoked in full the national 1-hour ozone ambient air quality standard, including associated designations and classifications.

Key:

ARB = California Air Resources Board

EPA = U.S. Environmental Protection Agency

SJVAPCD = San Joaquin Valley Air Pollution Control District

Rule 4101—Visible Emissions: This rule prohibits emissions of visible air contaminants to the atmosphere and applies to any source operation that emits or may emit air contaminants.

Rule 4102—Nuisance: This rule applies to any source operation that emits or may emit air contaminants or other materials. In the event that such emissions create a public nuisance, the owner/operator could be in violation and be subject to SJVAPCD enforcement action.

Rule 4601—Architectural Coatings: This rule limits volatile organic compounds from architectural coatings by specifying architectural coatings storage, clean up, and labeling requirements.

Rule 4641—Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations: This rule applies to the manufacture and use of the aforementioned asphalt types for paving and maintenance operations.

Rule 9510—Indirect Source Review: This rule was adopted to reduce the impacts of growth in emissions from all new development in the SJVAB. The purposes of Rule 9510 are to (1) fulfill the SJVAPCD's emission reduction commitments in the PM_{10} and Ozone Attainment Plans; (2) achieve emission reductions from the construction and use of development projects through design features and on-site measures; and (3) provide a mechanism for reducing emissions from the construction of and use of development projects through off-site measures.

The rule is applicable to any person or entity that undertakes a development project, which upon full build out is 2,000 square feet or more of retail/commercial uses, or 9,000 square feet or more of space not identified in Rule 9510, or any transportation or transit project where construction exhaust emissions equal or exceed 2 tons of NO_X or 2 tons of PM_{10}. As such, this rule is applicable to the San Joaquin River Restoration Program (SJRRP) because projects implemented under the SJRRP meet these criteria. Compliance with Rule 9510 would be required.

Fresno County General Plan

Section G, Air Quality, of the Open Space and Conservation Element of the Fresno County General Plan states that the County would support and implement SJVAPCD programs in maintaining air quality within the County and that the County would consider all air quality implications for new discretionary land use development and transportation infrastructure improvements (Policies OS-G.1 through OS-G.16) (Fresno County 2000).

Madera County General Plan

In 2010 Madera County adopted an Air Quality Element to its General Plan. The Air Quality Element states that the County would support and implement SJVAPCD programs in maintaining air quality within the County and that the County would integrate air quality planning into the transportation planning process (Madera County 2010).

City of Fresno General Plan

Section G-1, Air Quality, of the Resource Conservation Element includes the objective to, in cooperation with other jurisdictions and agencies in the SJVAB, take necessary actions to achieve and maintain compliance with State and national air quality standards (City of Fresno 2009).

City of Firebaugh

The city of Firebaugh does not currently have a general plan or any air quality regulations in its municipal code.

City of Mendota

The city of Mendota General Plan Update 2002-2005 states that the City would support and implement SJVAPCD programs in maintaining air quality within the City and that the City would integrate air quality planning into the transportation planning process. Policies are in support of land use designs to encourage infill and density to support pedestrian circulation which would decrease use of mobile sources. Policies are in support of energy efficient to reduce energy consumption. Policies are in support of construction equipment control devices when operating near sensitive receptors to control the diesel exhaust particulate matter (City of Mendota 2009).

Toxic Air Contaminants

At the local level, air pollution control or management districts may adopt and enforce ARB control measures. Under SJVAPCD Regulations II and VII, all sources that possess the potential to emit toxic air contaminants are required to obtain permits from the district. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations, including new-source review standards and air toxics control measures. The SJVAPCD limits emissions and public exposure to toxic air contaminants through a number of programs. The SJVAPCD prioritizes toxic air contaminant-emitting stationary sources based on the quantity and toxicity of the toxic air contaminant emissions and the proximity of the facilities to sensitive receptors.

Projects that require a permit are analyzed by the SJVAPCD (e.g., health risk assessment) on the basis of their potential to emit toxics. If it is determined that the project would emit toxics in excess of the SJVAPCD's threshold of significance for toxic air contaminants, as identified below, projects must implement the best available control technology for toxic air contaminants (T-BACT) to reduce emissions. If a project cannot reduce the risk below the threshold of significance, even after T-BACT has been implemented, the SJVAPCD would deny the permit required by the project. This helps to prevent new problems and reduces emissions from existing older sources by requiring them to apply new technology when retrofitting with respect to toxic air contaminants. It is important to note that the SJVAPCD's air quality permitting process applies to stationary sources; properties that are exposed to elevated levels of non-stationary type sources of toxic air contaminants, and the non-stationary type sources themselves (e.g., on-road vehicles), are not subject to air quality permits. Further, for reasons of feasibility and practicality, mobile sources (e.g., cars, trucks) are not required to implement T-BACT, even if they do have the potential to expose adjacent properties to elevated levels of toxic air contaminants. Rather, emissions controls on such sources (e.g., vehicles) are subject to regulations implemented on the Federal and State levels.

Odors

The SJVAPCD has determined some common types of facilities that have been known to produce odors, including wastewater treatment facilities, chemical manufacturing plants, painting/coating operations, feed lots/dairies, composting facilities, landfills and transfer stations. Any actions related to odors are based on citizen complaints to local governments and the SJVAPCD. According to the SJVAPCD, significant odor problems occur when there is more than one confirmed complaint per year averaged over a three-year period or when there are three unconfirmed complaints per year averaged over a three-year period (SJVAPCD 2002).

Two situations increase the potential for odor problems. The first occurs when a new odor source is located near existing sensitive receptors. The second occurs when new sensitive receptors are developed near existing sources of odor. In the first situation, the SJVAPCD recommends operational changes, add-on controls, process changes or buffer zones where feasible to address odor complaints. In the second situation, the potential conflict is considered significant if the project site is at least as close as any other site that has already experienced significant odor problems related to the odor source. For projects locating near a source of odors where there is no nearby development that may have filed complaints, and for odor sources locating near existing sensitive receptors, the SJVAPCD requires the determination of potential conflict to be based on the distance and frequency at which odor complaints from the public have occurred in the vicinity of a similar facility (SJVAPCD 2002). The SJVAPCD has adopted Rule 4102, as identified above, that applies to odor emissions.

4.3 Environmental Consequences and Mitigation Measures

4.3.1 Impact Assessment Methodology

This section addresses the potential for impacts to air quality and human health.

Construction activities associated with the Project would generate criteria air pollutant emissions: CO, SO_2, particulate matter (PM_{10} and $PM_{2.5}$); and ozone precursors (ROGs and NO_x). Construction of the Project would generate toxic air contaminant emissions: diesel particulate matter and gasoline related toxic air contaminants.

The following approach was used to estimate criteria pollutant emissions. Exhaust emissions from off-road construction equipment were estimated using the Roadway Construction Emissions Model (RoadMod) and In-Use Off-road Equipment 2011 Inventory Model[1] (Sacramento Metropolitan Air Quality Management District 2012). On-road mobile source emissions from worker and truck trips was calculated using estimates of vehicle miles traveled and appropriate emission factors from Emission Factors Modeling Software (EMFAC) (ARB 2007b). Fugitive dust from earthmoving activities was quantified using AP-42 emission factors. Fugitive dust emissions from mobile source trips and stockpiling was estimated using AP-42 Chapter 13.2 emission factors.

In addition, potential health risks from toxic air contaminants to nearby sensitive receptors (e.g., local parks, residential areas, and schools) were evaluated based on California Office of Environmental Health Hazard Assessment's (OEHHA's) guidelines (OEHHA 2012). Sensitive receptors are populations that are susceptible to the effects of exposure to air toxics such as children and elderly people. Heavy-duty diesel trucks are a

[1] This replaces OFFROAD2007 for construction and mining equipment.

source of diesel particulate matter, which is classified as a chronic and carcinogenic health risk.

Construction Emission Estimation

The construction emissions were broken down into three categories: off-road equipment exhaust, fugitive dust emissions from construction activities, and on-road mobile source exhaust emissions. Emissions were estimated using emission factors taken from RoadMod which has been updated to incorporate the emission factors from In-Use Off-road Equipment 2011 Inventory Model for the off-road equipment (ARB 2011e). The emission factors for on-road mobile sources are based on EMFAC for the SJVAPCD for calendar year 2014 (ARB 2007b). The fugitive dust emissions from construction equipment and travel on roads are based on AP-42 emission factors. Further details on the specific emission factors used are provided in Appendix 4-A – Tables.

The California Department of Water Resources (DWR) provided construction schedules and equipment lists that were used to determine the number, size, and duration of construction equipment activity.[2] A summary of this information is provided in Appendix 4-A – Tables. Project assumptions include: a constant of 100 workers would be used throughout the Project duration; there would be on average 18 working days per month; workers would travel 35 miles each one-way trip; and material hauling trips would average 135 miles for each one-way trip. The number of material hauling trips and the duration of equipment use varies by alternative based on the type of construction activity, as detailed in Appendix 4-A– Tables. Assumptions were based on information provided by DWR and are consistent with those detailed in the Traffic Analysis in Chapter 22.0.

Fugitive dust occurs from various types of construction activity associated with site preparation, grading, dozing, and loading/unloading material. The EPA’s AP-42 emission factors for Western Surface Coal Mining were used to estimate the emissions from fugitive dust from grading, bulldozing, and material loading and unloading (EPA 1998). On-road mobile sources generate fugitive dust when traveling on paved and unpaved roads. These were estimated using the EPA’s AP-42 emission factors for Paved and Unpaved Roads (EPA 2006, 2011a). Details of these calculations are in Appendix 4-A – Tables.

Operational Emission Estimation

The operational emissions are associated with vehicle traffic of workers to provide maintenance and operation of the Project. The trips were provided by the DWR and other assumptions detailed in the Traffic Analysis. The workers were assumed to travel 35 miles each one-way trip.

The emission factors for on-road mobile sources are conservatively based on EMFAC for the SJVAPCD for calendar year 2014 (ARB 2007b). The fugitive dust emissions travel on roads is based on AP-42 emission factors. Further details on the specific emission factors used are provided in Appendix 4-A – Tables.

[2] If phase duration was not specified, 18 days was assumed.

Health Risk Assessment

The construction equipment and material hauling vehicles emit diesel particulate matter that is classified as a toxic air contaminant. Gasoline-fueled vehicles emit various toxic air contaminants in much smaller quantities and health toxicity compared to diesel particulate matter. Thus, gasoline fueled emission sources have not been included further in this health risk assessment. The emissions of diesel particulate matter sources are used in the health risk assessment and the details of the emission rates used are contained in Appendix 4-A – Tables.

In order to evaluate the impacts of diesel particulate matter on nearby sensitive receptors, a health risk assessment was conducted consistent with OEHHA (OEHHA 2003, 2012) and SJVAPCD guidelines (SJVAPCD 2006) for determining local community risks and hazards. The health risk assessment evaluated the health risks associated with the Project emissions from construction equipment and material hauling vehicles. The detailed information on the methodology and data used to conduct the health risk assessment since air dispersion modeling was required is summarized in Appendix 4-B – Health Risk Assessment Methodology.

4.3.2 Significance Criteria

The Project was evaluated in accordance with the Air Quality section of Appendix G of the CEQA Environmental Checklist and professional judgment on anticipated impacts on air quality. Under the National Environmental Policy Act (NEPA) Council on Environmental Quality (CEQ) Regulations, effects must be evaluated in terms of their context and intensity. These factors have been considered when applying the CEQA Guidelines Appendix G. The Project would result in a significant impact on air quality if it would do any of the following:

- Conflict with or obstruct implementation of the applicable air quality plan.
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable Federal or State ambient air quality standard (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.

The regional criteria pollutant emissions were compared to the SJVAPCD significance thresholds to determine CEQA significance and to the General Conformity Rule *de minimis* thresholds to determine NEPA effects. These thresholds are shown in Table 4-5. If emissions exceed the SJVAPCD significance thresholds, the emissions would have to be mitigated in order for the impacts to be considered less than significant. If emissions exceed the General Conformity Rule *de minimis* thresholds, a general conformity analysis would be required. Construction emissions are compared to these significance thresholds to determine significance impacts. Operational emissions for criteria pollutants are also compared to these significance thresholds.

The health risk analysis used the OEHHA's guidance to estimate the Project's incremental increase in chronic and cancer health risks to nearby sensitive receptors. The OEHHA's guidance provides procedures for determining chronic and cancer risk. It provides guidance on exposure parameters such as breathing rates and provides guidance on how to use the tiered approach to analyze health risk impacts.

The significance threshold for health impacts to sensitive receptors is an incremental increase in cancer risk greater than 10 in a million or an chronic hazard index greater than 1 (SJVAPCD 2002, 2012, 2014).

Table 4-5.
SJVAPCD CEQA and General Conformity Rule *de minimis* Thresholds of Significance

Pollutant	SJVAPCD CEQA Thresholds (tpy)	GCR *de minimis* thresholds (tpy)
Ozone precursor (NO_x)	10	10
Ozone precursor (ROGs)	10	10
Carbon monoxide (CO)	100	N/A
Sulfur oxides (SO_x)	27	N/A
Fine Particulate Matter ($PM_{2.5}$)	15	100
$PM_{2.5}$ precursor (SO_2)	N/A	100
Respirable Particulate Matter (PM_{10})	15	100

Source: EPA 2011b, SJVAPCD 2002, 2012, 2014.
Key:
CEQA = California Environmental Quality Act
GCR = General Conformity Rule
SJVAPCD = San Joaquin Valley Air Pollution Control District
tpy = tons per year

4.3.3 Impacts and Mitigation Measures

This section provides a Project-level evaluation of direct and indirect effects of the Project alternatives on air quality. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to air quality, the environmental impact issues and concerns are the potential to:

1. Create Excess Amounts of Construction Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS.
2. Conflict with Applicable Plans or Policies Related to Air Quality.

3. Expose Sensitive Receptors to Substantial Air Pollutants Associated with Construction.
4. Create Excess Amounts of Operational Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS.
5. Expose Sensitive Receptors to Substantial Air Pollutants Associated with Operation.
6. Create Objectionable Odors from Construction.
7. Create Objectionable Odors from Operation.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these Program-level activities would not achieve Settlement goals. This section describes the impacts of the No-Action Alternative. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact AQ-1 (No-Action Alternative*): Create Excess Amounts of Construction Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS*. Under the No-Action Alternative, the Project would not be implemented and there would be no associated construction activities in the Project area. Therefore, there would be no Project-related construction related criteria air pollutants. As a result, there would be **no impact** on air quality from Project-related construction emissions.

Impact AQ-2 (No-Action Alternative): *Conflict with Applicable Plans or Policies Related to Air Quality*. Under the No-Action Alternative, the Project would not be implemented and there would be no associated construction activities in the Project area. In addition, there would be no change in any sources of operational related emissions in the Project area. This includes any emissions associated with vehicles traveling to the Project area for operation and maintenance of the existing facilities located in the Project area. The SJVAPCD has several plans and policies relating to air emissions in the SJVAB. These specifically address ozone, PM_{10} and $PM_{2.5}$ as these are designated as non-attainment under the State and national AAQS. The No-Action Alternative would not generate any new sources of emissions for construction or operation nor does the existing setting have any significant sources of emissions that would be targeted for reduction by the plans and policies. Therefore, there would be no conflicts with applicable plans or policies related to air quality and this would have **no impact**.

Impact AQ-3 (No-Action Alternative): *Expose Sensitive Receptors to Substantial Air Pollutants Associated with Construction*. Under the No-Action Alternative, the Project would not be implemented and there would be no associated construction activities in the

Project area. Therefore, there would be no construction related toxic air contaminants. As a result, there would be **no impact** on sensitive receptors due to toxic air contaminants.

Impact AQ-4 (No-Action Alternative): ***Create Excess Amounts of Operational Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Under the No-Action Alternative, the Project would not be implemented and there would be no Project-related operational activities in the Project area. Therefore, there would be no operational related criteria air pollutants. As a result, there would be **no impact** on air quality from operational emissions.

Impact AQ-5 (No-Action Alternative): ***Expose Sensitive Receptors to Substantial Air Pollutants Associated with Operation***. Under the No-Action Alternative, the Project would not be implemented and there would be no Project-related operational activities in the Project area. Therefore, there would be no operational related toxic air contaminants. As a result, there would be **no impact** on sensitive receptors due to toxic air contaminants.

Impact AQ-6 (No-Action Alternative): ***Create Objectionable Odors from Construction.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. Therefore, there would be no construction related odors. As a result, there would be **no impact** from odors.

Impact AQ-7 (No-Action Alternative): ***Create Objectionable Odors from Operation*****.** Under the No-Action Alternative, the Project would not be implemented and there would be no Project-related operational activities in the Project area. Therefore, there would be no operational related odors. There are no existing sources of odors in the Project area. As a result; there would be **no impact** from odors.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities including a Compact Bypass channel, a new levee system with a narrow floodplain encompassing the river channel, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure and fish passage facility, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact AQ-1 (Alternative A***): Create Excess Amounts of Construction Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Compared to No-Action, Alternative A would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment, material hauling vehicles, worker commute vehicles, and fugitive dust emissions from construction and travel on roads (Table 4-6). The construction emissions represent the worst-case scenario where none of the borrow materials would be sourced locally and materials would be hauled from more than 100 miles away. These construction emissions were compared to the General Conformity Rule *de minimis* thresholds for NEPA. The General Conformity Rule *de minimis* threshold would be exceeded for NOx and ROG and therefore construction emissions would be substantial.

Total construction emissions were compared to the SJVAPCD's significance thresholds for CEQA. CO, NOx, ROG, PM_{10}, and $PM_{2.5}$ criteria pollutants are above the SJVAPCD annual emissions thresholds which indicate that the Project could cause a significant impact compared to existing conditions. The CO, PM_{10}, and $PM_{2.5}$ emissions were modeled using air dispersion modeling to determine if the concentration including background was below the AAQS or below a significant impact level in the local area. NOx and ROG emissions were not modeled, as these are ozone precursors and contribute to the regional ozone problem.

The modeled 1-hour CO maximum concentration from Project sources is shown in Table 4-7. This was combined with the background concentration based on the average 1-hour concentration for 2010 to 2013. This indicates that at the point of maximum impact, the CO concentration is less than the AAQS. Therefore, modeling indicates that the Project has a less than significant impact for CO.

When modeled, the PM_{10} and $PM_{2.5}$ maximum concentrations from Project sources are shown in Table 4-8. Since the SJVAB is already in non-attainment for both PM_{10} and $PM_{2.5}$, a concentration above the significant impact level would contribute to exceedances of the AAQS. The significant impact levels are based on the Prevention of Significant Deterioration thresholds set by the SJVAPCD. The Fugitive PM_{10} annual significant impact level is 2.08 $\mu g/m^3$. The EPA vacated the $PM_{2.5}$ and Fugitive $PM_{2.5}$ annual significant impact level in 2013. As there is no adopted $PM_{2.5}$ significant impact level, the SJVAPCD recommends using the corresponding PM_{10} significant impact level for both PM_{10} and $PM_{2.5}$ analyses (Villalvazo, pers. comm., 2014). Therefore, 2.08 $\mu g/m^3$ is used as the Fugitive $PM_{2.5}$ annual significant impact level. As shown in Table 4-8 the PM_{10} and $PM_{2.5}$ Project concentrations are below this significance level. Therefore, after modeling, the construction emissions of PM_{10} and $PM_{2.5}$ are less than significant impacts. The calculated fugitive dust emissions would be further reduced if control measures from compliance with SJVAPCD Regulation VIII were quantified; as such, the fugitive dust emissions stated here are conservative because these control measures would be required through mandatory compliance with SJVAPCD Regulation VIII. Compliance with SJVAPCD Regulation VIII would reduce PM_{10} emissions (predominantly dust/dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations.

As discussed above, NOx and ROG are above the SJVAPCD annual emissions thresholds for regional air quality. Therefore, Alternative A would have a **significant** impact for construction-related criteria air pollutants for NOx and ROG.

Table 4-6.
Total Construction Emissions

Alt	Year	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
		Tons per Year					
A	Year 1	23.55		4.15	0.11	7.38	4.13
	Year 2	72.04			0.32		12.89
	Year 3	69.41			0.32		13.37
	Year 4	56.92		9.90	0.27	12.58	7.80
	Year 5	56.13		9.97	0.26		10.45
	Year 6				0.78		
	Year 7				0.78		
	Year 8				0.78		
	Year 9				0.77		
	Year 10				0.70		
B	Year 1	23.93		4.23	0.11	7.80	4.30
	Year 2	72.58			0.32		14.28
	Year 3	68.04			0.31		12.39
	Year 4	61.92			0.30	13.40	8.41
	Year 5	77.79			0.37		13.19
	Year 6				0.72		
	Year 7				0.72		
	Year 8				0.71		
	Year 9				0.72		
	Year 10				0.53		
C	Year 1	23.55		4.15	0.11	7.38	4.13
	Year 2	72.04			0.32		12.89
	Year 3	69.41			0.32		13.37
	Year 4	56.92		9.90	0.27	12.58	7.80
	Year 5	34.45		6.06	0.16	9.05	5.39
	Year 6				0.50		
	Year 7				0.50		
	Year 8				0.50		
	Year 9				0.48		
D	Year 1	23.93		4.23	0.11	7.80	4.30
	Year 2	72.58			0.32		14.28
	Year 3	68.04			0.31		12.39
	Year 4	61.92			0.30	13.40	8.41
	Year 5	59.99			0.29	14.35	8.82
	Year 6				0.50		
	Year 7				0.50		
	Year 8				0.50		
	Year 9				0.48		
SJVAPCD CEQA Threshold		100	10	10	27	15	15
General Conformity *de minimis* Threshold		NA	10	10	NA	100	100

Table 4-6.
Total Construction Emissions

Alt	Year	CO	NOx	ROG	SOx	PM_{10}	$PM_{2.5}$
		Tons per Year					

Notes:
1. Highlighted cells indicate emissions are above the CEQA significance threshold.
Key:
CEQA = California Environmental Quality Act
CO = carbon monoxide
NA = not applicable
NO_X = nitrogen oxides
PM_{10} = particulate matter smaller than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter
ROG = reactive organic gas
SJVAPCD = San Joaquin Valley Air Pollution Control District
SO_X = sulfur oxides

Table 4-7.
Ambient CO Concentrations-1hour

Alternative	Latitude (UTM)	Longitude (UTM)	Project Concentration (mg/m^3)	Background Concentration (mg/m^3)	Ambient air concentration (mg/m^3)
A	742100	4073300	5.30	2.34	7.64
B	742100	4073300	5.50	2.34	7.84
C	742100	4073300	5.51	2.34	7.85
D	742100	4073300	5.51	2.34	7.85

Notes:
To convert from ppm to mg/m^3 at standard conditions, multiply by 1.145.
Key:
UTM = Universal Transverse Mercator coordinate system northing (latitude) and easting (longitude) in meters.
mg/m^3 = milligrams per cubic meter
ppm = parts per million

Table 4-8.
Annual Ambient PM_{10} and $PM_{2.5}$Concentrations

Alternative	PM_{10} Project Concentration ($\mu g/m^3$)	$PM_{2.5}$ Project Concentration ($\mu g/m^3$)
A	1.76	0.82
B	1.34	0.75
C	1.35	0.55
D	1.22	0.77

Key:
$\mu g/m^3$ = micrograms per cubic meter

Mitigation Measure AQ-1A (Alternative A): ***Reduce Criteria Exhaust Emissions from Construction Equipment.*** This mitigation measure will apply to heavy-duty construction equipment used during the construction phase of the Project. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than the average fleet mix as set forth in the ARB's latest Off-road Construction Emission Database. The contractor will document efforts it undertook to locate newer equipment (Tier 4, Tier 3, or Tier 2), alternative fueled equipment (electric, compressed natural gas, or gasoline), and addition of after-market control devices. This will be documented as part of compliance with the SJVAPCD's Indirect Source Review (ISR). The mitigation would reduce criteria exhaust emissions from construction equipment.

Implementation Action: For off-road construction diesel equipment, the contractor will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than the average fleet mix as set forth in the ARB's latest Off-road Construction Emission Database. The contractor will document efforts it undertook to locate newer equipment (Tier 4, Tier 3, or Tier 2), alternative fueled equipment (electric, compressed natural gas, or gasoline), and addition of after-market control devices.

Location: The mitigation will apply to all construction areas.

Effectiveness Criteria: Effectiveness will be based on the emissions calculated based on actual equipment used and operating hours with a minimum performance criteria equal to the average fleet mix as set forth in the ARB's latest Off-road Construction Emission Database. This will be detailed in the Air Impact Assessment and Monitoring and Reporting Schedule submitted to the SJVAPCD in conjunction with ISR Rule 9510.

Responsible Agency: U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and California State Lands Commission (CSLC).

Monitoring/Reporting Action: Adequacy of the proposed practices will be confirmed with Reclamation construction managers and CSLC monitors as detailed in the Monitoring and Reporting Schedule submitted to the SJVAPCD. The SJVAPCD would prepare a Monitoring and Reporting Schedule Compliance letter upon completion.

Timing: Mitigation will be ongoing over the construction timeframe.

Mitigation Measure AQ-1B (Alternative A): ***Reduce Criteria Exhaust Emissions from Material Hauling Vehicles.*** This mitigation measure will apply to material hauling vehicles used during the construction phase of the Project. Material hauling trips will be consolidated into the fewest trips possible. All material-hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than the average fleet mix as set forth in the ARB's latest EMFAC emission database to any vehicle used that the contractor has control over (ARB 2007b). The contractor will document efforts it undertook to locate newer equipment, alternative fueled equipment (electric, compressed natural gas, or gasoline), and addition of after-market control devices. This will be documented as part of compliance with the SJVAPCD's ISR. The mitigation would reduce criteria exhaust emissions from material hauling vehicles.

Implementation Action: For material hauling vehicles, the contractor will consolidate trips into the fewest possible, use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than the average fleet mix as set forth in the ARB's latest EMFAC emission database. The contractor will document efforts it undertook to locate newer equipment, alternative fueled equipment (electric, compressed natural gas, or gasoline), and addition of after-market control devices.

Location: The mitigation will apply to all construction areas.

Effectiveness Criteria: Effectiveness will be based on the emissions calculated based on actual equipment used and operating hours with a minimum performance criteria equal to the average fleet mix as set forth in the ARB's latest EMFAC emission database. This will be detailed in the Air Impact Assessment and Monitoring and Reporting Schedule submitted to the SJVAPCD in conjunction with ISR Rule 9510.

Responsible Agency: Reclamation

Monitoring/Reporting Action: Adequacy of the proposed practices will be confirmed with Reclamation construction managers and CSLC monitors as detailed in the Monitoring and Reporting Schedule submitted to the SJVAPCD. The SJVAPCD would prepare a Monitoring and Reporting Schedule Compliance letter upon completion.

Timing: Mitigation will be ongoing over the construction timeframe.

Mitigation Measure AQ-1C (Alternative A): ***Offset Project Construction Emissions through a SJVAPCD Voluntary Emission Reduction Agreement***. This mitigation measure will require Reclamation to enter into a contractual agreement to mitigate by purchasing offsets to net zero the Project's actual emissions from exhaust equipment for ROG and NOx for any year that the emissions are projected to exceed the significance threshold based on the estimated construction emissions for any funded construction phase. This is required under the General Conformity Rule for projects that are above the *de minimis* threshold for ROG or NOx. The agreement will provide funds to the SJVAPCD's Emission Reduction Incentive Program to fund grants for projects that achieve emission reductions, thus offsetting Project-related impacts on air quality. At a minimum, mitigation/offsets will occur in the year of impact, or as otherwise permitted by 40 CFR Part 93 Section 93.163.

Implementation Action: Reclamation will enter into a contractual agreement to mitigate by purchasing offsets to net zero the Project's actual emissions from exhaust equipment for ROG and NOx for any year that the emissions are projected to exceed the significance threshold based on the estimated construction emissions for any funded construction phase. The mitigation will offset construction emissions by providing funds to the SJVAPCD's Emission Reduction Incentive Program to fund grants for projects that achieve emission reductions.

Location: The mitigation will apply to all construction areas.

Effectiveness Criteria: Effectiveness will be based on actual equipment used and operating hours for any emissions that are not reduced by on-site mitigation. This will be detailed in the Air Impact Assessment and Monitoring and Reporting Schedule submitted to the SJVAPCD in conjunction with ISR Rule 9510.

Responsible Agency: Reclamation

Monitoring/Reporting Action: Adequacy of the proposed practices will be confirmed with the SJVAPCD as detailed in the Monitoring and Reporting Schedule submitted to the SJVAPCD. The SJVAPCD would prepare a Monitoring and Reporting Schedule Compliance letter upon completion.

Timing: Mitigation will be ongoing over the construction timeframe.

Given the current construction phase schedule, the implementation of Mitigation Measures AQ-1A, AQ-1B, and AQ-1C would decrease the ROG and NOx emissions with the remainder of emissions off-set using the Voluntary Emission Reduction Agreement outlined in mitigation measure AQ-1C. In accordance with the SJVAPCD draft GAMAQI, impacts after mitigation would be **less than significant** for Alternative A.

Impact AQ-2 (Alternative A): *Conflict with Applicable Plans or Policies Related to Air Quality*. Compared to No-Action, Alternative A would implement the Project in Reach 2B and there would be short-term construction activities in the Project area. In addition, there would be a change in the operation related emissions of sources in the Project area. This includes emissions associated with vehicles traveling to the Project area for operation and maintenance of the existing facilities located in the Project area.

The SJVAPCD has several plans and policies relating to air emissions in the SJVAB. These specifically address ozone, PM_{10} and $PM_{2.5}$ as these are designated as non-attainment under the State and national AAQS. As part of this plan, the SJVAPCD has established significance thresholds of allowable emissions from Projects that would ensure consistency with these plans as they work to meet attainment of the Federal and State standards. The Project's emissions are above the ROG and NOx *de minimis* emission thresholds established by the General Conformity Rule, which would conflict with plans and policies for obtaining national AAQS.

Compared to existing conditions, Project-related ROGs, NOx, PM_{10}, and $PM_{2.5}$ emissions are above the SJVAPCD's annual significance threshold during Project construction under Alternative A. Dispersion modeling of PM_{10} and $PM_{2.5}$ showed that the incremental increase in concentration of PM_{10} and $PM_{2.5}$ would not exceed the significant impact levels and would not be considered to substantially contribute to further exceedances of the ambient air quality standards. However, since ROG and NOx emissions may exceed the SJVAPCD's annual significance threshold, the Project may impede successful implementation of the State air quality attainment plans. Alternative A would result in a **significant** impact.

Mitigation Measure AQ-2 (Alternative A): ***Reduce or Offset Project Emissions.*** Refer to Mitigation Measures AQ-1A, AQ-1B, and AQ-1C (Alternative A). The same measures would be used here. Since Project-related emissions would be above the General Conformity Rule *de minimis* threshold shown in Table 4-6, the Project must satisfy the General Conformity Rule by either reducing emissions below the threshold, enacting a SIP amendment that includes the Project's ROG and NOx emissions, or purchasing offsets for all ROG and NOx emissions for any year in which the emissions exceed 10 tons per year. Compliance with any of these requirements would ensure that the Project does not conflict with applicable portions of the SIP. The mitigation measures AQ-1A, AQ-1B, and AQ-1C would reduce and/or offset construction emissions. Purchasing offsets will contribute to the SJVAPCD emissions reduction incentive program which is part of the strategies outlined in their plans to reach attainment for both ozone and particulate matter. This fund was highlighted as needing additional funds to reach the anticipated project needs for this program. Therefore, by contributing to this fund to offset the Project emissions, Alternative A impacts would be **less than significant**.

> **Implementation Action:** Reduce or offset project emissions by implementing Mitigation Measures AQ-1A, AQ-1B, and AQ-1C.
>
> **Location:** The mitigation will apply to all construction areas.
>
> **Effectiveness Criteria:** Effectiveness will be based on actual equipment used and operating hours for any emissions that are not reduced by on-site mitigation. This will be detailed in the Air Impact Assessment and Monitoring and Reporting Schedule submitted to the SJVAPCD in conjunction with ISR Rule 9510.
>
> **Responsible Agency:** Reclamation
>
> **Monitoring/Reporting Action:** Adequacy of the proposed practices will be confirmed with the SJVAPCD or Reclamation construction managers and CSLC monitors, as detailed in the Monitoring and Reporting Schedule submitted to the SJVAPCD. The SJVAPCD would prepare a Monitoring and Reporting Schedule Compliance letter upon completion.
>
> **Timing:** Mitigation will be ongoing over the construction timeframe.

Impact AQ-3 (Alternative A): ***Expose Sensitive Receptors to Substantial Air Pollutants Associated with Construction***. Compared to the No-Action Alternative, Alternative A would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment and material hauling vehicles which are diesel fueled. These diesel fueled equipment emit the toxic air contaminant diesel particulate matter. The emissions were estimated and along with air dispersion modeling the concentration in the air was estimated. An exposure assessment and health risk assessment was conducted for sensitive receptors in the Project area. The anticipated health impact for excess cancer risk and chronic hazard index are shown in Table 4-9. The threshold of significance is an increase in excess cancer risk greater than 10 in a million or a chronic hazard index greater than 1.

Table 4-9.
Health Impacts at Maximally Exposed Sensitive Receptor

Receptor Type	Alternative	Latitude (UTM)	Longitude (UTM)	Maximum Carcinogen Risk at Receptor in a million	Chronic Hazard Index
Resident Child	A	739738	4072804	77.36	0.04
	B			78.40	0.03
	C			61.60	0.03
	D			70.80	0.03
School Child	A	733752	4071015	60.30	0.03
	B			54.99	0.02
	C			37.03	0.02
	D			38.43	0.02

Notes:

1. The risk is based on a cancer potency factor for diesel particulate matter of 1.1. Individual years' concentration and age specific factors were used to arrive at the total risk.
2. The chronic hazard index is based on a Reference Exposure Level for diesel particulate matter of 5. The year with the highest concentration was used to calculate the chronic hazard index.

Key:

UTM = Universal Transverse Mercator coordinate system northing (latitude) and easting (longitude) in meters.

Sensitive receptors are projected to have an increase in the excess cancer risk for both resident child and school child exposure scenarios. The resident child would potentially be located along San Mateo Avenue which sees a significant amount of material hauling emissions as well as being located near construction work areas. The school child would be at Washington Elementary and would be exposed to material hauling emissions and construction work areas. There is not anticipated to be any non-cancer health effects since the chronic hazard index is less than 1. However, the health risk assessment indicates an increase in cancer risk above the threshold of 10 in a million for sensitive receptors.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-

Action Alternative). Given the results of the health risk assessment, which indicate that sensitive receptors would have an increase in excess cancer risk above the threshold of 10 in a million, the impact would be **significant**.

Mitigation Measure AQ-3A (Alternative A): ***Reduce Diesel Particulate Matter Emissions from Construction Equipment.*** This mitigation measure will apply to heavy-duty construction equipment used during the construction phase of the Project. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than 85 percent reduction in particulate matter compared to a Tier 2 engine. The mitigation would reduce criteria exhaust emissions from construction equipment.

> **Implementation Action:** For off-road construction diesel equipment, the contractor will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than 85 percent reduction in particulate matter compared to a Tier 2 engine.
>
> **Location:** The mitigation will apply to all construction areas.
>
> **Effectiveness Criteria:** Effectiveness will be based on use of ARB certified after-market control devices or EPA certified engines.
>
> **Responsible Agency:** Reclamation
>
> **Monitoring/Reporting Action:** Adequacy of the proposed practices will be confirmed with Reclamation construction managers and CSLC monitors.
>
> **Timing:** Mitigation will be ongoing over the construction timeframe.

Mitigation Measure AQ-3B (Alternative A): ***Reduce Diesel Particulate Matter Emissions from Material Hauling Vehicles.*** This mitigation measure will apply to material hauling vehicles used during the construction phase of the Project. Material hauling trips will be consolidated into the fewest trips possible. All material-hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than the average fleet mix as set forth in the ARB’s latest EMFAC emission database to any vehicle used that the contractor has control over (ARB 2007b). The contractor will document efforts it undertook to locate newer equipment, alternative fueled equipment (electric, compressed natural gas, or gasoline), and addition of after-market control devices. The mitigation would reduce criteria exhaust emissions from material hauling vehicles.

> **Implementation Action:** For material hauling vehicles, the contractor will consolidate trips into the fewest possible, use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices (e.g., diesel particulate filters), but in no case less clean than the

average fleet mix as set forth in the ARB's latest EMFAC emission database. The contractor will document efforts it undertook to locate newer equipment, alternative fueled equipment (electric, compressed natural gas, or gasoline), and addition of after-market control devices.

Location: The mitigation will apply to all construction areas.

Effectiveness Criteria: Effectiveness will be based on the emissions calculated based on actual equipment used and operating hours with a minimum performance criteria equal to the average fleet mix as set forth in the ARB's latest EMFAC emission database. This will be detailed in the Air Impact Assessment and Monitoring and Reporting Schedule submitted to the SJVAPCD in conjunction with ISR Rule 9510.

Responsible Agency: Reclamation

Monitoring/Reporting Action: Adequacy of the proposed practices will be confirmed with Reclamation construction managers and CSLC monitors as detailed in the Monitoring and Reporting Schedule submitted to the SJVAPCD. The SJVAPCD would prepare a Monitoring and Reporting Schedule Compliance letter upon completion.

Timing: Mitigation will be ongoing over the construction timeframe.

If it is assumed that mitigation measures AQ-3A and AQ-3B could mitigate emissions by 85 percent for Alternative A, which is the maximum estimated if diesel particulate filters can be used by all equipment and trucks, this risk would be reduced to 18.3 in a million for the resident child. The excess cancer risk would still be above 10 in a million. This is due to the size of the construction Project and the receptors' close proximity to the roadway. Alternative A after mitigation would still have a substantial effect on exposure of sensitive receptors to health impacts. After mitigation, Alternative A impacts would remain **significant and unavoidable** in exposing sensitive receptors to substantial air pollutants.

Impact AQ-4 (Alternative A): ***Create Excess Amounts of Operational Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Compared to the No-Action Alternative, Alternative A would implement the Project and there would be some operational activities in the Project area. Operation emissions are estimated to be from workers driving to the Project area to perform routine maintenance and operation activities associated with the water control structures. These emissions were quantified based on the anticipated number of worker trips. The operational emissions are shown in Table 4-10. These operational emissions were compared to the SJVAPCD's significance thresholds and the General Conformity Rule *de minimis* thresholds. The operational emissions do not exceed these thresholds.

Alternative A would also convert active agricultural areas to natural areas and open space reducing agricultural emissions in the Project area. Agricultural field operations, such as tilling, planting, weeding, fertilizing, harvesting, and spreading of manure or compost can produce air pollution emissions from the mechanical movement of soil or from engine operation and fuel combustion. For example, wind erosion can transport dust after tillage (increasing PM_{10}) and fertilizer used for crops release ammonia to the atmosphere which mixes with other emissions to form microscopic airborne particles (increasing $PM_{2.5}$).

When comparing Alternative A to existing conditions, impacts would be similar to those described in in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Therefore, the operational related criteria air pollutants would result in a **less than significant** impact**.**

Table 4-10.
Total Operational Emissions

Alt	CO	NOx	ROG	SOx	PM_{10} Exhaust	PM_{10} Fugitive	PM_{10} Total	$PM_{2.5}$ Exhaust	$PM_{2.5}$ Fugitive	$PM_{2.5}$ Total
	tons									
A	0.032	0.004	0.002	0.0001	0.0005	0.024	0.0243	0.0003	0.006	0.0062
B	0.032	0.004	0.002	0.0001	0.0005	0.025	0.0256	0.0003	0.006	0.0066
C	0.032	0.004	0.002	0.0001	0.0005	0.025	0.0257	0.0003	0.006	0.0066
D	0.031	0.004	0.002	0.0001	0.0005	0.026	0.0262	0.0003	0.006	0.0067
SJVAPCD CEQA Threshold	100	10	10	27	NA	NA	15	NA	NA	15
General Conformity *de minimis* Threshold	NA	10	10	NA	NA	NA	100	NA	NA	100

Notes:

[1.] Emission factors are based on EMFAC for 2014 to be conservative as the starting year of operation varies (ARB 2007b).

[2.] Fugitive dust emissions are from travel on paved roads based on AP-42 Chapter 13.1.

Key:

CEQA = California Environmental Quality Act
CO = carbon monoxide
NA = not applicable
NO_X = nitrogen oxides
PM_{10} = particulate matter smaller than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter
ROG = reactive organic gas
SJVAPCD = San Joaquin Valley Air Pollution Control District
SO_X = sulfur oxides

Impact AQ-5 (Alternative A): *Expose Sensitive Receptors to Substantial Air Pollutants Associated with Operation*. Compared to the No-Action Alternative, Alternative A would implement the Project and there would be operational activities in the Project area. Operational activities would be associated with workers driving to the site to perform routine maintenance and operation activities associated with the water control structures. Most of these vehicles would be gasoline fueled and the gasoline exhaust has significantly less toxicity compared to diesel exhaust. The number of additional trips added to the area near sensitive receptors is minimal. Therefore, there would not be a substantial source of operational related toxic air contaminants.

When comparing Alternative A to existing conditions, impacts would be similar to those described in in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). As a result, there would be a **less than significant** impact on sensitive receptors due to toxic air contaminants from Project operation.

Impact AQ-6 (Alternative A): ***Create Objectionable Odors from Construction.*** Compared to the No-Action Alternative, Alternative A would implement the Project and there would be construction activities in the Project area. Construction equipment and material hauling vehicles using diesel fuel may emit objectionable odors associated with combustion of the diesel fuel. However, these emissions would be transitory.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). Therefore, odor impacts associated with diesel combustion during construction activities would be a **less than significant** impact from odors.

Impact AQ-7 (Alternative A): ***Create Objectionable Odors from Operation*****.** Compared to the No-Action Alternative, Alternative A would implement the Project and there would be operational activities in the Project area. The operational activities are associated with workers commuting to the Project area to perform routine operation and maintenance. The worker vehicles are not expected to noticeably increase the amount of odors associated with traffic along roads in the Project area.

When comparing Alternative A to existing conditions, impacts would be similar to those described in in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). Therefore, odor impacts associated with operational activities would result in a **less than significant** impact.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility. Other key features include construction of a fish passage facility at the San Joaquin River control structure of the Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass Control Structure), and removal of the San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Impact AQ-1 (Alternative B*): Create Excess Amounts of Construction Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS*. Compared to No-Action, Alternative B would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment, material hauling vehicles, worker commute vehicles, and fugitive dust emissions from construction and travel on roads. The construction emissions shown in Table 4-6 were compared to the General Conformity Rule *de minimis* threshold for NEPA. The General

Conformity Rule *de minimis* threshold would be exceeded for NOx and ROG and therefore construction emissions would be substantial.

Total construction emissions were compared to the SJVAPCD's significance thresholds for CEQA. CO, NOx, ROG, PM_{10}, and $PM_{2.5}$ criteria pollutants are above the annual emissions thresholds which indicate that the Project could cause a significant impact compared to existing conditions. The CO, PM_{10}, and $PM_{2.5}$ emissions were modeled using air dispersion modeling to determine if the concentration, including background, was below the AAQS or below a significant impact level in the local area. NOx and ROG emissions were not modeled as these are ozone precursors and contribute to the regional ozone problem.

The modeled CO maximum concentration from Project sources is shown in Table 4-7. This was combined with the background concentration based on the average 1 hour for 2010 to 2013. This indicates that at the point of maximum impact, the CO concentration is less than the AAQS. Therefore the Project, after modeling, indicates that there is less than significant impact for CO.

The modeled PM_{10} and $PM_{2.5}$ maximum concentrations from Project sources are shown in Table 4-8. Since the SJVAB is already in non-attainment for both PM_{10} and $PM_{2.5}$, a concentration above the significant impact level would contribute to the existing exceedances of the AAQS. The significant impact levels are based on the Prevention of Significant Deterioration thresholds set by the SJVAPCD. The Fugitive PM_{10} annual significant impact level is 2.08 $\mu g/m^3$. The EPA vacated the $PM_{2.5}$ and Fugitive $PM_{2.5}$ annual significant impact level in 2013. As there is no adopted $PM_{2.5}$ significant impact level, the SJVAPCD recommends using the corresponding PM_{10} significant impact level for both PM_{10} and $PM_{2.5}$ analyses (Villalvazo, pers. comm., 2014). Therefore, 2.08 $\mu g/m^3$ is used as the Fugitive $PM_{2.5}$ annual significant impact level. As shown in Table 4-8 the PM_{10} and $PM_{2.5}$ Project concentrations are below this significance level. Therefore, the construction emissions of PM_{10} and $PM_{2.5}$ are less than significant impacts. The calculated fugitive dust emissions would be further reduced if control measures from compliance with SJVAPCD Regulation VIII were quantified; as such, the fugitive dust emissions stated here are conservative because these control measures would be required through mandatory compliance with SJVAPCD Regulation VIII. Compliance with SJVAPCD Regulation VIII would reduce PM_{10} emissions (predominantly dust/dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations.

As discussed above, NOx, ROG are above the SJVAPCD annual emissions thresholds for regional air quality. Therefore, Alternative B would cause a **significant** impact for construction-related criteria air pollutants for NOx and ROG.

Mitigation Measure AQ-1A (Alternative B): ***Reduce Criteria Exhaust Emissions from Construction Equipment.*** Refer to Mitigation Measure AQ-1A (Alternative A). The same measure would be used here. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-1B (Alternative B): ***Reduce Criteria Exhaust Emissions from Material Hauling Vehicles.*** Refer to Mitigation Measure AQ-1B (Alternative A). The same measure would be used here. Material hauling trips will be consolidated into the fewest trips possible. All material hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-1C (Alternative B): ***Offset Project Construction Emissions through a SJVAPCD Voluntary Emission Reduction Agreement***. Refer to Mitigation Measure AQ-1C (Alternative A). The same measure would be used here. This mitigation measure will require Reclamation to enter into a contractual agreement to mitigate by purchasing offset to net zero the Project's actual emissions from exhaust equipment for ROG and NOx.

Implementation of these mitigation measures would decrease the ROG and NOx emissions with the remainder of emissions off-set using the Voluntary Emission Reduction Agreement outlined in mitigation measure AQ-1C. According to the SJVAPCD draft GAMAQI, impacts after mitigation would be **less than significant**.

Impact AQ-2 (Alternative B): ***Conflict with Applicable Plans or Policies Related to Air Quality***. Compared to No-Action, Alternative B would implement the Project and there would be short-term construction activities in the Project area. In addition, there would be a change in the operations related emissions from sources in the Project area. This includes emissions associated with vehicles traveling to the Project area for operation and maintenance of the existing facilities located in the Project area. The SJVAPCD has several plans and policies relating to air emissions in the SJVAB. These specifically address ozone, PM_{10} and $PM_{2.5}$ as these are designated as non-attainment under the State and national AAQS. As part of this plan the SJVAPCD has established significance thresholds of allowable emissions from Projects that would ensure consistency with these plans as they work to meet attainment of the Federal and State standards. These thresholds of significance are also consistent with the General Conformity Rule *de minimis* thresholds. The Project's emissions are above the ROG and NOx emission thresholds established by the General Conformity Rule. This would conflict with plans and policies for obtaining national AAQS.

Compared to existing conditions, Project emissions of ROG, NOx, PM_{10}, and $PM_{2.5}$ are above the SJVAPCD's annual significance threshold during Project construction under Alternative B. Dispersion modeling of PM_{10} and $PM_{2.5}$ showed that the incremental increase in concentration of PM_{10} and $PM_{2.5}$ would not exceed the significant impact levels and would not be considered to substantially contribute to further exceedances of the ambient air quality standards. However, since ROG and NOx emissions may exceed the SJVAPCD's annual significance threshold, the Project may impede the implementation of the State air quality attainment plans. Alternative B would result in a **significant** impact.

Mitigation Measure AQ-2 (Alternative B): ***Reduce or Offset Project Emissions.*** Refer to Mitigation Measure AQ-2 (Alternative A). The same measure would be used here. This mitigation measure would reduce criteria exhaust emissions from construction equipment and material hauling vehicles and would offset project construction emissions through a SJVAPCD Voluntary Emission Reduction Agreement. Impacts after mitigation would be **less than significant**.

Impact AQ-3 (Alternative B): ***Expose Sensitive Receptors to Substantial Air Pollutants Associated with Construction***. Compared to the No-Action Alternative, Alternative B would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment and material hauling vehicles which are diesel fueled. These diesel fueled equipment emit the toxic air contaminant diesel particulate matter. The emissions were estimated and along with air dispersion modeling the concentration in the air was estimated. An exposure assessment and health risk assessment was conducted for sensitive receptors in the Project area. The anticipated health impact for excess cancer risk and chronic hazard index are shown in Table 4-9. The threshold of significance is an increase in excess cancer risk greater than 10 in a million or a chronic hazard index greater than 1.

Sensitive receptors are projected to have an increase in the excess cancer risk for both a resident child and school child exposure scenario. The resident child is located along San Mateo Avenue which sees a significant amount of material hauling emissions as well as being located near construction work areas. The school child is at Washington Elementary and is exposed to material hauling emissions and construction work areas. There is not anticipated to be any non-cancer health effects since the chronic hazard index is less than 1. However, the health risk assessment indicates an increase in cancer risk above the threshold of 10 in a million for sensitive receptors.

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Given the results of the health risk assessment which indicate that sensitive receptors would have an increase in excess cancer risk above the threshold of 10 in a million, the impact would be **significant**.

Mitigation Measure AQ-3A (Alternative B): ***Reduce Diesel Particulate Matter Emissions from Construction Equipment.*** Refer to Mitigation Measure AQ-3A (Alternative A). The same measure would be used here. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-3B (Alternative B): ***Reduce Diesel Particulate Matter Emissions from Material Hauling Vehicles.*** Refer to Mitigation Measure AQ-3B (Alternative A). The same measure would be used here. Material hauling trips will be consolidated into the fewest trips possible. All material hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

If it is assumed that mitigation measures AQ-3A and AQ-3B could mitigate emissions by 85 percent which is the maximum estimated if diesel particulate filters can be used by all equipment and trucks, the risk associated with Alternative B would be reduced to 17.85 in a million for the resident child. The excess cancer risk would still be above 10 in a million. This is due to the size of the construction project and the receptors' close proximity to the roadway. Alternative B after mitigation would still have a substantial effect on exposure of sensitive receptors to health impacts. After mitigation, Alternative B impacts would remain **significant and unavoidable** in exposing sensitive receptors to substantial air pollutants.

Impact AQ-4 (Alternative B): ***Create Excess Amounts of Operational Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Compared to the No-Action Alternative, Alternative B would implement the Project and there would be some operational activities in the Project area. Operation emissions are estimated to be from workers driving to the Project area to do routine maintenance and operation activities associated with the water control structures. There are no other sources of emissions anticipated with operation of the Project. These emissions were quantified based on the anticipated number of worker trips. The operational emissions are shown in Table 4-10. These operational emissions were compared to the SJVAPCD's significance thresholds and the General Conformity Rule *de minimis* thresholds. The operational emissions do not exceed these thresholds.

Alternative B would also convert active agricultural areas to natural areas and open space reducing agricultural emissions in the Project area. Agricultural field operations, such as tilling, planting, weeding, fertilizing, harvesting, and spreading of manure or compost can produce air pollution emissions from the mechanical movement of soil or from engine operation and fuel combustion.

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Therefore, the operational related criteria air pollutants would result in a **less than significant** impact.

Impact AQ-5 (Alternative B): ***Expose Sensitive Receptors to Substantial Air Pollutants Associated with Operation***. Compared to the No-Action Alternative, Alternative B would implement the Project and there would be operational activities in the Project area. Operational activities would be associated with workers driving to the site to perform routine maintenance and operation activities associated with the water control structures. Most of these vehicles would be gasoline fueled and the gasoline exhaust has significantly less toxicity compared to diesel exhaust. The number of additional trips added to the area near sensitive receptors is minimal. Therefore, there would not be a substantial source of operational related toxic air contaminants.

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-

Action Alternative). As a result, there would be a **less than significant** impact on sensitive receptors due to toxic air contaminants from operation of Alternative B.

Impact AQ-6 (Alternative B): *Create Objectionable Odors from Construction.* Compared to the No-Action Alternative, Alternative B would implement the Project and there would be construction activities in the Project area. Construction equipment and material hauling vehicles using diesel fuel may emit objectionable odors associated with combustion of the diesel fuel. However, these emissions would be transitory.

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). Therefore, odor impacts of Alternative B associated with diesel combustion during construction activities would be a **less than significant** impact from odors.

Impact AQ-7 (Alternative B): *Create Objectionable Odors from Operation*. Compared to the No-Action Alternative, Alternative B would implement the Project and there would be operational activities in the Project area. The operational activities are associated with workers commuting to the Project area to perform routine operation and maintenance. The worker vehicles are not expected to noticeably increase the amount of odors associated with traffic along roads in the Project area.

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). Therefore, odor impacts of Alternative B associated with operational activities would result in a **less than significant** impact.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, construction of a fish passage facility at the San Joaquin River control structure of the Chowchilla Bifurcation Structure, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Impact AQ-1 (Alternative C*): Create Excess Amounts of Construction Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS*. Compared to No-Action, Alternative C would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment, material hauling vehicles, worker commute vehicles, and fugitive dust emissions from construction and travel on roads. These construction emissions shown in Table 4-6 were compared to the General Conformity Rule *de minimis* thresholds for NEPA. The General Conformity Rule *de minimis* threshold would be exceeded for NOx and ROG and therefore construction emissions would be substantial.

Total construction emissions were compared to the SJVAPCD's significance thresholds for CEQA. CO, NOx, ROG, PM_{10}, and $PM_{2.5}$ criteria pollutants are above the annual emissions thresholds which indicate that the Project could cause a significant impact compared to existing conditions. The CO, PM_{10}, and $PM_{2.5}$ emissions were modeled using air dispersion modeling to determine if the concentration including background was below the AAQS or below a significant impact level in the local area. NOx and ROG emissions were not modeled as these are ozone precursors and contribute to the regional ozone problem.

The modeled CO maximum concentration from project sources is shown in Table 4-7. This was combined with the background concentration based on the average 1 hour for 2010 to 2013. This indicates that at the point of maximum impact, the CO concentration is less than the AAQS. Therefore the Project, after modeling, indicates that it is less than significant impact for CO.

The modeled PM_{10} and $PM_{2.5}$ maximum concentrations from Project sources are shown in Table 4-8. Since the SJVAB is already significant for both PM_{10} and $PM_{2.5}$, a significant impact would significantly contribute to the existing exceedances of the AAQS. These significant impact levels are based on the Prevention of Significant Deterioration thresholds set by the SJVAPCD. The Fugitive PM_{10} annual significant impact level is 2.08 $\mu g/m^3$. The EPA vacated the $PM_{2.5}$ and Fugitive $PM_{2.5}$ annual significant impact level in 2013. As there is no adopted $PM_{2.5}$ significant impact level, the SJVAPCD recommends using the corresponding PM_{10} significant impact level for both PM_{10} and $PM_{2.5}$ analyses (Villalvazo, pers. comm., 2014). Therefore, 2.08 $\mu g/m^3$ is used as the Fugitive $PM_{2.5}$ annual significant impact level. As shown in Table 4-8 the PM_{10} and $PM_{2.5}$ Project concentrations are below this significance level. Therefore, after modeling, the construction emissions of PM_{10} and $PM_{2.5}$ are less than significant impacts. The calculated fugitive dust emissions would be further reduced if control measures from compliance with SJVAPCD Regulation VIII were quantified; as such, the fugitive dust emissions stated here are conservative because these control measures would be required through mandatory compliance with SJVAPCD Regulation VIII. Compliance with SJVAPCD Regulation VIII would reduce PM_{10} emissions (predominantly dust/dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations.

As discussed above, NOx, ROG are above the SJVAPCD annual emissions thresholds for regional air quality. Therefore, Alterative C would cause a **significant** impact for construction-related criteria air pollutants for NOx and ROG.

Mitigation Measure AQ-1A (Alternative C): ***Reduce Criteria Exhaust Emissions from Construction Equipment.*** Refer to Mitigation Measure AQ-1A (Alternative A). The same measure would be used here. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-1B (Alternative C): ***Reduce Criteria Exhaust Emissions from Material Hauling Vehicles.*** Refer to Mitigation Measure AQ-1B (Alternative A). The same measure would be used here. Material hauling trips will be consolidated into the fewest trips possible. All material hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-1C (Alternative C): ***Offset Project Construction Emissions through a SJVAPCD Voluntary Emission Reduction Agreement***. Refer to Mitigation Measure AQ-1C (Alternative A). The same measure would be used here. This mitigation measure will require Reclamation to enter into a contractual agreement to mitigate by purchasing offset to net zero the project's actual emissions from equipment exhaust for ROG and NOx.

Implementation of these mitigation measures would decrease the ROG and NOx emissions with the remainder of emissions off-set using the Voluntary Emission Reduction Agreement outlined in mitigation measure AQ-1C. According to the SJVAPCD draft GAMAQI, impacts after mitigation would be **less than significant**.

Impact AQ-2 (Alternative C): ***Conflict with Applicable Plans or Policies Related to Air Quality***. Compared to No-Action, Alternative C would implement the Project and there would be short-term construction activities in the Project area. In addition, there would be a change in the operations related emissions from sources in the Project area. This includes emissions associated with vehicles traveling to the Project area for operation and maintenance of the existing facilities located in the Project area. The SJVAPCD has several plans and policies relating to air emissions in the SJVAB. These specifically address ozone, PM_{10} and $PM_{2.5}$ as these are designated as non-attainment under the State and national AAQS. As part of this plan the SJVAPCD has established significance thresholds of allowable emissions from Projects that would ensure consistency with these plans as they work to meet attainment of the Federal and State standards. These thresholds of significance are also consistent with the General Conformity Rule *de minimis* thresholds. The Project's emissions are above the ROG and NOx emission thresholds established by the General Conformity Rule. This would conflict with plans and policies for obtaining national AAQS.

Compared to existing conditions, Project emissions of ROG, NOx, PM_{10}, and $PM_{2.5}$ are above the SJVAPCD's annual significance threshold during Project construction under Alternative C. Dispersion modeling of PM_{10} and $PM_{2.5}$ showed that the incremental increase in concentration of PM_{10} and $PM_{2.5}$ would not exceed the significant impact levels and would not be considered to substantially contribute to further exceedances of the ambient air quality standards. However, since ROG and NOx emissions may exceed the SJVAPCD's annual significance threshold, the Project may impede the implementation of the State air quality attainment plans. Alternative C would result in a **significant** impact.

Mitigation Measure AQ-2 (Alternative C): ***Reduce or Offset Project Emissions.*** Refer to Mitigation Measure AQ-2 (Alternative A). The same measure would be used here.

This mitigation measure would reduce criteria exhaust emissions from construction equipment and material hauling vehicles and would offset project construction emissions through a SJVAPCD Voluntary Emission Reduction Agreement. Impacts after mitigation would be **less than significant**.

Impact AQ-3 (Alternative C): *Expose Sensitive Receptors to Substantial Air Pollutants Associated with Construction*. Compared to the No-Action Alternative, Alternative C would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment and material hauling vehicles which are diesel fueled. These diesel fueled equipment emit the toxic air contaminant diesel particulate matter. The emissions were estimated and along with air dispersion modeling the concentration in the air was estimated. An exposure assessment and health risk assessment was conducted for sensitive receptors in the Project area. The anticipated health impact for excess cancer risk and chronic hazard index are shown in Table 4.9. The threshold of significance is an increase in excess cancer risk greater than 10 in a million or a chronic hazard index greater than 1.

Sensitive receptors are projected to have an increase in the excess cancer risk for both a resident child and school child exposure scenario. The resident child is located along San Mateo Avenue which sees a significant amount of material hauling emissions as well as being located near construction work areas. The school child is at Washington Elementary and is exposed to material hauling emissions and construction work areas. There is not anticipated to be any non-cancer health effects since the chronic hazard index is less than 1. However, the health risk assessment indicates an increase in cancer risk above the threshold of 10 in a million for sensitive receptors.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Given the results of the health risk assessment which indicate that sensitive receptors would have an increase in excess cancer risk above the threshold of 10 in a million, the impact would be **significant**.

Mitigation Measure AQ-3A (Alternative C): *Reduce Diesel Particulate Matter Emissions from Construction Equipment.* Refer to Mitigation Measure AQ-3A (Alternative A). The same measure would be used here. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-3B (Alternative C): *Reduce Diesel Particulate Matter Emissions from Material Hauling Vehicles.* Refer to Mitigation Measure AQ-3B (Alternative A). The same measure would be used here. Material hauling trips will be consolidated into the fewest trips possible. All material hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

If it is assumed that mitigation measures AQ-3A and AQ-3B could mitigate emissions by 85 percent which is the maximum estimated if diesel particulate filters can be used by all equipment and trucks, the risk associated with Alternative C would be reduced to 13.95 in a million for the resident child. The excess cancer risk would still be above 10 in a million. This is due to the size of the construction project and the receptors' close proximity to the roadway. Alternative C after mitigation would still have a substantial effect on exposure of sensitive receptors to health impacts. After mitigation, Alternative C impacts would remain **significant and unavoidable** in exposing sensitive receptors to substantial air pollutants.

Impact AQ-4 (Alternative C): ***Create Excess Amounts of Operational Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Compared to the No-Action Alternative, Alternative C would implement the Project and there would be some operational activities in the Project area. Operation emissions are estimated to be from workers driving to the Project area to do routine maintenance and operation activities associated with the water control structures. There are no other sources of emissions anticipated with operation of the Project. These emissions were quantified based on the anticipated number of worker trips. The operational emissions are shown in Table 4-10.These operational emissions were compared to the SJVAPCD's significance thresholds and the General Conformity Rule *de minimis* thresholds. The operational emissions do not exceed these thresholds.

Alternative C would also convert active agricultural areas to natural areas and open space reducing agricultural emissions in the Project area. Agricultural field operations, such as tilling, planting, weeding, fertilizing, harvesting, and spreading of manure or compost can produce air pollution emissions from the mechanical movement of soil or from engine operation and fuel combustion.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Therefore, the operational related criteria air pollutants would result in a **less than significant** impact.

Impact AQ-5 (Alternative C): ***Expose Sensitive Receptors to Substantial Air Pollutants Associated with Operation***. Compared to the No-Action Alternative, Alternative C would implement the Project and there would be operational activities in the Project area. Operational activities would be associated with workers driving to the site to perform routine maintenance and operation activities associated with the water control structures. Most of these vehicles would be gasoline fueled and the gasoline exhaust has significantly less toxicity compared to diesel exhaust. The number of additional trips added to the area near sensitive receptors is minimal. Therefore, there would not be a substantial source of operational related toxic air contaminants.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to the No-

Action Alternative). As a result, there would be a **less than significant** impact on sensitive receptors due to toxic air contaminants from operation of Alternative C.

Impact AQ-6 (Alternative C): ***Create Objectionable Odors from Construction.*** Compared to the No-Action Alternative, Alternative C would implement the Project and there would be construction activities in the Project area. Construction equipment and material hauling vehicles using diesel fuel may emit objectionable odors associated with combustion of the diesel fuel. However, these emissions would be transitory.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to the No-Action Alternative). Therefore, odor impacts of Alternative C associated with diesel combustion during construction activities would be a **less than significant** impact from odors.

Impact AQ-7 (Alternative C): ***Create Objectionable Odors from Operation*****.** Compared to the No-Action Alternative, Alternative C would implement the Project and there would be operational activities in the Project area. The operational activities are associated with workers commuting to the Project area to perform routine operation and maintenance. The worker vehicles are not expected to noticeably increase the amount of odors associated with traffic along roads in the Project area.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to the No-Action Alternative). Therefore, odor impacts of Alternative C associated with operational activities would result in a **less than significant** impact.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the North Canal bifurcation structure, and the North Canal fish passage facility, removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Impact AQ-1 (Alternative D***): Create Excess Amounts of Construction Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Compared to No-Action, Alternative D would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment, material hauling vehicles, worker commute vehicles, and fugitive dust emissions from construction and travel on roads. The construction emissions shown in Table 4-6 were compared to the General Conformity Rule *de minimis* thresholds for NEPA. The General Conformity Rule *de minimis* threshold would be exceeded for NOx and ROG and therefore construction emissions would be substantial.

Total construction emissions were compared to the SJVAPCD's significance thresholds for CEQA. CO, NOx, ROG, PM_{10}, and $PM_{2.5}$ criteria pollutants are above the annual emissions thresholds which indicate that the Project could cause a significant impact compared to existing conditions. The CO, $PM_{10,}$ and $PM_{2.5}$ emissions were modeled using air dispersion modeling to determine if the concentration including background was below the AAQS or below a significant impact level in the local area. NOx and ROG emissions were not modeled as these are ozone precursors and contribute to the regional ozone problem.

The modeled CO maximum concentration from project sources is shown in Table 4-7. This was combined with the background concentration based on the average 1 hour for 2010 to 2013. This indicates that at the point of maximum impact, the CO concentration is less than the AAQS. Therefore the Project, after modeling, indicates that it is less than significant impact for CO.

The modeled PM_{10} and $PM_{2.5}$ maximum concentrations from Project sources are shown in Table 4-8. Since the SJVAB is already significant for both PM_{10} and $PM_{2.5}$, a significant impact would significantly contribute to the existing exceedances of the AAQS. These significant impact levels are based on the Prevention of Significant Deterioration thresholds set by the SJVAPCD. The Fugitive PM_{10} annual significant impact level is 2.08 $\mu g/m^3$. The EPA vacated the $PM_{2.5}$ and Fugitive $PM_{2.5}$ annual significant impact level in 2013. As there is no adopted $PM_{2.5}$ significant impact level, the SJVAPCD recommends using the corresponding PM_{10} significant impact level for both PM_{10} and $PM_{2.5}$ analyses (Villalvazo, pers. comm., 2014). Therefore, 2.08 $\mu g/m^3$ is used as the Fugitive $PM_{2.5}$ annual significant impact level. As shown in Table 4-8 the PM_{10} and $PM_{2.5}$ Project concentrations are below this significance level. Therefore, after modeling, the construction emissions of PM_{10} and $PM_{2.5}$ are less than significant impacts. The calculated fugitive dust emissions would be further reduced if control measures from compliance with SJVAPCD Regulation VIII were quantified; as such, the fugitive dust emissions stated here are conservative because these control measures would be required through mandatory compliance with SJVAPCD Regulation VIII. Compliance with SJVAPCD Regulation VIII would reduce PM_{10} emissions (predominantly dust/dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations.

As discussed above, NOx, ROG are above the SJVAPCD annual emissions thresholds for regional air quality. Therefore, Alternative D would cause a **significant** impact for construction-related criteria air pollutants for NOx and ROG.

Mitigation Measure AQ-1A (Alternative D): ***Reduce Criteria Exhaust Emissions from Construction Equipment.*** Refer to Mitigation Measure AQ-1A (Alternative A). The same measure would be used here. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-1B (Alternative D): ***Reduce Criteria Exhaust Emissions from Material Hauling Vehicles.*** Refer to Mitigation Measure AQ-1B (Alternative A). The same measure would be used here. Material hauling trips will be consolidated into the fewest trips possible. All material hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-1C (Alternative D): ***Offset Project Construction Emissions through a SJVAPCD Voluntary Emission Reduction Agreement***. Refer to Mitigation Measure AQ-1C (Alternative A). The same measure would be used here. This mitigation measure will require Reclamation to enter into a contractual agreement to mitigate by purchasing offset to net zero the project's actual emissions from equipment exhaust for ROG and NOx.

Implementation of these mitigation measures would decrease the ROG and NOx emissions with the remainder of emissions off-set using the Voluntary Emission Reduction Agreement outlined in mitigation measure AQ-1C. According to the SJVAPCD draft GAMAQI, impacts after mitigations would be **less than significant**.

Impact AQ-2 (Alternative D): ***Conflict with Applicable Plans or Policies Related to Air Quality***. Compared to No-Action, Alternative D would implement the Project and there would be short-term construction activities in the Project area. In addition, there would be a change in the operations related emissions from sources in the Project area. This includes emissions associated with vehicles traveling to the Project area for operation and maintenance of the existing facilities located in the Project area. The SJVAPCD has several plans and policies relating to air emissions in the SJVAB. These specifically address ozone, $PM_{10,}$ and $PM_{2.5,}$ as these are designated as non-attainment under the State and national AAQS. As part of this plan the SJVAPCD has established significance thresholds of allowable emissions from Projects that would ensure consistency with these plans as they work to meet attainment of the Federal and State standards. These thresholds of significance are also consistent with the General Conformity Rule *de minimis* thresholds. The Project's emissions are above the ROG and NOx emission thresholds established by the General Conformity Rule. This would conflict with plans and policies for obtaining national AAQS.

Compared to existing conditions, Project emissions of ROG, NOx, PM_{10}, and $PM_{2.5}$ are above the SJVAPCD's annual significance threshold during Project construction under Alternative D. Dispersion modeling of PM_{10} and $PM_{2.5}$ showed that the incremental increase in concentration of PM_{10} and $PM_{2.5}$ would not exceed the significant impact levels and would not be considered to substantially contribute to further exceedances of the ambient air quality standards. However, since ROG and NOx emissions may exceed the SJVAPCD's annual significance threshold, the Project may impede the implementation of the State air quality attainment plans. Alternative D would results in a **significant** impact.

Mitigation Measure AQ-2 (Alternative D): ***Reduce or Offset Project Emissions.*** Refer to Mitigation Measure AQ-2 (Alternative A). The same measure would be used here.

This mitigation measure would reduce criteria exhaust emissions from construction equipment and material hauling vehicles and would offset project construction emissions through a SJVAPCD Voluntary Emission Reduction Agreement. Impacts after mitigation would be **less than significant**.

Impact AQ-3 (Alternative D): *Expose Sensitive Receptors to Substantial Air Pollutants Associated with Construction*. Compared to the No-Action Alternative, Alternative D would implement the Project and there would be short-term construction activities in the Project area. Construction emissions were estimated for the off-road construction equipment and material hauling vehicles which are diesel fueled. These diesel fueled equipment emit the toxic air contaminant diesel particulate matter. The emissions were estimated and along with air dispersion modeling the concentration in the air was estimated. An exposure assessment and health risk assessment was conducted for sensitive receptors in the Project area. The anticipated health impact for excess cancer risk and chronic hazard index are shown in Table 4-9. The threshold of significance is an increase in excess cancer risk greater than 10 in a million or a chronic hazard index greater than 1.

Sensitive receptors are projected to have an increase in the excess cancer risk for both a resident child and school child exposure scenario. The resident child is located along San Mateo Avenue which sees a significant amount of material hauling emissions as well as being located near construction work areas. The school child is at Washington Elementary and is exposed to material hauling emissions and construction work areas. There is not anticipated to be any non-cancer health effects since the chronic hazard index is less than 1. However, the health risk assessment indicates an increase in cancer risk above the threshold of 10 in a million for sensitive receptors.

When comparing Alternative D to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Given the results of the health risk assessment which indicate that sensitive receptors would have an increase in excess cancer risk above the threshold of 10 in a million, the impact would be **significant**.

Mitigation Measure AQ-3A (Alternative D): *Reduce Diesel Particulate Matter Emissions from Construction Equipment.* Refer to Mitigation Measure AQ-3A (Alternative A). The same measure would be used here. All off-road construction diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

Mitigation Measure AQ-3B (Alternative D): *Reduce Diesel Particulate Matter Emissions from Material Hauling Vehicles.* Refer to Mitigation Measure AQ-3B (Alternative A). The same measure would be used here. Material hauling trips will be consolidated into the fewest trips possible. All material hauling diesel equipment will use the cleanest reasonably available equipment or consider alternative fueled equipment or addition of after-market control devices.

If it is assumed that mitigation measures AQ-3A and AQ-3B could mitigate emissions by 85 percent which is the maximum estimated if diesel particulate filters can be used by all equipment and trucks, the risk associated with Alternative D would be reduced to 16.65 in a million for the resident child. The excess cancer risk would still be above 10 in a million. This is due to the size of the construction project and the receptors' close proximity to the roadway. Alternative D after mitigation would still have a substantial effect on exposure of sensitive receptors to health impacts. After mitigation, Alternative D impacts would remain **significant and unavoidable** in exposing sensitive receptors to substantial air pollutants.

Impact AQ-4 (Alternative D): ***Create Excess Amounts of Operational Related Criteria Air Pollutants that Exceed SJVAPCD Thresholds of Significance or Cause or Contribute to Exceedances of the AAQS***. Compared to the No-Action Alternative, Alternative A would implement the Project and there would be some operational activities in the Project area. Operation emissions are estimated to be from workers driving to the Project area to do routine maintenance and operation activities associated with the water control structures. There are no other sources of emissions anticipated with operation of the Project. These emissions were quantified based on the anticipated number of worker trips. The operational emissions are shown in Table 4-10. These operational emissions were compared to the SJVAPCD's significance thresholds and the General Conformity Rule *de minimis* thresholds. The operational emissions do not exceed these thresholds.

Alternative D would also convert active agricultural areas to natural areas and open space reducing agricultural emissions in the Project area. Agricultural field operations, such as tilling, planting, weeding, fertilizing, harvesting, and spreading of manure or compost can produce air pollution emissions from the mechanical movement of soil or from engine operation and fuel combustion.

When comparing Alternative D to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Therefore, the operational related criteria air pollutants would result in a **less than significant** impact.

Impact AQ-5 (Alternative D): ***Expose Sensitive Receptors to Substantial Air Pollutants Associated with Operation***. Compared to the No-Action Alternative, Alternative D would implement the Project and there would be operational activities in the Project area. Operational activities would be associated with workers driving to the site to perform routine maintenance and operation activities associated with the water control structures. Most of these vehicles would be gasoline fueled and the gasoline exhaust has significantly less toxicity compared to diesel exhaust. The number of additional trips added to the area near sensitive receptors is minimal. Therefore, there would not be a substantial source of operational related toxic air contaminants.

When comparing Alternative D to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative D to the No-

Action Alternative). As a result, there would be a **less than significant** impact on sensitive receptors due to toxic air contaminants from Project operation of Alternative D.

Impact AQ-6 (Alternative D): *Create Objectionable Odors from Construction.* Compared to the No-Action Alternative, Alternative D would implement the Project and there would be construction activities in the Project area. Construction equipment and material hauling vehicles using diesel fuel may emit objectionable odors associated with combustion of the diesel fuel. However, these emissions would be transitory.

When comparing Alternative D to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative D to the No-Action Alternative). Therefore, odor impacts of Alternative D associated with diesel combustion during construction activities would be a **less than significant** impact from odors.

Impact AQ-7 (Alternative D): *Create Objectionable Odors from Operation*. Compared to the No-Action Alternative, Alternative D would implement the Project and there would be operational activities in the Project area. The operational activities are associated with workers commuting to the Project area to perform routine operation and maintenance. The worker vehicles are not expected to noticeably increase the amount of odors associated with traffic along roads in the Project area.

When comparing Alternative D to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative D to the No-Action Alternative). Therefore, odor impacts of Alternative D associated with operational activities would result in a **less than significant** impact.

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5.0 Biological Resources – Fisheries

This section describes the fisheries within the Project area, including habitats, species, and special-status fish species. Section 5.1 describes the environmental setting and Project boundaries. Section 5.2 describes the regulations and local ordinances that would apply to aquatic wildlife resources. Section 5.3 discusses environmental consequences and mitigation measures, where needed.

5.1 Environmental Setting

The environmental setting focuses on Reach 2B, a section of the San Joaquin River which begins at the Chowchilla Bifurcation Structure and ends at Mendota Dam. The Project area also includes about 1,800 linear feet of river upstream of the Chowchilla Bifurcation Structure, about 1.7 miles of the river downstream of Mendota Dam, and a portion of Fresno Slough.

Existing conditions are defined as the conditions existing when the Notice of Intent and Notice of Preparation were filed, which was July 2009, prior to the start of Interim Flows. Several field efforts occurred at later dates, and therefore, the best available information to describe existing conditions also includes information from the period after the start of Interim Flows.

5.1.1 Aquatic Habitat

Mendota Pool is located at the confluence of Fresno Slough and the San Joaquin River. The San Joaquin River arm of Mendota Pool extends from Mendota Dam to San Mateo Avenue. San Mateo Avenue has a low-flow crossing consisting of a culvert and an earthen embankment supporting the roadbed which is overtopped during higher flows.

Water is typically delivered to Mendota Pool from the Delta-Mendota Canal (DMC) and is withdrawn at several canal or pump locations in the Pool including Columbia Canal, Helm Ditch, Main Canal, Outside Canal, Fresno County Waterworks District Canal, Mowry pumps, and others. Water is also delivered to the Pool by the Mendota Pool Pumpers group as well as by river flows. Mendota Pool has been dewatered biennially in mid-winter for inspections and maintenance of the dam, but some locations held standing water during this several week period. Although recent repairs at Mendota Dam have reduced the need to dewater the Pool for dam inspections, Mendota Pool was most recently dewatered for maintenance in the winter of 2011 to 2012.

Prior to the start of Interim Flows in October 2009, the section of Reach 2B between the Chowchilla Bifurcation Structure and San Mateo Avenue was mostly dry (San Joaquin River Restoration Program [SJRRP] 2010a). Surface flows throughout Reach 2B occurred during very wet periods (about every 3 to 5 years). Water released from

Mendota Dam was typically delivered to downstream water users. Downstream of the last diversion point, the river was typically dry.

Aquatic habitat in Reach 2B was either mostly absent within the dry section of the channel or was backwatered in the impounded water body. The river channel was composed of a sand bed with margins occupied by sparse riparian or ruderal vegetation (SJRRP 2010b). The portion of the Reach 2B channel upstream of San Mateo Avenue was composed of unconsolidated fine sand. Aquatic habitat was seasonal because flow was not sustained in the channel. The channel bed was generally devoid of a defined low-flow channel or aquatic habitat features such as pools and bars. Riparian vegetation was sparse and limited to the levees along the channel. Downstream of San Mateo Avenue, aquatic habitat was affected by the backwatering of Mendota Dam and sedimentation in Mendota Pool. The channel was defined by emergent, wetland, and riparian vegetation, including mature cottonwood trees, established along the backwatered portion of Mendota Pool. Most of the Pool was fairly shallow, and some areas also contained submerged aquatic vegetation. Mendota Pool contained mostly introduced fish and a few native fish.

Since the start of Interim Flows there have been some changes in Reach 2B, mostly between the Chowchilla Bifurcation Structure and San Mateo Avenue. The changes primarily consist of more regular inundation due to increased water releases from Friant Dam and the associated establishment of hydrophilic vegetation. Aquatic habitat includes a series of low gradient riffles, flatwater glides, and mid-channel pools (California Department of Fish and Wildlife [DFW] 2010). However, in dry years, portions of the channel still experience extended periods of desiccation. The section of Reach 2B affected by backwater is visibly unchanged by Interim Flows and generally persists as described above because it continues to have water year-round.

5.1.2 Aquatic Foodweb

The aquatic food web is poorly understood and documented in Reach 2B. However, what has been documented are modifications to habitat, introduction of nonnative species, water management activities, and alteration of water quality, which has substantially altered nutrient processing by the primary producers (diatoms and aquatic vegetation) and secondary producers (zooplankton and aquatic invertebrates), and has affected fish communities and other aquatic fauna (Brown 1996).

Food web processes in Reach 2B are influenced by invertebrate production within the reach and by the drift of benthic invertebrates into and out of the reach. The quantity of insects that would drift during times of flow into Reach 2B from upstream reaches is unknown. Reach 1 has gravel substrates and riffles which create productive habitat for benthic invertebrates, suggesting that many prey taxa are likely available for juvenile salmonids[1] (Stillwater Sciences 2003). While many of these taxa have high propensity to drift and are likely important components of fish diets, how far they drift and whether they would drift to locations downstream that do not retain gravel substrate (such as Reach 2B) is unknown. The amount of insect drift that enters Reach 2B would be

[1] Salmonids are those fishes from the *Salmonidae* family, such as salmon, trout, and char.

affected by flows directed into Chowchilla Bypass at the Chowchilla Bifurcation Structure. The amount of insect drift from Reach 2B to downstream reaches would be affected by the proportion of inflow that is exported out of Mendota Pool. Mendota Pool habitat and food web processes would also be affected by water that is imported through the DMC and groundwater inputs from the Mendota Pool Pumpers.

Floodplains that support riparian vegetation or grasslands that are seasonally inundated can also provide a source of nutrients and primary and secondary producers that can propagate to downstream channels, if not exported at on-river diversions. Floodplain habitats typically produce small invertebrates with short life cycles, such as chironomids and cladocerans (McBain and Trush 2002). The inundation timing, duration, and frequency of inundation influence invertebrate production and nutrient processing on floodplains (Ahearn et al. 2006; Grosholz and Gallo 2006). This resource availability, combined with warmer temperatures on the floodplains compared to main channel habitats, has been documented to accelerate juvenile salmonid growth in floodplain river systems (Jeffres et al. 2008). Under existing conditions, however, there is only the main river channel and very limited floodplain habitat is present between the existing levees in Reach 2B.

Invasive fish species may alter food webs and have adverse consequences to native fish species, including increased competition for resources, direct predation, and habitat or behavior interference (Moyle 2002). San Joaquin River non-native piscivores include largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), green sunfish (*Lepomis cyanellus*), warmouth (*Lepomis gulosus*), black crappie (*Pomoxis nigromaculatus*), striped bass (*Morone saxatilis*), brook trout (*Salvelinus fontinalis*), redear sunfish (*Lepomis microlophus*), spotted bass (*Micropterus punctulatus*), channel catfish (*Ictalurus punctatus*), and white catfish (*Ameiurus catus*). Because of their small size and weaker swimming abilities, larval and early life stages of fish are particularly vulnerable to predation. Imported water from the DMC is an ongoing source for some of these species. Millerton Reservoir and Fresno Slough can also be sources of nonnative fish species.

5.1.3 Aquatic Species Known to Occur in the Project Area and Vicinity

Table 5-1 provides a list of fish species captured and reported between Reaches 2A and 3. Many of these species were found in Mendota Pool.

Table 5-1.
Fish Species in the Vicinity of Reach 2B

Native Fish Species	
Hitch (*Lavinia exilicauda*) [*,1, 3]	Sacramento sucker (*Catostomus occidentalis*) [*,1, 2, 3]
Tule perch (*Hysterocarpus traskii*) [3]	Sacramento splittail (*Pogonichthys macrolepidotus*) [*, 2]
River lamprey (*Lampetra ayresi*) [3]	Prickly sculpin (*Cottus asper*) [2, 3]
Sacramento blackfish (*Orthodon microlepidotus*) [3]	Rainbow trout (*Oncorhynchus mykiss*) [2, 3]
Hardhead (*Mylopharodon conocephalus*) [3]	Sacramento pikeminnow (*Ptychocheilus grandis*) [2, 3]
Kern Brook lamprey (*Lampetra hubbsi*) [3]	Chinook salmon (*Oncorhynchus tshawytscha*) [2]

Table 5-1.
Fish Species in the Vicinity of Reach 2B

Pacific lamprey (*Lampetra tridentata*) [3]	Riffle sculpin (*Cottus gulosus*) [2]
Threespine stickleback (*Gasterosteus aculeatus*) [2, 3]	
Introduced Fish Species	
Threadfin shad (*Dorosoma petenense*) [*,1, 2, 3]	Black bullhead (*Ameiurus melas*) [*,1, 2, 3]
Black crappie (*Pomoxis nigromaculatus*) [*,1, 2, 3]	Largemouth bass (*Micropterus salmoides*) [*,1, 2, 3]
Inland silverside (*Menidia beryllina*) [*, 1, 2, 3]	White catfish (*Ameiurus catus*) [*,1, 2, 3]
Striped bass (*Morone saxatilis*) [*,1, 2, 3]	Pumpkinseed (*Lepomis gibbosus*) [*,1, 2, 3]
Channel catfish (*Ictalurus punctatus*) [*,1, 2, 3]	American shad (*Alosa sapidissima*) [*,1]
Bluegill (*Lepomis macrochirus*) [*,1, 2, 3]	Warmouth (*Lepomis gulosus*) [*,1, 2, 3]
White crappie (*Pomoxis annularis*) [*,1, 2, 3]	Golden shiner (*Notemigonus crysoleucas*) [*,1, 2, 3]
Goldfish (*Carassius auratus*) [*,1,2,3]	Brown bullhead (*Ameiurus nebulosus*) [*,1,2, 3]
Common carp (*Cyprinus carpio*) [*,1, 2, 3]	Western mosquitofish (*Gambusia affinis*) [*,1, 2, 3]
Green sunfish (*Lepomis cyanellus*) [*,1, 2, 3]	Bigscale logperch (*Percina macrolepida*) [*,1, 2, 3]
Redear sunfish (*Lepomis microlophus*) [*, 2, 3]	Red shiner (*Cyprinella letrensis*) [*, 2, 3]
Black bass spp. (*Micropterus spp.*) [*, 2]	Fathead minnow (*Pimephales promelas*) [*, 2, 3]
Spotted bass (*Micropterus punctulatus*) [*, 2, 3]	Yellow bullhead (*Ameiurus natalis*) [*, 2]
Shimofuri goby (*Tridentiger bifasciatus*) [*, 2, 3]	Weather loach (*Misgurnus anquillicaudatus*) [*]
Redeye bass (*Micropterus coosae*) [3]	

Notes:

* Fish species that are also found in Reaches 2A and/or 3

[1] Jones and Stokes 1986, Scientific and common names have been updated from Jones and Stokes (1986) to be consistent with current nomenclature (Nelson et al. 2004).

[2] Hutcherson 2013, unpublished data.

[3] Workman and Portz 2013.

Several fish surveys have been conducted in the San Joaquin River or in the major tributaries of the San Joaquin Valley. Jones and Stokes (1986) found two native fish species (hitch [*Lavinia exilicauda*] and Sacramento sucker [*Catostomus occidentalis*]) and 20 introduced species in Mendota Pool. Since the 1986 survey, additional introduced species have appeared in the Delta and are likely to have been transported to Mendota Pool causing species composition shifts. Previously unreported species were found during surveys of Reaches 1, 3, and 5 during 2004 and 2005. The number of species typically found increased with distance downstream from Friant Dam and the composition of fish assemblages shifted from native species to non-native species.

USFWS and Reclamation conducted comprehensive fish surveys in the San Joaquin River in 2012 and 2013, after the start of Interim Flows. These surveys have found previously unreported native and introduced fish species between Reach 2A and Reach 3. Native fish species captured include Pacific lamprey (*Lampetra tridentate*), prickly sculpin (*Cottus asper*), Sacramento splittail (*Pogonichthys macrolepidotus*), Sacramento blackfish (*Orthodon microlepidotus*), hardhead (*Mylopharodon conocephalus*), Kern Brook lamprey (*Lampetra hubbsi*), river lamprey (*Lampetra ayresi*), and tule perch

(*Hysterocarpus traskii*). Introduced species captured include redear sunfish, spotted bass, Shimofuri goby (*Tridentiger bifasciatus*), bigscale logperch (*Percina macrolepida*), redeye bass (*Micropterus coosae*), striped bass, red shiner (*Cyprinella letrensis*), fathead minnow (*Pimephales promelas*), and yellow bullhead (*Ameiurus natalis*) (Hutcherson 2013; Workman and Portz 2013). Pacific staghorn sculpin (*Leptocottus armatus*) and brook trout (*Salvelinus fontinalis*) have also been detected between Reach 2A and Reach 3. They were likely introduced as a result of the Delta-Mendota Canal and upstream hatcheries, respectively, but these species would be unable to complete their life cycle in Reach 2B and therefore should not be considered part of the Reach 2B fish community. Reaches 1 and 3 and Mendota Pool have likely been sources of fishes that colonize Reach 2B as flows have been restored to the San Joaquin River.

On October 6, 2014 during a 2014 fish sampling effort just upstream of the Chowchilla Bifurcation Structure in Reach 2A (River Mile 215 to 218), U.S. Fish and Wildlife Service (USFWS) captured a weather loach (*Misgurnus anquillicaudatus*), a previously undocumented nonnative species (SJRRP 2014; USFWS 2014). USFWS and CDFW conducted a more intensive fish sampling effort on November 12, 2014 (USFWS 2014). Six additional weather loaches were captured upstream of the structure while none were detected downstream of the structure. Possible negative effects of this species could include egg predation, competition, and pathogen transfer.

Fall-run Chinook salmon (*Oncorhynchus tshawytscha*) have occasionally been found moving into the San Joaquin River upstream of the Merced River (San Francisco Estuary Institute [SFEI] 2002). Although the Hills Ferry Barrier is seasonally installed to restrict movement of adult salmon into areas that presently do not provide access to spawning habitat, adult fall-run Chinook salmon have been observed upstream of the Hills Ferry Barrier and have been observed in wet years at the base of Mendota Dam (Portz et al. 2011).

Although anglers have reported catching 69 white sturgeon (*Acipenser transmontanus*) and one green sturgeon (*Acipenser medirostris*) downstream of the Project area between 2007 and 2012 (DFW 2012), there have been no documented capture of white or green sturgeon from Reach 2B. USFWS captured 28 subadult/adult white sturgeon from 2012 to 2013 and documented spawning at four locations between Vernalis and Grayson (Jackson and Van Eenennaam 2013), approximately 116 to 133 river miles downstream of Reach 2B.

5.1.4 Special Status Species

Based on records in the California Natural Diversity Database (CNDDB) (DFW 2015) and USFWS lists for the Bonita Ranch, Coit Ranch, Firebaugh, Firebaugh NE, Gravelly Ford, Jamesan, Mendota Dam, Poso Farm, and Tranquility U.S. Geological Survey (USGS) 7.5-minute quadrangles (USFWS 2015), three special-status fish species are discussed as to whether they are potentially present in the vicinity of Reach 2B (Table 5-2). Special-status fish species include those species that are Federally-listed, proposed for Federal listing, Federal candidate species, State listed, State fully protected species, or species of special concern.

Table 5-2.
Threatened or Endangered Fish Species, Associated Critical Habitat, or Essential Fish Habitat Considered as Potentially Occurring Within the Project Area

Scientific Name	Common Name	Status	Critical Habitat or Essential Fish Habitat in or near Project Area
Hypomesus transpacificus	Delta Smelt	SE, FT	No
Oncorhynchus mykiss	Central Valley steelhead	ST, FT	No
Oncorhynchus tshawytscha	Central Valley Fall-run and Late fall-run Chinook salmon	SSC	Yes, Essential Fish Habitat
Oncorhynchus tshawytscha	Central Valley Spring-run Chinook salmon[1]	FT	Yes, Essential Fish Habitat

Note:
[1] A nonessential experimental population of spring-run Chinook salmon was released into the Restoration Area in spring 2014. Members of the experimental population have special regulations written for them under Section 4(d).
Key:
FT = Federally Threatened
SE = State of California Endangered
ST = State of California Threatened
SSC = species of special concern

The Federal Endangered Species Act of 1973 (ESA) requires that USFWS and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) designate critical habitat for the listed species they manage. Federal agencies are required to consider the potential effects of their actions, including permit approval or funding, on listed species and their critical habitat.[2] Critical habitat has been designated for Delta smelt (*Hypomesus transpacificus*) and Central Valley steelhead (*Oncorhynchus mykiss*), but it does not occur within the Project area.

Essential fish habitat (EFH) for Chinook salmon has been designated in the Sacramento and San Joaquin River basins, including the Project area and vicinity. EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. Chinook salmon stocks with potential to occur in Reach 2B include Central Valley fall-run and late fall-run Chinook salmon and a nonessential experimental population of Central Valley spring-run Chinook salmon (Table 5-2). Federal fishery management plans identify EFH, as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The Pacific Coast Salmon Fishery Management Plan (Pacific Fishery Management Council [PFMC] 2012) identifies and protects habitat for Pacific coast salmonid species. Although the Central Valley fall-run and late fall-run Chinook salmon are not considered threatened or endangered under the ESA, the habitat is protected as EFH under the MSFCMA.

[2] The ESA defines critical habitat as "the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed that are determined by the Secretary of the Interior to be essential for the conservation of the species."

Delta Smelt

Species Description

Delta smelt are slender bodied fish about 2 to 3 inches long, in the Osmeridae family (smelts). The species is endemic to the Sacramento-San Joaquin Delta. Delta smelt are able to live in waters with a wide range of salinity and typically rear in shallow (< 10 feet), open waters of the estuary (Moyle 2002). They are mostly found within a salinity range of 2 to 7 parts per thousand and have been collected from the estuarine waters up to 14 parts per thousand. This species can be found in the Delta nearly year-round, with adults moving into the interior Delta before spawning, beginning in December. Spawning occurs from February through May with larval and juvenile fish developing during spring and summer.

USFWS has defined four constituent elements of delta smelt habitat, including: (1) shallow freshwater to slightly brackish sites for spawning; (2) protected channels and rivers to provide transport of larvae to downstream rearing sites; (3) estuary rearing habitat that provides a shallow, protective, food-rich environment; and (4) unrestricted access to spawning sites between December and July (USFWS 1994).

Known Occurrences

CNDDB describes no known occurrences within 10 miles of the Project footprint; in fact, the Project area is over 100 miles from the nearest occupied delta smelt habitat. Delta smelt have been found in the San Joaquin River as far upstream as Mossdale and above, but still within the legal boundaries of the Delta (over 100 river miles below Reach 2B). Delta smelt could be found in Mendota Pool since water from the Delta is pumped into the DMC, but the likelihood of delta smelt surviving the trip in the canal system is very low. Delta smelt reaching the Mendota Pool would be unlikely to survive because of unsuitable habitat that does not provide food resources that smelt depend on for survival and because of water temperatures would also be outside the optimal temperature range for delta smelt during late spring through summer. Potential Project-related flow volume, timing, or water quality changes from the San Joaquin River into the Delta that may affect delta smelt was addressed in the Program Environmental Impact Statement/Report (PEIS/R) (SJRRP 2011, pages 5-82 and 5-83). Based on the available data and existing habitat conditions, the potential for delta smelt to occur within the Project area is extremely low.

Central Valley Steelhead

Species Description

Central Valley steelhead Distinct Population Segment consists of naturally spawned anadromous populations of *O. mykiss* downstream of natural and man-made impassable barriers in the Sacramento and San Joaquin rivers and their tributaries. Steelhead can be divided into two life history types, winter (ocean-maturing) and summer (river-maturing), based on their sexual maturity at river entry and the duration of their spawning migration. Only winter run types are presently found within the Central Valley. Two artificial propagation programs are considered part of the Distinct Population Segment: the Coleman National Fish Hatchery and the Feather River Fish Hatchery steelhead hatchery programs. The San Joaquin Hatchery, located downstream of Friant Dam, rears rainbow trout for planting into Reach 1 and other locations above Millerton Lake in Fresno and Madera counties. The hatchery operations and facilities would be modified as necessary to support restoring runs of salmon to the San Joaquin River (as a separate project with separate environmental compliance documentation).

Central Valley steelhead generally leave the ocean from August through April and move upstream into Central Valley rivers. Spawning takes place from December through April with a peak between January and March. Steelhead are iteroparous (i.e., capable of spawning more than once over several years), so post-spawn adults (i.e., kelts during this life stage) can return to the ocean where they will mature and possibly migrate inland to spawn again. Juvenile steelhead rear in cold water streams in riffles, runs, and pools. Most steelhead will rear for at least a full year before they begin migrating downstream to the ocean. Outmigration occurs when fish reach 6 to 8 inches in size and begin to transform from a resident juvenile form to a smolt. Outmigration can occur from fall through spring with a peak from February through April.

The NMFS has defined six constituent elements of Central Valley steelhead habitat, including: (1) freshwater spawning sites; (2) freshwater rearing sites with sufficient shade, foraging areas, and space for growth and movement; (3) freshwater migration corridors with sufficient areas of cover; (4) estuarine areas that provide areas for foraging and cover; (5) near shore marine areas that allow for juvenile transition from natal streams to offshore environments; and (6) off-shore marine areas with sufficient forage (NMFS 2005).

Known Occurrences

Steelhead or resident rainbow trout have been captured in the three main tributaries of the San Joaquin River including the Stanislaus, Tuolumne and Merced rivers. They are not known to occur in Reach 5 or upstream within the San Joaquin River (Eilers et al. 2010). Since steelhead require year round habitat for juvenile rearing they would not be present in the typically dry sections of Reach 2B. It is possible, but highly unlikely that juvenile steelhead would be present in the Mendota Pool because water from the Delta is delivered to the pool via the DMC. These fish would have had to successfully be passed through Tracy Fish Collection Facility lift pumps and transit through a canal system full of predators. Aquatic habitat in Mendota Pool is unsuitable for steelhead during the warm summer months.

Based on the occurrence data and available information, there is extremely low potential for Central Valley steelhead to be present within the Project area under existing conditions. As flows are restored to the San Joaquin River and fish passage is provided it is likely that steelhead may move upstream and occupy Reach 2B seasonally during times of the year when water temperatures and habitat are suitable. For example, steelhead could reside year round in Reach 1 or use Reach 2B as a migration corridor if they become established in the San Joaquin River.

Central Valley Fall-Run Chinook Salmon

Species Description

Central Valley fall-run Chinook salmon occur in the Sacramento River and its tributaries; the Delta and Suisun Marsh; and the San Joaquin River and five of its east-side tributaries, including the Merced, Tuolumne, Stanislaus, Mokelumne, and Cosumnes rivers. The Central Valley evolutionarily significant unit (ESU) is considered the southernmost native spawning population of Chinook salmon. Fall-run Chinook are currently the most numerous of the Central Valley runs and the only race that regularly spawns in the San Joaquin basin (NMFS 2008).

Fall-run are ocean-type Chinook that tend to enter freshwater as fully mature fish, migrate to lowland reaches of large rivers and tributaries, and spawn within a few days or weeks of arriving on the spawning grounds. Currently, adult fall-run salmon in the San Joaquin River basin typically migrate upstream between mid-September and early December, and spawn between late October and early December in tributaries of the Sacramento and San Joaquin basins (Moyle 2002). Fall-run Chinook salmon typically rear in freshwater for 1 to 3 months before outmigrating to the ocean, but some may disperse downstream as fry soon after emerging from the streambed. Life history requirements for adult and juvenile Chinook salmon are more fully described in the SJRRP *Fisheries Management Plan* (SJRRP 2010c).

Known Occurrences

Fall-run Chinook salmon occur in the Stanislaus, Tuolumne, and Merced Rivers, but no longer occur within the Project area. Historically, the San Joaquin River likely supported relatively few fall-run Chinook salmon after diversions began at Sack Dam, sometime between 1860 and 1880. During all but wet years, the river was nearly completely dewatered downstream from Sack Dam until late November, by which time it was too late for most fall-run Chinook salmon to migrate upstream in the San Joaquin River Basin (SJRRP 2010c). Fall-run Chinook salmon likely used the San Joaquin River system only when flows were sufficient for upstream passage during the fall.

More recently, Chinook salmon have been found in the San Joaquin River in the vicinity of Mud Slough and the confluence of the Merced River. From 2001 to 2009, two adult Chinook salmon were collected from the San Joaquin River in the vicinity of the Merced River; one was collected at Fremont Ford on December 3, 2003, and the other was collected at Hills Ferry, below Mud Slough, on December 5, 2007 (SFEI 2002). An older report from the Grasslands Bypass program covering the period from 1993 to 2002 is referenced in the 2001 to 2002 report; it notes that 26 Chinook salmon were collected, but the data to support these claims were not verifiable (Eacock, pers. comm., 2011).

During the fall of 2010, after large, early storms damaged the Hills Ferry Barrier and allowed salmon to move above the barrier for several days, multiple adult Chinook salmon were observed by DFW biologists below Sack Dam between November 16 and 18, and below Mendota Dam between November 22 and December 8 (Guzman, pers. comm., 2011).

Based on the occurrence data and available information, fall-run Chinook salmon have not typically been present within the Project area prior to SJRRP restoration activities.

The SJRRP has been releasing fall-run Chinook salmon to the San Joaquin River since 2010 to study juvenile outmigration. Beginning in 2012, adult fall-run have been captured above the Hills Ferry Barrier and transported to Reach 1, to either spawn naturally or be spawned artificially, their progeny outmigrating the following winter/spring.

When fish passage and sufficient flows are provided to Sack Dam in Arroyo Canal located in Reach 3, adult fall-run Chinook salmon could migrate upstream through Reach 2B from October through December, and juvenile fish released in Reach 1 could use Reach 2B for migrant rearing from February through May. These young-of-the-year fish would occur in Reach 2B as transient juveniles as they migrate downstream toward the ocean (Stillwater Sciences 2003).

Central Valley Spring-Run Chinook Salmon

Species Description

The Central Valley spring-run Chinook salmon ESU consists primarily of three populations in three tributary systems (Mill, Deer, and Butte creeks), as well as Feather River and Clear Creek, which are all located within the Sacramento River basin. Recent reintroductions have also established a run in Battle Creek. The population uses rearing and migration habitats in the Sacramento River basin and Delta, San Francisco Bay, and offshore ocean waters.

Historically, spring-run salmon in the San Joaquin River migrated upstream between April and early July, with most adults migrating upstream in May and June. Currently, there is no population of spring-run salmon in the San Joaquin River basin.

Spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months (stream-type life history) (West Coast Chinook Salmon Biological Review Team [WCCSBRT] 1997). Spawning occurs in Sacramento River tributaries from late September through mid-November. Fry emerge from the gravel from November to March and spend about 3 to 15 months in freshwater habitats prior to emigrating to the ocean. Spring-run Chinook salmon generally mature between 2 and 4 years of age.

In addition to rearing in natal streams, spring-run Chinook salmon juveniles rear in the lower part of nonnatal tributaries and intermittent streams during the winter months (Maslin et al. 1997). Emigration can be highly variable. Some juveniles may begin outmigrating soon after emergence, whereas others over-summer and emigrate as yearlings with the onset of intense fall storms (DFW 1998). The emigration period for spring-run Chinook salmon extends from November to early May. Emigration appears to coincide with high precipitation and high Sacramento River flows.

NMFS designated critical habitat for spawning and rearing Central Valley spring-run Chinook salmon in the Sacramento River and specific tributaries, as well as in the Sacramento Delta Hydrologic Unit within the Sacramento-San Joaquin Delta.

Known Occurrences

Spring-run Chinook salmon no longer occur within the Project area. Historically, spring-run Chinook salmon spawned in the San Joaquin River from about the present day location of Friant Dam to as far upstream as Mammoth Pool (River Mile 322) (McBain and Trush 2002). During the late 1930s and early 1940s, as Friant Dam was being constructed, large runs continued to return to the river. After the dam was completed and the reservoir was filling, runs of 30,000 to 50,000 fish continued to return and spawn in the river downstream of Friant Dam. These runs were completely gone by 1950, as diversions from Friant Dam resulted in the river being dry at Gravelly Ford (McBain and Trush 2002).

There have been reports of Chinook salmon with spring-run-like life histories from tributaries of the San Joaquin River and Delta, specifically in the Stanislaus and Mokelumne rivers. Snorkel surveys in the Stanislaus River in the mid-2000s and netting surveys in the early 2000s resulted in observation or capture of adult Chinook salmon from the Stanislaus River in mid-summer (Wikert, pers. comm., 2011). There are reports that adult Chinook salmon exhibiting traits similar to spring-run Chinook have been counted in the Woodbridge Dam fish ladder by the East Bay Municipal Utility District (Wikert, pers. comm., 2011).

Based on the occurrence data and available information, spring-run Chinook salmon were not recently present within the Project area prior to SJRRP restoration activities.

Juvenile spring-run Chinook salmon, as part of an experimental population, were released into the Restoration Area in spring 2014 and spring 2015. This action as well as all other Chinook salmon reintroduction actions are analyzed under separate environmental documentation. If successful migration, holding, and spawning occurs, juvenile fish could be found using Reach 2B for migrant rearing from November through May. When migration flows are restored to the San Joaquin River and fish passage is provided, adult spring-run Chinook salmon from other rivers in the Central Valley may stray into the San Joaquin River during winter or spring.

5.2 Regulatory Setting

The Federal, State, and local laws and regulations applicable to fisheries in the Project area are described below.

5.2.1 Federal

The following subsections describe Federal laws and regulations governing the protection of fisheries resources.

Clean Water Act Sections 401 and 404

(See Chapter 14.0, “Hydrology - Surface Water Resources and Water Quality.”)

Rivers and Harbors Act Section 10

(See Chapter 14.0, “Hydrology - Surface Water Resources and Water Quality.”)

Federal Endangered Species Act of 1973 (16 United States Code [USC] Section 1531 et seq., 50 Code of Federal Regulations [CFR] Parts 17 and 222)

The ESA includes provisions for protection and management of species that are Federally-listed as threatened or endangered and designates critical habitat for these species. This law prohibits "take" of Federally-listed species, except as authorized under an incidental take permit or incidental take statement. USFWS is the administering agency for this authority for freshwater species. NMFS is the administering agency for anadromous species.

Section 4(d) of the Act allows USFWS or NMFS to establish special regulations for threatened species, subspecies, and Distinct Population Segments. These "4(d) rules" may either increase or decrease ESA's normal protections. One use of 4(d) rules is to relax normal ESA restrictions to reduce conflicts between people and the protections provided to the threatened species. This may occur in situations where conflicts would adversely affect recovery and the reduced protection would not slow the species' recovery.

Section 10(j) of the Act provides for the designation of specific reintroduced populations of listed species as "experimental populations." An experimental population is a geographically described group of reintroduced plants or animals that is isolated from other existing populations of the species. Members of the experimental population are considered to be threatened under ESA, and can have special regulations written for them under Section 4(d).

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) (16 USC 661 et seq.) amended 1946, 1958, 1978, and 1995 requires Federal agencies to coordinate with USFWS, or, in some instances, with NMFS, and with State fish and wildlife resource agencies before undertaking or approving water projects that control or modify surface water. The purpose of this coordination is to ensure that wildlife resources held in public trust receive appropriate consideration and be coordinated with the features of these water resource development projects. Federal agencies undertaking water projects are required to fully consider recommendations made by USFWS, NMFS, and State fish and wildlife resource agencies in project reports, such as documents prepared to comply with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), and to include measures to reduce impacts on wildlife in project plans.

Magnuson-Stevens Fishery Conservation and Management Act 1996 (Public Law 94-265)

This law provides for the conservation and management of all fish resources within the exclusive economic zone of the U.S. and supports and encourages the implementation and enforcement of international fisheries agreements for the conservation and management of highly migratory species. It called for the establishment of Regional Fisheries Management Councils to develop, implement, monitor, and revise fish management plans to promote domestic commercial and recreational fishing. Specifically to the SJRRP, it calls for the protection of EFH in review of projects conducted under Federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. NMFS is responsible for the administration of this act.

Central Valley Project Improvement Act

Implementation of the Central Valley Project Improvement Act (CVPIA) changed management of the Central Valley Project (CVP) by making fish and wildlife protection a project purpose, equal to water supply for agricultural and urban uses. The CVPIA affects water exports from the Delta to San Luis Reservoir and increases operational pressures on the reservoir to meet south-of-Delta water demands. CVPIA Section 3406 (b)(2) authorized and directed the Secretary of the Interior, among other actions, to dedicate and manage 800 thousand acre-feet (TAF) of CVP yield annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized in the CVPIA; assist the State in its efforts to protect the waters of the San Francisco Bay-Delta Estuary; and help meet obligations legally imposed on the CVP under Federal or State law following the date of enactment of the CVPIA. CVPIA Section 3406(d)(1) required that the Secretary of the Interior immediately provide specific quantities of water to the refuges, referred to as “Level 2” supplies. The CVPIA requires delivery of Level 2 water in all year–types except critically dry water year conditions, when Level 2 water can be reduced by 25 percent. Section 3406(d)(2) of the CVPIA refers to “Level 4” refuge water supplies, which are the quantities required for optimum habitat management of the existing refuge lands. Level 4 water supplies amount to about 163 TAF above Level 2 water supplies. The availability of Level 4 refuge water supplies is influenced by the availability of water for transfer from willing sellers. CVPIA Section 3406(c)(1) mandated development of a comprehensive plan that is reasonably prudent and feasible to be presented to Congress to address fish, wildlife, and habitat concerns on the San Joaquin River. However, Public Law 111-11 declared “that the Settlement satisfies and discharges all of the obligations of the Secretary contained in section 3406(c)(1).”

5.2.2 State of California

California Water Code

The California Water Code authorizes the State Water Resources Control Board (SWRCB) to allocate surface water rights and permit diversion and use of water throughout the State. SWRCB considers effects on fisheries as part of its permitting process. Division 7 of the California Water Code, known as the Porter-Cologne Water Quality Control Act, regulates activities that affect water quality.

California Fish and Game Code section 1600 et seq.

This law provides for the protection and conservation of fish and wildlife resources with respect to any project that may substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake. The administering agency is the DFW.

California Endangered Species Act of 1984 (Fish & G. Code, §§ 2050-2098)

This law provides for the protection and management of species and subspecies listed by the State as endangered or threatened, or designated as candidates for such listing. They are listed at California Code of Regulations, Title 14, section 670.5. This law prohibits “take” of state-listed or candidate species, except as otherwise authorized by the Fish and Game Code. The term “take” is defined by Fish and Game Code section 86 as “hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." This definition is different in some respects from the definition of "take" under the ESA. The administering agency is the DFW.

Sufficient Water for Fish Below Dams (Fish & G. Code, § 5937)

This law requires that an owner or operator of a dam allow sufficient water to pass through a fishway, or, in the absence of a fishway, allow sufficient water to pass over, around, or through the dam to keep fish in good condition, whether they are planted or exist below the dam. This law provides exceptions for the owner/operator to pass water through a culvert or waste gate during low flow years when the DFW determines that it is infeasible to pass water through a fishway.

California Freshwater Sport Fishing Regulations 2014-2015, effective March 1, 2014

Fishing gear, methods, limits and the kinds of fish allowed for sport harvest are defined in California Sport Fishing Regulations and are updated by recommendations made by the Fish and Game Commission to the DFW. These regulations (identified in Cal. Code Regs. tit. 14) are enforced by DFW in the field. The regulations cover activities allowed under a sport fishing license by fishing districts and are used to manage the harvest of game fish under General Regulations.

Trout, Salmon and Special Regulations, District General Regulations (Cal. Code Regs., tit. 14., ch. 3, art. 2, §7)

The fishing regulations define which waters and when those waters are open and closed to trout and salmon fishing. The regulations further describe gear restrictions, which other species may be taken, and daily bag and possession limits for each species. In waters where the bag limit for trout or salmon is zero, fish must be released unharmed and should not be removed from the water. The following regulations are applicable to the Valley District.

- All lakes and reservoirs except those listed by name in the Special Regulations. Season – All Year. Bag Limit: five.
- All anadromous waters except those listed by name in the Special Regulations. Season – All Year. Bag Limit: two hatchery trout or hatchery steelhead (four hatchery trout or hatchery steelhead in possession). Closed to the take of salmon.
- San Joaquin River from Friant Dam downstream to the Highway 140 bridge. Season – All Year. Bag Limit: two hatchery trout or hatchery steelhead (four hatchery trout or hatchery steelhead in possession).

Reach 2B is in the Valley District and is an anadromous waterbody. [3] Under existing fishing regulations, Valley District anadromous waters are closed to salmon fishing (i.e., no take or possession of salmon).

[3] Anadromous waters are inland waters that are accessible to fish migrating from the ocean.

Taking Fish near Dams, Fishways, Screens and Egg-Taking Stations (Cal. Code Regs., tit. 14., ch. 3, art. 2, § 2.35)

The fishing regulations also define fishing methods and gear restrictions that may be applicable to conditions found in all fishing districts. A regulation that restricts fishing from dams or fishways would be application to Reach 2B. No fish may be taken within 250 feet of:

- Any fishway or any egg-taking station.
- Any dam or any weir or rack which has a fishway or an egg-taking station.
- The upstream side of any fish screen.

Fish may be taken upstream or downstream from any dam that does not have a fishway or egg-taking station (this supersedes Fish & G. Code, § 5502).

5.2.3 Regional and Local

Fresno County Plans and Ordinances

County ordinances directed at maintaining safety for boating and reducing risks from people attempting to swim from, use or fish off of bridges or water control structures include the following:

- **13.32.041 - Restricted areas for mooring, fishing or operating a vessel or watercraft in an area designated by a regulation marker.** It is unlawful for any person or persons to moor, fish or operate any vessel or watercraft in an area in a lake, river or other body of water designated by a regulation marker placed in the water by any public agency to restrict or control the area designated.
- **13.32.055 - Bridge or water control structure—Certain acts upon prohibited.** It is unlawful to loiter upon, fish upon, or jump from any bridge or water control structure that crosses any river, lake, or canal in the County of Fresno. As used in this section, "water control structure" includes any dams, weirs, control gates or headgates that are used for controlling or diverting the water flow on the various waterways in the County of Fresno.

Madera County Plans and Ordinances

County General Plan policies are directed at maintaining recreational and natural resources within the county. Madera County ordinances are directed at maintaining safety for boating and reducing risks from people swimming in waters where motorized boating occurs. There are no county ordinances covering activities in the San Joaquin River. General Plan policies under Section 5, Agricultural and Natural Resources, include:

- Policy 5.C.8. The County shall support the policies of the San Joaquin River Parkway Plan to protect the San Joaquin River as an aquatic habitat and water source.
- Policy 5.E.7. The County shall support the preservation and reestablishment of fisheries in the rivers and streams within the county, whenever possible.

5.3 Environmental Consequences and Mitigation Measures

5.3.1 Impact Assessment Methodology

This section describes the impact assessment methodology for fisheries resources in the Project area. The qualitative impact assessment relied upon knowledge of aquatic resource habitat requirements and expected changes to habitat or populations under the Project alternatives.

The *Fisheries Management Plan* (SJRRP 2010c) describes how the SJRRP would adaptively manage efforts to restore and maintain naturally reproducing and self-sustaining populations of Chinook salmon and other fish in the Restoration Area. A key objective of the Project would be to support restoring and maintaining populations of salmon and other fish in the San Joaquin River by increasing flow capacity and providing habitat in Reach 2B, a portion of which has been mostly dry prior to implementation of the Interim Flows. There is no spawning habitat contained within Reach 2B. Juvenile rearing habitat would occur during the outmigration period only.

The assessment of effects on fisheries is based on changes to habitat conditions in the channel and on the floodplain compared to existing conditions and the No-Action Alternative. The assessment also includes an evaluation of fish passage conditions at proposed facilities and an evaluation of fish entrainment at proposed screening systems. Fish passage and screening facilities were evaluated with respect to the risk in creating potential predator sites for target species. The assessment includes effects of proposed construction activities and operations on fish species compared to existing conditions and the No-Action Alternative.

Channel Habitat

Channel habitat conditions in Reach 2B are linked to features such as pools, bars, and the amount of bordering riparian habitat. These conditions would be expected to change somewhat in the Reach 2B upstream of Mendota Pool; however, the amount and nature of the habitat change are not quantifiable. Channel habitat was evaluated by comparing the relative amount of levee disturbance and channel and floodplain connection for each Project alternative.

Floodplain Habitat

Floodplain habitat for rearing juvenile fish was assessed by evaluating the amount of direct and indirect rearing habitat for the Project alternatives. For the purpose of this analysis, direct rearing habitat is defined as acres of floodplain with a depth greater than 1.0 feet at 2,500 cubic feet per second (cfs), while indirect rearing habitat is defined as the acres of floodplain with a depth less than 1.0 feet at 2,500 cfs. [4] Indirect rearing habitat was evaluated as a proportion of the amount of very shallow water habitat to the amount of rearing habitat.

[4] Direct rearing habitat refers to the habitat areas that fish physically occupy for rearing. Indirect rearing habitat refers to the habitat areas that fish do not physically occupy, but that do provide food and nutrient resources used by rearing fish. Indirect rearing habitat is also known as primary production habitat.

Fish Passage

Fish passage facilities would be provided at existing or proposed structures that would otherwise prevent or impede up- and down-stream passage of migratory salmon and other native fishes. The fish passage assessment assumed that all proposed structures would meet fish passage criteria established by fisheries agencies (see Section 2.2.4); as a result, the impact assessment is qualitative and based on the total number of artificial structures in the migratory pathway. Each structure, whether it is a dam sill, fish ladder (or bifurcation structure), or road crossing, is counted as an individual structure. The total number of steps at structures, such as the number of steps an adult or juvenile salmon would need to jump or swim through was also evaluated.

Risk of Entrainment

Active water diversions within Reach 2B would be screened to prevent fish entrainment by screening fish from Mendota Pool, consolidating diversions, or installing individual screens on some smaller diversions. Even though the diversions would be screened, the type of screen and the size of the diversion can present some risk to out-migrating juvenile salmon or other juvenile native fishes. The risk of entrainment was evaluated by comparing the number of screens along Reach 2B that juvenile fish may encounter as they transit the reach.

Risk of Predation

Potential predation sites can develop along fish screens, at the entrance or exit of fish ladders or in association with bifurcation structures or road crossings. Potential predation sites could harbor predatory fish such as largemouth bass, smallmouth bass, Sacramento pikeminnow, striped bass, or other species. These species would be attracted to scour holes below artificial structures, or structures that create shear zones where areas of turbulent high velocity water are in close proximity to low-velocity water that would favor the feeding of opportunistic predators. The number of potential predation sites associated with structures for the Project alternatives was evaluated.

5.3.2 Significance Criteria

Significance criteria were developed based on applicable regulations and management policies, a review of the available information, and the professional judgment of the authors. The project would have a significant effect on aquatic resources if it will:

- Cause a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status fish species in local or regional plans, policies, or regulations, or by the DFW, NMFS, or USFWS.
- Interfere substantially with the movement of any native resident or migratory fish or impede the use of native fish nursery sites.
- Conflict with any local policies or ordinances protecting biological resources.
- Conflict with the provisions of an adopted or approved habitat conservation plan, or Natural Community Conservation Plan.

In addition to the thresholds of significance for impacts in the Environmental Checklist Form in Appendix G of the State CEQA Guidelines, as amended, thresholds also encompass factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its effects. Impacts to fish would also be considered significant if implementation, operation, or maintenance of actions included in the Project alternatives would do any of the following:

- Cause production and/or discharge of materials that pose a hazard to fish.
- Result in displacement of spawning fish such that year-class strength of any Federal or State special-status fish species or any commercially important fish species is substantially reduced.
- Substantially reduce the abundance, either directly or by reducing the amount or quality of habitat, of any life stage of a Federal or State special-status fish species or any commercially important fish species.
- Adversely modify designated critical habitat for any Federally-listed species.

5.3.3 Impacts and Mitigation Measures

There are nine impact topics selected to answer the questions above on substantial direct or indirect effects to special status, native resident, or migratory fish and their habitats:

1. Effects on Fish Habitat and Passage for Local Fish Populations
2. Effects on Salmonid Rearing Habitat
3. Effects on Upstream Migration of Adult Salmonids
4. Effects on Downstream Migration of Juvenile Salmonids
5. Effects of In-channel Construction Activities on Fish Species within Reach 2B
6. Effects of Floodplain Use by Agriculture on Fish Species within Reach 2B
7. Effects on Occurrence of Native Fish Species within Reach 2B
8. Effects on Predation of Juvenile Salmonids and Native Fish Species
9. Effects on the Aquatic Food Web within Reach 2B

Other fisheries-related issues covered in the PEIS/R are not covered here because they are programmatic in nature and/or are not relevant to the Project area.

Issues Eliminated from Further Analysis

Habitat Conservation Plans and Other Conservation Plans. Aside from the Pacific Coast Salmon Fishery Management Plan, there are no adopted habitat conservation plans, Natural Communities Conservation Plan, or other approved State, regional, or local habitat conservation plans in the Project area. Project activities would not conflict with the provisions of any such plans; therefore, this issue is not further addressed in this section.

Other Local and Regional Plans. The Fresno County General Plan and the Madera County General Plan are described under Regulatory Setting in Section 5.2.3, Regional and Local. The policies identified in these plans to protect biological resources are consistent with requirements of other State and Federal regulations. Project activities would not conflict with these policies; therefore, local and regional plans are not further addressed in this section.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these activities would be unlikely to achieve the Settlement goals. The potential effects of the No-Action Alternative are described below. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Under the No-Action Alternative, salmon would be reintroduced into the San Joaquin River as part of the Program. Downstream migrating juveniles would be entrained in diversions from Mendota Pool each spring during their outmigration. Adult salmon would be blocked on their upstream migration at Mendota Dam in all years except wet year types unless trapped and moved upstream of migration barriers in Reach 2B. Blocked adult salmon would potentially be exposed to poaching in the river below Mendota Dam and/or poor water quality later in the year. There is no spawning substrate in Reach 3, downstream of the dam, so blocked adult fish would not spawn successfully unless they were physically trapped and moved upstream of Mendota Dam.

Impact AQUA-1 (No-Action Alternative): ***Effects on Fish Habitat and Passage for Local Fish Populations.*** Under the No-Action Alternative, the Project would not be implemented and there would be no increase in flow capacity in Reach 2B, Mendota Pool bypass, no fish passage structures, no screens installed on water diversions, and no improvements to San Mateo Avenue crossing. Restoration Flows would occur below Friant Dam to the Merced River, but be limited to than-existing channel capacities. In the context of the Project area, Restoration Flows would provide benefits from the Chowchilla Bifurcation Structure to Mendota Pool by wetting the channel upstream of Mendota Pool and through more frequent and longer duration flows than those that occur under existing conditions. In addition to benefits attributed to the fish population in Reach 2B, Restoration Flows would have benefits throughout the Program area. Compared to existing conditions, the No-Action Alternative would have a **beneficial** effect on fisheries associated with increased flows in the San Joaquin River but would not fully meet the Project purpose and need or achieve the Settlement goals.

Impact AQUA-2 (No-Action Alternative): ***Effects on Salmonid Rearing Habitat.*** Under the No-Action Alternative, none of the proposed fish passage or protection facilities or floodplain habitat associated with setback levees within the Project area would be implemented. As described above, however, rearing habitat conditions would be enhanced from Restoration Flows in the Project area within the existing channel. Restoration Flows would wet an otherwise dry channel upstream of Mendota Pool and seasonal flows would substantially inundate the channel more frequently. Compared to existing conditions, the No-Action Alternative would have a **beneficial** effect on juvenile salmonid rearing habitat associated with increased flows in the San Joaquin River but would not fully meet the Project purpose and need or achieve the Settlement goals.

Impact AQUA-3 (No-Action Alternative): ***Effects on Upstream Migration of Adult Salmonids.*** Under the No-Action Alternative, fish passage facilities for upstream migration would not be implemented for the Project, but Restoration Flows would occur below Friant Dam to the Merced River. As part of the Program, other impediments to upstream migrating salmon would be modified to facilitate passage (e.g., Hills Ferry Barrier, Sack Dam). Under the No-Action Alternative, adult salmon likely would be trapped and moved upstream of migration barriers in Reach 2B as a Program action. Trapping and transporting adult Chinook salmon presents physiological stress for the fish that could result in reduced physical condition, injury, or in some cases, mortality. However, transporting Chinook salmon around barriers to access suitable spawning grounds would still have a beneficial effect, since fish downstream of barriers are not likely to find suitable spawning habitat. Compared to existing conditions, the No-Action Alternative would have a **beneficial** effect on upstream passage of adult salmon through trap and transport implemented by the Program but would not fully meet the Project purpose and need or achieve the Settlement goals.

Impact AQUA-4 (No-Action Alternative): ***Effects on Downstream Migration of Juvenile Salmonids.*** Under the No-Action Alternative, facilities associated with the Project would not be implemented, but Restoration Flows would occur below Friant Dam to the Merced River. Under existing conditions, the section of Reach 2B between the Chowchilla Bifurcation structure and San Mateo Avenue is often dry during the outmigration season. Under the No-Action Alternative, Restoration Flows would provide contiguous habitat connectivity from Friant Dam to the Merced River during typical outmigration periods for salmon and steelhead. Under the No-Action Alternative, juvenile salmon would migrate downstream through Reach 2B and would be exposed to several large, medium, and small unscreened diversions between the Chowchilla Bifurcation Structure and Mendota Dam. Although the flows and increased habitat connectivity would be an improvement over the dry conditions that typify existing conditions, without appropriately screened pumps and diversion structures juveniles would be subjected to high mortality rates as they encounter false migration pathways (i.e., canals and diversions) and experience mortality in pumps. Compared to existing conditions, the No-Action Alternative would have a **beneficial** effect on downstream migration of salmonid species but would not fully meet the Project purpose and need or achieve the Settlement goals.

Impact AQUA-5 (No-Action Alternative): ***Effects of In-channel Construction Activities on Fish Species within Reach 2B.*** Under the No-Action Alternative, no construction activity would occur in the active channel and there would be no adverse effects on aquatic species associated with construction-related crushing, disturbance, release of sediment, or release of pollutants from equipment operation and ground disturbance activities. Under the No-Action Alternative, the Project would not be implemented and there would be no Project-related short-term construction activities in the Project area. As a result, there would be **no impact** on existing aquatic resources within Reach 2B.

Impact AQUA-6 (No-Action Alternative): ***Effects of Floodplain Use by Agriculture on Fish Species within Reach 2B.*** Existing levees are not set back from the river channel. No agricultural practices presently occur within the existing levees. Under the No-Action Alternative, the Project would not be implemented and there would be no levee set-back and no agricultural use of lands within the existing levees. Compared to existing conditions, there would be **no impact** to fish species.

Impact AQUA-7 (No-Action Alternative): ***Effects on Occurrence of Native Fish Species within Reach 2B.*** Under the No-Action Alternative, the Project would not be implemented and no fish passage or screening facilities would be constructed and no channel improvements would occur. Restoration Flows would occur below Friant Dam to the Merced River. In addition to benefits attributed to the fish population in Reach 2B, Restoration Flows would have benefits throughout the Program area. In the context of the Project area, Restoration Flows within the existing channel capacity would provide benefits from the Chowchilla Bifurcation Structure to Mendota Pool by wetting the channel upstream of Mendota Pool and through more frequent and longer duration flows than those that occur under existing conditions. Compared to existing conditions, the No-Action Alternative would have a **beneficial** effect on native fishes associated with increased flows in the San Joaquin River but would not fully meet the Project purpose and need or achieve the Settlement goals.

Impact AQUA-8 (No-Action Alternative): ***Effects on Predation of Juvenile Salmonids and Native Fish Species.*** Restoration Flows could alter the presence and distribution of non-native predatory fish within Reach 2B. Under the No-Action Alternative, the Project would not be implemented, and no fish passage or screening facilities would be constructed and no channel improvements would occur. Restoration Flows would occur below Friant Dam to the Merced River. In addition to benefits attributed to the fish population in Reach 2B, Restoration Flows would have benefits throughout the Program area and would provide predator fish with better habitat conditions as well. In the context of the Project area, Restoration Flows would provide more opportunities for predators to move into Reach 2B, but would also provide improved habitat for native fishes. Prior to Interim Flows, habitat in Reach 2B was only marginally suitable for native fishes and supported more nonnative fishes than natives; however, increased flow would likely improve native habitat, allow native fishes to multiply in the reach, and increase the proportion of native fishes in Reach 2B. Because the proportion of native fishes is likely to increase as compared to non-native fishes, effects from predation would be reduced, and therefore the No-Action Alternative would have a **beneficial** effect on native fishes as compared to existing conditions.

Impact AQUA-9 (No-Action Alternative): ***Effects on the Aquatic Food Web within Reach 2B.*** Under the No-Action Alternative, the Project would not be implemented, but Restoration Flows would occur below Friant Dam to the Merced River. Levees would not be set back, but channel areas that are typically dry under existing conditions would be inundated under Restoration Flows, which would potentially create conditions for primary and secondary production which would otherwise not occur. Also, as noted in Impact AQUA-4 (No-Action Alternative), Restoration Flows would provide near contiguous habitat connectivity from Friant Dam to the Merced River, which would potentially bring nutrients and insects from upstream reaches that have different environmental conditions (e.g., gravel in Reach 1) and different insect drift components than found in Reach 2B (e.g., greater proportion of macroinvertebrates). Compared to existing conditions, the inundation of additional existing channel areas under the No-Action Alternative would have a **beneficial** effect on the aquatic food web but would not fully meet the Project purpose and need or achieve the Settlement goals.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Under Alternative A, construction of new Project facilities would occur, including a new levee system capable of conveying flows up to 4,500 cfs with 3 feet of freeboard; the Compact Bypass capable of conveying Restoration Flows up to 4,500 cfs around Mendota Pool and Dam; and 10 to 18 grade control structures to aid in upstream passage of adult salmon and other native fishes. A fish guidance barrier would be installed in the San Joaquin River where the Compact Bypass joins the river in Reach 3 to direct upstream adult salmon into the bypass. The Mendota Pool Dike would be constructed across the existing San Joaquin River arm of Mendota Pool to isolate the Mendota Pool from the San Joaquin River and direct flows into the Compact Bypass. The San Mateo Avenue Crossing would be improved. The crossing would accommodate the increased flows in the river by maintaining the required velocities for proper fish passage for flows up to 4,500 cfs. Alternative A includes construction of the South Canal with a bifurcation structure that would provide up to 2,500 cfs diversion into the South Canal and up to 4,500 cfs to the San Joaquin River. The South Canal intake would include a NMFS-compliant fish screen capable of screening juvenile salmon up to flows of 2,500 cfs with a fish return system that would convey screened fish back to the river. An upstream fish passage facility would be constructed at the South Canal bifurcation structure to provide upstream passage when operations prevent passage through the structure. The existing San Joaquin River control structure of the Chowchilla Bifurcation Structure would be removed.

Alternative A would include three upstream fish passage structures (the Compact Bypass grade control structures, San Mateo Avenue and South Canal bifurcation structure, and fish passage facility) that would include up to 43 steps. Downstream migrating fish would encounter the Lone Willow Slough, South Canal, South Canal passage supplemental flow, and Big and Little Bertha fish screens. Most major diversions that currently divert water from Mendota Pool would be isolated from the San Joaquin River.

This alternative would also create a floodplain with an average width of approximately 3,000 feet with low-lying areas on the floodplain connected to the river to prevent fish stranding. The alternative would restore floodplain habitat that would provide about 850 acres of seasonal rearing habitat (about 470 acres of primary production habitat and 380 acres of rearing habitat) for juvenile salmon and other native fishes at a flow of about 2,500 cfs. The alternative would allow agricultural practices in the floodplain (e.g., annual crops, pasture, or floodplain-compatible permanent crops). No changes would occur at Mendota Dam, under Alternative A, although this facility would be isolated from fish migration pathways. Construction activity is expected to occur intermittently over 102 to 132 months (8.5 to 11 years).

Impact AQUA-1 (Alternative A): *Effects on Fish Habitat and Passage for Local Fish Populations.* Compared to the No-Action Alternative, there would be major improvements to habitat quality and quantity, improvements to downstream migration by installation or isolation of the major diversions, and improvements to upstream fish passage around Mendota Dam, at the San Mateo Avenue crossing, and at the South Canal bifurcation structure under Alternative A. Additionally, Alternative A would add floodplain habitat to the river system and convey flows up to 4,500 cfs. Collectively, Alternative A would increase the amount of habitat and improve habitat quality through the added floodplain area for all fish species, reduce losses through unscreened diversion, and improve conditions for upstream passage from Reach 3 to Reach 2A. Conveying Restoration Flows and providing fish passage also restores connectivity of Reach 2B to the rest of the river, and would benefit the entire Restoration Area.

Compared to existing conditions, Alternative A would increase capacity for Restoration Flows, result in improved up and downstream passage, reduce losses to diversions, and increase floodplain habitat. Alternative A would have a **beneficial** effect on fisheries associated with increased mobility within the river, and would improve and expand habitat within Reach 2B.

Impact AQUA-2 (Alternative A): *Effects on Salmonid Rearing Habitat.* Compared to the No-Action Alternative, Alternative A would construct levees capable of conveying 4,500 cfs within Reach 2B. The new levee system would create a 3,000-foot-wide floodplain through Reach 2B that would support food production and rearing habitat. Alternative A would allow inundation of 850 acres of floodplain at 2,500 cfs. This magnitude of flow would create approximately 470 acres of shallow water habitat (less than 1 foot deep) for primary production, and approximately 380 acres of deeper habitat that could directly support rearing conditions (see Figure 2-9 of Chapter 2, "Description of Alternatives"). Floodplain areas adjacent to the main channel would start inundating between 1,200 and 2,200 cfs and would encourage riparian regeneration. Riparian trees may potentially contribute large woody debris to the river channel that could be used as cover by juvenile salmonids within the river channel and on the floodplain.

Compared to existing conditions, Alternative A would enhance overall floodplain acreage along Reach 2B and provide capacity for up to 4,500 cfs. The floodplain areas adjacent to the main channel would provide additional rearing habitat not otherwise available under existing conditions. These floodplains along the river would provide additional rearing habitat and may provide sites for riparian establishment that, in time, could improve habitat conditions for juvenile rearing in Reach 2B. Alternative A would provide a **beneficial** effect on rearing habitat for juvenile salmonid species rearing in Reach 2B.

Impact AQUA-3 (Alternative A): *Effects on Upstream Migration of Adult Salmonids*. Compared to the No-Action Alternative, Alternative A would provide upstream passage from Reach 3 through Reach 2B and into Reach 2A. A fish guidance barrier would be constructed to direct fish into the Compact Bypass. The Compact Bypass would be constructed with 10 to 18 grade control steps to facilitate upstream passage. A dike separating the San Joaquin River from the Mendota Pool would minimize adult fish straying into false migration pathways. The San Mateo Avenue crossing would be rebuilt to provide passage for adults at all migration flows. The most upstream feature adult fish would encounter is the South Canal bifurcation structure that would have fish passage provided in the form of a ladder or rock ramp fishway. The San Joaquin River control structure of the Chowchilla Bifurcation Structure would be removed, and its function would be combined with the South Canal bifurcation structure so adults could swim unimpeded into Reach 2A. Diversions would be consolidated and screened. There would be a total of 43 hydraulic jumps fish would have to pass over three river-spanning structures between Reach 3 and Reach 2A (Compact Bypass grade control structures, San Mateo Avenue, and the South Canal bifurcation structure and passage facility). All diversions would be screened or isolated in Mendota Pool, which would eliminate false migration pathways.

Under existing conditions, upstream migrating adult salmon are restricted from entering Reach 2B by Mendota Dam, and would have difficulty passing San Mateo Avenue during low flow ranges and passing the San Joaquin River control structure of the Chowchilla Bifurcation Structure at some flows. Adult salmon could also stray into the DMC, Main Canal, Helm Ditch, and Fresno Slough or into the Columbia Canal approach channel. In comparison to existing conditions, Alternative A would establish fish passage from Reach 3 through Reach 2B and into Reach 2A. Alternative A would have a **beneficial** effect by facilitating upstream migration for adult salmon and by isolating or screening possible false migration pathways.

Impact AQUA-4 (Alternative A): *Effects on Downstream Migration of Juvenile Salmonids*. Compared to the No-Action Alternative, Alternative A would improve downstream passage by screening water diversions, isolating operations of Mendota Pool from the river, and providing improved downstream passage for juvenile salmon. The South Canal bifurcation structure would provide for downstream juvenile passage and the South Canal would be screened for diversions. Screened juvenile fish would be directed back to the San Joaquin River and would not pass through Mendota Pool where they are exposed to loss through diversions and predators. Downstream fish passage would be improved at the San Mateo Avenue crossing and through the Compact Bypass, where juvenile fish would pass downstream into Reach 3 without having to pass through Mendota Dam. Under all the alternatives, fish passage and fish screening designs would be based upon criteria from Anadromous Salmonid Passage Facility Design (NMFS 2008) and Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001). Design would be further informed by the flow and depth criteria detailed in Table 2-1 of Chapter 2, “Description of Alternatives.” Outmigrating juvenile salmon would encounter four fish screens and 21 potential predation sites as they pass from Reach 2A through Reach 2B and into Reach 3.

Compared to existing conditions, Alternative A, like the No-Action Alternative, would greatly improve downstream passage for juvenile salmonids through Reach 2B from Reach 2A into Reach 3. Alternative A would have a **beneficial** effect by facilitating downstream passage.

Impact AQUA-5 (Alternative A): *Effects of In-channel Construction Activities on Fish Species within Reach 2B*. Compared to the No-Action Alternative, construction activity in the active channel could result in adverse effects on aquatic species, including crushing, disturbance of organisms, release of sediment, and release of pollutants associated with ground disturbance or equipment operation. Adverse effects to fish during in-channel construction activities would be minimized by including some or all of the following measures (see Section 2.2.4):

- Temporary bypass facilities around construction areas that meet fish passage criteria.
- Construction in the dry (i.e., not in active flows).
- Phased construction that would allow passage to continue in the channel or in the completed portions of structures while other portions are built.
- Fish rescue and relocation.

Cofferdams would likely be used to construct the Mendota Pool Dike, San Mateo Avenue Crossing, the fish screen return outlets, and the South Canal bifurcation structure. All other structures would likely be constructed in the dry.

The Project would implement Conservation Measures EFH-1, EFH-2, CVS-1, CVS-2, PL-1, GS-1, and SRCS-1 to avoid or minimize adverse effects on Central Valley Chinook salmon, Central Valley steelhead, pacific lamprey, green sturgeon, and associated habitat (see Section 2.2.10, Table 2-8). Adverse effects from construction activities would be minimized through the following measures:

- Disturbance of riparian vegetation would be avoided to the greatest extent practicable (Conservation Measure EFH-1).
- In-channel construction activities that could affect Pacific salmonid habitat would be limited to the low-flow period between June 1 and October 1 to minimize potential for adversely affecting Federally-listed anadromous salmonids during their emigration period (Conservation Measure EFH-2).
- In-channel construction activities that could affect habitat for Pacific salmonids would be limited to daylight hours during weekdays, leaving a nighttime and weekend period of passage for Federally-listed fish species (Conservation Measure EFH-2).
- Work in documented areas of Pacific lamprey presence would be timed to avoid in-channel work during typical lamprey spawning (March 1 to July 1). If temporary dewatering in documented areas of lamprey presence is required for instream channel work, salvage methods would be implemented to capture and move ammocoetes to a safe area, in consultation with USFWS (Conservation Measure PL-1).
- Actions that would affect an introduced experimental population of Central Valley spring-run Chinook salmon would be performed in accordance with the Experimental Population 4(d) rule, where applicable (Conservation Measure SRCS-1).

The Project would also implement the following control measures to avoid or minimize release of sediment or pollutants to the river (see Section 2.2.10, Table 2-8):

- A spill prevention plan would be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, would be restricted to designated construction staging areas, exclusive of any riparian and wetland areas (Conservation Measure EFH-1).
- Construction Best Management Practices (BMPs) for off-channel staging and storage of equipment and vehicles would be implemented. BMPs would also include minimization of erosion and stormwater runoff, as appropriate (Conservation Measure EFH-2).
- A qualified biological monitor would be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during construction initiation, midway through construction, and at the close of construction to monitor implementation of conservation measures and water quality (Conservation Measure EFH-1).

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action). Because control measures would be implemented to minimize adverse effects from in-channel construction activities, and because these impacts would occur intermittently within the overall construction timeframe for the entire Project, they are considered **less than significant**.

Impact AQUA-6 (Alternative A): ***Effects of Floodplain Use by Agriculture on Fish Species within Reach 2B.*** Compared to the No-Action Alternative, Alternative A would allow for agricultural use on the expanded floodplains within the levees. Juvenile salmon have been shown to grow more rapidly on the inundated Yolo Bypass floodway when compared to juveniles that remain in the Sacramento River (Sommer et al. 2001). A similar relationship is postulated for the San Joaquin River in Reach 2B. Agricultural use of these lands presently occurs, and moving the levees as part of Alternative A would incorporate these agricultural lands into the floodplain. The majority of the expanded floodplain would become inundated about every 2 years at flows of around 2,500 cfs and higher. Grazing of livestock, pasture, planting annual crops, or planting floodplain-compatible permanent crops would be the agricultural activities implemented on the floodplain between the levees. It is also assumed for the purpose of this analysis that agricultural activities would not occur within 300 feet of the active channel and would also not occur on any constructed floodplain benches adjacent to the main channel or on secondary channels. While flooding of a native floodplain may improve rearing habitat for outmigrating juvenile salmonids, agricultural activities may introduce contaminants (fertilizers, pesticides, manure) directly to the floodplain where they could potentially become entrained in the flow and affect juvenile fish rearing in Reach 2B or in downstream reaches.

Under existing conditions, no agricultural activities occur inside the existing levee alignments. Agricultural crops are presently grown on the area that would be incorporated into the wider floodplain, but these crops are primarily permanent crops (e.g., almonds, pistachios, grapes) that would not be suitable crops to grow in the floodplain and subject to inundation. Compared to existing conditions, agricultural uses under Alternative A would result in periodic soil disturbance, deposition of animal waste, fertilizer or pesticide applications associated with planting of grasses, annual crops or floodplain-compatible permanent crops on the floodplain. These activities would likely occur during periods when the floodplain is dry. Applicable agricultural practices would be in compliance with regulations from the Irrigated Lands Regulatory Program (see Section 14.2.3 for a description of this program). Agricultural use of the floodplain would result in an indirect impact to rearing salmonids in Reach 2B. Because these impacts would occur intermittently throughout the agricultural uses and occur under the control of existing programs, they are considered **less than significant**.

Impact AQUA-7 (Alternative A): ***Effects on Occurrence of Native Fish Species within Reach 2B.*** Compared to the No-Action Alternative, modifications within Reach 2B would facilitate up and downstream passage for native fishes in addition to juvenile and adult salmon. Native fish include lamprey species, Sacramento sucker, Sacramento pikeminnow, hardhead, hitch, Sacramento blackfish, prickly sculpin, and others. While Restoration Flows would assist in native species dispersal from upstream, the fish passage facilities would aid in downstream dispersal. Fish screens designed to help protect juvenile salmon and larger life stages would also protect similar sized juvenile fish from entrainment into diversions. The increased capacity and expansion of floodplains would also produce additional habitat for rearing larval and juvenile native fishes, in addition to habitat available in the channel. Isolation of Mendota Pool from the San Joaquin River would also provide a benefit to native fishes dispersing through the river or living in Reach 2B.

Under existing conditions, native fish moving downstream in Reach 2B are exposed to entrainment at the many unscreened diversions in Mendota Pool. Except for flood years, native fishes are not able to pass upstream over Mendota Dam and may also have difficulty moving upstream of the San Mateo Avenue crossing or through the Chowchilla Bifurcation Structure. Native fishes are exposed to nonnative piscivores in Mendota Pool. Compared to existing conditions, Alternative A would screen diversions along the San Joaquin River. While screens would not be designed specifically to screen all life stages of native fish, they would be designed to screen fry-sized and larger salmon, and would reduce the loss of juvenile life stages of native fishes to the diversions. Isolating the Pool from the river would reduce predation in Mendota Pool. Increasing capacity, expanding the floodplain, and adding floodplain benches adjacent to the main channel would provide additional habitat that would support larval and juvenile native fishes. In combination, these actions would greatly improve the ability of native fishes to move through and live within Reach 2B. Compared to existing conditions, this would be a **beneficial** effect.

Impact AQUA-8 (Alternative A): ***Effects on Predation of Juvenile Salmonids and Native Fish Species.*** Compared to the No-Action Alternative, Alternative A would add several structures while eliminating several features that may harbor predators along the migratory path of juvenile salmon. The No-Action Alternative has numerous diversion intakes in Mendota Dam, Mendota Pool with numerous diversion intakes, and the Chowchilla Bifurcation Structure. Alternative A would have the Compact Bypass, South Canal bifurcation structure, fish screens, and fish bypass return. The total number of potential predation sites associated with artificial structures is 21; however, the isolation of Mendota Pool from the river would eliminate a potentially large predator population from interacting with the outmigrating juvenile salmon.

Under existing conditions, juvenile salmon moving downstream in Reach 2B are exposed to predation at the flow control structures, unscreened intakes, and in Mendota Pool. Isolating the pool and many of the intake structures from the river would reduce opportunities for predation on outmigration juvenile salmon; however, additional structures would be added to the outmigration corridor, including grade control structures in the Compact Bypass and fish passage facilities at the South Canal bifurcation structure. In combination with increased capacity and the widened floodplain, these actions would greatly improve the ability of juvenile salmon to move through Reach 2B even though they would be experiencing some level of predation. Compared to existing conditions, this would be a **beneficial** effect.

Impact AQUA-9 (Alternative A): ***Effects on the Aquatic Food Web within Reach 2B.*** Compared to the No-Action Alternative, Alternative A would provide improved food-web conditions through increased capacity and expanded floodplains. Levees would be set back and floodplain areas would be expanded, making it possible to inundate the majority of the floodplain about every other year through Restoration Flows up to 4,500 cfs, which would potentially create conditions for improved primary and secondary production that would otherwise not occur.

When comparing Alternative A to existing conditions, effects on the aquatic food web would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). Compared to existing conditions, the increased floodplain area, increased frequency of inundation, and the wider floodplains under Alternative A, combined with Restoration Flows, would have a **beneficial** effect on the aquatic food web.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Under Alternative B, construction of new Project facilities would occur, including a new levee system capable of conveying flows up to 4,500 cfs with 3 feet of freeboard; and a new bypass channel, capable of conveying Restoration Flows around Mendota Pool and Mendota Dam, with 2 to 6 grade control structures to aid in upstream passage of adult and juvenile salmon and other native fishes. A new bifurcation structure would be constructed at the head of the Compact Bypass that would control flows down the San Joaquin River and into Mendota Pool. The Mendota Pool Control Structure would include a fish screen capable of screening juvenile salmon up to flows of 2,500 cfs with a fish return system that conveys screened fish back to the Compact Bypass. The San Mateo Avenue crossing would be removed. Alternative B would modify the Chowchilla

Bifurcation Structure to improve fish passage through the San Joaquin River Control Structure and add a NMFS-approved fish passage facility on that control structure when operations prevent passage through the structure.

Alternative B would include three upstream passage structures (Compact Bypass grade control structures, Compact Bypass Bifurcation Structure and fish passage facility, and the Chowchilla Bifurcation Structure and fish passage facility) that would include up to 54 steps. Downstream migrating fish would encounter the Chowchilla Bifurcation Structure passage facility supplemental flow, Lone Willow Slough, Big and Little Bertha, Compact Bypass Control Structure passage facility supplemental flow, and Mendota Pool Control Structure fish screens. Most major diversions that currently divert water from Mendota Pool would be isolated from the San Joaquin River.

This alternative would also create a floodplain with an average width of approximately 4,200 feet with low-lying areas on the floodplain connected to the river to prevent fish stranding. The alternative would restore floodplain habitat that would provide about 1,000 acres of seasonal rearing habitat (about 440 acres of primary production habitat and 560 acres of rearing habitat) for juvenile salmon and other native fishes at a flow of about 2,500 cfs. The floodplain under Alternative B would be about 44 percent primary production habitat at 2,500 cfs and about 42 percent at 4,500 cfs. The alternative would allow agricultural practices in the floodplain (e.g., annual crops, pasture, or floodplain-compatible permanent crops). No changes would occur at Mendota Dam under Alternative B. Construction activity is expected to occur intermittently over 106 to 157 months (9 to 13 years).

Impact AQUA-1 (Alternative B): ***Effects on Fish Habitat and Passage for Local Fish Populations***. Compared to the No-Action Alternative, there would be major improvements to habitat quality and quantity, improvements to up and downstream fish passage, and a reduction in entrainment under Alternative B. Alternative B would increase capacity to convey up to 4,500 cfs in flows through the reach, increase the amount of habitat, and improve habitat quality for all fish species in Reach 2B. Providing fish passage also restores connectivity of Reach 2B to the rest of the river and would have benefits throughout the Program area.

Compared to existing conditions, Alternative B would result in improved up and downstream passage, reduced loss of fish to diversions, and an increase in floodplain habitat. Alternative B would have a **beneficial** effect on fisheries associated with increased survival of juvenile life stages, increase connectivity within the river, and improved and expanded habitat within Reach 2B.

Impact AQUA-2 (Alternative B): ***Effects on Salmonid Rearing Habitat*****.** Compared to the No-Action Alternative, Alternative B would provide a new levee system that would create a 4,200 foot average-width floodplain through Reach 2B that would support food production and rearing habitat. The levee setbacks under Alternative B would allow inundation of 1,000 acres of floodplain at 2,500 cfs. This magnitude of flow would create approximately 440 acres of shallow water habitat (less than 1 foot deep) for primary production and approximately 560 acres of deeper habitat that could directly support rearing conditions (see Figure 2-12 of Chapter 2, "Description of Alternatives"). Floodplain areas adjacent to the main channel would start inundating between 1,200 and 2,200 cfs and would encourage riparian regeneration. Riparian trees may potentially contribute large woody debris to the river channel that could be used as hydraulic cover by juvenile salmonids within the river channel and on the floodplain.

Compared to existing conditions, Alternative B would provide enhanced rearing conditions on the widened floodplain acreage along Reach 2B and provide capacity for up to 4,500 cfs. The floodplain areas adjacent to the main channel would provide additional rearing habitat not otherwise available under existing conditions. These floodplains along the river may provide sites for riparian establishment that, in time, could improve habitat conditions in the channel for juvenile rearing in Reach 2B. Alternative B would provide a **beneficial** effect on rearing habitat for juvenile salmonids rearing in Reach 2B.

Impact AQUA-3 (Alternative B): ***Effects on Upstream Migration of Adult Salmonids***. Compared to the No-Action Alternative, Alternative B would provide upstream passage from Reach 3 through Reach 2B and into Reach 2A. The Compact Bypass would be constructed with two to six grade control steps to facilitate upstream passage. A fish passage facility (a ladder or rock ramp fish way) would provide up and downstream fish passage between the Compact Bypass and the river upstream of the Compact Bypass Control Structure during times when operation of the control structure impedes passage. The Mendota Pool Control Structure may allow some straying, but a fish screen would prevent adult fish from entering Mendota Pool. The San Mateo Avenue crossing would be removed. The Chowchilla Bifurcation Structure would have a fish passage facility to provide passage when operation impedes passage through the structure. All other diversions would be consolidated and/or screened. There would be a total of 54 hydraulic steps that fish would have to pass over three river-spanning structures between Reach 3 and Reach 2A (Compact Bypass grade control structures, Compact Bypass Control Structure and passage facility, and the Chowchilla Bifurcation Structure and passage facility). Diversions would be screened or isolated in Mendota Pool, which would eliminate false migration pathways.

This alternative does not include a fish barrier at the downstream end of the Compact Bypass to keep fish from migrating upstream of the Compact Bypass in Reach 3 toward the base of Mendota Dam. A false migration pathway up to the base of Mendota Dam – of approximately 2,000 feet – would be available to fish in all years, and a false migration pathway into Mendota Pool and Fresno Slough (potentially into the King River system) would occur about once in 5 years when the boards are taken out of Mendota Dam to pass Pine Flat flood releases into Reach 3. A false migration pathway to Mendota Dam would also occur under the No-Action Alternative. Because the Compact Bypass would provide upstream passage under Alternative B, the false migration pathway would affect less fish than under the No-Action Alternative.

When comparing Alternative B to existing conditions, effects would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). Compared to existing conditions, Alternative B would establish fish passage from Reach 3 through Reach 2B and into Reach 2A. As described above fish passage would be greatly improved over existing conditions. Alternative B would have a **beneficial** effect by facilitating upstream migration for adult salmon and by isolating or screening possible false migration pathways.

Impact AQUA-4 (Alternative B): ***Effects on Downstream Migration of Juvenile Salmonids*.** Compared to the No-Action Alternative, Alternative B would improve downstream passage by screening water diversions, isolating operations of Mendota Pool from the river, and providing improved downstream passage for juvenile salmon. The Mendota Pool Control Structure may be screened for diversions. Screened juvenile fish would be directed back to the San Joaquin River in the Compact Bypass and would not pass through Mendota Pool where they would be exposed to loss through diversions and predators. Even if not screened, the Mendota Pool Fish Screen would only be operated for Exchange Contractor diversions in summer months in highly infrequent dry years or during flood flow deliveries, when flows split several times before entering Mendota Pool and fish survival through the bypasses is high. Downstream fish passage would be improved at the Chowchilla Bifurcation Structure by installation of a fish passage facility on the San Joaquin River Control Structure. A fish passage facility at the Compact Bypass Control Structure would allow fish to migrate around when operations impede downstream passage. The San Mateo Avenue crossing would be removed. Outmigrating juvenile salmon would encounter three river spanning structures, five fish screens, and nine potential predation sites as they pass from Reach 2A through Reach 2B and into Reach 3.

When comparing Alternative B to existing conditions, effects would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). Compared to existing conditions, Alternative B would greatly improve downstream passage for juvenile salmonids through Reach 2B from Reach 2A into Reach 3. Alternative B would have a **beneficial** effect by facilitating downstream passage.

Impact AQUA-5 (Alternative B): ***Effects of In-channel Construction Activities on Fish Species within Reach 2B*.** Compared to the No-Action Alternative, Alternative B would include in-water construction and effects would be similar to Alternative A; refer to Impact AQUA-5 (Alternative A) for details. Measures employed in Alternative A, such as in-water construction techniques, would be employed in Alternative B, and would minimize effects of the cofferdams on fish and aquatic biota in Reach 2B during construction.

Compared to existing conditions, Alternative B would have a **less than significant** impact on fish and aquatic organisms due to these measures.

Impact AQUA-6 (Alternative B): ***Effects of Floodplain Use by Agriculture on Fish Species within Reach 2B.*** Compared to the No-Action Alternative, Alternative B would allow for agricultural use on the expanded floodplains within the levees and effects would be similar to Alternative A; refer to Impact AQUA-6 (Alternative A), with the following exceptions. Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) could occur on the floodplain in previous agricultural areas outside of State-owned and public trust lands. Growers would be required to leave cover on the ground and would be required to develop and implement a Water Quality Plan, approved by the Reclamation, to meet then-existing water quality standards for coldwater fisheries beneficial in downstream areas.

Similar to Alternative A, it is also assumed for the purpose of this analysis that agricultural activities would not occur within 300 feet of the active channel and would also not occur on any constructed floodplain benches adjacent to the main channel or on secondary channels. While flooding of a native floodplain may improve rearing habitat for outmigrating juvenile salmonids, agricultural activities may introduce contaminants (fertilizers, pesticides, manure) directly to the floodplain where they could potentially become entrained in the flow and affect juvenile fish rearing in Reach 2B or in downstream reaches.

Compared to existing conditions, agricultural uses under Alternative B would result in periodic soil disturbance, deposition of animal waste, fertilizer or pesticide applications associated with planting of grasses, annual crops or floodplain-compatible permanent crops on the floodplain. These activities would likely occur during periods when the floodplain is dry. Agricultural use of the floodplain would result in an indirect impact to rearing salmonids in Reach 2B. Because these impacts would occur intermittently throughout the agricultural uses and occur under the control of a water quality plan, they are considered **less than significant**.

Impact AQUA-7 (Alternative B): ***Effects on Occurrence of Native Fish Species within Reach 2B.*** Compared to the No-Action Alternative, Alternative B would be similar in performance to Alternative A with the following exceptions; refer to Impact AQUA-7 (Alternative A) for more detail.

- Under Alternative B, there would be a greater amount of floodplain habitat restored that would produce additional habitat for rearing larval and juvenile native fishes than in Alternative A.
- Under Alternative B, upstream native fish passage would be more difficult because there is potentially 11 additional hydraulic jumps to pass than in Alternative A.
- Survival in Reach 2B may be less difficult than in Alternative A because there are 12 fewer predation sites.

Similar to Alternative A, partial or complete isolation of Mendota Pool from the San Joaquin River would also provide a benefit to native fishes dispersing through the river or living in Reach 2B. Overall, Alternative B would provide improved conditions for native fish species in Reach 2B.

Compared to existing conditions, Alternative B would have a similar or better performance than Alternative A, with the exceptions noted above. In combination, these actions would improve the ability of native fishes to move through and live within Reach 2B. Compared to existing conditions, this would be a **beneficial** effect.

Impact AQUA-8 (Alternative B): ***Effects on Predation of Juvenile Salmonids and Native Fish Species.*** Compared to the No-Action Alternative, Alternative B would perform similarly to Alternative A with respect to predation effects; refer to Impact AQUA-8 (Alternative A) for details. Alternative B has nine potential predation sites. The No-Action Alternative includes Mendota Pool with numerous diversion intakes and predation sites and Mendota Dam. Alternative B would have improved fish passage conditions and partially or completely isolate Mendota Pool from the San Joaquin River. Overall, predation is likely reduced compared to the No-Action Alternative.

Compared to existing conditions, Alternative B would be similar in performance to Alternative A (see above). Compared to the existing conditions, overall predation would be reduced, which would be a **beneficial** effect.

Impact AQUA-9 (Alternative B): ***Effects on the Aquatic Food Web within Reach 2B.*** Compared to the No-Action Alternative, Alternative B would provide improved food-web conditions through increased capacity and expanded floodplains. Levees would be set back and floodplain areas would be expanded, making it possible to inundate the majority of the floodplain about every other year through Restoration Flows up to 4,500 cfs, which would potentially create conditions for improved primary and secondary production that would otherwise not occur.

When comparing Alternative B to existing conditions, effects on the aquatic food web would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). Compared to existing conditions, the increased floodplain area, increased frequency of inundation, and the wider floodplains under Alternative B combined with Restoration Flows would have a **beneficial** effect on the aquatic food web.

Alternative C (Fresno Slough Bypass with Narrow Floodplain and Short Canal)

Under Alternative C, construction of new Project facilities would occur, including a new levee system capable of conveying flows up to 4,500 cfs with 3 feet of freeboard. Mendota Pool would be restricted to Fresno Slough and the San Joaquin River would bypass Mendota Pool through its historic channel and would be capable of conveying Restoration Flows through Mendota Dam into Reach 3. Mendota Dam would be modified with a fish passage facility to allow passage when operations would impede passage at Mendota Dam. Five to 10 grade control structures would be added downstream of Mendota Dam to backwater the apron of Mendota Dam and facilitate fish passage. Fresno Slough Dam would be constructed in Fresno Slough with a fish directional barrier installed below the Fresno Slough Dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases. Diversions would be made to Mendota Pool by re-installing flashboards in Mendota Dam and taking water into the pool through the Short Canal. The Short Canal would be screened for juvenile salmon. Screened fish would be returned to the San Joaquin River. A fish guidance barrier would be installed below the proposed Fresno Slough Dam to guide adult salmon upstream to the San Joaquin River. The San Mateo Avenue Crossing would be improved. Alternative C would modify the Chowchilla Bifurcation Structure to improve fish passage through the San Joaquin River Control Structure and add a fish passage facility on the structure for times when operations impede passage through the structure. Sediment removal in the San Joaquin River is assumed to occur to bring the channel bed into a new equilibrium grade through the former San Joaquin arm of the Mendota Pool.

Alternative C would include four upstream passage structures (Mendota Dam grade control structures, Mendota Dam, San Mateo Avenue and the Chowchilla Bifurcation Structure and fish passage facility) that would include up to 59 steps. Downstream migrating fish would encounter the Chowchilla Bifurcation Structure passage facility supplemental flow, Lone Willow Slough, Big and Little Bertha, and Short Canal fish screens. Most major diversions that currently divert water from Mendota Pool would be isolated from the San Joaquin River. Sediment removal in the San Joaquin River is assumed under this alternative to bring the channel bed into a new equilibrium grade through the former Mendota Pool area.

This alternative would create a floodplain with an average width of approximately 3,000 feet with low-lying areas on the floodplain connected to the river to prevent fish stranding. The alternative would restore floodplain habitat that would provide about 750 acres of seasonal rearing habitat (about 520 acres of primary production habitat and 230 acres of rearing habitat) for juvenile salmon and other native fishes at a flow of about 2,500 cfs. In this alternative, the floodplain would not be used for agricultural activities. Construction activity is expected to occur intermittently over 91 to 133 months (7.5 to 11 years).

Impact AQUA-1 (Alternative C): ***Effects on Fish Habitat and Passage for Local Fish Populations.*** Compared to the No-Action Alternative, Alternative C would be very similar to Alternative A; refer to Impact AQUA-1 (Alternative A) for details. Alternative C would increase capacity to convey up to 4,500 cfs in flows through the reach and increase the amount of habitat and improve habitat quality for all fish species in Reach 2B. Conveying Restoration Flows and providing fish passage also restores connectivity of Reach 2B to the rest of the river and would have benefits throughout the Program area.

Compared to existing conditions, Alternative C would perform similar to Alternative A. Alternative C would have a **beneficial** effect on fisheries associated with increased mobility within the river and improved and expanded habitat within Reach 2B.

Impact AQUA-2 (Alternative C): ***Effects on Salmonid Rearing Habitat.*** Compared to the No-Action Alternative, Alternative C would perform similar to Alternative A because it has about the same amount of expanded floodplain; refer to Impact AQUA-2 (Alternative A) for details. Alternative C would provide for an average floodplain of about 3,000 feet. Alternative C would allow inundation of 750 acres of floodplain at 2,500 cfs. This magnitude of flow would create approximately 520 acres of shallow water habitat (less than 1 foot deep) for primary production and approximately 230 acres of deeper habitat that could directly support rearing conditions (see Figure 2-15 of Chapter

2, "Description of Alternatives"). Alternative C would improve rearing habitat conditions for juvenile salmonids in Reach 2B.

Compared to existing conditions, Alternative C would perform similar to Alternative A, because about the same amount of expanded floodplain would occur under both alternatives. Alternative C would have a **beneficial** effect on juvenile salmon rearing habitat within Reach 2B.

Impact AQUA-3 (Alternative C): ***Effects on Upstream Migration of Adult Salmonids***. Compared to the No-Action Alternative, Alternative C would substantially improve upstream passage from Reach 3 into Reach 2A. Alternative C would typically provide passage over Mendota Dam by removing the flashboards and adding five to ten grade control structures to backwater the river over a notched Mendota Dam sill. Mendota Pool would be restricted to Fresno Slough with water delivery from the San Joaquin River into Mendota Pool through the Short Canal. When water deliveries from the San Joaquin River are made to Mendota Pool, the flashboards would be installed in the dam and passage would occur through a fish passage facility around the dam. A fish directional barrier would be installed below the Fresno Slough Dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases from the Fresno Slough Dam. The San Mateo Avenue crossing would be improved. The Chowchilla Bifurcation Structure would have a fish passage facility to provide passage when operation impedes passage through the structure. All other diversions would be consolidated and screened. Upstream migration adults would encounter four river spanning structures (Mendota Dam grade control structures, Mendota Dam, San Mateo Avenue, and Chowchilla Bifurcation Structure and passage facility) with up to 59 steps. Alternative C would improve passage conditions compared to the No-Action Alternative.

Under existing conditions, upstream migrating adult salmon are restricted from entering Reach 2B by Mendota Dam. In comparison to existing conditions, Alternative C would create fish passage through Reach 2B from Reach 3 and into Reach 2A (see above). Alternative C would have a **beneficial** effect by allowing upstream migrating adults to pass upstream to potential spawning habitat.

Impact AQUA-4 (Alternative C): ***Effects on Downstream Migration of Juvenile Salmonids***. In comparison to the No-Action Alternative, Alternative C would improve downstream passage of juvenile salmonids by screening water diversions, isolating operations of Mendota Pool from the river and providing improved downstream passage for juvenile salmon. Juvenile salmon would be prevented from entering Mendota Pool by a fish screen at the head of the Short Canal. Downstream fish passage would be improved at the Chowchilla Bifurcation Structure by installation of a fish passage facility on the San Joaquin River Control Structure. The San Mateo Avenue crossing would be improved to facilitate downstream passage. Outmigrating juvenile salmon would encounter four river spanning structures, five fish screens, and 14 potential predation sites as they move through Reach 2B.

Compared to existing conditions, Alternative C would improve downstream migration of juvenile salmonids through Reach 2B from Reach 2A into Reach 3 for the same reasons as mentioned in the above paragraph. As such, Alternative C would have a **beneficial** effect on downstream passage of juvenile salmonids.

Impact AQUA-5 (Alternative C): *Effects of In-channel Construction Activities on Fish Species within Reach 2B.* Compared to the No-Action Alternative, Alternative C would include in-water construction, and the effects would be similar to Alternative A; refer to Impact AQUA-5 (Alternative A) for details. Measures employed in Alternative C, such as in-water construction techniques, would be the same as those employed in Alternative A, and would minimize the effects of the cofferdams on fish and aquatic biota in Reach 2B during construction.

Compared to existing conditions, Alternative C would have a **less than significant** impact on fish and aquatic organisms due to these measures.

Impact AQUA-6 (Alternative C): *Effects of Floodplain Use by Agriculture on Fish Species within Reach 2B.* Similar to the No-Action Alternative, Alternative C does not support agricultural purposes on the expanded floodplains within the levees; therefore, there would be no effect of floodplain agricultural activities on rearing salmonids in Reach 2B.

Compared to existing conditions, Alternative C would have **no effect** from floodplain agricultural activities on rearing salmonids.

Impact AQUA-7 (Alternative C): *Effects on Occurrence of Native Fish Species within Reach 2B.* Compared to the No-Action Alternative, Alternative C would perform slightly better than Alternative A; refer to Impact AQUA-7 (Alternative A) for details. While both alternatives have about the same amount of floodplain for rearing larval and juvenile native fishes, Alternative C has fewer potential predation sites. Isolation of Mendota Pool from the San Joaquin River would also provide a benefit to native fishes dispersing through the river or living in Reach 2B under Alternative C. Overall, Alternative C would provide improved conditions for native fish species in Reach 2B.

Compared to existing conditions, Alternative C would have similar or better performance than Alternative A because of the reduced number of potential predation sites. In combination, the actions described above would improve the ability of native fishes to move through and live within Reach 2B. Compared to existing conditions, this would be a **beneficial** effect.

Impact AQUA-8 (Alternative C): *Effects on Predation of Juvenile Salmonids and Native Fish Species.* Compared to the No-Action Alternative, Alternative C would perform slightly better than Alternative A; refer to Impact AQUA-8 (Alternative A) for details. The No-Action Alternative includes Mendota Pool with numerous diversion intakes and associated potential predation sites while Alternative C would reduce the total number of potential predation sites to 14, isolate Mendota Pool from the San Joaquin River and minimize the number of potential predation sites remaining in the river. As a result, Alternative C would likely reduce predation compared to the No-Action Alternative.

Compared to existing conditions, Alternative C would perform slightly better than Alternative A, for the reason mentioned in the paragraph above, and would have fewer potential predation sites than Alternative A. Compared to the existing conditions, overall predation would be reduced, which would have a **beneficial** effect.

Impact AQUA-9 (Alternative C): ***Effects on the Aquatic Food Web within Reach 2B.*** Compared to the No-Action Alternative, Alternative C would perform similarly to Alternative A because both alternatives have about the same size floodplain and other such features; refer to Impact AQUA-9 (Alternative A) for details. Levees would be set back a similar distance and floodplain areas would be expanded, making it possible to inundate the majority of the floodplain about every other year through Restoration Flows up to 4,500 cfs, which would potentially create conditions for primary and secondary production that would not otherwise occur. Alternative C would improve aquatic food web conditions within Reach 2B relative to the No-Action Alternative.

When comparing Alternative C to existing conditions, effects on the aquatic food web would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to the No-Action Alternative). The increased floodplain area, increased frequency of inundation, and the wider floodplains under Alternative C, combined with Restoration Flows, would have a **beneficial** effect on the aquatic food web.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Under Alternative D, construction of new Project facilities would occur, including a new levee system capable of conveying flows up to 4,500 cfs with 3 feet of freeboard. Mendota Pool would be restricted to Fresno Slough and the San Joaquin River would bypass Mendota Pool through its historic channel. The San Joaquin River would be capable of conveying Restoration Flows through Mendota Dam into Reach 3. Mendota Dam would be modified with a fish passage facility to allow passage when operations would impede passage at Mendota Dam. Five to 10 grade control structures would be added downstream of Mendota Dam to backwater the apron of Mendota Dam and facilitate fish passage. Fresno Slough Dam would be constructed in Fresno Slough with a fish directional barrier installed below the Fresno Slough Dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases. Diversions to Mendota Pool would occur at the new North Canal bifurcation structure that would provide up to 2,500 cfs diversion into the North Canal and up to 4,500 cfs to the San Joaquin River. The North Canal intake would include a fish screen capable of screening juvenile salmon and a fish return system that conveys screened fish back to the river. An upstream fish passage facility would be constructed at the North Canal bifurcation structure to provide upstream passage when operations impede passage through the structure. San Mateo Avenue crossing and the existing San Joaquin River control structure of the Chowchilla Bifurcation Structure would be removed.

Alternative D would include four upstream passage structures (Mendota Dam grade control structures, Mendota Dam, and the North Canal bifurcation structure and passage facility) totaling up to 36 steps. Downstream migrating fish would encounter the Lone Willow Slough, North Canal passage facility supplemental flow, and the North Canal and Big and Little Bertha fish screens. Most major diversions that currently divert water from the Mendota Pool would be isolated from the San Joaquin River. Sediment removal in the San Joaquin River is assumed under this alternative to bring the channel bed into a new equilibrium grade through the former Mendota Pool area.

This alternative would create a floodplain with an average width of approximately 4,200 feet with low-lying areas on the floodplain connected to the river to prevent fish stranding. The alternative would restore floodplain habitat that would provide about 1,050 acres of seasonal rearing habitat (about 740 acres of primary production habitat and 310 acres of rearing habitat) for juvenile salmon and other native fishes at a flow of about 2,500 cfs. The alternative would allow agricultural practices in the floodplain (e.g., annual crops, pasture, or floodplain-compatible permanent crops). Construction activity is expected to occur intermittently over 97 to 158 months (8 to 13 years).

Impact AQUA-1 (Alternative D): ***Effects on Fish Habitat and Passage for Local Fish Populations.*** Compared to the No-Action Alternative, Alternative D would be very similar in performance to Alternative B; refer to Impact AQUA-1 (Alternative B) for details. Alternative D has a similar sized floodplain as Alternative B and would increase capacity to convey up to 4,500 cfs in flows through the reach, which would increase the amount of habitat and improve habitat quality for all fish species in Reach 2B. Conveying Restoration Flows and providing fish passage would also restore connectivity through Reach 2B to the rest of the river, and would have benefits throughout the Program area.

Compared to existing conditions, Alternative D would be very similar performance to Alternative B. Alternative D would have a **beneficial** effect on fisheries using and moving through Reach 2B.

Impact AQUA-2 (Alternative D): ***Effects on Salmonid Rearing Habitat***. Compared to the No-Action Alternative, Alternative D would perform similar to Alternative B; refer to Impact AQUA-2 (Alternative B) for details. Alternative D would create about the same amount of new floodplain rearing habitat that would inundate 1,050 acres at 2,500 cfs. This magnitude of flow would create approximately 740 acres of shallow water habitat (less than 1 foot deep) for primary production and approximately 310 acres of deeper habitat that could directly support rearing conditions (see Figure 2-19 of Chapter 2, “Description of Alternatives”). Floodplain benches adjacent to the main channel could encourage riparian regeneration similar to Alternative B. Alternative D would improve salmonid rearing habitat in Reach 2B.

Compared to existing conditions, Alternative D would create a substantial amount of floodplain habitat that could be used as rearing habitat for juvenile salmonids (see above), and would be similar in performance to Alternative B. Alternative D would provide a **beneficial** effect on rearing habitat for listed salmonid species by expanding floodplain habitat supporting rearing juvenile salmon.

Impact AQUA-3 (Alternative D): ***Effects on Upstream Migration of Adult Salmonids***. In comparison to the No-Action Alternative, Alternative D would improve upstream passage from Reach 3 into Reach 2B, and from Reach 2B into Reach 2A. Under this alternative, the concrete portions of Mendota Dam would remain in place, the sill would be notched to improve fish passage and the five to 10 grade control structures installed downstream to backwater the river over the sill. The flash boards at the dam would be removed and flows would pass over the notched sill. The Fresno Slough Dam would be constructed in Fresno Slough with a fish directional barrier installed below the Fresno Slough Dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases. The North Canal bifurcation structure would be constructed to allow water deliveries from Reach 2B to Mendota Pool and to control flows from the San Joaquin River into the Chowchilla Bypass. The San Mateo Avenue road crossing and the existing San Joaquin River control structure of Chowchilla Bifurcation Structure would be removed under this alternative. Alternative D would result in three main river spanning structures (Mendota Dam grade control structures, Mendota Dam, and the North Canal bifurcation structure and passage facility) having up to 36 steps. All diversions would be screened or isolated in Mendota Pool, which would eliminate false migration pathways.

Under existing conditions, upstream migrating adult salmonids are restricted from entering Reach 2B by Mendota Dam, and would have difficulty passing San Mateo Avenue during low flow ranges and passing the San Joaquin River control structure of the Chowchilla Bifurcation Structure at some flows. Adult salmon could also stray into the DMC, Main Canal, Helm Ditch, and Fresno Slough or into the Columbia Canal approach channel. In comparison to existing condition, Alternative D would improve upstream fish passage through Reach 2B from Reach 3 and into Reach 2A for the reasons mentioned above. Alternative D would have a **beneficial** effect by allowing upstream migrating adults to pass upstream to potential spawning habitat.

Impact AQUA-4 (Alternative D): ***Effects on Downstream Migration of Juvenile Salmonids***. In comparison to the No-Action Alternative, Alternative D would be similar in performance to Alternative C; refer to Impact AQUA-4 (Alternative C) for details. Juvenile fish would encounter the same number of fish screens and potential predation sites as they would under Alternative C, so performance of the two alternatives for downstream migration would be similar. Alternative D would improve conditions relative to the No-Action Alternative.

Compared to existing conditions, Alternative D would be similar in performance as Alternative C, because fish would encounter the same number and types of fish screens and potential predation sites. As such, Alternative D would have a **beneficial** effect on downstream passage of juvenile salmonids.

Impact AQUA-5 (Alternative D): ***Effects of In-channel Construction Activities on Fish Species within Reach 2B.*** Compared to the No-Action Alternative, Alternative D would include in-water construction and effects would be similar to Alternative A; refer to Impact AQUA-5 (Alternative A) for details. Measures employed in Alternative A, such as in-water construction techniques, would be employed in Alternative D, and would minimize effects of the cofferdams on fish and aquatic biota in Reach 2B during construction.

Compared to existing conditions, Alternative D would have a **less than significant** impact on fish and aquatic organisms due to these measures.

Impact AQUA-6 (Alternative D): ***Effects of Floodplain Use by Agriculture on Fish Species within Reach 2B.*** Compared to the No-Action Alternative, Alternative D would perform similarly to Alternative A; refer to Impact AQUA-6 (Alternative A) for details. Agricultural use of these lands presently occurs under the No-Action Alternative, moving the levees would incorporate these agricultural lands into the floodplain. The majority of the expanded floodplain would become inundated about every 2 years at flows of around 2,500 cfs and higher. Juvenile salmon have been shown to grow more rapidly on the inundated Yolo Bypass floodway when compared to juveniles that remain in the Sacramento River (Sommer et al. 2001). A similar relationship is postulated for the San Joaquin River in Reach 2B.

Grazing of livestock, pasture, planting annual crops, or planting floodplain-compatible permanent crops would be the agricultural activities implemented on the floodplain between the levees. It is also assumed for the purpose of this analysis that agricultural activities would not occur within 300 feet of the active channel and would also not occur on any constructed floodplain benches adjacent to the main channel or on secondary channels. While flooding of a native floodplain may improve rearing habitat for outmigrating juvenile salmonids, agricultural activities may introduce contaminants (fertilizers, pesticides, manure) directly to the floodplain where they could potentially become entrained in the flow and affect juvenile fish rearing in Reach 2B or in downstream reaches.

Under existing conditions, no agricultural activities occur inside the existing levees. Agricultural crops are presently grown on the area that would be incorporated into the wider floodplain, but these crops are primarily permanent crops (e.g., almonds, pistachios, grapes) and would likely not be suitable crops to grow in the floodplain. Compared to existing conditions, agricultural uses under Alternative D would result in periodic soil disturbance, deposition of animal waste, fertilizer or pesticide applications associated with planting of grasses, annual crops or floodplain-compatible permanent crops on the floodplain. These activities would likely occur during periods when the floodplain is dry. Agricultural use of the floodplain would result in an indirect impact to rearing salmonids in Reach 2B. Because these impacts would occur intermittently throughout the agricultural uses and occur under the control of existing programs, they are considered **less than significant**.

Impact AQUA-7 (Alternative D): ***Effects on Occurrence of Native Fish Species within Reach 2B.*** Compared to the No-Action Alternative, modifications within Reach 2B under Alternative D would be similar in performance to Alternative B; refer to Impact AQUA-7 (Alternative B) for details. The increased capacity and expansion of floodplains would produce additional habitat for rearing larval and juvenile native fishes. Similar to other alternatives, isolation of Mendota Pool from the San Joaquin River would also provide a benefit to native fishes dispersing through the river or living in Reach 2B.

Compared to existing conditions, Alternative D would have similar performance as Alternative B (see above). Alternative D would have one less fish screen (four instead of five) fewer predation sites (14 instead of 22), which would improve the performance of Alternative D relative to Alternative B. In combination, these actions would improve the ability of native fishes to move through Reach 2B and greatly expand the habitat within Reach 2B. Compared to existing conditions, this would be a **beneficial** effect.

Impact AQUA-8 (Alternative D): ***Effects on Predation of Juvenile Salmonids and Native Fish Species.*** Compared to the No-Action Alternative, Alternative D would perform similar to Alternative C; refer to Impact AQUA-8 (Alternative C) for details.

The No-Action Alternative includes continued operation of Mendota Pool with numerous diversion intakes and associated potential predation sites, and potential predation sites at Mendota Dam and the Chowchilla Bifurcation Structure. Alternative D would have potential predation sites at the North Canal bifurcation structure, Mendota Dam, and the Mendota Dam grade control structures. However, the North Canal fish screen would screen water flowing into Mendota Pool and the pool would be isolated from the river. The San Joaquin River control structure of the Chowchilla Bifurcation Structure and the San Mateo Avenue crossing would be removed. Alternative D would reduce predation compared to the No-Action Alternative.

Compared to existing conditions, Alternative D would be similar in performance to Alternative C (see above). Alternative D has the same number of screens and potential predation sites as Alternative C. Compared to the existing conditions, this would be a **beneficial** effect.

Impact AQUA-9 (Alternative D): ***Effects on the Aquatic Food Web within Reach 2B.*** Compared to the No-Action Alternative, Alternative D would be similar in performance to Alternative B, because both alternatives have about the same amount of floodplain habitat; refer to Impact AQUA-9 (Alternative B) for details. Levees would be set back and floodplain areas would be expanded, making it possible to inundate the majority of the floodplain about every other year through Restoration Flows up to 4,500 cfs, which would potentially create conditions for improved primary and secondary production that would otherwise not occur.

When comparing Alternative D to existing conditions, effects on the aquatic food web would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative D to the No-Action Alternative). Compared to existing conditions, the increased floodplain area, increased frequency of inundation, and the wide floodplains under Alternative D, combined with Restoration Flows, would have a **beneficial** effect on the aquatic food web.

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6.0 Biological Resources – Vegetation

This chapter describes the environmental and regulatory setting for vegetation and special-status plants in the Project area, analyzes the environmental consequences associated with the Project alternatives, and identifies impacts and mitigation measures.

6.1 Environmental Setting

Biological resources addressed in this section include special-status plants, vegetation alliances, and non-native invasive plant species. Existing conditions are the baseline biological resource conditions that existed when the Notice of Intent and Notice of Preparation were filed, which was July 2009. However, field data were collected at later dates, after the start of Interim Flows. Therefore, the best available information to describe existing conditions was typically from the period after the start of Interim Flows.

6.1.1 Regional Setting

The San Joaquin River downstream of Friant Dam is a deeply incised channel that discharges to the San Joaquin Valley floor near Gravelly Ford. The San Joaquin River and its main tributaries in their historic natural state meandered across alluvial fans along the main axis of the valley. The river distributed higher flows into a complex network of sloughs that branched off both sides of the river. It flowed through a flat, homogeneous topography and supported a limited riparian forest. The flat valley floor surrounding the riparian forest supported extensive wetlands dominated by tule marsh. Riparian forest zones were present along the margins of the main channel and were not very extensive (The Bay Institute 1998).

Near Mendota, the San Joaquin River merged with Fresno Slough, which was part of an intricate slough system that exchanged water between the Tulare Lake Basin and the San Joaquin River. Downstream from Mendota, the San Joaquin River flowed through a network of large slough channels supporting riparian woodlands, tule marshes, and backwater ponds until the Merced River confluence. Downstream from this point, the floodplain was more confined and the river exhibited a highly sinuous pattern of meanders with a complex of oxbow lakes, backwater sloughs, ponds, and sand bars. In its lower sections just upstream from the Delta, the river formed low natural levees approximately 6 feet high (The Bay Institute 1998).

The San Joaquin River has changed dramatically since the early 20th century. The river is now largely confined within constructed levees and bounded by agricultural and urban development, flows are regulated through dams and water diversions, and floodplain habitats have been fragmented and reduced in size and diversity (McBain and Trush 2002). As a result, the riparian communities and associated wildlife have substantially changed from historic conditions (Bureau of Reclamation [Reclamation] 1998a).

Vegetation in the Restoration Area has been heavily impacted by levee construction, conversion of riparian areas into agricultural fields, ongoing agricultural practices, livestock grazing, introduction of non-native invasive plant species, and the quantity and duration of river flows. In typical water years, Friant Dam is operated to store flows in the spring for water deliveries during the summer months, resulting in abrupt decreases in stream flow. A rapid rate of drawdown generally prevents the establishment of new willow, cottonwood, and other riparian tree and shrub species. Water diversions upstream of the Project area have caused substantial loss of riparian vegetation in several reaches of the river (e.g., Reaches 2 and 4A), and urban and agricultural development have caused a gradual loss in the area available for riparian habitat (Reclamation 1998a).

6.1.2 Project Setting

The Project area includes Reach 2B and a small portion of Reach 3, situated along approximately 12 miles of the San Joaquin River from the Chowchilla Bifurcation Structure to 2 miles downstream of Mendota Dam. Figure 1-2 of Chapter 1.0, "Introduction," includes a map of the Project area.

The river reach within the Project area consists primarily of a sandy river channel constricted by levees on both sides. The river is lined with narrow bands of riparian vegetation that extend from sparse and narrow riparian terraces to the top of the levees. Until the recently implemented Interim Flow regime, the portion of the Project area upstream of San Mateo Avenue was dry most of the year and the portion downstream was inundated by Mendota Pool.

Vegetation Alliances

Riparian vegetation types on levee banks, narrow terraces, small floodplains, and within the active channel include:

- Riparian forests and woodlands.
- Riparian thickets.
- Riparian scrub.
- Grasslands and herbaceous fields.
- Marshes and wet meadows.

These general vegetation types are subdivided into vegetation alliances based on the predominant species present. Table 6-1 provides a cross-reference between the special-status vegetation alliances recognized by the California Department of Fish and Wildlife (DFW) (2009) and found in the Project area, the former sensitive natural community types (DFW 2003), and plant community types (Holland 1986) used to classify vegetation in California. For the purpose of this document, special-status vegetation alliances are defined as natural communities that are considered vulnerable, imperiled, or critically imperiled, in California (State ranks 1-3 and riparian and wetland alliances). DFW currently requires that the vegetation alliance nomenclature based on the current system be used when evaluating project impacts (DFW 2009, Hickson 2009). Most types of wetlands and riparian communities are considered special-status vegetation alliances due to their limited distribution in California.

Table 6-1.
Cross-Reference of Vegetation Alliance, Natural Community, and Plant Community Types

Vegetation Alliance Common/ Scientific Name (DFW 2009)	Natural Community (DFW 2003)	Plant Community (Holland 1986)
Riparian Forest and Woodland Vegetation Alliances		
Fremont cottonwood forest/ *Populus fremontii* alliance	Fremont Cottonwood Riparian Forests and Woodlands	Cottonwood Riparian Forest
Oregon ash groves/ *Fraxinus latifolia* forest alliance	Oregon Ash Riparian Forest	Mixed Riparian Forest
Valley oak woodland/ *Quercus lobata* woodland alliance	Valley Oak Forests and Woodlands	Valley Oak Riparian Forest
Riparian Thicket Alliances		
Black willow thickets/ *Salix gooddingii* alliance	Black Willow Riparian Forests and Woodlands	Willow Riparian Forest
Buttonwillow thickets/ *Cephalanthus occidentalis* alliance	Buttonbush Scrub	Riparian Scrub
Red willow thickets/ *Salix laevigata* woodland alliance	Red Willow Riparian Forests	Willow Riparian Forest
Arrow weed thickets/ *Pluchea sericea* shrubland alliance	Arrow Weed Scrubs	Riparian Scrub
Riparian Scrub Alliances		
Blue elderberry stands/ *Sambucus nigra* shrubland alliance	Elderberry Scrub and Savanna	Elderberry Savanna
California rose briar patches/ *Rosa californica* alliance	California Rose Riparian Scrub	Riparian Scrub
Spinescale scrub/ *Atriplex spinifera* alliance	Spinescale Scrub	Alkali Sink
Grassland and Herbaceous Field Alliances		
Tar plant fields/ *Centromadia pungens* or other species herbaceous alliance	Tar Plant Fields	Grassland and Pasture
Creeping rye grass turfs/ *Leymus triticoides* herbaceous alliance	Creeping Ryegrass Grassland	Grassland and Pasture
Salt grass flats/ *Distichlis spicata* herbaceous alliance	Saltgrass	Emergent Wetland
Marsh and Wet Meadow Alliances		
California bulrush marsh/ *Schoenoplectus californicus* herbaceous alliance	California Bulrush Wetland	Emergent Wetland
Pale spike rush marshes/ *Eleocharis macrostachya* herbaceous alliance	Spikerush	Emergent Wetland
Yerba mansa meadows/ *Anemopsis californica* herbaceous alliance	Alkali Meadow	Alkali Sink
Alkali heath marsh/ *Frankenia salina* alliance	Alkali Heath Dwarf Scrub	Alkali Sink

Table 6-2 below lists special-status vegetation alliances observed in the Project area, their extent, and vegetation alliance state ranking. DFW ranks vegetation alliances based on their rarity, vulnerability to disturbance, and association with sensitive habitat types such as streams and wetlands.

Table 6-2.
Special-Status Vegetation Alliances in the Project Area

Common Name	Scientific Name	State Rank	Area (acres)
Riparian Forest and Woodland Alliances			
Fremont cottonwood forest	*Populus fremontii* alliance	S3.2/Riparian	90.9
Oregon ash groves	*Fraxinus latifolia* forest alliance	S3.2/Riparian	7.1
Valley oak woodland	*Quercus lobata woodland* alliance	S3 to S2	0.2
Riparian Thicket Alliances			
Black willow thickets	*Salix gooddingii* alliance	S3/Riparian	146.8
Buttonwillow thickets	*Cephalanthus occidentalis* alliance	S2/Riparian	1.6
Red willow thickets	*Salix laevigata* woodland alliance	S3/Riparian	0.6
Arrow weed thickets	*Pluchea sericea* shrubland alliance	S3/Wetland	0.4
Riparian Scrub Alliances			
Blue elderberry stands	*Sambucus nigra* shrubland alliance	S3	76.4
California rose briar patches	*Rosa californica* alliance	S3/Riparian	13.4
Spinescale scrub	*Atriplex spinifera* alliance	S3	0.7
Silver bush lupine scrub	*Lupinus albifrons* shrubland alliance	S4	4.1
Grassland and Herbaceous Field Alliances			
Tar plant fields	*Centromadia pungens* or other species herbaceous alliance	S2	35.4
Creeping rye grass turfs	*Leymus triticoides* herbaceous alliance	S3/Riparian	6.2
Salt grass flats	*Distichlis spicata* herbaceous alliance	S4/Wetland	2.3
Marsh and Wet Meadow Alliances			
California bulrush marsh	*Schoenoplectus californicus* herbaceous alliance	S4/Wetland	47.0
Pale spike rush marsh	*Eleocharis macrostachya* herbaceous alliance	S4/Wetland	1.6
Yerba mansa meadows	*Anemopsis californica* herbaceous alliance	S2/Wetland	0.8
Alkali heath marsh	*Frankenia salina* alliance	S3/Wetland	0.7

Vegetation Alliance State Ranking by DFW:
S1 = statewide critically imperiled
S2 = statewide imperiled
S3 = statewide vulnerable
S3.2 = vulnerable and threatened – at moderate risk of extinction or elimination in the State due to a restricted range, relatively few populations, recent and widespread declines, or other factors.
S4 = statewide apparently secure
S5 = secure

Riparian Forest and Woodland

Riparian forest and woodland alliances in the Project area include Fremont cottonwood forest, Oregon ash groves, and valley oak woodland.

Fremont cottonwood forest (*Populus fremontii* alliance) is a multilayered riparian forest occurring on high floodplain areas along the San Joaquin River. Older and decadent stands of cottonwood riparian forest also exist in areas that were formerly active floodplains, but are now on functional terraces because of the reduction in high flow regime following the completion of Friant Dam. Fremont cottonwood forests are typically up to 80 feet tall and the canopy cover is open in woodlands to continuous in forests. Fremont cottonwood is the dominant or co-dominant species in the tree canopy with other trees such as Oregon ash (*Fraxinus latifolia*), California black walnut (*Juglands californica*), California sycamore (*Platanus racemosa*), and black willow (*Salix gooddingii*). California wild grape (*Vitis californica*) is a conspicuous vine usually growing within the canopy of Fremont cottonwoods. The mid-story is typically dominated by open to intermittent shade-tolerant shrubs and small trees. Other shrubby species of willow such as sandbar willow (*Salix exigua*) may also be present within the mid-story along the sunny edges of the forest. The understory is typically dominated by native grasses and forbs, such as creeping wildrye (*Leymus triticoides*), stinging nettle (*Urtica dioica* ssp. *holosericea*), and at the lower mesic edges, Santa Barbara sedge (*Carex barbarae*). Fremont cottonwood forest occurs on 66 acres in the Project area.

Oregon ash groves (*Fraxinus latifolia* forest alliance) occur where Oregon ash is the dominant or co-dominant species in the tree canopy with other riparian trees. Oregon ash groves are typically up to 50 feet tall and the canopy cover is open to continuous. Shrubs are sparse to intermittent because of heavy shade under the dense canopy. The herbaceous layer is sparse and variable. The alliance occurs on terraces and levee slopes with alluvial soils in the Project area.

Valley oak woodlands (*Quercus lobata* woodland alliance) have valley oak as the dominant or co-dominant tree. Although this alliance was found in the Project area, only individual trees were observed and these were possibly planted. The alliance occurs on the south side of Mendota Pool in soils that may be seasonally saturated or intermittently flooded during very high flows.

Riparian Thickets

Riparian thicket vegetation alliances in the Project area include black willow thickets, buttonwillow thickets, red willow thickets, and arrow weed thickets.

Black willow thickets (*Salix gooddingii* alliance) have black willow as the dominant or co-dominant species in the tree canopy with other trees such as white alder, Fremont cottonwood, red willow, arroyo willow, shining willow and yellow willow (*Alnus rhombifolia, Populus fremontii, Salix laevigata, S. lasiolepis, S. lucida* ssp. *lasiandra,* and *S. lutea*). In the Project area, black willow thickets are typically up to 60 feet tall and the alliance canopy cover is open to continuous. Shrubs are open to continuous with blue elderberry (*Sambucus nigra*), coyote brush (*Baccharis pilularis*), and mulefat (*B.*

salicifolia). The alliance occurs in riparian corridors, rocky floodplains, small intermittent streams, springs, and seeps.

Buttonwillow thicket (*Cephalanthus occidentalis* alliance) is a vegetation alliance where buttonwillow shrubs are dominant in the canopy or co-dominant with black willow, shining willow (*S.lucida* ssp. *lasiandra*), and sandbar willow (*S. exigua*). Buttonwillow shrubs are typically less than 20 feet tall and the alliance provides open, intermittent, or continuous canopy cover. The herbaceous understory layer is sparse or grassy. The alliance occurs in seasonally flooded basins with slowly moving or stagnant water and in floodplains with subsurface water at the end of the growing season. Many small stands of buttonwillow occur on the lower margins of the levee banks throughout most of the Project area and these stands often form narrow strips along levees.

Red willow thicket (*Salix laevigata* woodland alliance) is a vegetation alliance where red willow is the dominant or co-dominant in the tree canopy with other trees. In the Project area, these can be Fremont cottonwood, black willow, and blue elderberry. Red willow thickets are up to 70 feet tall and the alliance canopy cover is open to continuous. The shrub layer is open to continuous. The alliance occurs in the Project area only sparsely with other riparian trees on floodplains and low-gradient depositions along the river.

Arrow weed thickets (*Pluchea sericea* shrubland alliance) have arrow weed as the dominant or co-dominant species with other plants in the shrub canopy. In the Project area, they can be mulefat, sandbar willow, and dogbane. The alliance occurs along stream borders or seasonally flooded areas. Arrow weed is a wetland plant. Several large areas of this vegetation alliance were observed in the Project area in low-lying areas that are seasonally flooded on the south bank in the meander loop between River Mile (RM) 207 and RM 208.

Riparian Scrub

Riparian scrub alliances in the Project area include the blue elderberry stands, California rose briar patches, and spinescale scrub vegetation alliances.

Blue elderberry stands (*Sambucus nigra* shrubland alliance) have blue elderberry as the dominant or co-dominant species in the shrub canopy with other shrubs such as mugwort, coyote brush, mulefat, toyon, tobacco tree, sandbar willow, poison oak and California grape. Emergent trees, such as California walnut, Fremont cottonwood, and Oregon ash may occur. In the Project area, blue elderberry stands are typically up to 20 feet tall and the canopy cover is open. The herbaceous layer is variable and usually grassy. The alliance occurs primarily on levee banks and in meander loop bottomlands. The blue elderberry is especially abundant in the southeast, undeveloped pastures of the Project area and in the meander loops between RM 213 and RM 216 near the Chowchilla Bifurcation Structure. The alliance occurs on sand and gravelly soil alluvium that is intermittently flooded. Blue elderberry shrubs in the Project area are habitat for the Federally-listed, threatened valley elderberry longhorn beetle.

California rose briar patches (*Rosa californica* alliance) have California rose as the dominant or co-dominant species in the shrub canopy with other shrubs such as coyote brush, sandbar willow, blue elderberry, and mulefat. California rose briar patches are typically up to 7 feet tall and the cover is typically very dense and continuous. The herbaceous layer is open and sparse because of heavy shading. The alliance occurs on levee banks throughout the reach on soils that are either mixed coarse alluvium or levee import.

Spinescale scrub *(Atriplex spinifera* alliance) has spinescale as the dominant or co-dominant species in the shrub canopy with other shrubs such as alkali heath (*Frankenia salina)* or mulefat. Spinescale scrub is typically up to 7 feet tall and the canopy cover is open. The herbaceous layer is variable with seasonal annuals reaching high cover. The alliance is scattered in several sandy areas high above the current water surface.

Grasslands and Herbaceous Fields

Grassland and herbaceous field alliances in the Project area include tar plant fields, creeping rye grass turfs, and salt grass flats.

Tarplant fields (*Centromadia pungens* herbaceous alliance) have tarplant as dominant to conspicuous in the herbaceous layer. Tarplant is typically lower than 2 feet and the cover is intermittent to continuous. The alliance occurs in vernally wet habitats, including alkaline flats subjected to periodic or intermittent water inundation. It is common in and near the meander loop between RM 207 and RM 208 that is now typically flooded in the winter. It occurs here on soils that are finer-textured, silty alluvium that is poorly drained. Common tarplant often covers large areas.

Creeping rye grass turfs (*Leymus triticoides* herbaceous alliance) has creeping rye as the dominant or co-dominant species in the herbaceous layer with other herbs such as yerba mansa (*Anemopsis californica*), salt grass (*Distichlis spicata*), and barley grasses (*Hordeum* species) on poorly drained floodplains, moderately moist flat to sloping topography, levee slopes and marsh margins.

Salt grass flats (*Distichlis spicata* herbaceous alliance) has salt grass is the dominant or co-dominant species in the herbaceous layer with other herbs such as yerba mansa, creeping rye, alkali heath, and barley grasses on poorly drained floodplains, wet meadows, and marsh margins.

Marsh and Wet meadow

Marsh and wet meadow alliances include California bulrush marsh, pale spike rush marsh, yerba mansa meadow and alkali heath marsh.

California bulrush marsh (*Schoenoplectus californicus* herbaceous alliance) has California bulrush as the dominant species. It occurs with hardstem bulrush (*Scirpus acutus*), broadleaf cattail (*Typha latifolia*), narrowleaf cattail (*Typha angustifolia*), and river bulrush (*Scirpus fluviatilis*). It is an emergent species that occurs along the edges of Mendota Pool. It also forms numerous vegetation islands in low velocity reaches of the river.

Pale spike rush marsh (*Eleocharis macrostachya* herbaceous alliance) is a vegetation alliance where pale spike rush is the dominant species.

Yerba mansa meadows (*Anemopsis californica* herbaceous alliance) have yerba mansa as dominant or co-dominant with other herbaceous species such as alkali heath (*Frankenia grandiflora*), salt grass (*Distichlis spicata*), western goldenrod (*Euthamia occidentalis*), prickly lettuce (*Lactuca serriola*), and creeping rye grass (*Leymus triticoides*). Yerba mansa meadows occur on alkaline or saline soils on stream terraces and floodplains adjacent to the river. Yerba mansa is a wetland plant that almost always occurs in wetland areas. The alliance was observed in well preserved riparian meadows on the south bank of the river in areas where the river backs up behind Mendota Dam.

Alkali heath marsh (*Frankenia salina* alliance) has alkali heath as the dominant or co-dominant species in the herbaceous or subshrub layer with other species such as salt grass *(Distichlis spicata*) and creeping rye grass (*Leymus triticoides*). Alkali heath marsh is typically composed of herbs and subshrubs up to 2 feet tall and the alliance canopy cover is open to continuous. In the Project area, it occurs on soils that are typically alkaline, saline, sandy to clayey alluvium.

Special-Status Plants

Special-status plant species include those that meet any one of the following definitions:

- Listed or candidates for listing under the Federal Endangered Species Act (ESA) (50 Code of Federal Regulations [CFR] §17.12).
- Listed or candidates for listing by the State as threatened or endangered under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.).
- Listed as rare under the California Native Plant Protection Act (CNPPA) (Fish & G. Code, § 1900 et seq.).
- Species considered by the California Native Plant Society (CNPS) to be "rare, threatened or endangered in California" (Lists 1A, 1B and 2).
- Other plant species that are considered by the scientific community to meet the definition of rare or endangered plants under the California Environmental Quality Act (CEQA) section 15380.

Special-status plant species evaluated for the potential to occur in the Project area are listed in Table 6-3. The table includes field survey results and an evaluation of the potential for the species to occur in the portions of the Project area that were not accessible for field surveys. Table 6-3 includes an assessment of potential for special-status plants to occur in these areas based on generally known habitat characteristics and the range and distribution of plant species. No special-status plant species were identified during field surveys.[1]

[1] Special-status plant surveys took place from August 2010 through July 2011 where access had been granted in the Project area. Detailed vegetation alliance surveys were conducted on December 15, 2009, and on May 19, 2010.

Table 6-3.
Federal-, State-, or CNPS-Listed Plant Species with a Potential to Occur in the Project Area

Scientific Name **Common Name**	**Federal/ State/ CNPS Status**	**Habitat/ Communities**	**Potential to Occur in inaccessible Project Areas and Survey Results**	**Blooming Period/ Survey Date**
Atriplex cordulata heartscale	--/--/1B.2	Chenopod scrub, meadows and seeps, and sandy/saline or alkaline valley and foothill grassland	Moderate potential to occur based on marginal habitat, disturbance, and reported observations within 5 miles of the Project area Not observed during surveys.	Apr-Oct/ late April
Atriplex depressa brittlescale	--/--/1B.2	Chenopod scrub, meadows and seeps, playas, valley and foothill grassland, and alkaline or clay vernal pools	Moderate potential to occur based on marginal habitat, disturbance, and reported observations within 10 miles of the Project area Not observed during surveys.	Apr-Oct/ late April
Atriplex minuscula lesser saltscale	--/--/1B.1	Chenopod scrub, playas, and alkaline or sandy valley and foothill grassland	Moderate potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. However, CNDDB observations within 10 miles of the Project area. Not observed during surveys.	May-Oct/ mid-June
Atriplex persistens vernal pool smallscale	--/--/1B.2	Alkaline vernal pools	Low potential to occur based on absence during accessible area surveys, no alkaline vernal pools & disturbance. However, CNDDB observations within 10 miles of the Project area. Not observed during surveys.	Jun-Oct/ mid-June
Atriplex subtilis subtle orache	--/--/1B.2	Valley and foothill grassland	Moderate potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. However, CNDDB observations within 5 miles of the Project area. Not observed during surveys.	Jun-Aug (Oct*) *uncommon /mid-June
Atriplex vallicola Lost Hills crownscale	--/--/1B.2	Chenopod scrub, valley and foothill grassland, and alkaline vernal pools	Moderate potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. However, CNDDB observations within 5 miles of the Project area. Not observed during surveys.	Apr-Aug/ late April

Table 6-3.
Federal-, State-, or CNPS-Listed Plant Species with a Potential to Occur in the Project Area

Scientific Name **Common Name**	**Federal/ State/ CNPS Status**	**Habitat/ Communities**	**Potential to Occur in inaccessible Project Areas and Survey Results**	**Blooming Period/ Survey Date**
Castilleja campestris ssp. *succulenta* succulent owl's-clover	FT/SE/1B.2	Vernal pools (often acidic)	Very low potential to occur based on absence during accessible area surveys, no suitable habitat & disturbance. Some potential based on elevation.	Apr-May/ late April
			Not observed during surveys.	
Caulanthus californicus California jewel-flower	FE/SE/1B.1	Chenopod scrub, pinyon and juniper woodland, and sandy valley and foothill grassland	Very low potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance.	Feb-May/ mid-March
			Not observed during surveys.	
Cordylanthus palmatus palmate-bracted bird's-beak	FE/SE/1B.1	Chenopod scrub and alkaline valley and foothill grassland	Low potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. However, CNDDB observations within 5 miles of the Project area.	May-Oct/ mid-June
			Not observed during surveys.	
Delphinium recurvatum recurved larkspur	--/--/1B.2	Chenopod scrub, cismontane woodland, and alkaline valley and foothill grassland	Low potential to occur based on absence during accessible area surveys, little suitable habitat, & disturbance. However, CNDDB observations within 10 miles of the Project area.	Mar-Jun/ mid-March
			Not observed during surveys.	
Imperata brevifolia California satintail	--/--/2.1	Chaparral, coastal scrub, Mojavean desert scrub, meadows and seeps (often alkali), and mesic riparian scrub	Low potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. Elevation is suitable.	Sep-May/ mid-March
			Not observed during surveys.	
Layia munzii Munz's tidy tips	--/--/1B.2	Chenopod scrub and alkaline clay valley and foothill grassland	Moderate potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. However, CNDDB observations within 5 miles of the Project area.	Mar-Apr/ mid-March
			Not observed during surveys.	

Table 6-3.
Federal-, State-, or CNPS-Listed Plant Species with a Potential to Occur in the Project Area

Scientific Name **Common Name**	**Federal/ State/ CNPS Status**	**Habitat/ Communities**	**Potential to Occur in inaccessible Project Areas and Survey Results**	**Blooming Period/ Survey Date**
Leptosiphon serrulatus Madera leptosiphon	--/--/1B.2	Cismontane woodland and lower montane coniferous forest	No potential to occur based on absence during accessible area surveys, no suitable habitat, lower elevation & disturbance. Not observed during surveys.	Apr-May/ late April
Monolopia congdonii San Joaquin woollythreads	FE/--/1B.2	Chenopod scrub and sandy valley and foothill grassland	Moderate potential to occur based on absence during accessible area surveys & disturbed habitat. However, CNDDB observations within 10 miles of the Project. Not observed during surveys.	Feb-May/ mid-March
Orcuttia inaequalis San Joaquin Valley Orcutt grass	FT/SE/1B.1	Vernal pools	Very low potential to occur based on absence during accessible area surveys, no vernal pools & disturbance. Not observed during surveys.	Apr-Sep/ late April
Orcuttia pilosa hairy Orcutt grass	FE/SE/1B.1	Vernal pools	Very low potential to occur based on absence during accessible area surveys, no vernal pools & disturbance. Not observed during surveys.	May-Sep/ mid-June
Sagittaria sanfordii Sanford's arrowhead	--/--/1B.2	Assorted shallow freshwater marshes and swamps	Moderate potential to occur based on absence during accessible area surveys & disturbance. However, CNDDB observations within 5 miles of the Project area and suitable habitat. Not observed during surveys.	May-Oct/ mid-June
Tropidocarpum capparideum caper-fruited tropidocarpum	--/--/1B.1	Alkaline hills valley and foothill grassland	Low potential to occur based on absence during accessible area surveys, little suitable habitat & disturbance. Not observed during surveys.	Mar-Apr/ mid-March

Key:
CNDDB = California Natural Diversity Database
FE = federally endangered
SE = State endangered
1B.1 = California Rare Plant Rank 1B (rare, threatened, or endangered plant), seriously threatened in California
1B.2 = California Rare Plant Rank 1B (rare, threatened, or endangered plant), fairly threatened in California
2.1 = California Rare Plant Rank 2 (rare, threatened, or endangered in California, but more common elsewhere)
-- = not listed

Non-Native Invasive Plants

Non-native invasive plants are species that are not native to the region, persist without human assistance, and adversely affect areas where they colonize because they outcompete or exclude more desirable native species, reduce agricultural productivity, or have other impacts (Davis and Thompson 2000). The term “invasive plant” differs from the classification terms “nonnative,” “exotic,” or “introduced plant” because it describes those non-native plant species that displace native species on a large enough scale to alter habitat functions and values. The California Invasive Plant Council (Cal-IPC) maintains a list of non-native invasive plant species considered invasive in California. The term “noxious weed” is used by government agencies for non-native plants that have been defined as pests in agriculture by law or regulation (California Department of Food and Agriculture [CDFA] 2012). Many invasive noxious trees and shrubs that have the ability to occupy channel and floodplain surfaces threaten river floodway capacity, and substantial cost and resources are required to remove and control large infestations.

Invasive plant species may interfere with the success of Restoration actions because of their ability to rapidly colonize new habitats and prevent the establishment of desirable native vegetation. Field surveys identified several invasive plant species in the Project area. Table 6-4 lists these species and indicates the degree of their invasiveness based on CDFA and Cal-IPC criteria. Of the invasive plant species observed in the Project area, the following have a Cal-IPC high rating (indicating a potential for severe ecological impacts): barbed goatgrass, giant reed, red brome, cheatgrass, yellow-star thistle, English ivy, broad-leafed pepper, Himalayan blackberry, small-flower tamarisk, saltcedar, and spotted knapweed. The following invasive plant species were also observed nearby or upstream and have a Cal-IPC high rating: red sesbania, water hyacinth, and spongeplant.

Table 6-4.
Invasive Plant Species Observed in the Project Area

Scientific Name	Common Name	Invasiveness
Acroptilon repens	Russian knapweed	CDFA List B, Cal-IPC moderate
Aegilops triuncialis	barb goatgrass	CDFA List B, Cal-IPC high
Ailanthus altissima	tree-of-heaven	Cal-IPC moderate
Arundo donax	giant reed	Cal-IPC high
Atriplex semibacchata	Australian saltbush	Cal-IPC moderate
Avena barbata	slender wild oats	Cal-IPC moderate
Avena fatua	common wild oats	Cal-IPC moderate
Brassica nigra	black mustard	Cal-IPC moderate
Bromus diandrus	ripgut brome	Cal-IPC moderate
Bromus madritensis ssp. *rubens*	red brome	Cal-IPC high
Bromus tectorum	downy brome, cheatgrass	Cal-IPC high
Carduus pycnocephalus	Italian thistle	CDFA List C, Cal-IPC moderate
Centaurea maculosa	spotted knapweed	CDFA List A, Cal-IPC high
Centaurea solstitialis	yellow-star thistle	CDFA List C, Cal-IPC high
Cirsium vulgare	bull thistle	Cal-IPC moderate
Conium maculatum	poison hemlock	Cal-IPC moderate
Cynara cardunculus	artichoke thistle, cardoon	Cal-IPC moderate

Table 6-4.
Invasive Plant Species Observed in the Project Area

Scientific Name	Common Name	Invasiveness
Cynodon dactylon	Bermuda grass	Cal-IPC moderate
Ficus carica	edible fig	Cal-IPC moderate
Hedera helix	English ivy	Cal-IPC high
Hirschfeldia incana	Mediterranean hoary mustard	Cal-IPC moderate
Hordeum murinum ssp. *murinum*	foxtail barley	Cal-IPC moderate
Lepidium latifolium	broad-leafed pepper (i.e., perennial pepperweed)	CDFA List B, Cal-IPC high
Lolium multiflorum	Italian rye grass	Cal-IPC moderate
Lotus corniculatus	birdsfoot treefoil	Cal-IPC moderate
Lythrum hyssopifolium	hyssop loosestrife	Cal-IPC moderate
Mentha pulegium	pennyroyal	Cal-IPC moderate
Nicotiana glauca	tree tobacco	Cal-IPC moderate
Oxalis pes-caprae	Bermuda buttercup	Cal-IPC moderate
Phalaris aquatica	Harding grass	Cal-IPC moderate
Rubus discolor	Himalayan blackberry	Cal-IPC high
Rumex acetosella	sheep sorrel	Cal-IPC moderate
Sisymbrium irio	London rocket	Cal-IPC moderate
Tamarix parviflora	small-flower tamarisk	Cal-IPC high
Tamarix pentandra	saltcedar	Cal-IPC high
Torilis arvensis	hedge parsley	Cal-IPC moderate
Vulpia myuros	rattail fescue	Cal-IPC moderate
Washingtonia robusta	Washington fan palm	Cal-IPC moderate

Key:
Cal-IPC = California Invasive Plant Council
CDFA = California Department of Food and Agriculture
Cal-IPC high = severe ecological impacts on physical processes, plant and animal communities, and vegetation structure.
Cal-IPC moderate = substantial and apparent ecological impacts on physical processes, plant and animal communities, and vegetation structure
CDFA List A = either not known to be established in the State or is present in a limited distribution; recommended for exclusion and eradiacation
CDFA List B = widely distributed in some regions of the State; recommended for regional eradication
CDFA List C = widespread throughout the State; recommended for local eradication

6.2 Regulatory Setting

Federal, State, and local laws and regulations applicable to vegetation in the Project area include ESA, National Environmental Policy Act (NEPA), CESA, CEQA, CNPPA, which cover impacts to natural vegetation, sensitive communities, and rare plants, and Public Resources Code section 21083.4, which covers oak woodlands conservation and directs counties to describe and mitigate impacts to oak woodlands.

6.2.1 Federal

Federal Endangered Species Act of 1973 (50 CFR Part 17)

The ESA defines special-status plants as species listed or proposed for listing as threatened or endangered under the ESA, or candidates for possible future listing as threatened or endangered under the ESA (50 CFR §17.12).

Recovery Plan for Upland Species of the San Joaquin Valley, California

The Recovery Plan for Upland Species of California was released by U.S. Fish and Wildlife Service (USFWS) on September 30, 1998. This plan focuses on 34 species of plants and animals that occur in the San Joaquin Valley and that are either Federally-listed as threatened or endangered or are candidates for Federal listing or species of concern. The ultimate goal of the recovery plan is to delist the 11 endangered and threatened species addressed in the plan and ensure the long-term conservation of the other 23 species (USFWS 1998). The plan provides for both an ecosystem approach and a community-level strategy. While not regulatory in nature, the Recovery Plan would be taken into consideration when analyzing potential impacts on upland natural community habitats in the San Joaquin Valley to ensure that projects do not prevent or impair the plan's future long-term implementation success. It is also used by the USFWS to determine recommendations and requirements during endangered species consultation for these species.

Invasive Species (Executive Order 13112)

Executive Order 13112 requires Federal agencies to perform measures to minimize the spread of invasive species and to reintroduce native species where possible. This order applies to "actions that may affect the status of invasive species" (Section 2). Federal agencies must pursue the duties mandated under the order in consultation with the Invasive Species Council (Section 2(b)). The order also requires agencies to formulate their own Invasive Species Management Plan (Section 5).

6.2.2 State of California

Vegetation Alliances

DFW and its collaborators use a suite of factors to assess the conservation ranking of vegetation alliances. All California vegetation alliances are described, ranked, and assembled into a list. DFW then issues the ranked list of California vegetation alliances for the public's use, for California Natural Diversity Database (CNDDB) mapping efforts, and for project impact assessment. The current version of the List of California Vegetation Alliances was released in December 2009 (DFW 2009).

Conservation ranks in this list provide an estimate of the risk of elimination for vegetation alliances. They are based on a one to five scale rank (NatureServe Explorer 2009), ranging from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales of the assessment (G = Global, N = National, and S = Subnational or State).

For the purpose of this document, special-status vegetation alliances (sensitive plant communities) are defined as natural communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental impacts of projects. The current version of the List of California Vegetation Alliances (DFW 2009) indicates vegetation alliances of high inventory priority for conservation status, which are those globally or State ranked 1-3 (critically imperiled, imperiled and vulnerable). Most types of wetlands and riparian communities are considered special-status vegetation alliances due to their limited distribution in California. These high-priority vegetation alliances often contain special-status plants.

Special-Status Plants

California laws and regulations define special-status plants as those:

- Listed or candidates for listing by the State as threatened or endangered under CESA (Fish & G. Code, § 2050 et seq.).
- Listed as rare under CNPPA (Fish & G. Code, § 1900 et seq.).
- Meet the definition of rare or endangered under CEQA § 15380, subds. (b) and (d).

California Endangered Species Act (Fish & G. Code, § 2050 et seq.) CESA defines special-status plants as species that are listed or are candidates for listing by the State as threatened or endangered under CESA (Fish & G. Code, § 2050 et seq.). A species, subspecies, or variety of plant is endangered when the prospects of its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease, or other factors (Fish & G. Code, § 2062). A plant is threatened when it is likely to become endangered in the foreseeable future in the absence of special protection and management measures (Fish & G. Code, § 2067).

California Native Plant Protection Act (Fish & G. Code, § 1900 et seq.) The CNPPA is intended to preserve, protect, and enhance endangered or rare native plants in the State. The CNPPA defines special-status plants as those listed as rare under CNPPA (Fish & G. Code, § 1900 et seq.). A plant is rare when, although not presently threatened with extinction, the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens (Fish & G. Code, § 1901).

California Environmental Quality Act section 15380, subdivisions (b) and (d). CEQA defines special-status plants as those that meet the definition of rare or endangered under CEQA section 15380, subdivisions (b) and (d). Species that may meet the definition of rare or endangered include the following:

- Species considered by CNPS to be “rare, threatened or endangered in California” (Lists 1A, 1B and 2).
- Species that may warrant consideration on the basis of local significance or recent biological information.

- Some species included on the CNDDB Special Plants, Bryophytes, and Lichens List (DFW 2015).

California Native Plant Society Species Designations. CNPS is a statewide nonprofit organization that seeks to increase understanding of California's native flora, and to preserve this rich resource for future generations. CNPS has developed and maintains lists of vascular plants of special concern in California. CNPS-listed species have no formal legal protection, but the value and importance of these lists are widely recognized. CNPS List 1 and 2 species are considered rare plants pursuant to section 15380 of CEQA, and it is recommended that they be fully considered while preparing environmental documents relating to CEQA.

6.2.3 Regional and Local

Regional and local regulations or protected plant lists may define special-status plant species that could meet the definition of rare or endangered plants under CEQA section15380. Regional and local plans and policies pertaining to vegetation are discussed below.

Riparian Habitat Joint Venture

The Riparian Habitat Joint Venture (RHJV) was initiated in 1994 and includes signatories from 18 Federal, State, and private agencies. The RHJV promotes conservation and the restoration of riparian habitat to support native bird populations through three goals:

- Promote an understanding of the issues affecting riparian habitat through data collection and analysis.
- Double riparian habitat in California by funding and promoting on-the-ground conservation projects.
- Guide land managers and organizations to prioritize conservation actions.

RHJV conservation and action plans are documented in the Riparian Bird Conservation Plan (RHJV 2004). The conservation plan targets 14 "indicator" species of riparian-associated birds and provides recommendations for habitat protection, restoration, management, monitoring, and policy. The report notes habitat loss and degradation as one of the most important factors causing the decline of riparian birds in California.

County Plans

Pertinent county plans include the Fresno and Madera county general plans.

Fresno County General Plan

The Fresno County General Plan was updated in October 2000. In the Project area and vicinity, Fresno County's land use jurisdiction lies south and west of the San Joaquin River centerline, through Reaches 1, 2, and 3, and into Reach 4A. The general plan identifies 27 primary land use designations (defined in terms of allowable uses and intensity standards) and three overlay designations (an overlay land use designation modifies the policies, standards, or procedures established for the underlying primary land use designation). One of the three overlay designations is for the San Joaquin River corridor.

The general plan also identifies as a priority the protection and enhancement of water quality and quantity in Fresno County's streams, creeks, and groundwater basins through the protection of floodplain lands.

Policies in the general plan seek to protect natural areas, particularly riparian and wetland habitats, in the county, and to preserve habitat diversity in Fresno County through restoring and enhancing habitats that support fish and wildlife species so that populations are maintained at viable levels. Notably, the general plan seeks to preserve and enhance the San Joaquin River corridor areas adjoining the county's river corridor by avoiding adverse impacts from development and encouraging environmentally friendly recreational and agricultural activities. One policy in the general plan directs the county to require riparian protection zones around natural watercourses, recognizing that these areas provide highly valuable wildlife habitat. Another policy recommends the acquisition (through fee acquisition or protective easements, often in cooperation with other local, State, and Federal agencies and private entities) of creek corridors, wetlands, and areas rich in wildlife, or of a fragile ecological nature as public open space where such areas cannot be effectively preserved through the regulatory process. The general plan prioritizes the protection of wetlands, riparian habitat, and meadows because they are recognized as essential habitats for birds and wildlife, and it requires a minimum 200-foot-wide wildlife corridor along particular stretches of the San Joaquin River and Kings River, whenever possible.

Madera County General Plan Policy Document

The Madera County General Plan Policy Document, adopted in October 1995, is a stand-alone document that is part of the Madera County General Plan. In the Project area and vicinity, Madera County's land use jurisdiction lies northeast of the San Joaquin River centerline and continues downstream from Friant Dam through Reaches 1, 2, 3, and 4A.

One of the goals in the general plan is to protect and enhance the natural qualities of Madera County's streams, creeks, and groundwater, minimizing sedimentation and erosion of creeks and damage to riparian habitat. The general plan also prioritizes the protection of wetland communities and related riparian areas throughout Madera County as valuable resources, the protection of riparian zones around natural watercourses, and the conservation of remaining upland habitat areas adjacent to wetlands and riparian areas that are critical to the feeding or nesting of wildlife species associated with these wetland and riparian areas. One policy in the general plan directs the county to support the goals and policies of the San Joaquin River Parkway Master Plan to preserve existing habitat and maintain, enhance, or restore native vegetation to provide essentially continuous riparian and upland habitat for wildlife along the river between Friant Dam and the State Route (SR) 145 crossing.

The general plan also identifies a goal to protect, restore, and enhance habitats that support fish and wildlife species so as to maintain populations at viable levels, by protecting critical nesting and foraging areas, important spawning grounds, migratory routes, waterfowl resting areas, oak woodlands, wildlife movement corridors, and other unique wildlife habitats critical to protecting and sustaining wildlife populations, and by ensuring the conservation of sufficiently large, continuous expanses of native vegetation to provide suitable habitat for maintaining abundant and diverse wildlife if this preservation does not threaten the economic well-being of the county. Another goal of the general plan is to preserve and enhance open space lands to maintain the natural resources of the county by supporting preservation and enhancement of natural land forms, natural vegetation, and natural resources (including wetland preserves, riparian corridors, woodlands, and floodplains) as open space. These open space and natural areas should be interconnected and of sufficient size to protect biodiversity, accommodate wildlife movement, and sustain ecosystems.

6.3 Environmental Consequences and Mitigation Measures

This section describes the effects that the Project Alternatives would have on special-status plants and vegetation alliances relative to the "No-Action conditions" in accordance with NEPA, and "existing conditions" based on CEQA requirements. The potential effects of each alternative are assessed with respect to significance criteria. Measures to avoid, minimize, or mitigate potential negative impacts are described. The Project Alternatives evaluated in this section are described in detail in Chapter 2.0, "Description of Alternatives." The potential impacts are summarized below.

6.3.1 Impact Assessment Methodology

Identification of Vegetation Resources in the Project Area

Existing biological resources were determined through review of scientific literature, existing data sources, and field surveys. Existing documents reviewed include:

- *Historical Riparian Habitat Conditions of the San Joaquin River — Friant Dam to the Merced River*, prepared by Jones & Stokes Associates, Inc. for U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Fresno, California. April 1998 (Reclamation 1998a).
- *Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River — Friant Dam to the Merced River*, prepared by Jones & Stokes Associates, Inc. for Reclamation, Fresno, California. October 1998 (Reclamation 1998b).
- *Riparian Vegetation of the San Joaquin River*, prepared by California Department of Water Resources (DWR) for Reclamation, May 2002 (DWR 2002).
- *San Joaquin River Restoration Study Background Report*, edited by McBain and Trush, December 2002 (McBain and Trush 2002).
- *Draft Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results*, November 2011 (San Joaquin River Restoration Program [SJRRP] 2011a).

Permits to enter private property in the Project area to perform biological surveys were not obtained until summer of 2010, so biological fieldwork occurred in 2010 and 2011.

Field surveys were performed according to DFW protocol by walking those portions of the Project area where access was granted during the flowering period of special-status plants which had a potential to occur in the Project area. Plant species observed during field surveys are listed in *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011a, Attachment A). Species observed were identified to a level sufficient to determine their rarity status. These reviews and surveys provided the best available information about the biological resource condition closest to the baseline date.

Impact Evaluation Methodology

There were no special-status plants identified in the Project area. Therefore, the impact analysis focuses on vegetation alliances, and the potential impacts and beneficial effects on vegetation alliances that would result from implementing the Project Alternatives as compared to the No-Action Alternative and existing conditions.

The impact assessment is based on review and analysis of the following environmental concerns and topics:

- The extent and type of existing special-status vegetation alliances documented within the Project area that have the potential to be affected by the Project Alternatives.
- The quantity and quality of the special-status vegetation alliances proposed to be installed under the Project Alternatives and their development over time.
- The habitat requirements of special-status vegetation alliances under the Project Alternatives as compared to the No-Action Alternative and existing conditions.
- Long-term and temporary effects of the Project Alternatives.
- Direct, indirect, and cumulative effects of the Project Alternatives.
- Threats to special-status vegetation alliances including those from invasive plant species.
- The immediacy of potential effects.
- Recommended measures to avoid, minimize, or mitigate impacts.

Potential effects evaluated include direct, indirect, temporary, and long-term. Direct impacts include the direct removal or loss of vegetation within the footprint of ground disturbing actions. Indirect impacts are those incidental to Project implementation, such as changes in the hydrologic regime that results in different plant species establishment over time. Temporary impacts have a short duration and vegetation would be expected to recover or be restored within 3 to 5 years of Project implementation. An example would be the trimming and pruning of vegetation to install infrastructure, followed by vegetation re-growth. Long-term impacts involve the long-term alteration of vegetation or habitat such as the removal of mature trees or the conversion of backwater marsh area to active channel riparian habitat, resulting in permanent changes to vegetation type.

Key impact issues for special-status vegetation alliances are those that change vegetation health or survival. Where possible, impacts of stress are differentiated from impacts resulting directly or indirectly in the mortality of riparian vegetation. Assumptions used in the impact assessment include:

- The distribution and abundance of special-status vegetation alliances would be proportional to the amount and quality of habitat available.
- Direct and indirect habitat modifications would reach maturity by the end of the planning horizon of the Project (2035).
- Site evolution would allow some habitats to form immediately or within several years of construction.
- Control and management of non-native invasive plant species would be implemented throughout the duration of Project construction and monitoring.

6.3.2 Significance Criteria

State CEQA Guidelines Appendix G and NEPA Council on Environmental Quality (CEQ) Regulations were used to develop the significance criteria. Under NEPA CEQ Regulations, impacts must be evaluated in terms of their context and intensity. Effects may be beneficial or adverse. An example of a beneficial effect would be the conversion of non-native grassland to a habitat with greater functions and values for special-status species. These factors have been considered when applying the State CEQA Guidelines, which state that the Project would result in a significant impact on vegetation resources if it would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species (including listed species) or on any riparian habitat or other special-status vegetation alliances identified in local or regional plans, policies, or regulations, or by DFW or USFWS. Examples of such effects are listed below.
  - Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, riparian wetlands, seasonal wetlands, etc.) through direct removal, filing, hydrological interruption, or other means.
  - Have the potential to degrade the quality of the environment, substantially reduce the habitat of a listed or sensitive plant species, threaten to eliminate a plant or plant community, reduce the number or restrict the range of a rare or endangered plant.
  - Eliminate important vegetation examples of major periods of California history.
- Conflict with any local policies or ordinances protecting biological resources, such as a conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan.
- Facilitate a substantial increase in distribution and abundance of invasive plants in the Project area.

6.3.3 Impacts and Mitigation Measures

This section provides an evaluation of the long-term and temporary effects of the Project alternatives on special-status vegetation alliances. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA requirements and potential impacts compared to existing conditions to meet CEQA requirements. With respect to vegetation, the environmental impact issues and concerns are the following:

1. Substantially Alter Riparian Habitat and Other Sensitive Communities during Construction.
2. Substantially Alter Riparian Habitat and Other Sensitive Communities during the Operations and Maintenance Phase of the Project.
3. Facilitate Increase in Distribution and Abundance of Invasive Plants in the Project area.
4. Conflict with Provisions of Local Plans in the Project area.

Other vegetation-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) are not covered here because they are programmatic in nature and/or are not relevant to the Project area.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these activities would not achieve the Settlement goals. The potential effects of the No-Action Alternative are described below. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact VEG-1 (No-Action Alternative): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during Construction.*** Under the No-Action Alternative, Project construction activities that could fragment, separate or remove native wetland, riparian, and other special-status vegetation alliances from their habitat or eliminate them would not be carried out. Compared to existing conditions, there would be **no impact**.

Impact VEG-2 (No-Action Alternative): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during the Operations and Maintenance Phase of the Project.*** Under the No-Action Alternative, Restoration Flows in Reach 2B would increase the extent and duration of inundation, raise groundwater levels, and restore flows in areas that are inundated by flood flows only periodically (every 2 to 5 years). Restoration Flows may recruit new vegetation along the wetted channel banks; however, native riparian vegetation along the channel banks downstream of the San Mateo Avenue crossing would be maintained by the relatively stable water level held by Mendota Dam. River flows would not convert special-status vegetation alliances in the Project area to other vegetation types. For example, wetland habitats supported by Mendota Pool would not be altered. Riparian habitat would mature in areas upstream of San Mateo Avenue crossing, a **beneficial** effect.

Impact VEG-3 (No-Action Alternative): ***Facilitate Increase in Distribution and Abundance of Invasive Plants in the Project Area.*** Under the No-Action Alternative, current water and land management practices that facilitate the dispersal and establishment of invasive plant species would continue. In addition, other reasonably foreseeable projects could facilitate the dispersal and establishment of invasive plants in several ways: through transporting invasive plants' propagules into the Project area; creating bare ground for them to establish; by altering hydrology in a manner that is advantageous to invasive plant species; and eliminating competing native vegetation. Future projects would be subject to environmental review; however, only projects that have a Federal nexus are required to address impacts of invasive plant species (required under Federal Executive Order 11312), and CEQA-only projects would not necessarily be required to mitigate such impacts.

Under the No-Action Alternative, existing populations of invasive plant species would continue to be introduced and spread in the Project area. Invasive plant species would be dispersed to suitable sites by Restoration Flows, flood flows, natural and agricultural drainage, and other water releases from Friant Dam, Mendota Pool, and other facilities. Specifically, invasive plant species observed in the Project area ranked Cal-IPC high (see Section 6.1.2) have been identified as having the potential to adversely affect habitats and increase substantially as a result of continued water management operations in the Project area. However, as part of the Program, PEIS/R Conservation Measure INV-1 would implement an invasive plant monitoring and management plan to control, and where possible eradicate, invasive plant infestations (SJRRP 2011b, PEIS/R Table 2-7, page 2-75). As a result, there would be a **less than significant** impact from invasive plants.

Impact VEG-4 (No-Action Alternative): ***Conflict with Provisions of Local Plans in the Project Area.*** The No-Action Alternative would not reduce the effectiveness of the Madera and Fresno counties' general plan conservation strategies, and attainment of conservation plan goals and objectives would not otherwise be prevented. However, the No-Action Alternative would not result in beneficial effects on these plans because it would not actively support attainment of goals or objectives related to enhancing or restoring biological resources along Reach 2B. Compared to existing conditions without Interim or Restoration flows, there would be **no impact**.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities including a Compact Bypass channel, a new levee system encompassing the river channel with a narrow floodplain, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure and fish passage facility, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

This alternative includes passive riparian habitat restoration and farming in the floodplain. It is assumed that over time wetland communities (obligate, facultative-wet, and facultative species) would develop within the main channel and that a dense riparian scrubland would develop along the main river channel banks. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur. Invasive, non-native plant species would be removed from the channel and riparian areas during or following construction, and the Project would include long-term management for invasive plant species.

Impact VEG-1 (Alternative A): *Substantially Alter Riparian Habitat and Other Sensitive Communities during Construction.* Compared to No-Action, construction of Project features under Alternative A could have substantial effects on special-status vegetation alliances. Project actions related to these effects would include the following:

- The re-grading of the floodplain.
- The operation of equipment during construction, including, excavators, dump trucks, and graders.
- The breaching/removal of existing levees.
- Modifications to existing levees.

Re-grading the floodplain would occur primarily in existing agricultural areas but some areas of riparian habitat and other sensitive communities would be affected where floodplain grading connects to the river channel because some vegetation would be removed to complete the grading. The operation of equipment during construction would potentially affect riparian habitat and other sensitive communities through clearing, grubbing, pruning, and incidental damage, such as compression of root zones and accidental impact by machinery. Breaching and removal of existing levees, which is necessary to allow overbank flows to spread onto the floodplain, would remove existing riparian vegetation along the existing levees.

Construction of Alternative A could affect the acreages of special-status vegetation alliances shown in Table 6-5. These acreages represent the worst-case scenario where all existing floodplain areas are assumed to be impacted. “Infrastructure” generally refers to area permanently converted to structures, levees or roads. “Floodplain” primarily refers to the floodplain of the San Joaquin River and the acreage impacted under this category may be disturbed up to 3 years following construction, but eventually return to natural habitat or farming. “Borrow” refers to the maximum amount of habitat that could be disturbed to take fill materials for levees. Other impacts refer to construction staging areas, temporary access roads and other construction-related disturbances. Areas temporarily disturbed during construction will be restored to their previous contours, if feasible, and then seeded with a native vegetation seed mixture to prevent soil erosion. Some areas, such as borrow areas, may not be feasible to restore previous contours, but these areas would be smoothed and seeded (see Section 2.2.4).

However, Conservation Measures RHSNC-1 and RHSNC-2 would be implemented as part of the Project to offset adverse effects of Project construction on special-status vegetation alliances. These measures would avoid and minimize loss of riparian habitat and other sensitive natural communities during construction of the Project, and promote re-establishment of this vegetation after construction (see Table 2-8 in Chapter 2.0, "Description of Alternatives"). Conservation Measure RHSNC-1 requires biological surveys to identify, map, and quantify riparian and other sensitive communities in the Project area. Construction in riparian habitat and other sensitive communities would be avoided, to the extent practicable. Conservation Measure RHSNC-2 requires implementing the Program's Riparian Habitat Mitigation and Monitoring Plan. If losses of sensitive vegetation communities are not offset by the Program, then compensation would be provided through creating, restoring, or preserving in-kind communities. Development and implementation of the Program mitigation and monitoring plans would support this process.

Conservation Measure PLANTS-1 would also be implemented, as appropriate, to identify, avoid, and minimize temporary or permanent loss of special-status plant species found in the Project area, if any. (No special-status plant species were identified in the Project area during field surveys in 2010 and 2011). In addition, Conservation Measure INV-1 includes monitoring and controlling the spread of invasive plant species that could interfere with successful establishment and survival of native riparian plant species. This measure would enhance riparian and emergent wetland communities by controlling invasive plant species, such as red sesbania and giant reed, which can displace native riparian and wetland species (discussed below under Impact VEG-3).

Table 6-5.
Special-Status Vegetation Alliances Potentially Affected by Alternative A

Common Name	Scientific Name	Maximum Impacted Area (Acres) Infra-structure (not future habitat)	Flood-plain (future habitat or agriculture)	Borrow	Other
Riparian Forest and Woodland Alliances					
Fremont cottonwood forest	*Populus fremontii* alliance	7.4	37.7	1.0	14.2
Oregon ash groves	*Fraxinus latifolia* forest alliance	0.2	6.7	-	-
Valley oak woodland	*Quercus lobata woodland* alliance	-	-	-	-
Riparian Thicket Alliances					
Black willow thickets	*Salix gooddingii* alliance	14.3	97.3	1.8	7.3
Buttonwillow thickets	*Cephalanthus occidentalis* alliance	0.1	0.9	-	-
Red willow thickets	*Salix laevigata* woodland alliance	-	0.6	-	-
Arrow weed thickets	*Pluchea sericea* shrubland alliance	0.1	0.4	-	-
Riparian Scrub Alliances					
Blue elderberry stands	*Sambucus nigra* shrubland alliance	13.8	61.6	-	-
California rose briar patches	*Rosa californica* alliance	0.7	10.1	0.7	0.3
Spinescale scrub	*Atriplex spinifera* alliance	-	0.0	-	-
Silver bush lupine scrub	*Lupinus albifrons* shrubland alliance	0.7	1.3	-	-

Table 6-5.
Special-Status Vegetation Alliances Potentially Affected by Alternative A

Common Name	Scientific Name	Maximum Impacted Area (Acres)			
		Infra-structure	Flood-plain	Borrow	Other
		(not future habitat)	(future habitat or agriculture)		
Grassland and Herbaceous Field Alliances					
Tar plant fields	*Centromadia pungens* or other species herbaceous alliance	0.5	33.0	-	-
Creeping rye grass turfs	*Leymus triticoides* herbaceous alliance	0.1	6.1	-	-
Salt grass flats	*Distichlis spicata* herbaceous alliance	-	1.4	-	-
Marsh and Wet Meadow Alliances					
California bulrush marsh	*Schoenoplectus californicus* herbaceous alliance	4.1	12.0	0.8	0.7
Pale spike rush marsh	*Eleocharis macrostachya* herbaceous alliance	1.6	-	-	-
Yerba mansa meadows	*Anemopsis californica* herbaceous alliance	-	0.8	-	-
Alkali heath marsh	*Frankenia salina* alliance	-	0.2	-	-
Total		***43.5***	***270.2***	***4.3***	***22.6***

Key:
Infrastructure = structures, levees, or roads
Floodplain = floodplain of the San Joaquin River (passive restoration and agricultural activities)
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Avoidance, minimization, and compensation for loss of riparian habitat, other sensitive natural communities (i.e., special-status vegetation alliances), and special-status plant species would reduce the potential for adverse effects to vegetation during construction. Because these conservation measures would be implemented as part of the Project, Alternative A would not have substantial effects on existing special-status vegetation alliances.

When comparing Alternative A to existing conditions, impacts to riparian habitat and other sensitive natural communities would be similar to those discussed in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action). Compared to existing conditions, impacts of Alternative A would be **less than significant** for the reasons stated above.

Impact VEG-2 (Alternative A): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during the Operations and Maintenance Phase of the Project.*** Compared to the No-Action Alternative, Alternative A would result in expanding the river's floodplain and increasing the flow conveyance capacity of Reach 2B. These changes, in combination with Restoration Flows, would cause hydrologic modifications that would change the inundation regime (duration, depth, timing, or extent), scour or deposition (due to changes in streamflow velocity), or soil moisture (due to changes in groundwater level) available for plant growth. These changes would facilitate establishment of riparian habitat and other sensitive natural communities (special-status vegetation alliances) in some areas of the floodplain, but convert some existing vegetation to other vegetation types.

In some locations within the Project area, Restoration Flows would submerge the roots, shoots and leaves of existing riparian and wetland plants for weeks or months during each growing season. The growth of mature submerged plants would be reduced, and some plant parts would be damaged (Coops et al. 1996). Sapling trees, immature shrubs and poorly established herbaceous perennials would be killed. Successive years of prolonged submergence would result in mortality of the majority of trees, shrubs, and perennial forbs and grasses that are dominant in the riparian areas subject to flooding. However, many mature riparian and wetland plants that would be submerged are resistant to flooding damage and would survive inundation lasting up to several weeks (Karrenberg et al. 2002). Mortality would be expected in riparian and wetland vegetation subjected to complete and continual submergence for several weeks every year.

The scour and deposition of sediment can damage riparian and wetland vegetation by abrasion or burial (Friedman and Auble 1999). Along Reach 2B, scour and sediment deposition may occur, as described in Chapter 14, "Surface Water Resources and Water Quality." However, most riparian vegetation along this reach is Fremont cottonwood, black willow, and sandbar willow scrub and the dominant species of these communities (e.g., the willows) are particularly resistant to damage by scour or burial. The dominant species of emergent wetlands (e.g., cattail and tule species) also are resistant to such damage (Grace and Harrison 1986). Furthermore, scour and deposition of sediment sustains floodplain habitats and creates opportunities for plant establishment, thus sustaining the diversity of riparian and wetland vegetation. Scour and deposition of sediment would ultimately enhance floodplain habitat and increase establishment opportunities. As a result, a substantial adverse effect on riparian or wetland vegetation is not expected.

In the long term, the Project is expected to result in a net increase in riparian and emergent wetland vegetation throughout the Project area. Passive riparian habitat restoration of the San Joaquin River would improve native floodplain and in-channel habitats, which would likely benefit native species. Benefits to native species would be realized through the re-introduction of perennial base flows as well as seasonal high flows in the river, which in turn would promote the establishment of native riparian vegetation. Well-established native plant communities in the floodplain would support rich and diverse native flora, potentially including special status plant species, and could effectively prevent invasive vegetation encroachment. Alternative A would restore river-floodplain connectivity and longitudinal connectivity of riparian vegetation near the channel (without major breaks in the distribution of woody vegetation except where natural conditions prevent establishment of native trees or shrubs), enhance landscape connectivity between the river corridor and adjacent areas of ecological significance (e.g., adjacent sloughs or tributary channels with existing riparian habitat), and protect, restore, or enhance special status vegetation communities and other plant species.

Reclamation conducted a study of vegetation response to flow regimes and mechanical actions of Project alternatives using a one-dimensional flow, sediment transport, vegetation growth model called Sedimentation and River Hydraulics One Dimensional Vegetation Model (SRH-1DV). Although there are some differences in the predicted changes in vegetation by reach between the SRH-1DV vegetation modeling results and the more qualitative potential future vegetation evaluation, both predict an overall expansion of riparian vegetation in Reach 2B in response to Restoration Flows. Similarly, pilot flow studies conducted in 2000 and 2001 suggest that restoring perennial and seasonally variable flows would increase riparian plant establishment and encourage greater plant species diversity (McBain and Trush 2002).

During certain times of year in Reach 2B, Restoration Flows would increase groundwater elevations in the root zones of riparian and wetland plants and possibly submerge some, but not all, of their aboveground parts. Where this hydration or partial submergence occurs during late spring to fall, plant growth would increase because the growth of riparian and wetland plants is sensitive to water availability at these times of year (Grace and Harrison 1986, U.S. Army Corps of Engineers [Corps] 2000).

Inundation would also create conditions suitable for dispersal and establishment of riparian or wetland plants. These conditions could be created by scour and sediment deposition, water transport of plant seeds and fragments to new locations, increased water availability, and reduced competition from upland plant species (such as some nonnative grasses) that are intolerant of prolonged submergence.

When comparing Alternative A to existing conditions, impacts to riparian habitat and other sensitive natural communities would be similar to those discussed in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action). According to habitat restoration estimates, Alternative A could support up to 1,420 acres of sensitive natural vegetation communities (SJRRP 2012, Attachment A). This represents more than a 3-fold increase in sensitive natural communities as compared to existing conditions. Therefore, compared to existing conditions, the Alternative A is expected to result in a **beneficial** effect.

Impact VEG-3 (Alternative A): ***Facilitate Increase in Distribution and Abundance of Invasive Plants in the Project Area.*** Compared to No-Action, the increased conveyance capacity, increased floodplain area, and the floodplain and channel grading of Alternative A, in combination with flood flows and Restoration Flows, could enhance dispersal of invasive plant species, and substantially increase opportunities for establishment, growth, and reproduction of invasive plant species. Invasive plants are capable of substantially affecting riparian and wetland vegetation.

Under Alternative A, invasive, non-native plant species would be removed from the Project area during the construction phase. Removal techniques may include mechanical removal, root excavation, hand pulling, mowing, disking, controlled burning, grazing, aquatic-safe herbicides, or a combination of techniques as appropriate (see Section 2.2.5). This could cause a short-term reduction in invasive plant species in the Project area.

However, invasive plant species would likely recolonize the Project area after these activities are complete.

The conveyance capacity of Reach 2B would increase under Alternative A. Flood flows and Restoration Flows could substantially increase the quantity of water flowing through Reach 2B during wet years. These hydrologic alterations could facilitate the spread of invasive plant species (e.g., red sesbania, salt cedar, giant reed-grass, and sponge plant) to new floodplain areas in Reach 2B and to downstream reaches. Flows could disperse propagules of these invasive plant species, particularly giant reed and red sesbania. Giant reed-grass, currently present at Mendota Pool and other reaches upstream, is dispersed by high flows (and machinery) that fragment plants and carry fragments downstream to new sites, where they take root and begin forming a new colony (Bossard et al. 2000). Red sesbania is currently abundant and widespread throughout Reaches 1 and 2A, but has not been observed in Reach 2B. Red sesbania produces seed pods that float for several days (Hunter and Platenkamp 2003). Sponge plant is an aquatic species distributed by water; it is present in Reach 1 but currently has a very restricted distribution in California. Therefore, these species could be dispersed to additional locations.

Floodplain and channel grading would increase the inundation area of the floodplain. In the San Joaquin Valley, invasive plant species are largely confined to sites with moderate or high levels of water availability. Therefore, by increasing water availability throughout the growing season, particularly in locations that would otherwise lack surface water (e.g., floodplain benches), Restoration Flows could aid their establishment in Reach 2B. Established plants are less sensitive than seedlings to water availability and have deeper and more extensive root systems; therefore, these plants, once established, would likely persist at additional sites. In particular, Restoration Flows may aid the establishment of red sesbania at additional locations. Because red sesbania is abundant in Reach 1 and produces floating seed that can remain dormant for at least several years, the increased availability of water during the growing season would likely allow the establishment of numerous individuals in floodplain locations where they otherwise would not have been able to germinate, grow, and survive. Furthermore, invasive plant species are more likely to become established in newly graded areas and areas subject to scour than in areas with existing cover.

Long-term management of the Project would include removal of invasive non-native plant species currently found within the reach and removal of other invasive species that are currently found in upstream reaches which eventually colonize the Project area (see Section 2.2.5). The Project would also implement Conservation Measure INV-1. Conservation Measure INV-1 requires the lead agencies to implement the Program's Invasive Vegetation Monitoring and Management Plan to control the spread and introduction of invasive plants including measures to monitor, control, and eradicate, where possible, invasive plant infestations. The Invasive Vegetation Monitoring and Management Plan includes monitoring procedures, success criteria, and adaptive management measures for controlling invasive plant species (see Section 2.2.10).

When comparing Alternative A to existing conditions, impacts would be similar to those discussed in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action). For these reasons, this impact would be **less than significant**.

Impact VEG-4 (Alternative A): ***Conflict with Provisions of Local Plans in the Project Area.*** Compared to the No-Action Alternative, Alternative A would not conflict with the provisions of the Fresno and Madera counties' general plans. The Project would not substantially reduce the viability of target species, reduce habitat value or interfere with the management of conserved lands, or eliminate opportunities for conservation actions. The Project is expected to result in a long-term increase in wetland and riparian habitats and other sensitive natural communities that support special-status vegetation alliances. These consequences of implementing the Project would benefit general plans that strive to conserve, restore, and enhance these habitats and maintain the species they support. The Project would enhance opportunities to implement conservation strategies and attain conservation goals by providing hydrologic conditions necessary to restore riparian and aquatic habitats and other sensitive natural communities.

When comparing Alternative A to existing conditions, impacts would be similar to those discussed in the preceding paragraph (i.e., the comparison of Alternative A to No-Action). This would result in supporting the two general plan policies, a **beneficial** effect.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility. Other key features include construction of a fish passage facility at the San Joaquin River control structure at the Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass control structure), and removal of the San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Alternative B includes a mixture of active and passive riparian and floodplain habitat restoration and compatible agricultural activities in the floodplain. Active restoration planting would occur along the low flow channel of the river and in riparian establishment areas to establish a riparian area and seed bank, and floodplain areas would be seeded with native plants. Active revegetation activities would likely include a combination of seeding, transplanting, and pole/live stake plantings. Plantings would generally be designed as clusters of trees and shrubs with larger areas of seeded grasses and forbs. Spacing and alignment of plantings would take into account species growth patterns, potential equipment access needs for monitoring and maintenance, and desired future stand development. Passive restoration would occur in areas that rely on Restoration Flows for additional vegetation recruitment. Natural riparian recruitment (passive restoration) would promote continual habitat succession, particularly in areas where sediment is deposited or vegetation is removed by natural processes. Plantings that are wetland species or borderline wetland species would be irrigated and managed as necessary during the establishment period of 3 to 5 years. Invasive, non-native plant species would be removed from the Project area during or following construction, and the Project would include long-term management for invasive plant species.

Impact VEG-1 (Alternative B): *Substantially Alter Riparian Habitat and Other Sensitive Communities during Construction.* Impacts and effects during Project construction would be similar to those analyzed under Impact VEG-1 (Alternative A), with the following exceptions. Construction of the Project under Alternative B would affect the acreages of special-status vegetation alliances shown in Table 6-6. In general, there would be fewer impacts to special-status vegetation alliances from Project infrastructure and staging areas, but more potential impacts from borrow, under Alternative B than compared to Alternative A. The amount of special-status vegetation alliances located in the Project floodplain would be higher, but much of the area impacted in the floodplain created by Alternative B would be restored through active and passive riparian and floodplain habitat restoration.

Table 6-6.
Special-Status Vegetation Alliances Potentially Affected by Alternative B

Common Name	Scientific Name	Maximum Impacted Area (Acres)			
		Infra-structure	Flood-plain	Borrow	Other
		(not future habitat)	(future habitat or agriculture)		
Riparian Forest and Woodland Alliances					
Fremont cottonwood forest	*Populus fremontii* alliance	9.7	47.5	1.4	0.3
Oregon ash groves	*Fraxinus latifolia* forest alliance	0.3	6.6	-	0.1
Valley oak woodland	*Quercus lobata woodland* alliance	-	-	-	-
Riparian Thicket Alliances					
Black willow thickets	*Salix gooddingii* alliance	13.2	104.6	2.7	1.8
Buttonwillow thickets	*Cephalanthus occidentalis* alliance	0.1	0.9	<0.01	0.2
Red willow thickets	*Salix laevigata* woodland alliance	-	0.6	-	-
Arrow weed thickets	*Pluchea sericea* shrubland alliance	-	0.4	-	-
Riparian Scrub Alliances					
Blue elderberry stands	*Sambucus nigra* shrubland alliance	6.1	66.4	-	-
California rose briar patches	*Rosa californica* alliance	0.4	10.4	0.7	0.4
Spinescale scrub	*Atriplex spinifera* alliance	-	<0.04	<0.01	-
Silver bush lupine scrub	*Lupinus albifrons* shrubland alliance	0.4	2.0	-	1.7
Grassland and Herbaceous Field Alliances					
Tar plant fields	*Centromadia pungens* or other species herbaceous alliance	0.4	33.0	-	1.4
Creeping rye grass turfs	*Leymus triticoides* herbaceous alliance	-	6.1	-	-
Salt grass flats	*Distichlis spicata* herbaceous alliance	-	1.4	0.6	-

Table 6-6.
Special-Status Vegetation Alliances Potentially Affected by Alternative B

Common Name	Scientific Name	Maximum Impacted Area (Acres) Infra-structure (not future habitat)	Flood-plain (future habitat or agriculture)	Borrow	Other
Marsh and Wet Meadow Alliances					
California bulrush marsh	*Schoenoplectus californicus* herbaceous alliance	0.2	18.7	3.0	0.7
Pale spike rush marsh	*Eleocharis macrostachya* herbaceous alliance	-	-	-	-
Yerba mansa meadows	*Anemopsis californica* herbaceous alliance	-	0.8	-	-
Alkali heath marsh	*Frankenia salina* alliance	-	0.2	<0.05	-
Total		***30.6***	***299.6***	***8.4***	***6.6***

Key:
Infrastructure = structures, levees, or roads
Floodplain = floodplain of the San Joaquin River (mixture of active and passive restoration and agricultural activities)
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

The existing native vegetation in the Project area designated to remain would be temporarily fenced with orange snow fencing (or equivalent) to prevent entry, driving, parking, or storing equipment or material within these areas during construction. This existing vegetation would be left in place or only minimally trimmed to facilitate access and work at the site. In order to maximize plant growth and planting success, existing soil and topsoil would be preserved unless the soil contains invasive non-native seed or fragmented stems and rhizomes, in which case it should not be preserved, and disturbance during construction would be minimized to the maximum practicable extent.

As described under Impact VEG-1 (Alternative A), avoidance, minimization, and compensation for loss of riparian habitat, other sensitive natural communities (i.e., special-status vegetation alliances), and special-status plant species would reduce the potential for adverse effects to vegetation during construction. Impacts of Alternative B would be **less than significant**.

Impact VEG-2 (Alternative B): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during the Operations and Maintenance Phase of the Project.*** Project effects would be similar to those analyzed under Impact VEG-2 (Alternative A), with the following exceptions. Alternative B includes a mixture of active and passive riparian and floodplain habitat restoration and compatible agricultural activities in the floodplain in a wide, consensus-based floodplain.

Table 6-7 lists the species that are likely to be planted or seeded during active restoration. Emergent wetlands and water tolerant woody species of riparian scrub would be selected for development within the main channel, woody shrubs and trees with an herbaceous understory would be selected for development along the main river channel banks, and bands of other habitat types (e.g., grasses) would be selected for development at higher elevations along the channel corridor. Active vegetation restoration would occur following construction and these areas would be irrigated and managed as necessary during the establishment period. Phased implementation of active vegetation restoration at strategic locations could occur concurrently with phased implementation of construction and physical infrastructure.

Table 6-7.
Potential Species for Revegetation

Common Name	Scientific Name	Vegetation Type
Riparian Shrub and Wetland Areas (0 to 2 feet above summer baseflow elevations)		
Gooding's willow	*Salix gooddingii*	tree
common buttonbrush	*Cephalanthus occidentalis*	shrub
narrowleaf willow	*Salix exigua*	shrub
redroot flatsedge	*Cyperus erythrorhizos*	annual sedge
baltic rush	*Juncus balticus*	perennial rush
dwarf barley	*Hordeum depressum*	annual grass
spike bentgrass	*Agrostis exarata*	perennial grass
meadow barley	*Hordeum brachyantherum*	perennial grass
distant phacelia	*Phacelia distans*	annual forb
seep monkeyflower	*Mimulus guttatus*	annual/perennial forb
yerba mansa	*Anemopsis californica*	perennial forb
Douglas' sagewort	*Artemisia douglasiana*	perennial forb
Dense Riparian Areas (2 to 8 feet above summer baseflow elevations)		
white alder	*Alnus rhombifolia*	tree
Oregon ash	*Fraxinus latifolia*	tree
California sycamore	*Platanus racemosa*	tree
Fremont cottonwood	*Populus fremontii*	tree
Gooding's willow	*Salix gooddingii*	tree
mule-fat	*Baccharis salicifolia*	shrub
California wildrose	*Rosa californica*	shrub
narrowleaf willow	*Salix exigua*	shrub
dwarf barley	*Hordeum depressum*	annual grass
spike bentgrass	*Agrostis exarata*	perennial grass
meadow barley	*Hordeum brachyantherum*	perennial grass
Douglas' sagewort	*Artemisia douglasiana*	perennial forb
Upland Areas (greater than 8 feet above summer baseflow elevations)		
cattle saltbush	*Atriplex polycarpa*	shrub
California wildrose	*Rosa californica*	shrub
Saltgrass	*Distichlis spicata*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
beardless wildrye	*Leymus triticodes*	perennial grass
California goldfields	*Lasthenia californica*	annual forb
bull clover	*Trifolium fucatum*	annual forb

Plantings that are wetland species or borderline wetland species would need regular aboveground irrigation (typically April through October) during their establishment period (typically 3 to 5 years depending on rainfall conditions and the plants' growth rates and vigor). An extensive temporary aboveground irrigation system, such as aerial spray or drip irrigation, would provide water for the plants several times a week during the hot months of the year.

Maintenance and monitoring would be conducted following revegetation. Monitoring activities include monitoring of the installed plants for drought stress and overwatering, identification of competitive, invasive, non-native species for removal, identification of diseased, dead and washed-out plants, irrigation system function, and identification of trash and debris for removal. Maintenance activities would include controlling invasive plant species, mitigating animal damage, irrigation, replacement of diseased, dead, or washed-out plants, irrigation system maintenance, and removal of trash and debris.

Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) could occur on the floodplain in previous agricultural areas outside of State-owned and public trust lands. Growers would be required to leave cover on the ground and would be required to develop and implement a Water Quality Plan, approved by the Reclamation, to meet then-existing water quality standards for coldwater fisheries beneficial in downstream areas.

When comparing Alternative B to existing conditions, impacts to riparian habitat and other sensitive natural communities would be similar to those discussed in the preceding paragraphs (i.e., the comparison of Alternative B to No-Action). According to habitat restoration estimates, Alternative B could support up to 1,970 acres of sensitive natural vegetation communities (SJRRP 2012, Attachment A). This represents more than a 5-fold increase in sensitive natural communities as compared to existing conditions. This would be a **beneficial** effect.

Impact VEG-3 (Alternative B): ***Facilitate Increase in Distribution and Abundance of Invasive Plants in the Project Area.*** Refer to Impact VEG-3 (Alternative A). Potential impacts for Alternative B would be similar to potential impacts of Alternative A with the exception that Alternative B includes a mixture of active and passive riparian and floodplain habitat restoration which may delay the establishment of invasive plant species. This impact would be **less than significant**.

Impact VEG-4 (Alternative B): ***Conflict with Provisions of Local Plans in the Project Area.*** Refer to Impact VEG-4 (Alternative A). Potential impacts for Alternative B would be the same as potential impacts of Alternative A, and would result in a **beneficial** effect compared to existing conditions.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Similar to Alternative B, Alternative C includes active riparian and floodplain habitat restoration. It is assumed that wetland communities would develop within the main channel, that a dense riparian scrubland would develop along the main river channel banks, and that bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the floodplain corridor. The wetland, floodplain, and riparian areas would be planted following construction and then irrigated and managed as necessary during the establishment period.

Impact VEG-1 (Alternative C): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during Construction.*** Refer to Impact VEG-1 (Alternative A). Potential impacts during Project construction for Alternative C would be similar to potential impacts of Alternative A, with the following exception. Construction of the Project would affect the acreages of special-status vegetation alliances shown in Table 6-8. As described under Impact VEG-1 (Alternative A), avoidance, minimization, and compensation for loss of riparian habitat, other sensitive natural communities (i.e., special-status vegetation alliances), and special-status plant species would reduce the potential for adverse effects to vegetation during construction. Impacts of Alternative C would be **less than significant**.

Table 6-8.
Special-Status Vegetation Alliances Potentially Affected by Alternative C

Common Name	Scientific Name	Maximum Impacted Area (Acres)			
		Infra-structure	Flood-plain	Borrow	Other
		(not future habitat)	(future habitat)	(future habitat or agriculture)	
Riparian Forest and Woodland Alliances					
Fremont cottonwood forest	*Populus fremontii* alliance	7.4	52.3	10.5	5.7
Oregon ash groves	*Fraxinus latifolia* forest alliance	0.2	6.7	-	0.1
Valley oak woodland	*Quercus lobata woodland* alliance	-	-	-	-
Riparian Thicket Alliances					
Black willow thickets	*Salix gooddingii* alliance	11.5	107.1	1.8	17.0
Buttonwillow thickets	*Cephalanthus occidentalis* alliance	0.4	0.9	-	0.2
Red willow thickets	*Salix laevigata* woodland alliance	-	0.6	-	-
Arrow weed thickets	*Pluchea sericea* shrubland alliance	-	0.4	-	-
Riparian Scrub Alliances					
Blue elderberry stands	*Sambucus nigra* shrubland alliance	9.0	66.4	-	-
California rose briar patches	*Rosa californica* alliance	1.8	10.6	0.5	0.5
Spinescale scrub	*Atriplex spinifera* alliance	0.4	0.0	-	0.2

Table 6-8.
Special-Status Vegetation Alliances Potentially Affected by Alternative C

Common Name	Scientific Name	Maximum Impacted Area (Acres)			
		Infra-structure (not future habitat)	**Flood-plain (future habitat)**	**Borrow (future habitat or agriculture)**	**Other**
Silver bush lupine scrub	*Lupinus albifrons* shrubland alliance	0.4	2.0	-	1.7
Grassland and Herbaceous Field Alliances					
Tar plant fields	*Centromadia pungens* or other species herbaceous alliance	0.9	33.0	-	1.4
Creeping rye grass turfs	*Leymus triticoides* herbaceous alliance	-	6.1	-	-
Salt grass flats	*Distichlis spicata* herbaceous alliance	0.3	1.4	-	0.1
Marsh and Wet Meadow Alliances					
California bulrush marsh	*Schoenoplectus californicus* herbaceous alliance	4.1	15.8	4.9	24.8
Pale spike rush marsh	*Eleocharis macrostachya* herbaceous alliance	-	0.8	-	0.8
Yerba mansa meadows	*Anemopsis californica* herbaceous alliance	0.4	0.2	0.1	0.7
Alkali heath marsh	*Frankenia salina* alliance	0.2	-	-	0.2
Total		***37.2***	***304.5***	***12.7***	***32.0***

Key:
Infrastructure = structures, levees, or roads
Floodplain = floodplain of the San Joaquin River (active restoration)
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact VEG-2 (Alternative C): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during the Operations and Maintenance Phase of the Project.*** Alternative C includes active riparian and floodplain habitat restoration. The wetland, floodplain, and riparian areas would be planted following construction and then irrigated and managed as necessary during the establishment period.

Several native vegetation alliances could be incorporated into the floodplain and habitat planting design. The grass-dominated vegetation alliances could be substantially larger than those that would develop under the No-Action Alternative. All of the elevated areas of the meander loops could be maintained or restored to saltgrass flats. The adjacent existing wetland areas within the loops could be preserved or enhanced by additional wetland species plantings and removal of numerous invasive plant species. The lower lying portions of the reach could be planted with the buttonwillow thicket vegetation alliance. Because of the wide floodplain and the slowly moving water, the extent of this vegetation alliance could be substantially larger than that which would develop under No-Action. The extent of black willow thicket and California mugwort brush could also increase over what might develop under the No-Action Alternative.

Additional restoration work could focus on the re-establishment of the riparian bank herbs, California bulrush marsh, Oregon ash groves, creeping rye grasslands, and Fremont cottonwood forests. Because of the fast growth and its soft and brittle wood, the cottonwood is considered to be a good source of large woody debris and organic matter within the riverine channel. The riverside levee banks would be planted with native grass species such as those in the creeping rye grassland alliance. Since creeping wild rye (*Leymus triticoides*) is a facultative wetland species that thrives in the upper parts of riparian areas, the extent of creeping rye grassland could be substantially larger than that which would develop under No-Action, a beneficial effect.

When comparing Alternative C to existing conditions, impacts to riparian habitat and other sensitive natural communities would be similar to those discussed in the preceding paragraphs (i.e., the comparison of Alternative C to No-Action). According to habitat restoration estimates, Alternative C could support up to 1,450 acres of sensitive natural vegetation communities including buttonwillow thickets, California bulrush marsh, California mugwort brush, creeping rye grass turfs, riparian banks forbes and herbs, salt grass flats, Fremont cottonwood forest, Oregon ash groves, sandbar willow thickets, and black willow thickets (SJRRP 2012, Attachment A). This represents more than a 3-fold increase in sensitive natural communities as compared to existing conditions. This would be a **beneficial** effect.

Impact VEG-3 (Alternative C): ***Facilitate Increase in Distribution and Abundance of Invasive Plants in the Project Area.*** Refer to Impact VEG-3 (Alternative A). Potential impacts for Alternative C would be similar to potential impacts of Alternative A with the exception that Alternative C includes active riparian and floodplain habitat restoration which may delay the establishment of invasive plant species. This impact would be **less than significant**.

Impact VEG-4 (Alternative C): ***Conflict with Provisions of Local Plans in the Project Area.*** Refer to Impact VEG-4 (Alternative A). Potential impacts for Alternative C would be the same as potential impacts of Alternative A. This would be a **beneficial** effect compared to existing conditions.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the North Canal bifurcation structure and North Canal fish passage facility, removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Similar to Alternative A, Alternative D includes passive riparian habitat restoration and farming in the floodplain. It is assumed that over time wetland communities would develop within the main channel and that a dense riparian scrubland would develop along the main river channel banks. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur.

Impact VEG-1 (Alternative D): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during Construction.*** Refer to Impact VEG-1 (Alternative A). Potential impacts for Alternative D during Project construction would be similar to potential impacts of Alternative A with the following exception. Construction of the Project would affect the acreages of special-status vegetation alliances shown in Table 6-9. As described under Impact VEG-1 (Alternative A), avoidance, minimization, and compensation for loss of riparian habitat, other sensitive natural communities (i.e., special-status vegetation alliances), and special-status plant species would reduce the potential for adverse effects to vegetation during construction. Impacts of Alternative D would be **less than significant**.

Impact VEG-2 (Alternative D): ***Substantially Alter Riparian Habitat and Other Sensitive Communities during the Operations and Maintenance Phase of the Project.*** Refer to Impact VEG-2 (Alternative A). Similar to Alternative A, Alternative D includes passive riparian habitat restoration and farming in the floodplain. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur. According to habitat restoration estimates, Alternative D could support up to 2,000 acres of sensitive natural vegetation communities including buttonwillow thickets, California bulrush marsh, California mugwort brush, creeping rye grass turfs, riparian banks forbes and herbs, salt grass flats, Fremont cottonwood forest, Oregon ash groves, sandbar willow thickets, and black willow thickets (SJRRP 2012, Attachment A). This represents more than a 5-fold increase in sensitive natural communities as compared to existing conditions. This would be a **beneficial** effect.

Table 6-9.
Special-Status Vegetation Alliances Potentially Affected by Alternative D

		Maximum Impacted Area (Acres)			
		Infra-structure	Flood-plain	Borrow	Other
Common Name	Scientific Name	(not future habitat)	(future habitat or agriculture)		
Riparian Forest and Woodland Alliances					
Fremont cottonwood forest	*Populus fremontii* alliance	10.4	57.0	3.0	5.6
Oregon ash groves	*Fraxinus latifolia* forest alliance	1.0	5.9	-	-
Valley oak woodland	*Quercus lobata woodland* alliance	-	-	-	0.2
Riparian Thicket Alliances					
Black willow thickets	*Salix gooddingii* alliance	17.1	100.5	1.8	17.8
Buttonwillow thickets	*Cephalanthus occidentalis* alliance	0.4	0.9	-	0.2

Table 6-9.
Special-Status Vegetation Alliances Potentially Affected by Alternative D

Common Name	Scientific Name	Maximum Impacted Area (Acres)			
		Infra-structure	Flood-plain	Borrow	Other
		(not future habitat)	(future habitat or agriculture)		
Red willow thickets	*Salix laevigata* woodland alliance	-	0.6	-	-
Arrow weed thickets	*Pluchea sericea* shrubland alliance	-	0.4	-	-
Riparian Scrub Alliances					
Blue elderberry stands	*Sambucus nigra* shrubland alliance	9.8	65.6	-	-
California rose briar patches	*Rosa californica* alliance	3.1	8.9	0.7	0.3
Spinescale scrub	*Atriplex spinifera* alliance	0.4	-	-	0.2
Silver bush lupine scrub	*Lupinus albifrons* shrubland alliance	0.1	1.9	-	-
Grassland and Herbaceous Field Alliances					
Tar plant fields	*Centromadia pungens* or other species herbaceous alliance	0.8	33.0	-	0.1
Creeping rye grass turfs	*Leymus triticoides* herbaceous alliance	-	6.1	-	-
Salt grass flats	*Distichlis spicata* herbaceous alliance	0.3	1.4	-	0.1
Marsh and Wet Meadow Alliances					
California bulrush marsh	*Schoenoplectus californicus* herbaceous alliance	3.2	15.8	-	5.2
Pale spike rush marsh	*Eleocharis macrostachya* herbaceous alliance	-	-	-	-
Yerba mansa meadows	*Anemopsis californica* herbaceous alliance	-	0.8	-	-
Alkali heath marsh	*Frankenia salina* alliance	0.0	0.2	-	0.4
Total		***46.7***	***298.9***	***5.5***	***30.3***

Key:
Infrastructure = structures, levees, or roads
Floodplain = floodplain of the San Joaquin River (passive restoration and agricultural activities)
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact VEG-3 (Alternative D): *Facilitate Increase in Distribution and Abundance of Invasive Plants in the Project Area.* Refer to Impact VEG-3 (Alternative A). Potential impacts for Alternative D would be the same as potential impacts of Alternative A. This impact would be **less than significant**.

Impact VEG-4 (Alternative D): *Conflict with Provisions of Local Plans in the Project Area.* Refer to Impact VEG-4 (Alternative A). Potential impacts for Alternative D would be the same as potential impacts of Alternative A. This would be a **beneficial** effect compared to existing conditions.