

DRAFT ◦ DECEMBER 2018

Environmental Impact Report for the Lower Klamath Project License Surrender Volume I

State Clearinghouse No. 2016122047



This page left blank intentionally.

Draft Environmental Impact Report for the Lower Klamath Project License Surrender

Volume I

Prepared by:

Stillwater Sciences
2855 Telegraph Avenue # 400
Berkeley, CA 94705

Prepared for:

State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

December 2018

This page left blank intentionally

The Lower Klamath Project License Surrender Draft Environmental Impact Report is being made available to the public in accordance with the California Environmental Quality Act. Public Comments are due on Tuesday, February 26, 2019.

Visit Lower Klamath Project License Surrender Project Web Site

(https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/low_er_klamath_ferc14803.shtml) where you can:

- View and download an electronic copy of the Draft EIR.
- View or download a list of libraries and other locations where hardcopies of the Draft EIR are available for review.

To receive future email notifications regarding the Lower Klamath Project, please subscribe to the “Lower Klamath Project License Surrender” email subscription list under “Water Rights”.

Instructions on how to sign up for the State Water Board’s Email Subscription List are outlined below:

1. Visit: http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml#rights
2. Provide your name and email in the required fields.
3. In the categories below the email and name fields, select “Water Rights,” then “Lower Klamath Project License Surrender.”
4. Click on the "Subscribe" button.
5. An email will be sent to you. You must respond to the email message(s) to confirm your membership on the selected list(s).

Suggested Citation:

California State Water Resources Control Board. 2018. Lower Klamath Project License Surrender Draft Environmental Impact Report. Prepared by State Water Resources Control Board, Sacramento, CA. December.

This page left blank intentionally.

Table of Contents

ACRONYMS AND ABBREVIATIONS	xxiii
EXECUTIVE SUMMARY	ES-1
Proposed Project Location.....	ES-1
Proposed Project Objectives	ES-4
Proposed Project.....	ES-4
Dam and Powerhouse Deconstruction.....	ES-4
Reservoir Drawdown	ES-5
Reservoir Sediment Deposits and Erosion During Drawdown.....	ES-5
Restoration within the Reservoir Footprint	ES-6
Restoration of Upland Areas Outside of the Reservoir Footprint.....	ES-7
Fish Hatcheries.....	ES-7
City of Yreka Water Supply Pipeline Relocation.....	ES-7
Other Project Components	ES-8
Land Disposition	ES-8
Summary of Proposed Project Effects, Potential Impacts, and Potential Cumulative Impacts	ES-9
Effects Found to be Beneficial	ES-9
Significant Unavoidable Adverse Impacts	ES-11
Cumulative Impacts	ES-15
Alternatives to the Proposed Project.....	ES-16
No Project Alternative	ES-16
Partial Removal Alternative.....	ES-17
Continued Operations with Fish Passage Alternative.....	ES-17
Three Dam Removal Alternative	ES-18
Two Dam Removal Alternative.....	ES-19
No Hatchery Alternative	ES-20
Public Involvement and Agency Consultation	ES-20
Areas of Controversy.....	ES-21
Issues to be Resolved	ES-24
References.....	ES-25
1 INTRODUCTION.....	1-1
1.1 Authorization, Purpose, and Use of EIR.....	1-1
1.1.1 CEQA Guidance Regarding State Boundaries	1-2
1.2 Brief Introduction to the Proposed Project.....	1-2
1.3 Scope and Content of the EIR.....	1-2
1.4 EIR Process Overview	1-3
1.5 Public Involvement and Agency Consultation in Preparing Draft EIR	1-4
1.5.1 Scoping Meetings.....	1-5
1.5.2 Scoping Comments.....	1-5
1.5.3 Agency and Tribal Consultation.....	1-7
2 PROPOSED PROJECT	2-1
2.1 Project Objectives	2-1
2.2 Project Location	2-1
2.3 Existing Lower Klamath Project Features.....	2-8
2.3.1 J.C. Boyle Dam and Associated Facilities	2-8
2.3.2 Copco No. 1 Dam and Associated Facilities.....	2-11
2.3.3 Copco No. 2 Dam and Associated Facilities.....	2-13
2.3.4 Iron Gate Dam and Associated Facilities.....	2-13
2.4 Surrounding Land Ownership and Land Use.....	2-16

2.5	Surrounding Land Cover	2-16
2.6	Project Background.....	2-20
2.6.1	Water Conflicts in the Klamath River Basin	2-20
2.6.2	Relationship with Klamath Hydroelectric Project.....	2-22
2.6.3	Klamath Settlement Agreements.....	2-23
2.6.4	Prior/Related Environmental Reviews	2-24
2.7	Proposed Project	2-25
2.7.1	Dam and Powerhouse Deconstruction	2-30
2.7.2	Reservoir Drawdown.....	2-54
2.7.3	Reservoir Sediment Deposits and Erosion During Drawdown	2-60
2.7.4	Restoration Within the Reservoir Footprint.....	2-69
2.7.5	Restoration of Upland Areas Outside of the Reservoir Footprint	2-77
2.7.6	Hatchery Operations	2-77
2.7.7	City of Yreka Water Supply Pipeline Relocation	2-84
2.7.8	Other Project Components.....	2-87
2.7.9	KHSA Interim Measures.....	2-102
2.7.10	Land Disposition and Transfer.....	2-108
2.8	Intended Uses of the EIR	2-110
2.9	References	2-111
3	ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES.....	3-1
3.1	Introduction	3-1
3.1.1	Area of Analysis	3-1
3.1.2	Environmental Setting	3-2
3.1.3	Significance Criteria	3-2
3.1.4	Impact Analysis Approach.....	3-2
3.1.5	Potential Impacts and Mitigation.....	3-2
3.1.6	Summary of Available Hydrology Information for the Proposed Project.....	3-3
3.1.7	References.....	3-13
3.2	Water Quality	3-15
3.2.1	Area of Analysis	3-15
3.2.2	Environmental Setting	3-17
3.2.3	Significance Criteria	3-43
3.2.4	Impact Analysis Approach.....	3-64
3.2.5	Potential Impacts and Mitigation.....	3-74
3.2.6	References.....	3-173
3.3	Aquatic Resources.....	3-191
3.3.1	Area of Analysis	3-191
3.3.2	Environmental Setting	3-194
3.3.3	Significance Criteria	3-258
3.3.4	Impact Analysis Approach.....	3-259
3.3.5	Potential Impacts and Mitigation.....	3-266
3.3.6	References.....	3-354
3.4	Phytoplankton and Periphyton	3-389
3.4.1	Area of Analysis	3-390
3.4.2	Environmental Setting	3-392
3.4.3	Significance Criteria	3-422
3.4.4	Impact Analysis Approach.....	3-422
3.4.5	Potential Impacts and Mitigation.....	3-426
3.4.6	References.....	3-440

- 3.5 Terrestrial Resources.....3-453
 - 3.5.1 Area of Analysis3-453
 - 3.5.2 Environmental Setting3-457
 - 3.5.3 Significance Criteria3-514
 - 3.5.4 Impact Analysis Approach.....3-515
 - 3.5.5 Potential Impacts and Mitigation.....3-518
 - 3.5.6 References.....3-576
- 3.6 Flood Hydrology.....3-587
 - 3.6.1 Area of Analysis3-587
 - 3.6.2 Environmental Setting3-589
 - 3.6.3 Significance Criteria3-624
 - 3.6.4 Impacts Analysis Approach3-625
 - 3.6.5 Potential Impacts and Mitigation.....3-626
 - 3.6.6 References.....3-636
- 3.7 Groundwater3-639
 - 3.7.1 Area of Analysis3-639
 - 3.7.2 Environmental Setting3-641
 - 3.7.3 Significance Criteria3-661
 - 3.7.4 Impacts Analysis Approach3-662
 - 3.7.5 Potential Impacts and Mitigation.....3-663
 - 3.7.6 References.....3-665
- 3.8 Water Supply/Water Rights.....3-667
 - 3.8.1 Area of Analysis3-667
 - 3.8.2 Environmental Setting3-670
 - 3.8.3 Significance Criteria3-674
 - 3.8.4 Impacts Analysis Approach3-674
 - 3.8.5 Potential Impacts and Mitigation.....3-676
 - 3.8.6 References.....3-683
- 3.9 Air Quality3-685
 - 3.9.1 Area of Analysis3-685
 - 3.9.2 Environmental Setting3-687
 - 3.9.3 Significance Criteria3-697
 - 3.9.4 Impact Analysis Approach.....3-699
 - 3.9.5 Potential Impacts and Mitigation.....3-701
 - 3.9.6 References.....3-711
- 3.10 Greenhouse Gas Emissions3-713
 - 3.10.1 Area of Analysis3-713
 - 3.10.2 Environmental Setting3-715
 - 3.10.3 Significance Criteria3-719
 - 3.10.4 Impact Analysis Approach.....3-721
 - 3.10.5 Potential Impacts and Mitigation.....3-724
 - 3.10.6 References.....3-730
- 3.11 Geology, Soils, and Mineral Resources3-733
 - 3.11.1 Area of Analysis3-733
 - 3.11.2 Environmental Setting3-735
 - 3.11.3 Significance Criteria3-759
 - 3.11.4 Impacts Analysis Approach3-759
 - 3.11.5 Potential Impacts and Mitigation.....3-761
 - 3.11.6 References.....3-776

- 3.12 Historical Resources and Tribal Cultural Resources3-781
 - 3.12.1 Area of Analysis3-782
 - 3.12.2 Environmental Setting3-789
 - 3.12.3 Significance Criteria3-813
 - 3.12.4 Impact Analysis Approach3-814
 - 3.12.5 Potential Impacts and Mitigation.....3-816
 - 3.12.6 References.....3-854
- 3.13 Paleontologic Resources3-861
 - 3.13.1 Area of Analysis3-861
 - 3.13.2 Environmental Setting3-863
 - 3.13.3 Significance Criteria3-866
 - 3.13.4 Impacts Analysis Approach3-868
 - 3.13.5 Potential Impacts and Mitigation.....3-870
 - 3.13.6 References.....3-872
- 3.14 Land Use and Planning.....3-875
 - 3.14.1 Area of Analysis3-875
 - 3.14.2 Environmental Setting3-877
 - 3.14.3 Significance Criteria3-882
 - 3.14.4 Impact Analysis Approach3-882
 - 3.14.5 Potential Impacts and Mitigation.....3-882
 - 3.14.6 References.....3-887
- 3.15 Agriculture and Forestry Resources3-889
 - 3.15.1 Area of Analysis3-889
 - 3.15.2 Environmental Setting3-889
 - 3.15.3 Significance Criteria3-895
 - 3.15.4 Impact Analysis Approach3-896
 - 3.15.5 Potential Impacts and Mitigation.....3-896
 - 3.15.6 References.....3-901
- 3.16 Population and Housing3-903
 - 3.16.1 Area of Analysis3-903
 - 3.16.2 Environmental Setting3-903
 - 3.16.3 Significance Criteria3-905
 - 3.16.4 Impact Analysis Approach3-905
 - 3.16.5 Potential Impacts and Mitigation.....3-906
 - 3.16.6 References.....3-907
- 3.17 Public Services3-909
 - 3.17.1 Area of Analysis3-909
 - 3.17.2 Environmental Setting3-909
 - 3.17.3 Significance Criteria3-912
 - 3.17.4 Impact Analysis Approach3-912
 - 3.17.5 Potential Impacts and Mitigation.....3-913
 - 3.17.6 References.....3-922
- 3.18 Utilities and Service Systems3-925
 - 3.18.1 Area of Analysis3-925
 - 3.18.2 Environmental Setting3-925
 - 3.18.3 Significance Criteria3-927
 - 3.18.4 Impact Analysis Approach3-927
 - 3.18.5 Potential Impacts and Mitigation.....3-928
 - 3.18.6 References.....3-931

3.19	Aesthetics	3-933
3.19.1	Area of Analysis	3-933
3.19.2	Environmental Setting	3-936
3.19.3	Significance Criteria	3-951
3.19.4	Impact Analysis Approach	3-951
3.19.5	Potential Impacts and Mitigation	3-952
3.19.6	References	3-966
3.20	Recreation	3-969
3.20.1	Area of Analysis	3-969
3.20.2	Environmental Setting	3-971
3.20.3	Significance Criteria	3-1001
3.20.4	Impact Analysis Approach	3-1002
3.20.5	Potential Impacts and Mitigation	3-1004
3.20.6	References	3-1022
3.21	Hazards and Hazardous Materials	3-1029
3.21.1	Area of Analysis	3-1029
3.21.2	Environmental Setting	3-1029
3.21.3	Significance Criteria	3-1041
3.21.4	Impact Analysis Approach	3-1041
3.21.5	Potential Impacts and Mitigation	3-1042
3.21.6	References	3-1054
3.22	Transportation and Traffic	3-1057
3.22.1	Area of Analysis	3-1057
3.22.2	Environmental Setting	3-1059
3.22.3	Significance Criteria	3-1067
3.22.4	Impact Analysis Approach	3-1067
3.22.5	Potential Impacts and Mitigation	3-1069
3.22.6	References	3-1078
3.23	Noise	3-1079
3.23.1	Area of Analysis	3-1079
3.23.2	Environmental Setting	3-1082
3.23.3	Significance Criteria	3-1089
3.23.4	Impact Analysis Approach	3-1091
3.23.5	Potential Impacts and Mitigation	3-1093
3.23.6	References	3-1101
3.24	Cumulative Effects	3-1103
3.24.1	Introduction	3-1103
3.24.2	Water Quality	3-1147
3.24.3	Aquatic Resources	3-1162
3.24.4	Phytoplankton and Periphyton	3-1166
3.24.5	Terrestrial Resources	3-1174
3.24.6	Flood Hydrology	3-1181
3.24.7	Groundwater	3-1182
3.24.8	Water Supply/Water Rights	3-1183
3.24.9	Air Quality	3-1185
3.24.10	Greenhouse Gas Emissions	3-1187
3.24.11	Geology, Soils, and Mineral Resources	3-1191
3.24.12	Historical Resources and Tribal Cultural Resources	3-1194
3.24.13	Paleontologic Resources	3-1198
3.24.14	Land Use and Planning	3-1199
3.24.15	Agriculture and Forestry	3-1201

3.24.16 Population and Housing3-1203

3.24.17 Public Services3-1204

3.24.18 Utilities and Service Systems3-1206

3.24.19 Aesthetics3-1208

3.24.20 Recreation3-1211

3.24.21 Hazards and Hazardous Materials3-1214

3.24.22 Transportation and Traffic3-1216

3.24.23 Noise3-1218

3.24.24 References3-1219

4 ALTERNATIVES4-1

4.1 Alternatives Selection/Overview4-1

4.1.1 Alternatives Selection.....4-1

4.2 No Project Alternative4-15

4.2.1 Introduction4-15

4.2.2 Water Quality4-24

4.2.3 Aquatic Resources4-36

4.2.4 Phytoplankton and Periphyton.....4-59

4.2.5 Terrestrial Resources4-63

4.2.6 Flood Hydrology4-66

4.2.7 Groundwater4-68

4.2.8 Water Supply/Water Rights4-68

4.2.9 Air Quality4-69

4.2.10 Greenhouse Gas Emissions.....4-70

4.2.11 Geology, Soils, and Mineral Resources.....4-70

4.2.12 Historical Resources and Tribal Cultural Resources.....4-71

4.2.13 Paleontologic Resources.....4-71

4.2.14 Land Use and Planning4-72

4.2.15 Agriculture and Forestry Resources4-72

4.2.16 Population and Housing4-72

4.2.17 Public Services4-72

4.2.18 Utilities and Service Systems4-73

4.2.19 Aesthetics4-73

4.2.20 Recreation.....4-73

4.2.21 Hazards and Hazardous Materials4-74

4.2.22 Transportation and Traffic4-74

4.2.23 Noise.....4-74

4.3 Partial Removal Alternative4-75

4.3.1 Introduction4-75

4.3.2 Water Quality4-84

4.3.3 Aquatic Resources4-85

4.3.4 Phytoplankton and Periphyton.....4-85

4.3.5 Terrestrial Resources4-86

4.3.6 Flood Hydrology4-88

4.3.7 Groundwater4-88

4.3.8 Water Supply/Water Rights4-89

4.3.9 Air Quality4-89

4.3.10 Greenhouse Gas Emissions.....4-90

4.3.11 Geology, Soils, and Mineral Resources.....4-91

4.3.12 Historical and Tribal Cultural Resources4-91

4.3.13 Paleontologic Resources.....4-92

4.3.14 Land Use and Planning4-92

- 4.3.15 Agriculture and Forestry Resources4-92
- 4.3.16 Population and Housing4-93
- 4.3.17 Public Services4-93
- 4.3.18 Utilities and Service Systems4-94
- 4.3.19 Aesthetics4-94
- 4.3.20 Recreation.....4-95
- 4.3.21 Hazards and Hazardous Materials4-96
- 4.3.22 Transportation and Traffic4-96
- 4.3.23 Noise.....4-97
- 4.4 Continued Operations with Fish Passage Alternative4-99
 - 4.4.1 Introduction4-99
 - 4.4.2 Water Quality4-102
 - 4.4.3 Aquatic Resources4-125
 - 4.4.4 Phytoplankton and Periphyton.....4-162
 - 4.4.5 Terrestrial Resources4-165
 - 4.4.6 Flood Hydrology4-169
 - 4.4.7 Groundwater4-169
 - 4.4.8 Water Supply/Water Rights4-170
 - 4.4.9 Air Quality4-170
 - 4.4.10 Greenhouse Gas Emissions.....4-171
 - 4.4.11 Geology, Soils, and Mineral Resources.....4-172
 - 4.4.12 Historical Resources and Tribal Cultural Resources.....4-172
 - 4.4.13 Paleontologic Resources.....4-173
 - 4.4.14 Land Use and Planning4-174
 - 4.4.15 Agriculture and Forestry Resources4-174
 - 4.4.16 Population and Housing4-174
 - 4.4.17 Public Services4-174
 - 4.4.18 Utilities and Service Systems4-175
 - 4.4.19 Aesthetics4-176
 - 4.4.20 Recreation.....4-176
 - 4.4.21 Hazards and Hazardous Materials4-178
 - 4.4.22 Transportation and Traffic4-179
 - 4.4.23 Noise.....4-180
- 4.5 Two Dam Removal Alternative4-181
 - 4.5.1 Introduction4-181
 - 4.5.2 Water Quality4-186
 - 4.5.3 Aquatic Resources4-204
 - 4.5.4 Phytoplankton and Periphyton.....4-223
 - 4.5.5 Terrestrial Resources4-228
 - 4.5.6 Flood Hydrology4-230
 - 4.5.7 Groundwater4-231
 - 4.5.8 Water Supply/Water Rights4-231
 - 4.5.9 Air Quality4-232
 - 4.5.10 Greenhouse Gas Emissions.....4-233
 - 4.5.11 Geology, Soils, and Mineral Resources.....4-234
 - 4.5.12 Historical Resources and Tribal Cultural Resources.....4-235
 - 4.5.13 Paleontologic Resources.....4-236
 - 4.5.14 Land Use and Planning4-237
 - 4.5.15 Agriculture and Forestry Resources4-237
 - 4.5.16 Population and Housing4-237
 - 4.5.17 Public Services4-237

4.5.18	Utilities and Service Systems	4-239
4.5.19	Aesthetics	4-239
4.5.20	Recreation.....	4-240
4.5.21	Hazards and Hazardous Materials	4-242
4.5.22	Transportation and Traffic	4-243
4.5.23	Noise.....	4-245
4.6	Three Dam Removal Alternative	4-247
4.6.1	Introduction	4-247
4.6.2	Water Quality	4-250
4.6.3	Aquatic Resources	4-267
4.6.4	Phytoplankton and Periphyton.....	4-285
4.6.5	Terrestrial Resources	4-290
4.6.6	Flood Hydrology	4-290
4.6.7	Groundwater	4-290
4.6.8	Water Supply/Water Rights	4-291
4.6.9	Air Quality	4-292
4.6.10	Greenhouse Gas Emissions.....	4-292
4.6.11	Geology, Soils, and Mineral Resources.....	4-293
4.6.12	Historical Resources and Tribal Cultural Resources.....	4-294
4.6.13	Paleontologic Resources.....	4-295
4.6.14	Land Use and Planning	4-295
4.6.15	Agriculture and Forestry Resources	4-295
4.6.16	Population and Housing	4-295
4.6.17	Public Services	4-296
4.6.18	Utilities and Service Systems	4-296
4.6.19	Aesthetics	4-296
4.6.20	Recreation.....	4-297
4.6.21	Hazards and Hazardous Materials	4-298
4.6.22	Transportation and Traffic	4-299
4.6.23	Noise.....	4-300
4.7	No Hatchery Alternative	4-301
4.7.1	Introduction	4-301
4.7.2	Water Quality	4-303
4.7.3	Aquatic Resources	4-304
4.7.4	Phytoplankton and Periphyton.....	4-313
4.7.5	Terrestrial Resources	4-314
4.7.6	Flood Hydrology	4-316
4.7.7	Groundwater	4-316
4.7.8	Water Supply/Water Rights	4-316
4.7.9	Air Quality	4-317
4.7.10	Greenhouse Gas Emissions.....	4-317
4.7.11	Geology, Soils, and Mineral Resources.....	4-318
4.7.12	Historical Resources and Tribal Cultural Resources.....	4-318
4.7.13	Paleontologic Resources.....	4-319
4.7.14	Land Use and Planning	4-320
4.7.15	Agriculture and Forestry Resources	4-320
4.7.16	Population and Housing	4-320
4.7.17	Public Services	4-320
4.7.18	Utilities and Service Systems	4-320
4.7.19	Aesthetics	4-321
4.7.20	Recreation.....	4-321

4.7.21 Hazards and Hazardous Materials4-322

4.7.22 Transportation and Traffic4-323

4.7.23 Noise.....4-323

4.8 Alternatives References.....4-325

5 OTHER REQUIRED CEQA DISCUSSION AND CONSIDERATION OF SOCIAL AND ECONOMIC FACTORS.....5-1

5.1 Irreversible and Irretrievable Commitment of Resources.....5-1

5.2 Growth Inducing Impacts5-1

5.3 Areas of Controversy and Issues Raised by Agencies and the Public.....5-3

5.4 Social and Economic Factors Under CEQA5-3

5.4.1 Consideration of Economic Information for Resources Potentially Affected by Dam Removal.....5-4

5.4.2 Consistency Under CEQA With Respect to Consideration of Economic or Social Factors.....5-11

5.5 References5-12

List of Tables

Table ES-1. Summary of Impacts and Mitigation Measures..... ES-26

Table ES-2. Areas of Controversy and Issues Raised by Agencies and the Public..... ES-22

Table 1.5-1. Public Scoping Meetings – Dates and Locations.....1-5

Table 2.3-1. Lower Klamath Project Dam and Powerhouse Components.2-8

Table 2.7-1. Proposed Lower Klamath Project Schedule.....2-27

Table 2.7-2. Copco No. 1 Dam and Powerhouse Decommissioning and Removal Proposal.....2-31

Table 2.7-3. Estimated quantities of waste disposal for full removal of Copco No. 1 Dam.2-40

Table 2.7-4. Copco No. 2 Dam and Powerhouse Removal Proposal.2-42

Table 2.7-5. Estimated quantities of waste disposal for full removal of Copco No. 2 Dam.....2-44

Table 2.7-6. Iron Gate Dam and Powerhouse Removal and Decommissioning Proposal.....2-45

Table 2.7-7. Estimated quantities of waste disposal for full removal of Iron Gate Dam.2-52

Table 2.7-8. Workforce Projections for Dam Removal for the Proposed Project...2-53

Table 2.7-8. Range of Release Flows from Reservoirs due to Drawdown.2-59

Table 2.7-9. Stored Sediment in the Klamath Hydroelectric Project, Fall 2009.2-67

Table 2.7-10. Estimated Amount of Sediment in the Lower Klamath Project Reservoirs in 2020.2-68

Table 2.7-11. Estimated Amount of Sediment Anticipated to Erode with Dam Removal.....2-69

Table 2.7-12. Existing Goals and Proposed Hatchery Production for Operations at Iron Gate and Fall Creek Hatcheries.2-80

Table 2.7-13. Summary of Other Project Components.2-87

Table 2.7-14. Recreation Facilities scheduled for removal under the Proposed Project.....2-94

Table 2.7-15. Recreation Facilities retained with potential modification under the Proposed Project.....2-94

Table 2.7-16. Primary Local and Regional Access Roads.2-96

Table 2.7-17. Water Quality Monitoring Plan Parameters.....2-98

Table 2.7-18.	KHSA Interim Measures Relevant to California Under Existing Conditions and the Proposed Project.	2-103
Table 3.1-1.	Minimum Klamath River Discharge below Iron Gate Dam under the 2013 BiOp Flows.	3-5
Table 3.1-2.	Average Monthly Flow at Iron Gate Dam for 2013 Joint Biological Opinion and KBRA Operations Criteria.....	3-6
Table 3.1-3.	Average Monthly Flow at Keno Dam for 2013 Joint Biological Opinion and KBRA Operations Criteria.....	3-7
Table 3.2-1.	River Mile Locations of Klamath River Features Relevant to the Water Quality Analysis	3-17
Table 3.2-2.	Designated Beneficial Uses of Water in the Water Quality Area of Analysis.....	3-45
Table 3.2-3.	Water Bodies Included on the 303(d) List within the Water Quality Area of Analysis	3-47
Table 3.2-4.	California Surface-Water Quality Objectives Relevant to the Proposed Project.....	3-49
Table 3.2-5.	Minimum Dissolved Oxygen Concentrations in mg/L Based on Percent Saturation Criteria.	3-51
Table 3.2-6.	California Marine Water Quality Objectives Relevant to the Proposed Project.....	3-52
Table 3.2-7.	Hoopla Valley Tribe Surface-Water Quality Objectives.....	3-53
Table 3.2-8.	Yurok Tribe Surface-Water Quality Objectives Relevant to the Proposed Project.....	3-54
Table 3.2-9.	Yurok Tribe Water Temperature Numerical Criteria.....	3-57
Table 3.2-10.	California Cyanobacteria Harmful Algal Bloom Trigger Levels for Human Health	3-61
Table 3.2-11.	Yurok Tribe Posting Guidelines for Blue-Green Algae Public Health Advisories	3-62
Table 3.2-12.	Estimated Range of Sediment Volume Transported by Sediment Jetting During Drawdown Compared to Total Sediment Volume Anticipated to Erode with Dam Removal.	3-86
Table 3.2-13.	Summary of Model Predictions for SSCs in the Klamath River Downstream from Iron Gate Dam for the Proposed Project During Dam Removal Years 1 and 2	3-98
Table 3.2-14.	Estimated Short-term Immediate Oxygen Demand and Biochemical Oxygen Demand by Month for Modeled Flow and SSCs Immediately Downstream from Iron Gate Dam Under the Proposed Project.....	3-122
Table 3.2-15.	Potential General Treatment and Therapeutic Chemicals Used at California Department of Fish and Wildlife Hatcheries.....	3-169
Table 3.3-1.	Special-status Aquatic Species Documented in the Vicinity of the Proposed Project and Included in Aquatic Resources Analysis.	3-195
Table 3.3-2.	Historical and Recent Status of Klamath River Anadromous Fish...3-197	
Table 3.3-3.	Life-history Timing of Fall-run Chinook Salmon in the Klamath River Basin Downstream of Iron Gate Dam.	3-203
Table 3.3-4.	Life-history Timing of Spring-run Chinook Salmon in the Klamath River Basin Downstream of Iron Gate Dam. Peak Activity is Indicated in Black.	3-205
Table 3.3-5.	Life-history Timing of Coho Salmon in the Klamath River Basin Downstream of Iron Gate Dam. Peak Activity is Indicated in Black.	3-208

Table 3.3-6.	Life-history Timing of Summer Steelhead in the Klamath River Basin Downstream of Iron Gate Dam.	3-211
Table 3.3-7.	Life-history Timing of Fall-and Winter-run Steelhead and Rainbow Trout in the Klamath River Basin Downstream of Iron Gate Dam.	3-212
Table 3.3-8.	Life-history Timing of Pacific Lamprey in the Klamath River Basin Downstream of Iron Gate Dam.	3-214
Table 3.3-9.	Life-history Timing of Green Sturgeon in the Klamath River Basin Downstream of Iron Gate Dam.	3-216
Table 3.3-10.	<i>Ceratomyxa Shasta</i> Genotypes in the Klamath Basin.	3-241
Table 3.3-11.	Hatchery releases and adult returns under the Proposed Project. ...	3-283
Table 3.4-1.	2016 California Cyanobacteria Harmful Algal Bloom Trigger Levels for Human Health.	3-402
Table 3.4-2.	Daily Mean Nutrient Loads at Mainstem Klamath River and Major Tributary Sites Calculated Using the Five Different Methods to Estimate Daily Nutrient Concentrations.	3-424
Table 3.5-1.	Vegetation Types Documented in the Primary Area of Analysis for Terrestrial Resources.	3-458
Table 3.5-2.	Comparison of Historical and Current Wet Habitat Types at Copco Nos. 1 and 2 and Iron Gate Reservoirs.	3-468
Table 3.5-3.	Invasive Plants Documented Within and in the Vicinity of the Primary Area of Analysis for Terrestrial Resources.	3-473
Table 3.5-4.	Special-status Plant Species with the Potential to Occur in the Primary Area of Analysis for Terrestrial Resources.	3-480
Table 3.5-5.	Suitable Habitat and Occurrence Information for Special-status Wildlife Species.	3-501
Table 3.5-6.	Summary of Proposed Project Components and Recommended Terrestrial Measures.	3-531
Table 3.5-7.	Noise Disturbance Buffers and Seasonal Timing Restrictions for Nesting Raptors.	3-540
Table 3.5-8.	Evidence of Bat Use at Structures Based on June 2017 Reconnaissance and Available Information from 2018 Surveys	3-547
Table 3.5-9.	Disturbance Distances for the Northern Spotted Owl During the Breeding Period.	3-554
Table 3.6-1.	USGS Gages on the Klamath River.	3-598
Table 3.6-2.	Historical Monthly Average Flows in Wetter Years during Water Years 1961–2009 on the Klamath River.	3-599
Table 3.6-3.	Annual and Seasonal Daily Flows.	3-600
Table 3.6-4.	Klamath River Reservoir Information.	3-601
Table 3.6-5.	Average Spillage at J.C. Boyle, Copco No. 1, and Iron Gate Dams from January 2, 1990 through December 5, 2004.	3-604
Table 3.6-6.	Monthly Discharge Statistics for Klamath River gages.	3-609
Table 3.6-7.	Ramping Rate Requirements for Iron Gate Dam.	3-610
Table 3.6-8.	Iron Gate Dam Target Flow Release Criteria According to the 2013 Biological Opinion.	3-612
Table 3.6-9.	Monthly Discharge Statistics for USGS Gages along the Lower Klamath River and for the Shasta, Scott, Salmon, and Trinity Rivers.	3-616
Table 3.6-10.	Minimum Releases for Trinity River Restoration.	3-619
Table 3.6-11.	Annual Flood Frequency Analysis on Klamath River for 10-Year to 100-Year Flood Events.	3-622

Table 3.6-12.	Flood Attenuation of Iron Gate and Copco No. 1 Reservoirs on Flows at RM 193.	3-631
Table 3.7-1.	Abbreviations Used to Characterize Well Logs in Cross-sections...	3-647
Table 3.7-2.	Well Parameters for Copco No. 1 and Copco No. 2 Reservoir Wells used in Cross-sections A, B, C, D, and M.	3-653
Table 3.7-3.	Well Parameters for Iron Gate Reservoir ¹ Wells used in Cross-sections E, G, and H.	3-660
Table 3.8-1.	Summary of Water Right Listings from California's Electronic Water Rights Information Management System that list the Klamath River or One of the California Lower Klamath Project Reservoirs as the Water Source.....	3-672
Table 3.9-1.	Summary of Annual Ambient Air Quality Data.	3-691
Table 3.9-2.	Attainment Status Summary, Siskiyou County.....	3-692
Table 3.9-3.	Summary of 2015 Estimated Emissions Inventory for Siskiyou County.....	3-694
Table 3.9-4.	Uncontrolled Emissions Inventories for the Proposed Project.....	3-703
Table 3.9-5.	Uncontrolled Emissions Inventories for Dam and Powerhouse Deconstruction.	3-704
Table 3.9-6.	Uncontrolled Emissions from Restoration Activities	3-706
Table 3.9-7.	Uncontrolled Emissions from Relocation and Demolition of Recreation Facilities.	3-706
Table 3.9-8.	Uncontrolled Emissions from Construction of the Yreka Water Supply Pipeline.	3-707
Table 3.10-1.	Lower Klamath Project Dam Complexes.	3-719
Table 3.10-2.	Uncontrolled Direct GHG Emissions Inventories for the Proposed Project.....	3-725
Table 3.11-1.	Earthquake and Fault Information.	3-737
Table 3.11-2.	Mineral Resource Sites within the Area of Analysis for Geology and Soils.	3-741
Table 3.11-3.	Estimated Annual Sediment Delivery to the Klamath River.....	3-749
Table 3.11-4.	Sediment stored in Lower Klamath Project reservoirs, Fall 2009. ...	3-754
Table 3.11-5.	Physical Properties of Reservoir Sediment.....	3-758
Table 3.11-6.	Estimated Amount of Sediment in the Lower Klamath Project Reservoirs in 2020.	3-766
Table 3.11-7.	Estimated Amount of Sediment Erodible with Dam Removal.....	3-768
Table 3.12-1.	Non-confidential Historic-period Cultural Resources within the Area of Analysis.	3-808
Table 3.13-1.	Hornbrook Formation Geologic Unit and Fossil Descriptions.....	3-866
Table 3.13-2.	Paleontologic Potential.	3-869
Table 3.14-1.	Land Ownership in Acres within the Area of Analysis for Land Use and Planning.	3-877
Table 3.15-1.	Summary of Agricultural Land Conversion in Siskiyou County, 2012–2014.	3-890
Table 3.15-2.	Upland tree habitats and mapped between the Oregon-California state line and Iron Gate Dam.....	3-895
Table 3.16-1.	Siskiyou County Housing Units.....	3-905
Table 3.19-1.	Visual Resource Inventory Matrix.	3-939
Table 3.20-1.	Public Lands Offering Recreational Opportunities in the Area of Analysis for Recreation.	3-972
Table 3.20-2.	Rivers Providing Recreational Fishing Opportunities in the Region.....	3-974

Table 3.20-3.	Rivers with Whitewater Boating Opportunities in the Region.	3-975
Table 3.20-4.	Comparison of Lower Klamath Project Reservoirs with Lakes and Reservoirs in the Region.	3-976
Table 3.20-5.	Keno Impoundment/Lake Ewauna Developed Recreation Facilities.	3-978
Table 3.20-6.	Acceptable Flow Ranges for Various River-Based Activities for Reaches of the Klamath River.	3-979
Table 3.20-7.	Hell's Corner Reach Developed Recreation Facilities.	3-985
Table 3.20-8.	River-Based Recreation Opportunities in the Middle Klamath River, Between Iron Gate Dam and the Confluence with the Trinity River.	3-987
Table 3.20-9.	Estimated Number of Recreational Salmon Angler Days and Chinook Salmon Harvest on the Klamath River, 2001–2015.	3-989
Table 3.20-10.	Estimated Number of Recreational Steelhead Angler Days on the Klamath River (excluding the Trinity River), 2003–2008.	3-990
Table 3.20-11.	J.C. Boyle Reservoir Developed Recreation Facilities.	3-991
Table 3.20-12.	Copco No. 1 Reservoir Developed Recreation Facilities.	3-992
Table 3.20-13.	Iron Gate Reservoir Developed Recreation Facilities.	3-993
Table 3.20-14.	Comparison of 1981 Flows to the Acceptable Range for Whitewater Boating and Fishing.	3-998
Table 3.20-15.	Estimated Abundance of Fish Species at the 1981 Wild and Scenic River Designation.	3-1001
Table 3.21-1.	Hazards-related Discussion Found Elsewhere in this EIR.	3-1029
Table 3.21-2.	Hazardous Materials Spill Report.	3-1034
Table 3.21-3.	2010–2015 Battalion 2 Fire Causes.	3-1038
Table 3.21-4.	2010–2018 Incident Information.	3-1038
Table 3.22-1.	Local and Regional Access Roads within the Traffic and Transportation Area of Analysis.	3-1059
Table 3.22-2.	Maximum Daily Volume Thresholds for Roadway Classes.	3-1062
Table 3.22-3.	Siskiyou Transportation and General Express Routes.	3-1066
Table 3.22-4.	Transportation-related Discussion Found Elsewhere in this EIR.	3-1068
Table 3.22-5.	Workforce Projections for Dam Removal for the Proposed Project.	3-1069
Table 3.22-6.	Vehicle Trips for the Import/Export of Materials for the Proposed Project.	3-1071
Table 3.23-1.	Existing Noise Levels at Residential Receptors near Construction Sites.	3-1086
Table 3.23-2.	Existing Daytime Peak Hour Leq along Proposed Haul and Commute Routes.	3-1087
Table 3.23-3.	Siskiyou County General Plan Maximum Allowable Noise Levels from Construction Equipment.	3-1090
Table 3.23-4.	Construction Operations, Equipment Types, and Their Noise Levels.	3-1092
Table 3.23-5.	Equipment Types for which Siskiyou County Maximum Allowable Noise Levels Exceed Typical Equipment Noise Levels.	3-1094
Table 3.23-6.	Summary of Noise Levels from Construction Activities Compared to Existing.	3-1095
Table 3.23-7.	Summary of Vibration from Construction Activities.	3-1099

Table 3.23-8.	Summary of Construction-Related Traffic Noise from Off-site Hauling and Construction Worker Commuting for the Proposed Project.....	3-1100
Table 3.24-1.	List of Planned, Approved, or Reasonably Foreseeable Projects that Would Potentially Result in Related or Cumulative Effects When Combined with the Proposed Project.	3-1106
Table 4.2-1.	KHSA Interim Measures Relevant to California Under the No Project Alternative Compared with Existing Conditions and the Proposed Project.....	4-19
Table 4.3-1.	Copco No. 1 Dam and Powerhouse Removal Under the Partial Removal Alternative.	4-76
Table 4.3-2.	Copco No. 1 Features to be Retained and New or Different Construction Activities Under the Partial Removal Alternative as Compared with the Proposed Project.	4-77
Table 4.3-3.	Copco No. 2 Dam and Powerhouse Removal Under the Partial Removal Alternative.	4-78
Table 4.3-4.	Copco No. 2 Features to be Retained and New or Different Construction Activities Under the Partial Removal Alternative as Compared with the Proposed Project.	4-80
Table 4.3-5.	Iron Gate Dam and Powerhouse Removal Under the Partial Removal Alternative.	4-81
Table 4.3-6.	Iron Gate Features ¹ to be Retained and New or Different Construction Activities Under the Partial Removal Alternative as Compared with the Proposed Project.	4-83
Table 4.3-7.	Uncontrolled Daily Emissions for the Partial Removal Alternative.....	4-90
Table 4.4-1.	Workforce Projections for Continued Operations with Fish Passage Alternative.	4-101
Table 4.4-2.	Summary of Peak Daily Emissions for Construction Activities for the Continued Operations with Fish Passage Alternative.	4-170
Table 4.5-1.	Estimated Construction Workforce for the Two Dam Removal Alternative.	4-185
Table 4.5-2.	Total Uncontrolled Daily Emissions from the Two Dam Removal Alternative.	4-232
Table 4.7-1.	Natural and Hatchery smolts and adult returns in Klamath River under the No Hatchery Alternative.....	4-302
Table 5.4-1.	Land Use Breakdown.	5-9
Table 5.4-2.	Single-family Homes on Copco No. 1 and Iron Gate Reservoirs.....	5-9

List of Figures

Figure ES-1.	Klamath Basin and Mainstem River Reaches.....	ES-2
Figure ES-2.	Proposed Project Boundary – California Portion.....	ES-3
Figure 2.2-1.	Regional Location.....	2-3
Figure 2.2-2.	Klamath Basin and Mainstem River Reaches.....	2-4
Figure 2.2-3.	Upper Klamath Basin Reaches.....	2-5
Figure 2.2-4.	Proposed Project Boundary.....	2-6
Figure 2.2-5.	Proposed Project Boundary – California Portion.....	2-7
Figure 2.3-1.	J.C. Boyle Dam and Associated Facilities.	2-10
Figure 2.3-2.	Example Flows in Peaking Reach downstream from J.C. Boyle Powerhouse	2-11

Figure 2.3-3.	Copco No. 1 Dam and Copco No. 2 Dam and Associated Facilities.	2-12
Figure 2.3-4.	Iron Gate Dam and Associated Facilities.	2-15
Figure 2.5-1.	Surrounding Land Ownership.	2-17
Figure 2.5-2.	Surrounding Siskiyou General Plan Zoning Classifications.	2-18
Figure 2.5-3.	Surrounding Land Cover.	2-19
Figure 2.7-1.	Distribution and Life-History Timing of Aquatic Species in the Klamath Basin. Source: CDM Smith.	2-29
Figure 2.7-2.	Copco No. 1 and Copco No. 2 Dam Removal Features and Limits of Work.	2-35
Figure 2.7-3.	Lower Klamath Project Access Overview.	2-48
Figure 2.7-4.	Iron Gate Dam Removal Features and Limits of Work.	2-50
Figure 2.7-5.	Copco No. 1 Reservoir Bathymetry.	2-55
Figure 2.7-6.	Iron Gate Reservoir Bathymetry.	2-56
Figure 2.7-7.	J.C. Boyle Reservoir Estimated Average Sediment Thickness and Sample Site Locations.	2-62
Figure 2.7-8.	Copco Reservoir Estimated Average Sediment Thickness and Sample Site Locations.	2-63
Figure 2.7-9.	Iron Gate Reservoir Estimated Average Sediment Thickness and Sample Site Locations.	2-64
Figure 2.7-10.	Examples of Restored Habitat Types and Components.	2-72
Figure 2.7-11.	Restoration Actions Identified for the Copco No. 1 Reservoir Area.	2-75
Figure 2.7-12.	Restoration actions identified for the Iron Gate Reservoir area.	2-76
Figure 2.7-13.	Iron Gate Hatchery Existing Features and Proposed Modifications.	2-79
Figure 2.7-14.	Bogus Creek Existing Flow and Proposed Flow Diversion to Support Production at Iron Gate Hatchery for Eight Years Following Dam Removal.	2-80
Figure 2.7-15.	Fall Creek Hatchery Existing Features and Proposed Modifications.	2-83
Figure 2.7-16.	Proposed Non-consumptive Fall Creek Hatchery Water Diversions to Support Production at the Fall Creek Hatchery Following Dam Removal, Historical Fall Creek Flow Measured at USGS 11512000 Downstream of the City of Yreka Diversion, Historical City of Yreka Diversion, and Fall Creek Minimum Flow Requirement Downstream of Compliance Point.	2-84
Figure 2.7-17.	Alignments for Yreka Waterline Replacement - Klamath River Crossing Conceptual Alternatives.	2-86
Figure 2.7-18.	Parcel B Lands – California Portion.	2-109
Figure 3.1-1.	Monthly Flow Exceedance Curves at Iron Gate Dam for the KBRA Flows and 2013 Joint Biological Opinion Flows.	3-10
Figure 3.1-2.	Monthly Flow Exceedance Curves at Keno Dam for the KBRA Flows and 2013 Joint Biological Opinion Flows.	3-11
Figure 3.2-1.	Klamath River Reaches Included in the Area of Analysis for Water Quality.	3-16
Figure 3.2-2.	General Seasonal Pattern of Thermal Stratification, Dissolved Oxygen Concentrations, and Algae Blooms in Relatively Deep, Productive Reservoirs in Temperate Climates, With Darker Green Shading in Surface Waters Representing a Higher Intensity of Algae Growth.	3-19

Figure 3.2-3	Simulated Hourly Water Temperature Downstream from Iron Gate Dam Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams.....	3-24
Figure 3.2-4	Vertical Profiles of pH and Dissolved Oxygen Measured During 2007 in Copco No 1. Reservoir at the Log Boom and Iron Gate Reservoir at the Log Boom.....	3-32
Figure 3.2-5.	Longitudinal Analysis of Summer Chlorophyll-a Concentrations from 2005–2007 Along the Klamath River.	3-36
Figure 3.2-6	Klamath River Estuary Sediment Sampling Site Locations.....	3-41
Figure 3.2-7.	Predicted Water Temperature at the Oregon-California State Line for the Klamath River TMDL Scenarios Similar to the Proposed Project and Existing Conditions.	3-75
Figure 3.2-8.	Simulated Hourly Water Temperature Downstream from Iron Gate Dam Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams.....	3-78
Figure 3.2-9.	Simulated Hourly Water Temperature Immediately Upstream of the Scott River Confluence Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams.	3-79
Figure 3.2-10.	Simulated Hourly Water Temperature Downstream from the Salmon River Confluence Based on Year 2004 for Existing Conditions Compared to Hypothetical Conditions without J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams.	3-79
Figure 3.2-11.	Suspended Sediment Concentrations Modeled at J.C. Boyle Reservoir Under the Proposed Project Assuming Typical Dry Hydrology.....	3-88
Figure 3.2-12.	Suspended Sediment Concentrations Modeled at J.C. Boyle Reservoir Under the Proposed Project Assuming Median Hydrology.....	3-89
Figure 3.2-13.	Suspended Sediment Concentrations Modeled at J.C. Boyle Reservoir Under the Proposed Project Assuming Typical Wet Hydrology.....	3-89
Figure 3.2-14.	Sediment Concentration Downstream of Copco No. 1 Reservoir During Drawdown Using SRH-2D v3 Under Three Hydrological Scenarios..	3-92
Figure 3.2-15.	SSCs Modeled Downstream from Iron Gate Dam Under the Proposed Project Assuming Typical Dry Hydrology.....	3-97
Figure 3.2-16.	SSCs Modeled Downstream from Iron Gate Dam Under the Proposed Project Assuming Median Hydrology.....	3-97
Figure 3.2-17.	SSCs Modeled Downstream from Iron Gate Dam Under the Proposed Project Assuming Typical Wet Hydrology.....	3-98
Figure 3.2-18.	Comparison of Annual TP and TN Concentrations from Iron Gate Dam to Turwar for June–October and July–September 2007–2008: Measured Current Conditions, Dams-Out Estimate using Calculated Percent Retention Rates by Reach, and Dams-Out Estimate using Percent Retention Rates Predicted by the Empirical Relationship between Reach Inflow Concentration and Retention.....	3-116

Figure 3.2-19. Predicted Dissolved Oxygen at the Oregon-California State Line for the Klamath River TMDL Scenarios Similar to the Proposed Project and Existing Conditions.....3-126

Figure 3.2-20. Predicted Dissolved Oxygen Downstream from Iron Gate Dam for the Klamath River TMDL Scenarios Similar to the Proposed Project and Existing Conditions.....3-129

Figure 3.2-21. Predicted Dissolved Oxygen Downstream from the Mainstem Confluence with the Shasta River for the Klamath River TMDL Scenarios Similar to the Proposed Project and Existing Conditions3-129

Figure 3.2-22. Predicted Dissolved Oxygen at Seiad Valley for the Klamath River TMDL Scenarios Similar to the Proposed Project and Existing Conditions.....3-130

Figure 3.2-23. Predicted Dissolved Oxygen Just Upstream of the Confluence with the Trinity River for the Klamath River TMDL Scenarios Similar to the Proposed Project and Existing Conditions.3-130

Figure 3.2-24. Predicted pH at the Oregon-California State Line for the Klamath River TMDL Scenarios Similar to the Proposed Project and the Modeled Existing Conditions3-132

Figure 3.2-25. Predicted Klamath River pH Immediately Downstream from Iron Gate Dam for the Klamath River TMDL Scenarios Similar to the Proposed Project and the No Project Alternative.....3-134

Figure 3.2-26. Predicted Klamath River pH upstream of the Scott River for the Klamath River TMDL Scenarios Similar to the Proposed Project and the No Project Alternative.....3-135

Figure 3.2-27. Summary of Exposure Pathway Conclusions for Inorganic and Organic Contaminants.....3-141

Figure 3.3-1. Study Reaches within the Area of Analysis for Aquatic Resources. 3-193

Figure 3.3-2. Lifecycle of *Ceratomyxa shasta*. Source: NMFS 2012.....3-240

Figure 3.3-3. Lifecycle of *Ichthyophthirius multifis*.3-245

Figure 3.3-4. Perry et al. Modeled Time Series of Average Daily Mean Water Temperature Predicted at Iron Gate Dam Under the Proposed Project and Existing Conditions.3-274

Figure 3.3-5. PacifiCorp Simulated hourly Water Temperatures Below Iron Gate Dam Based on a Dry Water Year for Existing Conditions Compared to the Proposed Project, and USEPA Water Temperature Criteria for Salmonid Growth and Migration.....3-275

Figure 3.4-1. Klamath River Reaches Included in the Area of Analysis for Phytoplankton and Periphyton.....3-391

Figure 3.4-2. Dense Summer and Fall Blue-green Algae Bloom in Iron Gate Reservoir with Higher Concentrations of Blue-green Algae Occurring Along the Shoreline of the Reservoir in Slower Moving Water.3-394

Figure 3.4-3. Blue-green Algae Bloom Along the Copco No. 1 Shoreline on 7/13/2005.3-394

Figure 3.4-4. Microscopic View of *Aphanizomenon flos-aquae* Showing it in Bundles and Individual Filaments3-396

Figure 3.4-5. *Aphanizomenon flos-aquae* bloom..3-397

Figure 3.4-6. Microscopic view of *Anabaena flos-aquae*, recently renamed *Dolichospermum flos-aquae*.....3-398

Figure 3.4-7. Microscopic views of *Microcystis aeruginosa*.....3-400

Figure 3.4-8.	Blue-green algae <i>Microcystis aeruginosa</i> bloom..	3-401
Figure 3.4-9	Lifecycle of <i>Ceratomyxa shasta</i>	3-405
Figure 3.4-10.	Blue-green Algae Transport From the Upper Klamath Lake into the Upper Klamath River..	3-406
Figure 3.4-11.	Total Phytoplankton Biovolume in mm ³ /L from June 1 to September 30 for the Years 2001 to 2004.	3-407
Figure 3.4-12.	<i>Microcystis aeruginosa</i> Biovolume in um ³ /mL from July to October for the Years 2001 to 2004.	3-409
Figure 3.4-13.	Biovolume and Percent Biovolume of <i>Microcystis aeruginosa</i> Above, Within, and Downstream from Copco No. 1 and Iron Gate Reservoirs During 2005.....	3-411
Figure 3.4-14.	Relative Proportion of the <i>Microcystis aeruginosa</i> Population Comprised of Two <i>Microcystis aeruginosa</i> Genetic Types at Sites in the Klamath River and Reservoirs.	3-412
Figure 3.4-15.	<i>Microcystis aeruginosa</i> Density and Microcystin Concentration Variations Between Open Water and Along the River Edge in the Klamath River.	3-416
Figure 3.4-16.	<i>Microcystis aeruginosa</i> Cell Density in the Klamath River Estuary Between 2010 and 2015.....	3-421
Figure 3.5-1.	Area of Analysis for Terrestrial Resources.	3-456
Figure 3.5-2.	Historical Vegetation Types in Copco No. 1 and Copco No. 2 Reservoirs.....	3-469
Figure 3.5-3.	Historical Vegetation Types in Iron Gate Reservoir.	3-470
Figure 3.5-4.	Current Vegetation Types within a 300-foot Buffer of Copco No. 1 and Copco No.2 Reservoirs.	3-471
Figure 3.5-5.	Current Vegetation Types within a 300-foot Buffer of Iron Gate Reservoir.....	3-472
Figure 3.5-6.	Bighorn Sheep 2017 Collar Data for the Klamath Basin.	3-477
Figure 3.5-7.	Western Pond Turtle Suitable Basking and Nesting Habitat in Green and Purple and Potential Aquatic Overwintering Habitats in Water Depths of Less Than Two Meters in Yellow at Copco No. 1 Reservoir	3-565
Figure 3.5-8.	Western Pond Turtle Suitable Basking and Nesting Habitat in Green and Purple and Potential Aquatic Overwintering Habitats in Water Depths of Less Than Two Meters in Yellow at Iron Gate Reservoir.....	3-566
Figure 3.6-1.	Flood Hydrology Area of Analysis.....	3-588
Figure 3.6-2.	Mean Daily Flows (cubic feet per second) for the Klamath River at the USGS Gage at Keno for Three Different Water Years, Generally Representing Drier, More Normal, and Wetter Conditions.	3-592
Figure 3.6-3.	Mean Daily Flows (cubic feet per second) for the Klamath River at the USGS Gage Near Fall Creek for Three Different Water Years, Generally Representing Drier, Normal, and Wetter Conditions.	3-594
Figure 3.6-4.	Comparison of Mean Daily Flows Recorded at Keno Historically with More Recent Conditions.....	3-595
Figure 3.6-5.	Mean Monthly Precipitation Across the Klamath River Watershed.....	3-597
Figure 3.6-6.	Daily Average Flows at Five USGS Stream Gages on the Klamath River.....	3-599

Figure 3.6-7.	Discharge for the Klamath River at Keno Dam, 1961–2015.....	3-602
Figure 3.6-8.	Discharge for Klamath River Downstream from J.C. Boyle Powerhouse, 1959–2015.....	3-605
Figure 3.6-9.	Discharges for Klamath River Downstream from Iron Gate Dam, 1963–2015.....	3-608
Figure 3.6-10.	Discharges for Klamath River Downstream from Iron Gate Dam, 2009–2015.....	3-608
Figure 3.6-11.	Discharge for Klamath River at Seiad Valley, 1963–2015.....	3-614
Figure 3.6-12.	Discharge for Klamath River at Orleans, 1963–2015.....	3-615
Figure 3.6-13.	Daily Inflow from the Trinity River at the Confluence with the Klamath River, 1963–2015.....	3-619
Figure 3.6-14.	Discharge for Klamath River at Klamath, 1963–2015.....	3-621
Figure 3.7-1.	Groundwater Area of Analysis.....	3-640
Figure 3.7-2.	Regional Groundwater Map.....	3-642
Figure 3.7-3.	Locatable Wells within 2.5 Miles of Copco No. 1 and Copco No. 2 Reservoirs and Cross-section Locations.....	3-646
Figure 3.7-4.	Copco No. 1 Reservoir, Cross-Section A-A Depicting Groundwater Elevations and Stratigraphy Characterized in Wells.....	3-648
Figure 3.7-5.	Copco No. 1 Reservoir, Cross-Section B-B Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-649
Figure 3.7-6.	Copco No. 1 Reservoir, Cross-Section C-C Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-650
Figure 3.7-7.	Copco No. 1 Reservoir, Cross-Section D-D Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-651
Figure 3.7-8.	Copco No. 1 Reservoir, Cross-Section M-M Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-652
Figure 3.7-9.	Locatable Wells within 2.5 Miles of Iron Gate Reservoir and Cross-section Locations.....	3-655
Figure 3.7-10.	Locatable Wells within 2.5 Miles of Iron Gate Reservoir and Cross-section Locations.....	3-656
Figure 3.7-11.	Iron Gate Reservoir, Cross-Section E-E Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-657
Figure 3.7-12.	Iron Gate Reservoir, Cross-Section G-G Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-658
Figure 3.7-13.	Iron Gate Reservoir, Cross-Section H-H Depicting Groundwater Conditions and Stratigraphy Characterized in Wells.....	3-659
Figure 3.8-1.	Water Supply/Water Rights Area of Analysis.....	3-668
Figure 3.8-2.	Water Supply/Water Rights Area of Analysis includes portions of the Klamath Irrigation Project within California.....	3-669
Figure 3.9-1.	Area of Analysis for Air Quality.....	3-686
Figure 3.9-2.	Particulate Matter California Ambient Air Quality Standards Designations.....	3-693
Figure 3.10-1.	Area of Analysis for Greenhouse Gas Emissions.....	3-714
Figure 3.10-2.	California GHC Emission Sources, in Million Metric Tons of CO ₂ e.....	3-716

Figure 3.11-1.	Geomorphic Provinces in the Klamath Basin and Geomorphic Reaches within the Area of Analysis for Geology and Soils.	3-734
Figure 3.11-2.	Mineral Resource Sites within the Area of Analysis for Geology and Soils.	3-740
Figure 3.11-3.	Surficial geology at Copco No. 1 Reservoir	3-743
Figure 3.11-4.	Surficial geology at Iron Gate Reservoir.	3-745
Figure 3.11-5.	Particle Size Parameters from Pebble Counts of the Klamath River Bed Surface Downstream of Iron Gate Dam.	3-752
Figure 3.11-6.	Flow and Corresponding Return Period at which Bed Mobilization Begins Under Existing Conditions.	3-753
Figure 3.11-7.	J.C. Boyle Reservoir Estimated Sediment Thickness and Sample Site Locations.....	3-755
Figure 3.11-8.	Copco Reservoir Estimated Sediment Thickness and Sample Site Locations.....	3-756
Figure 3.11-9.	Iron Gate Reservoir Estimated Sediment Thickness and Sample Site Locations.....	3-757
Figure 3.11-10.	Results of slope failure analysis at Copco No. 1 Reservoir.....	3-764
Figure 3.11-11.	Volume of Sediment Eroded from Reservoirs in the Hydroelectric Reach During 2020 Drawdown Beginning in January.....	3-768
Figure 3.11-12.	Annual Predicted Sediment Delivery to the Pacific Ocean Under the Proposed Project and Existing Conditions by Water Year.	3-770
Figure 3.11-13.	Reach-Averaged Erosion in the Hydroelectric Reach during a Representative Wet Water Year.....	3-771
Figure 3.11-14.	Simulated Bed Composition from Copco No. 2 to Iron Gate Reservoirs during Two Successive Representative Dry Water Years During and After Drawdown.	3-771
Figure 3.11-15.	Reach Averaged Bed Elevation Change for Two Successive Wet, Median, or Dry Water Years Following Reservoir Drawdown.	3-772
Figure 3.11-16.	Simulated Bed Composition from Iron Gate Dam to Bogus Creek during Two Successive Dry Water Years Following Reservoir Drawdown	3-773
Figure 3.11-17.	Simulated D50 from Iron Gate Dam to Bogus Creek during Successive Wet, Median, and Dry Water Years Following Reservoir Drawdown	3-774
Figure 3.12-1.	Area of Analysis for Historical and Tribal Cultural Resources.	3-784
Figure 3.12-2.	Area of Analysis <i>Subarea 1</i> for Historical and Tribal Cultural Resources.....	3-785
Figure 3.12-3.	Area of Analysis <i>Subarea 2</i> for Historical and Tribal Cultural Resources.....	3-786
Figure 3.12-4.	Area of Analysis <i>Subarea 3</i> for Historical and Tribal Cultural Resources.....	3-787
Figure 3.12-5.	Area of Analysis <i>Subarea 4</i> for Historical and Tribal Cultural Resources.....	3-788
Figure 3.12-6.	Traditional Homelands of the Shasta People.....	3-795
Figure 3.12-7.	Discharge (flow) for Klamath River Downstream from J.C. Boyle Powerhouse, 1959–2015.....	3-829
Figure 3.13-1.	Area of Analysis for Paleontologic Resources.	3-862
Figure 3.13-2.	Late Cretaceous Hornbrook Formation mapped along the Klamath River.....	3-865
Figure 3.14-1.	Land Use and Planning Area of Analysis.....	3-876

Figure 3.14-2.	Surrounding Land Ownership.....	3-878
Figure 3.14-3.	Siskiyou County Land Use by Zoning Classification.	3-880
Figure 3.14-4.	Road Maintenance Responsibility within the Land Use and Planning Area of Analysis.....	3-884
Figure 3.15-1.	Agricultural and Forestry Resources Area of Analysis.	3-892
Figure 3.15-2.	Farmland classification along the Klamath River from Interstate 5 to the Oregon-California state line.	3-893
Figure 3.17-1.	Diagram of Typical Dry Hydrant System.....	3-917
Figure 3.17-2.	Locations of Potential Dry Hydrants for Copco No. 1 Reservoir.....	3-920
Figure 3.17-3.	Locations of Potential Dry Hydrants for Iron Gate Reservoir.....	3-921
Figure 3.19-1.	Aesthetics Area of Analysis.	3-935
Figure 3.19-2.	Views of Klamath River Downstream of Iron Gate Dam	3-942
Figure 3.19-3.	Views of Klamath River from Tree of Heaven River Access Boat Ramp	3-943
Figure 3.19-4.	Views of Klamath River from Stateline Takeout.....	3-944
Figure 3.19-5.	Views of Klamath River from Fishing Access #5.....	3-945
Figure 3.19-6.	Copco Lake at Mallard Cove Recreation Area during Low and High Pool Conditions.....	3-948
Figure 3.19-7.	Iron Gate Reservoir at Long Gulch Recreation Area during Low and High Pool Conditions.	3-949
Figure 3.19-8.	View of Copco No. 1 Powerhouse and Copco No. 2 Dam.	3-950
Figure 3.19-9.	Iron Gate Dam Before Removal and a Simulation of What the Facility Could Look Like After Dam Removal Except for Landform/Vegetation Restoration Details Which Were Not Known at the Time of Simulation.	3-962
Figure 3.19-10.	Copco No. 1 Dam Before Removal and a Simulation of what the Facility Could Look Like After Full Removal Except for Landform/Vegetation Restoration Details Were Not Known at the Time of Simulation.....	3-963
Figure 3.20-1.	Area of Analysis for Klamath River Corridor and Regional Recreation Opportunities.....	3-970
Figure 3.20-2.	California Stateline to Copco No. 1 Reservoir Recreation Area.	3-981
Figure 3.20-3.	Klamath Wild and Scenic River Corridor.....	3-996
Figure 3.21-1.	School Sites Near the Project Area.	3-1032
Figure 3.21-2.	Map of CALFIRE Fire Hazard Severity Zones with Proposed Project Boundary Depicted.....	3-1040
Figure 3.22-1.	Traffic and Transportation Area of Analysis.....	3-1058
Figure 3.23-1.	Proposed Project Access Overview.....	3-1080
Figure 3.23-2.	Primary Haul Routes from Lower Klamath Project Dam Sites.	3-1081
Figure 3.23-3.	Decibel Scale and Common Noise Sources.	3-1083
Figure 3.23-4.	Copco 1 and 2 Noise Receptor.....	3-1085
Figure 3.23-5.	Iron Gate Noise Receptors	3-1088
Figure 3.24-1.	Proposed Project Modeled Drawdown Flow Downstream of Iron Gate Dam and Iron Gate Reservoir Elevation for Representative Wet and Above Normal Water Year Types.....	3-1153
Figure 3.24-2.	Proposed Project Modeled Drawdown Flow Downstream of Iron Gate Dam and Iron Gate Reservoir Elevation for Representative Median and Dry Water Year Types.....	3-1154
Figure 4.5-1.	Simulated Hourly Water Temperature Downstream from Iron Gate Dam Based on Year 2004 for Current Conditions Compared to Hypothetical Conditions: without Iron Gate, Copco	

Figure 4.6-1. No. 1 and 2, and J.C. Boyle Dams and without Iron Gate and Copco No. 1 and 2 Dams.....4-188
 Simulated Hourly Water Temperature Downstream from Iron Gate Dam Based on Year 2004 for Current Conditions Compared to Hypothetical Conditions: without Iron Gate, Copco No. 1 and 2, and J.C. Boyle Dams and without Iron Gate and Copco No. 1 and 2 Dams.....4-252

List of Appendices

Appendix A Notice of Preparation and Scoping Report for Lower Klamath Project License Surrender Environmental Impact Report
 Appendix B Definite Plan
 Appendix C Water Quality Supporting Technical Information
 Appendix D Water Quality Environmental Effects Determination Methodology Supplemental Information
 Appendix E An Analysis of Potential Suspended Sediment Effects on Anadromous Fish in the Klamath Basin
 Appendix F An Analysis of Potential Bedload Sediment Effects on Anadromous Fish in the Klamath Basin
 Appendix G Vegetation Communities in the Area of Analysis
 Appendix H Rare Natural Communities Documented in the Project Vicinity
 Appendix I Terrestrial Scoping Quadrangles
 Appendix J Terrestrial Special-Status Plant and Wildlife Scoping List
 Appendix K Flood Hydrology
 Appendix L Groundwater
 Appendix M Water Supply/Water Rights
 Appendix N Air Quality Impacts
 Appendix O Greenhouse Gases
 Appendix P Shasta Nation Confidential Tribal Cultural Appendix
 Appendix Q Shasta Indian Nation Confidential Tribal Cultural Appendix
 Appendix R Aesthetics
 Appendix S Recreation Supporting Technical Information
 Appendix T Noise and Vibration Impact Analysis
 Appendix U Alternatives
 Appendix V KHSA 2012 EIS/EIR Section 3.12 Tribal Trust
 Appendix W Additional Information Incorporated by Reference