Office of
Energy
Projects

February 2022

FERC/EIS-0313D

Draft Environmental Impact Statement For Hydropower License Surrender and Decommissioning

Lower Klamath Project—FERC Project No. 14803-001
Klamath Hydroelectric Project—FERC Project No. 2082-063
Oregon and California

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Administration & Compliance
888 First Street N.E.
Washington, DC 20426

Cooperating Agencies:

U.S. Environmental
Protection Agency, Region 9

U.S. Army Corps of Engineers
San Francisco District

February 2022

COVER PHOTO CREDITS Clockwise from upper left:

“*Copco No. 1, General View, Looking Northeast*” (Construction Camp Above). Source: PacifiCorp Archives

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FERC/EIS-0313D

DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR HYDROPOWER LICENSE SURRENDER AND DECOMMISSIONING

Lower Klamath Project—FERC Project No. 14803-001
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February 2022

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
OFFICE OF ENERGY PROJECTS

To the Agency or Individual Addressed:

Reference: Draft Environmental Impact Statement

Attached is the environmental impact statement (EIS) for the proposed surrender and decommissioning of the Lower Klamath Project (P-14803-001), formerly part of the Klamath Hydroelectric Project (P-2082-063), located on the Klamath River in Klamath County in south-central Oregon, and in Siskiyou County in north-central California. The project occupies 395.09 acres of federal lands, other than for transmission line right-of-way, and 5.75 acres of federal lands for transmission line right-of-way. These federal lands are administered by the U.S. Department of the Interior's Bureau of Land Management (BLM). BLM administers the federal lands occupied by these projects under the Redding District Resource Management Plan.

This draft EIS documents the views of governmental agencies, non-governmental organizations, affected Native American Tribes, the public, the license applicants, and Federal Energy Regulatory Commission (Commission) staff. It contains the Commission's staff evaluations of the applicants' proposal and alternatives for surrendering/decommissioning the Lower Klamath Project.

Before the Commission makes a decision, it will take into account all concerns relevant to the public interest. The draft EIS will be part of the record from which the Commission will make its decision. This draft EIS was sent to the U.S. Environmental Protection Agency and made available to the public on or about March 4, 2022.

The U.S. Army Corps of Engineers and U.S. Environmental Protection Agency participated as cooperating agencies in the preparation of the draft EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the National Environmental Policy Act analysis. Although these agencies provided input to the conclusions and recommendations presented in this draft EIS, the agencies will present their own conclusions and recommendations in any respective record of decision or determination for the project.

A copy of the draft EIS is available for review on the Commission's website at http://www.ferc.gov using the "eLibrary" link. Enter the docket number excluding the last three digits in the docket number field to access the document. At this time, the Commission has suspended access to the Commission's Public Reference Room due to the Proclamation on Declaring a National Emergency Concerning the Novel Coronavirus Disease (COVID-19) Outbreak, issued by the President on March 13, 2020. For assistance, please contact FERC Online Support at FERCOnlineSupport@ferc.gov, (866) 208-3676 (toll free), or (202) 502-8659 (TTY).

Any person wishing to comment on the draft EIS may do so. Comments on the draft EIS must be filed on or before April 18, 2022. The Commission strongly encourages electronic filing. Please file comments using the Commission's eFiling system at http://www.ferc.gov/docs-filing/efiling.asp. Commenters can submit brief comments up to 6,000 characters, without prior registration, using the eComment system at http://www.ferc.gov/docs-filing/ecomment.asp. You must include your name and contact information at the end of your comments. For assistance, please contact FERC Online Support. In lieu of electronic filing, you may submit a paper copy. Submissions sent via the U.S. Postal Service must be addressed to: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street NE, Room 1A, Washington, DC 20426. Submissions sent via any other carrier must be addressed to: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 12225 Wilkins Avenue, Rockville, Maryland 20852. The first page of any filing should include docket numbers P-14803-001 and P-2082-063.

Attachment: Draft Environmental Impact Statement

COVER SHEET

a. Title:	License Surrender and Decommissioning for the Lower Klamath Project No. 14803-001, formerly part of the Klamath Hydroelectric Project (P-2082-063).
b. Subject:	Draft Environmental Impact Statement (EIS)
c. Lead Agency:	Federal Energy Regulatory Commission
d. Cooperating Agencies:	U.S. Army Corps of Engineers Environmental Protection Agency
e. Deadline to Submit Comments:	To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments on or before April 18, 2022.
f. Abstract:	On November 17, 2020, the Klamath River Renewal Corporation and PacifiCorp filed an amended application for surrender of license and removal of project works for the Lower Klamath Project, located on the Klamath River in Klamath County in south-central Oregon, and in Siskiyou County in north-central California. The project occupies 395.09 acres of federal lands, other than for transmission line right-of-way, and 5.75 acres of federal lands for transmission line right-of-way. These federal lands are administered by the U.S. Department of the Interior's, Bureau of Land Management. The project consists of four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) that the licensees propose to surrender and decommission. These developments, with a combined generation capacity of 163 megawatts, were formerly part of the Klamath Hydroelectric Project No. 2082. After taking mitigation into account, the project would have some significant adverse effects, but would provide many significant benefits including the protection and restoration of anadromous fisheries that are of vital importance to the Tribes. The staff's recommendation is for approval of the license surrender as proposed with additional staff recommendations.
g. Contact:	Diana Shannon Ecologist Federal Energy Regulatory Commission Office of Energy Projects 888 First Street, NE Washington, D.C. 20426 (202) 502-6136
h. Transmittal:	This draft EIS evaluating the proposed surrender and decommissioning of the Lower Klamath Project, formerly part of the Klamath Hydroelectric Project, will be made available for public comment on or about March 4, 2022, as required by the National Environmental Policy Act of 1969 (40 C.F.R. pts. 1500–1508 (2021)), the Commission's Regulations Implementing the National Environmental Policy Act (18 C.F.R. pt. 380), the U.S. Army Corps of Engineers' NEPA Implementation Procedures for the Regulatory Program (33 C.F.R. pt. 230; 33 C.F.R. pt. 325, appendix B), and the Council on Environmental Quality's regulations in effect as of September 14, 2020 (40 C.F.R. pts. 1500–1508).

FOREWORD

The Federal Energy Regulatory Commission (Commission), pursuant to the Federal Power Act (FPA)[1] and the U.S. Department of Energy Organization Act[2] is authorized to issue licenses for up to 50 years for the construction and operation of non-federal hydroelectric developments subject to its jurisdiction, on the necessary conditions:

> That the project adopted . . . shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 4(e) . . . . [3]

Section 6 of the FPA allows licensees to voluntarily surrender existing licenses to the Commission and cease operating their facilities. The Commission may require such other conditions not inconsistent with the FPA as may be found necessary to provide for the various public interests to be served by the project.[4] Compliance with such conditions during the license surrender period is required. The Commission's Rules of Practice and Procedure allow any person objecting to a licensee's compliance or noncompliance with such conditions to file a complaint noting the basis for such objection for the Commission's consideration.[5]

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[1] 16 U.S.C. §§ 791(a)-825r, as amended by the Electric Consumers Protection Act of 1986, Pub. L. 99-495 (1986), the Energy Policy Act of 1992, Pub. L. 102-486 (1992), and the Energy Policy Act of 2005, Pub. L. 109-58 (2005).

[2] Pub. Law No. 95-91, 91 Stat. 556 (1977).

[3] 16 U.S.C. § 803(a).

[4] 16 U.S.C. § 803(g).

[5] 18 C.F.R. § 385.206 (2021).

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ACRONYMS AND ABBREVIATIONS

µg/l	micrograms per liter
7DADM	7-day average daily maximum
AADT	average annual daily traffic
ACEC	Area of Critical Environmental Concern
ADI	area of direct impacts
Advisory Council	Advisory Council on Historic Preservation
AIRs	additional information requests
APE	area of potential effects
AQ	air quality
BA	biological assessment
BiOp	biological opinion
BLM	U.S. Department of the Interior, Bureau of Land Management
BMI	benthic macroinvertebrates
BMPs	best management practices
BOD	biological oxygen demand
B.P.	Before Present
ºC	degrees Celsius
CAL FIRE	California Department of Forestry and Fire Protection
California DFG	California Department of Fish and Game (now California Department of Fish and Wildlife)
California DFW	California Department of Fish and Wildlife
California DWR	California Department of Water Resources
California Water Board	California State Water Resources Control Board
CARB	California Air Resources Board
CEII	critical energy infrastructure
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Commission	Federal Energy Regulatory Commission

CO2	carbon dioxide
COPC	chemicals of potential concern
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
dB	decibel
dBA	A-weighted decibel
DPS	distinct population segment
EDRRA	Evaluation of Dam Removal and Restoration of Anadromy
EFH	Essential Fish Habitat
EIR	environmental impact report
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
ºF	degrees Fahrenheit
FERC	Federal Energy Regulatory Commission
FMP	Fire Management Plan
Forest Service	U.S. Department of Agriculture, Forest Service
FPA	Federal Power Act
FR	Federal Register
FWS	U.S. Department of the Interior, Fish and Wildlife Service
GHG	greenhouse gas
GIS	geographic information system
HPMP	Historic Properties Management Plan
hydroelectric reach	Klamath River from the upstream end of J.C. Boyle Reservoir to the base of Iron Gate Dam
Hz	Hertz
Interior	U.S. Department of the Interior
KBRA	Klamath Basin Restoration Agreement
KHSA	Klamath Hydroelectric Settlement Agreement
KMZ	Klamath Management Zone
KRRC	The Klamath River Renewal Corporation
lbs/day	pounds per day
Leq	equivalent sound level

LiDAR	Light Detection and Ranging
Lmax	maximum sound level
LOESS	locally weighted scatterplot smoothing
Lower Klamath River	Klamath River from Iron Gate Dam downstream to the Pacific Ocean
mg/l	milligrams per liter
m	meter
mm	millimeter
MOA	Memorandum of Agreement
mph	miles per hour
msl	mean sea level
MTCO2e	metric tons of carbon dioxide equivalents
MW	megawatt
MWh	megawatt-hour
NAAQS	National Ambient Air Quality Standards
National Register	National Register of Historic Places
NCRWQB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act of 1969
NGO	non-governmental organization
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOx	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
NVCP	Noise and Vibration Control Plan
NWSRS	National Wild and Scenic Rivers System
O&M	Operation and Maintenance
ONHP	Oregon Natural Heritage Program
Oregon DEQ	Oregon Department of Environmental Quality
Oregon DFW	Oregon Department of Fish and Wildlife
Oregon WRD	Oregon Water Resources Department
ORV	outstandingly remarkable values
PA	Programmatic Agreement
PAHs	polycyclic aromatic hydrocarbons

PBFs	physical and biological factors
PCBs	polychlorinated biphenyls
PEA	ß-phenylethyl alcohol
PFMC	Pacific Fisheries Management Council
PM	particulate matter
ppt	parts per thousand
RAMP	Reservoir Area Management Plan
REA	ready for environmental analysis
Reclamation	U.S. Bureau of Reclamation
RM	river mile
RSL	regional screening level
RV	recreational vehicle
SHPO	State Historic Preservation Officer
SD1	Scoping Document 1
SEF	Sediment Evaluation Framework
SL	screening level
SLV	screening-level value
SONCC	Southern Oregon/Northern California Coasts
SRH-1D	Sedimentation and River Hydraulics – One Dimensional Model
SSC	suspended sediment concentration
SVOC	semi-volatile organic compound
SWPPP	Stormwater Pollution Prevention Plan
TCP	traditional cultural properties
TEQ	toxic equivalency
TMDL	total maximum daily load
TOC	total organic carbon
tons/yr	tons per year
TRD	Trinity River Diversion
TWMP	Terrestrial and Wildlife Management Plan
UKOA	Upper Klamath Outfitters Association
USGCRP	United States Global Change Research Program
U.S.C.	United States Code
USGS	U.S. Department of the Interior, Geological Survey
v/c	volume to capacity

VES	Visual Estimation Surveys
VOC	volatile organic compounds
VRM	visual resource management
VRMC	visual resource management classification
WNS	white-nose syndrome
WQC	water quality certification
WY	water year
YTEP	Yurok Tribal Environmental Program

EXECUTIVE SUMMARY

On November 17, 2020,[6] the Klamath River Renewal Corporation (KRRC) and PacifiCorp filed an amended application[7] for surrender of license and removal of project works for the Lower Klamath Project with the Federal Energy Regulatory Commission (Commission or FERC). The filing includes a Memorandum of Agreement entered into by PacifiCorp, KRRC, the Karuk Tribe, the Yurok Tribe, and the States of California and Oregon to implement the amended Klamath Hydroelectric Settlement Agreement (KHSA),[8] which established a process for the timely decommissioning of project facilities. The application includes revised exhibits, a revised construction schedule, revised costs, and a revised environmental report. The November 17, 2020, filing informed the Commission that KRRC and PacifiCorp are not accepting co-licensee status, as approved by the Commission's July 16, 2020, order, and would be filing a new transfer application by January 16, 2021. A new application to transfer the Lower Klamath Project from PacifiCorp to KRRC, the State of Oregon, and the State of California as co-licensees was filed on January 13, 2021, and approved by the Commission on June 17, 2021, under P-14803-004.[9]

The Lower Klamath Project is located on the Klamath River in Klamath County in south-central Oregon, and in Siskiyou County in north-central California. It occupies 395.09 acres of federal lands, other than for transmission line right-of-way, and 5.75

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[6] Underlined dates shown in blue text include a hyperlink to the document filed on eLibrary on that date.

[7] KRRC filed the original Application for Surrender of License for Major Project and Removal of Project Works on September 23, 2016.

[8] The amended KHSA was signed by representatives from PacifiCorp, KRRC, the Department of the Interior, National Marine Fisheries Service (NMFS), the State of California, California Department of Fish and Wildlife (DFW), California Natural Resources Agency, the State of Oregon, Oregon Department of Environmental Quality (DEQ), Oregon DFW, Oregon Water Resources Department, the Karuk Tribe, the Yurok Tribe, Humboldt County (California), American Rivers, California Trout, Institute for Fisheries Resources, Northern California/Nevada Council Federation of Fly Fishers, Pacific Coast Federation of Fishermen's Associations, Sustainable Northwest, and Trout Unlimited.

[9] The transfer would not be effective unless the Commission approves the license surrender and the transferees accept the license for the Lower Klamath Project.

acres of federal lands for transmission line right-of-way.[10] These federal lands are administered by the U.S. Department of the Interior's (Interior) Bureau of Land Management (BLM). The project consists of four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) that the licensees propose to surrender and decommission. These developments were formerly part of the Klamath Hydroelectric Project No. 2082. The developments have a combined installed capacity of 163 megawatts (MW), and currently generate approximately 686,000 megawatt-hours (MWh) annually.

The Commission's staff prepared this environmental impact statement (EIS) to assess the environmental effects associated with the proposed action as required under the National Environmental Policy Act of 1969 (NEPA), as amended. The analysis was based on information provided by KRRC and PacifiCorp and further developed from previous analyses of the effects of dam removal including EISs and environmental impact reports (EIRs) prepared by FERC (2007), Interior and California Department of Fish and Game (California DFG)(2012), and the California State Water Resources Control Board (California Water Board)(2020a); reports prepared to support the secretarial determination on dam removal and the overview report prepared by Interior and the National Marine Fisheries Service (NMFS)(2013); water quality certifications (WQCs) and supporting documents issued by the California Water Board and Oregon DEQ; literature searches; information from public scoping, and other information filed on the project record for the Klamath Hydroelectric Project (P-2082) and the Lower Klamath Project (P-14803), including comments filed on the record from federal, state, and local agencies as well as comments from individual members of the public. The purpose of this EIS is to provide a full and fair discussion of any significant environmental effects of the proposed action and the no-action alternative and inform FERC decision-makers, the public, and the permitting agencies of reasonable alternatives that would avoid or minimize adverse effects or enhance the quality of the human environment.

The Commission is the lead agency for the preparation of this EIS. The U.S. Army Corps of Engineers (Corps) and U.S. Environmental Protection Agency (EPA) participated in the NEPA review as cooperating agencies.[11]

Mandatory Conditions

Final section 401 WQCs were issued by the State of Oregon on September 7, 2018, and by the California Water Board on April 7, 2020. Biological opinions (BiOps)

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[10] Order Amending License and Deferring Consideration of Transfer Application, PacifiCorp, 162 FERC ¶ 61,236 (2018). We note here this acreage differs from both the acreage identified in the amended surrender application, filed on November 17, 2020, as well as the federal lands identified in recent exhibit drawings filed with the Commission on December 16, 2021.

[11] A cooperating agency is an agency that has jurisdiction over all or part of a project area and must make a decision on a project, and/or an agency that provides special expertise with regard to environmental or other resources.

on the proposed action, including terms and conditions necessary to implement reasonable and prudent measures,[12] were filed by NMFS on December 20, 2021, and the U.S. Department of the Interior, Fish and Wildlife Service (FWS) on December 22, 2021. Conditions included in the WQCs and BiOps are final and mandatory.

Proposed Action

KRRC proposes to decommission and remove most project facilities, as described in the revised Definite Plan, which was filed as appendix A-1 of its November 17, 2020, amended surrender application. Detailed engineering specifications were filed on February 26, 2021.[13] KRRC also proposes to implement 16 management plans that specify the sequence of procedures that would be used to draw down the four reservoirs; remove the dams and associated facilities; restore lands currently occupied by the dams, reservoirs, and other facilities; improve access for salmon to historical and existing habitat; and minimize adverse effects on environmental resources. KRRC filed[14] revised management plans, reflecting the results of ongoing consultation with various agencies on December 14, 2021. A list of these plans, many of which include multiple subplans, is provided in table ES-1. Under KRRC's proposal (proposed action), removal of the project facilities would require 20 months, followed by at least 5 years of restoration and monitoring activities.

Table ES-1. Management plans and subplans proposed for implementation by KRRC (Source: staff)

Management Plan	Subplan(s)
Reservoir Drawdown and Diversion Plan (Exhibit K)	Appendix A - California Reservoir Drawdown and Diversion Plan Appendix B - California Slope Stability Monitoring Plan Appendix C - Oregon Reservoir Drawdown and Diversion Plan

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[12] Reasonable and prudent measures are actions that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 C.F.R. 402.02).

[13] The detailed engineering specifications were filed as CEII (critical energy infrastructure information) and are not accessible through eLibrary.

[14] Use of the word "filed" in this draft EIS indicates that the document was filed on the public record for the project using FERC's eLibrary system.

Management Plan	**Subplan(s)**
Construction Management Plan (Exhibit B)	Appendix A - Oregon Traffic Management Plan Appendix B - California Traffic Management Plan Appendix C - Emergency Response Plan Appendix D - Use and Occupancy Plan for Bureau of Land Management Lands Appendix E - Construction Camp Plan
Health and Safety Plan (Exhibit E)	Appendix B - Site Specific Health and Safety Plan Appendix C - Public Safety Plan
Remaining Facilities Plan (Exhibit I)	Appendix A - California Remaining Facilities Plan Appendix B - Oregon Remaining Facilities and Operations Plan
Erosion and Sediment Control Plan (Exhibit C)	Appendix A - Oregon Erosion and Sediment Control Plan
Waste Disposal and Hazardous Materials Management Plan (Exhibit N)	Appendix A - California Hazardous Materials Management Plan Appendix B - California Waste Disposal Plan Appendix C - Oregon Waste Disposal and Hazardous Materials Management Plan Appendix D - Oregon Spill Prevention, Control, and Countermeasure Plan
Water Quality Monitoring and Management Plan (Exhibit O)	Appendix A - Oregon Water Quality Management Plan Appendix B - California Water Quality Monitoring Plan Appendix C - Quality Assurance Project Plan
Sediment Deposit Remediation Plan (Exhibit L)	Appendix A - California Sediment Deposit Remediation Plan Appendix B - Del Norte Sediment Management Plan

Management Plan	**Subplan(s)**
Aquatic Resources Management Plan (Exhibit A)	Appendix A - Spawning Habitat Availability Report and Plan Appendix B - California AR-6 Adaptive Management Plan-Suckers Appendix C - Fish Presence Monitoring Plan Appendix D - Tributary-Mainstem Connectivity Plan Appendix E - Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan Appendix F - Oregon AR-6 Adaptive Management Plan-Suckers
Hatcheries Management and Operations Plan (Exhibit D)	Appendix C - Water Quality Monitoring and Protection Plan
Reservoir Area Management Plan (Exhibit J)	Appendices B through M provide discussions of a variety of associated topics
Terrestrial and Wildlife Management Plan (Exhibit M)	Appendix A - California Terrestrial and Wildlife Management Plan Appendix B - Oregon Terrestrial and Wildlife Management Plan
Recreation Facilities Plan (Exhibit H)	No subplans
Historic Properties Management Plan (Exhibit F - filed February 26, 2021)	Appendix C - Monitoring and Inadvertent Discovery Plan Appendix D - Looting and Vandalism Prevention Plan
Water Supply Management Plan (Exhibit P)	Appendix A - California Water Supply Management Plan Appendix B - California Public Drinking Water Management Plan Appendix C - Oregon Groundwater Well Management Plan Appendix D - Fire Management Plan
Interim Hydropower Operations Plan (Exhibit G)	Appendix A - Agreement for Operation and Maintenance

Note: The current versions of the plans were filed on December 14, 2021, except for the HPMP, which was not included in that filing; KRRC intends to file a revised version of the HPMP by March 31, 2022.

Alternatives Considered

This draft EIS analyzes the effects of project decommissioning and recommends conditions for surrender of the project license. We consider three alternatives: (1) the proposed action (KRRC and PacifiCorp's proposal); (2) the proposed action with staff modifications; and (3) no action (continued project operation with no changes[15]). Other alternatives submitted during scoping that we do not consider to be reasonable are discussed in appendix A, *Alternatives, Information, and Analyses Submitted during Scoping*.

Proposed Action with Staff Modifications

Under the proposed action with staff modifications, the project would be decommissioned as proposed by KRRC and PacifiCorp with the inclusion of all of their proposed mitigation measures. In addition, staff would include the conditions from the WQCs issued by the California Water Board and Oregon Department of Environmental Quality (Oregon DEQ) and the BiOps issued by NMFS and FWS and the following additional recommendations:

- Require that all consultations, final management plans, delineations, pre-drawdown mitigation measures, agreements, and wetland delineations be completed before any surface disturbance commences.
- Modify the Construction Management Plan to include measures AQ-1 through AQ-5 to minimize effects of deconstruction activities on air quality, measure ENR-1 to purchase carbon offsets, and the Noise and Vibration Control Plan. These measures, which KRRC has agreed to implement, are described in section 2.1.3.
- Specify measures in the California Slope Stability Monitoring Plan (a subplan of the Reservoir Drawdown and Diversion Plan) about repairs and replacements of private property to be implemented if any reported structural damage to properties abutting Copco No. 1 Reservoir is found to be related to the drawdown, following monitoring and inspection.
- Extend the planned Light Detection and Ranging (LiDAR) monitoring of the reservoir and embankment rim for six months after completion of the drawdown—at a reduced survey interval of once per month and limited to 1,780-linear-foot long segments of the Copco No. 1 Reservoir rim identified to be potentially affected by slope failure. The rationale for limiting this measure to Copco No. 1 Reservoir is discussed in section 3.1, *Geology and Soils*.

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[15] However, no entity is seeking approval to continue operating the project.

- Modify the Del Norte Sediment Management Plan (a subplan of the Sediment Deposit Remediation Plan) to require that KRRC reimburse Del Norte County for any increase in the cost of maintaining the Klamath River boat ramps in an operable condition that is attributable to sediment deposited as a result of the proposed action.
- Modify the Aquatic Resource Management Plan to include translocation of freshwater mussels as modified in KRRC's October 10, 2018, letter to the California Water Board.
- Modify the Hatchery Management and Operations Plan to clarify whether and when ownership would be transferred to California Department of Fish and Wildlife (California DFW) or another entity.
- Modify the Reservoir Area Management Plan to include two periods of vegetation sampling each year. One sampling period should occur in late spring/early summer as proposed. The second sampling period should occur in late fall, but prior to the onset of woody vegetation dormancy.
- Modify the Reservoir Area Management Plan to include detailed maps that identify areas of grading, water runoff control measures, planting, seeding, mulching, and irrigation areas. These maps should include final limits of work zones, delineated wetlands within areas of proposed disturbance, the reservoir footprints, the J.C. Boyle canal and scour hole, and all areas of temporary disturbance where revegetation activities would occur.
- Develop an eagle conservation plan that includes occupancy and nest productivity surveys; timing restrictions on vegetation clearing and construction noise; monitoring of active eagle nests; coordination with FWS, California DFW, and Oregon Department of Fish and Wildlife (Oregon DFW); and reporting as described in California Water Board WQC condition 17.
- Modify the Oregon and California Terrestrial Wildlife Management Plans to include: (1) additional criteria for the potential removal of structures containing bats between April 16 and August 31. If it is necessary to remove structures during this period, conduct surveys to determine whether the structure is occupied as a maternity roost and prohibit removal of structures with maternity roosts. In the absence of maternity roosts, only remove structures when bats are active (i.e., at night) and when less than 0.5 inch of rain is predicted within the following 24 hours; (2) use of bat gates to close portal outlets, tunnels, and other water conveyance structures; and (3) require staff entering areas with potential bat activity to follow the National White-Nose Syndrome Decontamination Protocol (WNS Response Team, 2020).

- Modify the Recreation Facilities Plan to include: (1) removal or fragmentation of remaining construction-related debris in the river at the Sidecast Slide location and encroaching vegetation growth within the river channel in the Copco No. 2 bypassed reach that create hazardous boating conditions; (2) developing a plan for funding the construction and maintenance of the potential access sites described in the Recreation Facilities Plan to include, at a minimum, development of the planned access points that are within the existing reservoir footprints; and (3) consulting with Upper Klamath Outfitters Association (UKOA) to schedule construction activities and access restrictions to minimize adverse effects on whitewater boaters.
- Prepare a supplemented Historic Properties Management Plan (HPMP) in consultation with the Oregon State Historic Preservation Officer (SHPO), California SHPO, participating Tribes, and other appropriate agencies and organizations to address the following: (1) results of Phase II archaeological studies; (2) results of additional surveys and evaluations of historic structures; (3) results of the pending Traditional Cultural Properties studies and Tribal consultation; (4) identification of specific effects on all historic properties, and resource-specific measures to resolve effects determined to be adverse; and (5) additional items identified by the Commission requiring clarification.
- Modify the Reservoir Area Management Plan to incorporate the pre- and post-drawdown requirements for cultural resources inspections, surveys, evaluations, mitigation, and management as specified in the HPMP. Additionally, should ground conditions permit access for depositional sediment grading during reservoir drawdown, include provisions in the Reservoir Area Management Plan for a cultural monitor to be present to ensure that if any cultural resources are identified on the historical pre-dam ground surface, grading stops and the measures outlined in appendix C, section 7.1 of the HPMP (Monitoring and Inadvertent Discovery Plan, Procedures) are closely followed within 48 hours. These protocols include: (1) notifying the team supervisor of any discovery of cultural or archaeological resources, (2) suspending work within 100 feet of the find in all non-dewatering situations, (3) completing an initial assessment of the discovery, (4) notifying the Commission, SHPO, and participating Tribes of the find, and (5) consulting with these entities to determine and implement agreed-upon treatment measures for discoveries that are potentially eligible for listing on the National Register.
- Modify the Sediment Deposit Remediation Plan, the Water Supply Management Plan, the Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services to include a public outreach component that specifically addresses communication with environmental justice communities.

- Modify the Fire Management Plan (a subplan of the Water Supply Management Plan) and the Construction Management Plan in consultation with the California Department of Forestry and Fire Protection, Oregon Department of Forestry, and the Fire Safe Council of Siskiyou County to address the following issues raised by stakeholders:
    1. Insufficient stream depth and pump lift requirements at proposed locations for dry fire hydrants
    2. Location of dry fire hydrants on blind corners
    3. Lack of suitable locations for fire trucks to turn around near dry fire hydrants
    4. Lack of any proposed river access boat ramps within the Copco No. 1 Reservoir area
    5. Identification of the entity that would be responsible for storage, deployment, and refill of portable water tanks
    6. The potential need to install additional water sources (such as dip tanks) to address the potential filling of existing dip sites by gravel transported from the reservoirs.

No-action Alternative

Under the no-action alternative, the Lower Klamath Project would continue to operate as it does today, under the terms and conditions of the existing annual license. There would be no disturbance of existing environmental conditions at the site, and there would be no new environmental protection, mitigation, or enhancement measures. The project dams would remain in place.

The no-action alternative would not address the water quality and disease issues which, when combined with the ongoing trend of increased temperatures, poses a substantial risk to the survival of one of the few remaining Chinook salmon populations in California that still sustain important commercial, recreational, and Tribal fisheries.

If hydropower generation were to continue under the no-action alternative, the Commission's relicensing proceeding would resume, and the Commission would ultimately have to determine whether and under what conditions to relicense the project. The current licensee, PacifiCorp, has decided not to seek a license for the project and no other entity has come forward to continue operating the project for hydropower generation. Until it is relicensed, the project features would be maintained and operated by KRRC and the states, assuming acceptance of the transfer of the license, or by PacifiCorp, the current licensee. Ultimately, the project would have to be either relicensed or decommissioned because perpetual annual licensing is not authorized under the FPA.

Public Involvement and Areas of Concern

Before KRRC and PacifiCorp's Surrender Application

Since the late 1990s, the potential removal of the Lower Klamath Project dams has been the subject of environmental studies leading to multiple federal and state agency regulatory analysis under the National Environmental Policy Act of 1969, section 401 of the Clean Water Act[16] (CWA), and the California Environmental Policy Act to consider and disclose the effects of relicensing or decommissioning of the J.C. Boyle, Copco No. 1, Copco No. 2 and Iron Gate Developments. This environmental analysis through the 2000s contributed to the KHSA[17] (2010, as amended in 2016), in which state and federal agencies, PacifiCorp, and many stakeholders agreed on a process to decommission these four developments.

The KHSA included over 20 interim measures that have been implemented by PacifiCorp since 2010 to assess and address environmental conditions and improve fisheries prior to dam removal. The KHSA defines the interim period as the period between the date that the KHSA was originally executed (February 18, 2010) and the decommissioning of the dams, which would occur once there has been a physical disconnection of the facility from PacifiCorp's transmission grid. The KHSA measures include funding for coho salmon habitat restoration and acquisition, measures to improve water quality, hatchery operations, studies and pilot projects, and removal of several diversion dams on tributaries to the Klamath River. The KHSA interim measures and their completion status are described in section 2.5.

After KRRC and PacifiCorp's Surrender Application

On December 16, 2020, the Commission issued a notice of application for surrender of license, soliciting comments, motions to intervene, and protests. On June 17, 2021, the Commission issued a notice of intent to prepare an EIS for the proposed Lower Klamath Project surrender and removal, request for comments on

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[16] 33 U.S.C. § 1341(a)(1).

[17] In February 2010, PacifiCorp and 47 other parties, including the States of Oregon and California, Department of the Interior, and NMFS, executed the KHSA, which provided for the removal of the four developments after passage of federal legislation and approval by the Secretary of the Interior. Congress, however, did not enact the required legislation by January 2016, which triggered the KHSA's dispute resolution procedures. The Klamath Basin Restoration Agreement, which was executed concurrently with the KHSA and was part of the basis for federal legislation to remove the dams, expired on December 31, 2015. Following several dispute resolution meetings, the States of Oregon and California, Department of the Interior, U.S. Department of Commerce, and PacifiCorp proposed amendments to the Settlement Agreement that would eliminate the need for federal legislation and instead achieve dam removal through a license transfer and surrender process, which led to the 2016 amended KHSA.

environmental issues, schedule for environmental review, and notice of public virtual scoping sessions. The Commission issued a scoping document on the same day and conducted virtual scoping sessions on July 20, 21, and 22, 2021. Concerns raised and alternatives submitted by commenters during scoping are discussed in appendix A.

The primary issues associated with surrendering the project license are: potential effects on consumptive water uses, flooding, and navigation; effects on aquatic biota, including Chinook salmon, coho salmon, Endangered Species Act-listed suckers, other fish and wildlife species, and wildlife refuges; adequacy of measures proposed to restore vegetation on formerly inundated lands; effects on riverine and reservoir-based recreation; effects on local property owners due to effects on waterfront access, wells, firefighting/prevention, slope stability, reservoir aesthetics, and property values, as well as effects on traffic, emergency response times, air quality, and noise during deconstruction activities; effects of dewatering on culturally important sites; and socioeconomic effects on disadvantaged communities.

Effects of Proposed Action with Staff Modifications

Table ES-2 summarizes and contrasts the relative environmental effects of the no-action alternative with the proposed action with staff modifications alternative. The proposed action with staff modifications includes all of the conditions of section 401 WQCs issued by the California Water Board and Oregon DEQ, and the terms and conditions specified by NMFS and FWS in their BiOps to monitor incidental take, as well as several minor modifications to KRRC's proposed measures recommended by staff. KRRC has continued to consult with the relevant agencies to refine its management plans to address the requirements of the WQCs, and filed a revised version of the management plans on December 14, 2021, documenting changes made as an outcome of consultation to date. As a result of this consultation, in combination with the minor nature of staff's modifications, the overall effects and benefits of the proposed action with staff modifications are not substantively different from the proposed action. All the staff modifications would reduce the severity of effects for some resources, particularly, freshwater mussels, bats, and fire management.

The proposed action would not include salvage and transport of freshwater mussels to suitable habitat that would not be affected by increases in suspended sediments and sediment deposition. Staff recommends such transport because it would reduce effects on freshwater mussels and supplement populations that would function as sources for dispersal into restored free-flowing stream reaches. While short-term effects of the proposed project with staff modification on freshwater mussels would still be significant and adverse, they would be less significant than the proposed action. Similarly, staff's modification to preserve access to project tunnels for bats, instead of permanently sealing off tunnel entrances, would reduce project effects on bats. Staff modifications to include pre- and post-reservoir drawdown inspections for cultural resources and revisions to the HPMP would improve Tribal consultation and protection of historic sites. Modifying the Sediment Deposit Remediation Plan, the Water Supply

Management Plan, the Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services to include a public outreach component that specifically addresses communication with environmental justice communities; and including Spanish and Hmong languages on signage posted at recreation sites would improve communication with environmental justice communities and increase participation in mitigation activities on private land. While we conclude the proposed action would have less than significant effects on fire management agencies' ability to control wildfires, staff's recommendation to modify the Fire Management Plan to address stakeholder comments associated with fire hydrant locations, river access, and dip tanks would further reduce the potential for any adverse effects on wildfire suppression.

Staff Conclusions

Based on our independent review and evaluation of the environmental and economic effects of the proposed action, the proposed action with staff modifications, and the no-action alternative, with the best available information at the time of this analysis, we recommend the proposed action with staff modifications as the preferred action. We recommend this because: (1) the environmental protection, mitigation, and enhancement measures proposed by KRRC, along with staff's additional recommendations, would adequately protect environmental resources, restore project lands to a good condition, minimize adverse effects on environmental resources, maximize benefits to the Chinook salmon fishery that is of vital importance to the Tribes, and restore the landscape of the areas that are currently impounded within the project reach to a more natural state consistent with the Wild and Scenic designated sections between J.C. Boyle and Copco No. 1 Dams and downstream of the hydroelectric reach[18]; (2) any short- and long-term, adverse environmental effects and the loss of power generation resulting from the proposed action would be outweighed by the substantial long-term environmental benefits gained from project decommissioning; (3) no entity has come forward willing to ensure the long-term maintenance or needed upgrades to facilities left in place under the no-action alternative; and (4) section 6 of the Federal Power Act and the Commission's regulations allow licensees to surrender existing project licenses and cease project operation.

Under the proposed action with staff additional recommendations, the Commission would authorize the decommissioning of the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments. However, license surrender would become effective only after all measures required by the surrender order are adequately completed.

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[18] We define the hydroelectric reach as the section of river that contains the Lower Klamath Project reservoirs and facilities, extending from the upstream extent of J.C. Boyle Reservoir to Iron Gate Dam.

Table ES-2. Comparison of effects of the proposed action with staff modifications to the no-action alternative (Source: staff)

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Geology and Soils		
Bank Stability	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect** – Draining J.C. Boyle, Copco No. 2, and Iron Gate Reservoirs is expected to have minimal effect on bank stability and would be monitored. **Short-term, significant, adverse effect** – Draining Copco No. 1 Reservoir could cause bank instability at some private properties along the reservoir, but these effects would be mitigated. **Permanent, significant, beneficial effect** – Revegetation of the reservoir footprint area after drawdown would decrease erosion of fine sediments from exposed reservoir terraces.
Sediment Transport		
Hydroelectric Reach (Defined as the reach extending from the upstream extent of J.C. Boyle Reservoir downstream to Iron Gate Dam)	**Long-term, significant, adverse effect** – The reservoirs would continue to intercept sediments, having an adverse effect on channel morphological conditions in the hydroelectric reach.	**Short-term, significant, unavoidable, adverse effect** – Reservoir sediments mobilized during drawdown and dam removal would result in increased suspended sediment concentrations and some fine sediment deposition in the river channel and floodplain in the hydroelectric reach. **Permanent, significant, beneficial effect** – Erosion and mobilization of reservoir sediment would restore the natural geomorphology in the hydroelectric reach.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Downstream from Iron Gate Dam	**Long-term, significant, adverse effect** – The reservoirs would continue to intercept sediments and adversely affect channel morphological conditions and the abundance of gravel suitable for salmon spawning downstream of Iron Gate Dam.	**Short-term, significant, unavoidable, adverse effect** – Reservoir sediments mobilized during drawdown and dam removal would result in increased suspended sediment concentrations and some fine sediment deposition in the river channel and floodplain. Both effects would diminish with distance downstream. **Short-term, significant, unavoidable, adverse effect** – Bedload transport of larger sediments from the formerly impounded reaches would cause aggradation of the river channel, primarily in the first 8 miles downstream from the Iron Gate Dam site with lesser effects extending another 11 miles to Humbug Creek. **Permanent, significant, beneficial effect –** Normal sediment transport processes would be restored, improving spawning gravel and restoring natural geomorphology.
Klamath River Estuary and Pacific Ocean	**No effect** – The sediment loads contributed from the Klamath River and its tributaries would not change.	**Short-term, less than significant, unavoidable, adverse effect** – The volume of sediment delivered into the estuary and ocean during the drawdown year would increase by 25 to 39 percent compared to the average amount of sediment delivered under existing conditions. However, the total amount of sediment delivered would likely be within the normal range of variation.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Navigation	**No effect** – No change from existing conditions.	**Short-term, less than significant, unavoidable, adverse effect –** Transport of reservoir sediments to the estuary and the Pacific Ocean could add to siltation at boat ramps in the Lower Klamath River and in Crescent City Harbor, but these effects would be mitigated.
Water Quantity		
Flows (Note: Resource-specific beneficial or adverse effects of changes in flow regime are identified in subsequent sections of this table.)	**Long-term, significant, effects** – Operation of the project would continue to reduce flows in the bypassed reaches and cause large daily flow variations in the J.C. Boyle peaking reach. Although peaking flows benefit whitewater boating, the altered flow regime adversely affects aquatic resources.	**Short-term, less than significant effect –** Flows downstream of Iron Gate Dam would be elevated during drawdown, but larger increases would be avoided by restricting the drawdown rate and the incremental deconstruction of dams and cofferdams.
Floods	**Long-term, less than significant, beneficial effect** – A small amount of available storage in the project reservoirs would continue to provide some attenuation of minor floods but have no effect on larger floods.	**Long-term, significant, unavoidable, adverse effect –** Streambed aggradation could result in changes to the 100-year floodplain in the first 10 to 20 miles downstream from the Iron Gate Dam site. **Long-term, less than significant, adverse effect –** Flooding in the first 10 to 20 miles downstream of Iron Gate Dam would have little effect on existing structures with proposed implementation of mitigation measures. **Permanent, less than significant, unavoidable, adverse effect –** The ability of available reservoir storage to

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		attenuate minor floods would be lost.
Surface Water Supply and Water Rights	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect –** Implementation of the Water Supply Management Plan would mitigate effects on water rights holders and water supply downstream from the Iron Gate Dam site. **Temporary, less than significant, adverse effect –** Construction of the Yreka Water Supply Pipeline would cause water supply to be interrupted briefly during transition to the use of the new pipeline.
Groundwater Supply Wells	**No effect** – No change from existing conditions.	**Long-term, less than significant, adverse effect** – Draining the reservoirs would lower groundwater levels in the aquifer adjacent to the reservoirs, which could affect existing wells. Proposed mitigation would address adverse effects on wells owned by parties that agree to participate in well monitoring.
Water Right Transfer	**No effect** – No change from existing conditions.	**Permanent, significant, beneficial effect –** Upon decommissioning, PacifiCorp would convert its existing hydroelectric water rights in Oregon to instream water rights and abandon its hydroelectric water rights at the Copco No. 1, Copco No. 2, and Iron Gate facilities, avoiding continued negative effects of hydroelectric generation.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Water Quality		
Water Temperature	**Long-term, significant, adverse effect** – Impoundment of water in the reservoirs would continue to cause a seasonal shift in water temperatures that would not meet applicable Oregon DEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the hydroelectric reach.	**Permanent, significant, beneficial effect –** Draining of reservoirs would restore the natural thermal regime of the river to earlier warming in the spring and earlier cooling in the fall, meeting Oregon DEQ and California Basin Plan water quality objectives.
Nutrients	**Long-term, significant, adverse effect** – Impoundment of water in the reservoirs would continue to result in long-term interception and retention of total phosphorus and total nitrogen, causing algae blooms and seasonal increases in nutrients released from sediments in the reservoirs.	**Short-term, less than significant, adverse effect** – Draining the reservoirs and release of sediment would cause short-term increases in sediment-associated nutrients within and downstream of the project. **Permanent, significant, beneficial effect –** Conversion of reservoirs to free-flowing river conditions would eliminate internal loading of ammonia and orthophosphate.
Dissolved Oxygen	**Long-term, significant, adverse effect** – Impoundment of water in the reservoirs would continue to cause long-term seasonal and daily variability in dissolved oxygen concentrations in the hydroelectric reach, and low dissolved oxygen levels below the project that do not meet California North Coast Basin Plan water quality objectives and have an adverse effect on beneficial uses.	**Short-term, significant, unavoidable, adverse effect** – Draining reservoirs and release of sediment would cause short-term increases in oxygen demand and reductions in dissolved oxygen within the hydroelectric reach and downstream of the Iron Gate Dam site. This effect would diminish with distance downstream due to aeration and tributary inflows, with minimal effects downstream of Seiad Valley.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		Permanent, significant, beneficial effect – Conversion of reservoir areas to free-flowing river conditions would cause long-term increases in dissolved oxygen within and downstream of the hydroelectric reach.
pH	**Long-term, significant, adverse effect –** Impoundment of water in the reservoirs would continue to cause elevated and daily variability in pH in the hydroelectric reach and in the Lower Klamath River.	**Permanent, significant, beneficial effect –** Conversion of reservoirs to free-flowing river conditions would eliminate large pH fluctuations caused by phytoplankton blooms in Copco No. 1 and Iron Gate Reservoirs.
Algal Toxins	**Long-term, significant, adverse effect** – The reservoirs would continue to support toxin-producing nuisance algal species such as *M. aeruginosa*, resulting in high seasonal concentrations of algal toxins (i.e., microcystin) within and downstream of the hydroelectric reach.	**Permanent, significant, beneficial effect –** Conversion of the reservoirs to free-flowing river conditions would substantially reduce or eliminate algal toxins (i.e., microcystin) within and downstream of the hydroelectric reach.
Inorganic and Organic Contaminants	**Long-term, less than significant effect** – Impoundment of water and the retention of sediments behind the dams would continue to cause low-level exposure to inorganic and organic contaminants for freshwater aquatic species and humans in the hydroelectric reach.	**Short- to long-term, less than significant, adverse effect –** Draining the reservoirs and sediment release could cause short-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species and humans within and downstream of the hydroelectric reach.
Yreka Water Supply Pipeline Relocation	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect –** Construction of the Yreka Water Supply Pipeline could cause short-term increases in

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		suspended material in the hydroelectric reach during the construction period.
Aquatic Resources		
Coho Salmon, Chinook Salmon, Steelhead, and Pacific Lamprey	**Long-term, significant, adverse effect –** Access to historical habitat would be limited to below Iron Gate Dam, recruitment of gravel would continue to be blocked by the project dams, and disease outbreaks would continue to cause mortality of juvenile and adult salmon due to poor water quality, crowding in available cool-water refugia, and high levels of pathogens. Ongoing increases in water temperature are likely to contribute to a severe decline in the abundance of both naturally produced and hatchery-produced salmon within several decades.	**Short-term, significant, unavoidable, adverse effect –** High suspended sediment concentrations and fine sediment deposition in spawning gravel during and following drawdown and deconstruction activities and associated decreases in dissolved oxygen, would have adverse effects on all life stages of anadromous fish that are present in the Lower Klamath River during the drawdown year. **Permanent, significant, beneficial effect –** Access to additional habitat and cool-water refugia upstream of Iron Gate Dam would increase the numbers of naturally produced salmon and steelhead and increase the resiliency of these populations to ongoing increases in water temperature. Any short-term, adverse effects from barriers to passage formed via mobilized sediments would be minimized by KRRC's proposed measures. **Permanent, significant, beneficial effect –** The proposed action would improve the water temperature regime for anadromous fish spawning, rearing, and migrating in the mainstem Klamath River. **Permanent, significant, beneficial effect –** Increased recruitment of gravel downstream of Iron Gate Dam

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		would improve spawning habitat for salmon and reduce habitat for the polychaete host of *C. Shasta*. **Permanent, significant, beneficial effect –** Reduced crowding, temperature stress, and pathogen densities would decrease disease incidence and associated kills of anadromous fish in the Lower Klamath River, including fish produced in tributaries that migrate through the Lower Klamath River on their migrations to and from the ocean.
Redband Trout	**No effect** – No change from existing conditions.	**Permanent, less than significant, adverse effect –** Restoration of access for anadromous fish to upstream habitat could increase disease transmission to upstream habitat, but most pathogens (including *C. Shasta*) are already present in upstream areas. **Permanent, less than significant, adverse effect –** Restoration of access for anadromous fish to upstream habitat could increase competition with fry and juvenile redband trout for food and habitat. **Permanent, significant, beneficial effect –** Fry and juvenile anadromous fish produced in upstream habitat would increase the available food base for adult redband trout.
Freshwater Mussels	**Long-term, significant, adverse effect** – Impoundment of riverine mussel habitat and blockage	**Short-term, significant, adverse effect –** Reservoir drawdown and dam removal would increase suspended sediment

Resource/Attribute	No Action	Proposed Action with Staff Modifications
	of the migration of host fish species would continue to adversely affect native freshwater mussels.	concentrations and bedload sediment transport and deposition in the Lower Klamath River, which would adversely affect freshwater mussels in the short term. Some mussels would also be killed during in-river construction activities, but this effect would be minimized by translocating mussels prior to in-water construction activities. **Permanent, significant, beneficial effect** – Dam removal would restore connectivity for host fish species and increase available riverine habitat in previously impounded reach benefiting freshwater mussels.
Benthic Macroinvertebrates	**Long-term, significant, adverse effect –** Impoundment of water within the reservoirs and associated poor water quality and substrate conditions would continue to have adverse effects on the diversity and abundance of benthic macroinvertebrates in the hydroelectric reach.	**Short-term, significant, adverse effect –** Increased suspended sediment concentrations, sediment deposition, and bedload transport of larger sediments would cause mortality to many macroinvertebrates in the hydroelectric reach and Lower Klamath River, but populations would recover quickly. **Permanent, significant, beneficial effect –** Dam removal would restore connectivity through the hydroelectric reach and would rehabilitate and increase availability of riverine habitat within and downstream of the hydroelectric reach, benefiting benthic macroinvertebrates.
Hatchery Production	**Long-term, significant, adverse effect –** Iron Gate Hatchery would continue to produce Chinook and coho	**Short-term, significant, adverse effect –** The elimination of hatchery-produced Chinook and coho salmon at Iron Gate

Resource/Attribute	No Action	Proposed Action with Staff Modifications
	salmon consistent with its existing Hatchery and Genetics Management Plan. Salmon returns to the Klamath River would remain highly variable but would continue to exhibit ongoing decreases in abundance over time. **Long-term significant, beneficial effect** – Southern Oregon/Northern California Coasts (SONCC) coho salmon produced at Iron Gate Hatchery would continue to protect and conserve the population's genetic resources and reduce extinction risks, but this benefit would diminish over time as conditions in the migration corridor continue to degrade.	Hatchery would likely result in a short-term reduction in adult returns in post-dam removal years (before the benefits of dam removal are realized). **Permanent, significant, beneficial effect –** Hatchery operations during, and for at least eight years following dam removal, would likely facilitate the repopulation of newly available Chinook and coho salmon habitat upstream from Iron Gate Dam. The expected increase in natural production would likely be higher than what would be lost due to the decommissioning of Iron Gate Hatchery.
Commercial, Recreational, and Tribal Fisheries	**Long-term, significant, adverse effect –** Although fish produced at Iron Gate Hatchery currently contribute to higher harvest rates in the fishery than what would happen without hatchery stocks, frequent closures and/or fishing curtailments (associated with low abundance) are likely to become more restrictive over time.	**Permanent, significant, beneficial effect –** The potential for harvest is predicted to be greater under the proposed action due to the expected increase in the production of wild salmon and steelhead in the Klamath River Basin. The proposed action would also likely reduce the frequency of low escapement leading to fishery closures.
Botanical Resources		
Wetlands	**Long-term, significant, beneficial effect** – Continued impoundment of water in the reservoirs would support reservoir-dependent wetland and riparian communities.	**Short-term, significant, unavoidable, adverse effect –** Dam removal would result in the loss of reservoir-dependent wetland and riparian vegetation communities, but wetland

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		restoration efforts would result in no net loss of riparian and wetland acreage.
Vegetation	**Long-term, significant adverse effect –** Continued inundation of the reservoir footprint would exclude upland and riparian vegetation development. Continued use and management of lands with project facilities would affect botanical resources, including special status species, if present.	**Short-term, unavoidable, significant, adverse effect–** Draining reservoirs would create exposed, unvegetated soils susceptible to erosion and colonization by invasive species in the short term, but revegetation efforts would prevent long-term effects. **Short-term, significant, unavoidable, adverse effect –** Removal of dams and associated facilities, staging and storage areas would cause short-term ground disturbance and vegetation removal. **Permanent, significant, beneficial effect –** Recontouring, grading, and revegetation of reservoir footprints using native species and exotic weed control would result in riparian and upland vegetation establishment.
Special Status Plant Species	**Long-term, significant, adverse effect –** The continued use and management of lands with project facilities could affect special status species.	**Short-term, significant, unavoidable, adverse effect –** Reservoir drawdown and the construction of temporary access roads or the improvement of existing roads could have adverse effects on these plants, but these effects would be minimized by avoiding special status plant species sites, if feasible, and salvaging and transplanting special status plant species. **Permanent, significant, beneficial effect –** Transplanting special status plant species combined with recontouring,

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		grading, and revegetation of reservoir footprints would expand potential special status plant species habitat.
Wildlife Resources		
Wildlife Habitat	**Long-term, significant adverse effect –** The continued inundation of lands in the reservoir footprint and continued use and management of lands with project facilities would exclude these lands as terrestrial wildlife habitat.	**Permanent, significant, unavoidable, adverse effect –** Draining reservoirs and deconstruction of project facilities would have adverse effects on wildlife that prefer reservoir habitats. **Permanent, significant, beneficial effect –** Restoration of inundated lands and deconstructed facilities would benefit terrestrial wildlife that prefer upland habitats.
Large Mammals	**Long-term, significant, adverse effect** – The project reservoirs would continue to inundate habitat and present a barrier to movement of some terrestrial species.	**Permanent, significant, beneficial effect** – Dam removal and restoration activities would restore upland and riparian riverine habitat and reduce movement barriers to large mammals.
Reptiles and Amphibians	**Long-term, significant beneficial effect** – The reservoirs would continue to support amphibians and reptiles that use reservoir habitats.	**Short-term, less than significant, adverse effect** – Reservoir drawdown and construction activities could result in direct mortality or harm to amphibian and reptile species, but relocation of reptiles and amphibians at construction sites would minimize adverse effects on these species. Long-term or population-level effects would be permanent, less than significant, and beneficial or adverse, depending on species (terrestrial or aquatic, respectively).

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Nesting Birds	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect** – Removal of vegetation at and near construction sites could result in short-term, adverse effects on nesting birds but effects would be minimized with mitigation measures. **Permanent, significant, beneficial effect –** Revegetation efforts and establishment of native upland and riparian communities would expand existing wildlife habitat and have long-term benefits for nesting birds.
Special Status Wildlife Species	**Long-term, significant, beneficial effect** – The continued impoundment of water in the reservoirs and management of upland habitats would support aquatic and upland dependent special status wildlife species.	**Permanent, significant, unavoidable, adverse effect** – Removal of the reservoirs would reduce habitat for species that prefer reservoir habitats. **Short-term, significant, adverse effect** – Construction at upland sites would disturb existing wildlife habitat for special status species. **Permanent, less than significant, beneficial effect –** Revegetation and establishment of native upland and riparian communities would expand existing wildlife habitat for special status species.
Sensitive Species		
Bald and Golden Eagles	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide foraging opportunities to nesting and wintering bald eagles.	**Short-term, less than significant, adverse effect** – Use of heavy machinery, blasting, and material transport may disturb nesting and foraging eagles.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		Permanent, significant, unavoidable, adverse effect – Loss of the reservoirs would reduce foraging areas for bald eagles. **Permanent, significant, beneficial effect** – Restored salmon runs would increase foraging resources for bald eagles and restoration of the reservoir footprints to open grasslands and shrublands would create foraging habitat for golden eagles.
Bats	**Long-term, significant, beneficial effect** – Project facilities and appurtenant structures would continue to provide roosting, hibernating and maternity sites for bats.	**Short-term, significant, adverse effect –** Removal of facility structures and deconstruction-related activities would have adverse effects on roosting, hibernating, and maternity sites of bat species, but such effects would be reduced by prohibiting removal of structures when maternity colonies are present and following the National White-Nose Syndrome Decontamination Protocol. Long-term effects would be mitigated by creating or enhancing artificial roosting habitat and using bat gates to continue to provide access to tunnels and conveyances to maternity, roosting, and hibernating sites.
Threatened and Endangered Aquatic Species		
Southern Distinct Population Segment (DPS) Green Sturgeon, and Eulachon	**Short-term, less than significant effect** – Green sturgeon and eulachon would continue to occupy the Lower Klamath River, Klamath River estuary, and nearshore	**Short-term, significant adverse effect –** Elevated suspended sediment concentration (SSC) levels in the Lower Klamath River resulting from the proposed action are likely to

Resource/Attribute	No Action	Proposed Action with Staff Modifications
(See Aquatic Resources section for effects on SONCC evolutionarily significant unit [ESU] coho salmon)	environment during the winter and spring, and use these areas for spawning, egg incubation, and early rearing. However, all green sturgeon that have been documented to occur in the Klamath River are members of the unlisted Northern DPS.	adversely affect Southern DPS eulachon in the short term. **Short-term, less than significant, adverse effect –** Because there would be no predicted substantial decrease in green sturgeon abundance or substantial decrease in habitat quality or quantity, implementation of the proposed action would have a less than significant, adverse effect on these species in the short term. **Long-term, less than significant, beneficial effect –** In the long term, green sturgeon and the eulachon population may benefit from the more normative ecological processes that would develop under the proposed action.
Southern Resident Killer Whales	**Long-term, significant, adverse effect –** Although Klamath River salmon only contribute approximately 2.3 percent of the prey base for Southern Resident killer whales, the potential for a severe and permanent decline in Klamath River salmon abundance under the no-action alternative would have a significant, adverse effect on the whale's prey base.	**Short-term, less than significant, adverse effect –** Because the Klamath River contributes a small number of Chinook salmon to the Southern Resident killer whale prey base, short-term, adverse effects on salmon from elevated SSCs would have a less than significant effect on Southern Resident killer whales. Similarly, long-term, beneficial effects on salmon abundance would have a less than significant, beneficial effect on Southern Resident killer whales.
Lost River and Shortnose Suckers	**No effect** – The reservoirs would continue to provide rearing habitat for suckers that emigrate into this habitat.	**Short-term, significant, unavoidable, adverse effect** – Dam removal and conversion of the reservoir areas to a free-flowing river would likely cause

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		mortality to the suckers residing in the project reservoirs, but the suckers in the reservoirs do not reproduce or contribute to recovery.
Bull Trout	**No effect –** Access to spawning habitat and water quality conditions would not change.	**No effect –** Dam removal would not affect access, spawning habitat or water quality for bull trout.
Threatened and Endangered Wildlife Species		
Franklin's Bumble Bee, Monarch Butterfly, and Western Bumble Bee	**Long-term, significant, adverse effect** – Inundated lands in the reservoir footprint and occupied by project facilities would not be available to support these species.	**Short-term, less than significant, adverse effect –** Vegetation clearing and other ground disturbance for dam removal and structure demolition could destroy or disturb potentially suitable habitat for bumble bees and monarch butterflies. **Permanent, significant, beneficial effect –** Vegetation restoration and increased pollen and nectar sources would have long-term, beneficial effects on nectar feeding species such as bumble bees and monarch butterfly.
Little Brown Bat	**Long-term, significant, beneficial effect** – Project facilities and appurtenant structures would continue to provide roosting, hibernating and maternity sites to bats.	**Short-term, significant, adverse effect –** Removal of facility structures and deconstruction-related activities would have adverse effects on roosting, hibernating, and maternity sites of bat species, but such effects would be reduced by prohibiting removal of structures when maternity colonies are present and following the National White-Nose Syndrome Decontamination Protocol. Long-term effects would be mitigated by creating or

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		enhancing artificial roosting habitat and using bat gates to continue to provide access to tunnels and conveyances to maternity, roosting, and hibernating sites.
Northern Spotted Owl	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect** – Decommissioning and restoration activities could disturb nearby suitable northern spotted owl habitat, which is limited near the project; the closest suitable habitat that could be used by owls for nesting is located approximately 1.3 miles southeast of the Copco No. 1 Reservoir. **Permanent, less than significant, beneficial effect** – The proposed action would not modify any suitable habitat for northern spotted owl nesting, roosting, or foraging. Restoration of the river channel and riparian forest would increase northern spotted owl dispersal habitat over the long term.
Oregon Spotted Frog	**No effect** – No change from existing conditions.	**Long-term, less than significant, beneficial effect** – The proposed action is not likely to affect the Oregon spotted frog because all known occupied habitat occurs upstream of the project, but improved water quality and habitat conditions could benefit dispersing Oregon spotted frog. Removal of reservoirs would also reduce, but not eliminate, populations of predatory non-native bullfrogs.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Western Pond Turtle	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide habitat for western pond turtle.	**Temporary, significant, adverse effect** – Drawdown, deconstruction, bank failures, floodplain entrapment, and habitat alterations could cause mortality to some individual western pond turtles. **Permanent, significant, beneficial effect** – Dam removal and free-flowing aquatic habitat would provide for western pond turtle dispersal and increased genetic exchange among isolated populations, reduce predatory non-native bullfrogs and warmwater fishes, and improve water quality.
Recreation		
Recreation Access	**Long-term, significant, beneficial effect** – Continued access to recreational facilities would benefit recreational users of whitewater and flatwater reaches in and downstream of the project.	**Temporary, significant, adverse effect –** To protect public safety, access would be restricted to some areas during project deconstruction, which would limit recreational access. **Permanent, significant, adverse effect –** Eleven recreation sites would be removed, preventing access and displacing recreational users in- and downstream of the hydroelectric reach. **Permanent, significant, beneficial effect –**Measures at remaining facilities and potential newly developed sites would provide river access, depending on a party committing to funding their construction and operation.
Reservoir Recreation	**Long-term, significant, beneficial effect** – The reservoirs would continue to	**Permanent, significant, unavoidable, adverse effect –** Draining the reservoirs would

Resource/Attribute	**No Action**	**Proposed Action with Staff Modifications**
	provide reservoir-based recreational opportunities.	eliminate reservoir-based recreational opportunities.
Whitewater Boating	**Long-term, significant, beneficial effect** – Operation of the project would continue to provide predictable whitewater boater opportunities in the Hell's Corner reach.	**Permanent, significant, unavoidable, adverse effect –** Eliminating peaking operations would reduce whitewater boating opportunities in the Hell's Corner reach. **Permanent, significant, beneficial effect –** Removing encroaching vegetation in the Copco No. 1 bypassed reach and remaining construction debris at Sidecast Slide would enhance whitewater boating safety**.** **Permanent, significant, beneficial effect** – New whitewater opportunities would be created along the hydroelectric reach, including Ward's Canyon.
Water Contact Recreation	**Long-term, significant, adverse effect** – Poor water quality conditions and high microcystin concentrations would continue to adversely affect recreational activities.	**Permanent, significant, beneficial effect –** Improved water quality conditions would negate the safety risk from exposure to microcystin toxin.
Wild and Scenic Rivers	**Permanent, significant, adverse effect –** The declining fish populations in future decades would have a permanent, significant, adverse effect on the fisheries outstandingly remarkable values (ORV) in the Recreational River segment (Iron Gate Dam to the Pacific Ocean).	**Short-term, significant, adverse effect –** Short-term decreases in water clarity would adversely affect recreation. **Permanent, significant, beneficial effect –** The proposed action would have beneficial effects on the scenic landscape, fisheries, and recreation ORVs in the Scenic River segment reach below J.C. Boyle reach and the fisheries ORV in the Recreation River segment (Iron Gate Dam to the Pacific Ocean).

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Land Use		
Fire Suppression	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide fire breaks and a water source for ground and air based wildfire suppression efforts.	**Permanent, less than significant, adverse effect** – Draining of reservoirs would eliminate fire breaks and use of the reservoirs as a water source for wildfire suppression efforts. Measures to improve early detection of wildfires, assistance with improving defensible space around home sites, and development of additional sites to access water for ground-based and aerial fire suppression efforts would reduce adverse effects. However, the additional water source locations would not be suitable for refilling some types of aircraft that require large expanses of water to collect water without landing.
Land Exchange	**Short- and long-term, less than significant effect** – Parcel B lands would continue to be managed by PacifiCorp for hydropower operations, recreation, and natural (fish, wildlife and botanical) resources.	**Short- and long-term, significant, beneficial effect –** PacifiCorp Parcel B lands are expected to be transferred to the States of Oregon and California to be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access.
Aesthetics		
Viewshed	**Long-term, significant, adverse effect** – Hard lines of the dam and large expanses of water in the reservoirs would continue to affect visual qualities in areas surrounding the project.	**Permanent, significant, unavoidable, adverse effect –** Neighboring landowners on Copco No. 1 and Iron Gate Reservoirs would lose open-water views. **Temporary, significant, unavoidable, adverse effect –** Deconstruction activities would

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		have a temporary, adverse effect on scenic quality of the viewshed. **Short-term, significant, unavoidable, adverse effect –** Draining the reservoirs would expose barren, formerly inundated areas adversely effect on scenic quality of the viewshed until vegetation becomes established. **Permanent, significant, beneficial effect –** After dam removal and landscape restoration, hard lines of the dams and large expanses of water in the reservoirs would transform into natural river canyon landforms with a more natural flow regime and landscape character.
Cultural Resources		
Archaeological Sites	**Long-term, significant, beneficial effect** – The Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and traditional cultural properties (TCPs) that are located within the area of potential effects (APE) would remain under federal protection afforded by NHPA.	**Permanent, significant, adverse effect –** Removal of federal protection of archaeological sites and resources on lands under the Commission's jurisdiction would have adverse effect on cultural resources protection under section 106. **Short-term, significant, adverse effect to long-term, less than significant, adverse effect –** Erosion and slumping along reservoir shorelines, ground-disturbance activities, and vandalism of exposed, previously submerges sites could have adverse effects on archaeological resources.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Built Environment Resources	**Long-term, significant, beneficial effect** – The Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and TCPs that are located within the APE would remain under federal protection afforded by NHPA.	**Permanent, significant, unavoidable, adverse effect –** Deconstruction of the Lower Klamath Project facilities would have adverse effects on archaeological resources that may be eligible for listing in the National Register of Historic Sites. Historic American Building Survey/Historic American Engineering Record/Historic American Landscapes Survey documentation would help to mitigate adverse effects of decommissioning of historic buildings and implementation of the HPMP would avoid, minimize, or mitigate various adverse effects on cultural resources listed or eligible for inclusion in the National Register.
Traditional Cultural Properties	**Long-term, significant, beneficial effect** – The Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and TCPs that are located within the APE would remain under federal protection afforded by NHPA.	**Permanent, significant, beneficial effect –** Restoring the impounded reaches to a free-flowing river would have significant beneficial effect on restoring salmon runs, access to traditional foods, Tribal cultural practices, and a characteristic fluvial landscape.
Tribal Trust Responsibilities		
	Permanent, significant, adverse effect – Under the no-action alternative, it is likely that the Klamath salmon fisheries will become severely diminished within several decades. The continued lack of a healthy fishery would not enable the	**Permanent, significant, beneficial effect** – The proposed action would result in benefits to water quality, aquatic resources, fisheries, and terrestrial resources used by all Tribes. These benefits would aid in the continuation and restoration of Tribal practices and traditions

Resource/Attribute	No Action	Proposed Action with Staff Modifications
	Tribes to operate successful Tribal commercial fishery endeavors. Absent these opportunities for employment and self-sufficiency, Tribal unemployment and the associated Tribal economy would continue to suffer. This would result in a continued disproportionate and permanent significant, adverse effect on Tribal communities. **Long-term, significant, adverse effect** – Under the no-action alternative, the continued occurrence of toxic algae blooms would impede the Tribes' ability to safely continue their many rituals that involve bathing or other means of contact with the waters of the Lower Klamath River. This would result in a continued disproportionate and permanent significant, adverse effect on Tribal communities.	that have been adversely affected.
Socioeconomics		
Employment, Recreation, Property Values, Tax Revenues and Electric Rates	**Long-term, significant, beneficial effect** – Property owners near reservoirs would not have adverse effects on their properties, and employment, property values, tax revenue, and electric rates would remain similar to existing conditions.	**Short-term, significant, adverse effect** – Property owners near the reservoirs could have adverse economic effects on wells, slope instability, property values, and susceptibility to damage from wildfires. Dam removal could have adverse effects on employment, whitewater boating and reservoir recreation, property values, tax revenue, and electric rates.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		Short-term, significant, beneficial effect – The regional economy would benefit in the short term by construction and restoration activities associated with dam removal. **Permanent, significant, beneficial effect –** Dam removal and restoration would have beneficial effects on income from commercial fishing, subsistence fishing, ocean and in-river sport fishing, riverine recreation, and tourism.
Environmental Justice		
Environmental Justice Communities	**Disproportionately high and adverse effect on environmental justice populations –** The dams would continue to negatively affect environmental justice communities by affecting water quality and decreasing the quality of the salmon fishery.	**Disproportionately high and adverse effect on environmental justice populations –** Adverse effects associated with the removal of the Copco No. 1, Copco No. 2, and Iron Gate project facilities, including effects on property values, noise, traffic, sediment deposition on private property and private well productivity would disproportionately affect environmental justice communities.
Public Safety		
Hazardous, Toxic, and Radiological Waste	**No effect** – No change from existing conditions.	**Temporary, less than significant, adverse effect –** Implementation of a Hazardous Material Management Plan during deconstruction and removal would minimize the potential for adverse effects from the transport, use, and disposal of hazardous materials.
Construction Traffic	**No effect** – No change from existing conditions.	**Temporary, significant, adverse effect** – Traffic volume

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		and heavy equipment use due to construction activities would have adverse effect on congestion, road safety and conditions, and emergency response time, but measures included in the Construction Management Plan would minimize adverse effects.
Other Construction-Related Hazards	**No effect** – No change from existing conditions.	**Temporary, less than significant, adverse effect –** Implementation of the proposed Health and Safety Plan and Emergency Response Plan would effectively minimize risks to public safety associated with deconstruction and restoration activities.
Air Quality, Noise and Vibration		
Air Quality	**No effect** – No change from existing conditions.	**Temporary, significant, unavoidable, adverse effect** – Vehicle exhaust and fugitive dust emissions from the removal of dams and appurtenant facilities could increase emissions of NOx, that could exceed applicable thresholds of significance.
Noise and Vibration	**No effect** – No change from existing conditions.	**Temporary, significant, unavoidable, adverse effect** – Increase in outdoor noise levels (heavy equipment operation, hauling) and vibrations (blasting) due to deconstruction activities would have a temporary significant adverse effect on residents living near deconstruction sites.
Greenhouse Gas Emissions		
Deconstruction and Restoration	**No effect** – No change from existing conditions.	**Temporary, less than significant, adverse effect –** Over a two-year period, direct

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		greenhouse gas (GHG) emissions would be generated by decommissioning- and restoration activities but purchasing carbon offsets would have a net-zero GHG result. **Short-term, less than significant, unavoidable, adverse effect** – GHG emissions due to reservoir drawdowns and to the conversion of inundated lands to riverine, wetland and terrestrial habitats would exceed the no net increase threshold but would not conflict with any applicable plan, policy, or regulation. **Permanent, less than significant, unavoidable, adverse effect** – Loss of renewable hydropower would be offset by increasing renewable energy in PacifiCorp power mix at a rate that more than covers the loss from the baseline condition to comply with the California Renewable Portfolio Standard.

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Administration & Compliance
Washington, D.C.

Lower Klamath Project
FERC Project No. 14803-001—California and Oregon
Formerly part of the Klamath Hydroelectric Project,
FERC Project No. 2082-063

1.0 INTRODUCTION

1.1 APPLICATION

The Federal Energy Regulatory Commission (Commission or FERC), under the authority of the Federal Power Act (FPA),[19] licenses and oversees the construction and operation of non-federal hydroelectric projects in the United States. Moreover, the FPA allows licensees to voluntarily surrender existing licenses to the Commission and cease operation of their project facilities.

The Lower Klamath Project is located on the Klamath River in Klamath County in south-central Oregon, and in Siskiyou County in north-central California (figure 1-1). It occupies 395.09 acres of federal lands, other than for transmission line right-of-way and 5.75 acres of federal lands for transmission line right-of-way.[20] These federal lands are administered by the U.S. Department of the Interior (Interior)'s Bureau of Land Management (BLM). The project consists of four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) that the licensees propose to surrender and decommission. These developments were formerly part of the Klamath Hydroelectric Project No. 2082.

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[19] 16 U.S.C. §§ 791(a)-825r.

[20] Order Amending License and Deferring Consideration of Transfer Application, PacifiCorp, 162 FERC ¶ 61,236 (2018). We note here this acreage differs from both the acreage identified in the amended surrender application, filed on November 17, 2020, and the federal lands identified in recent exhibit drawings filed with the Commission on December 16, 2021.

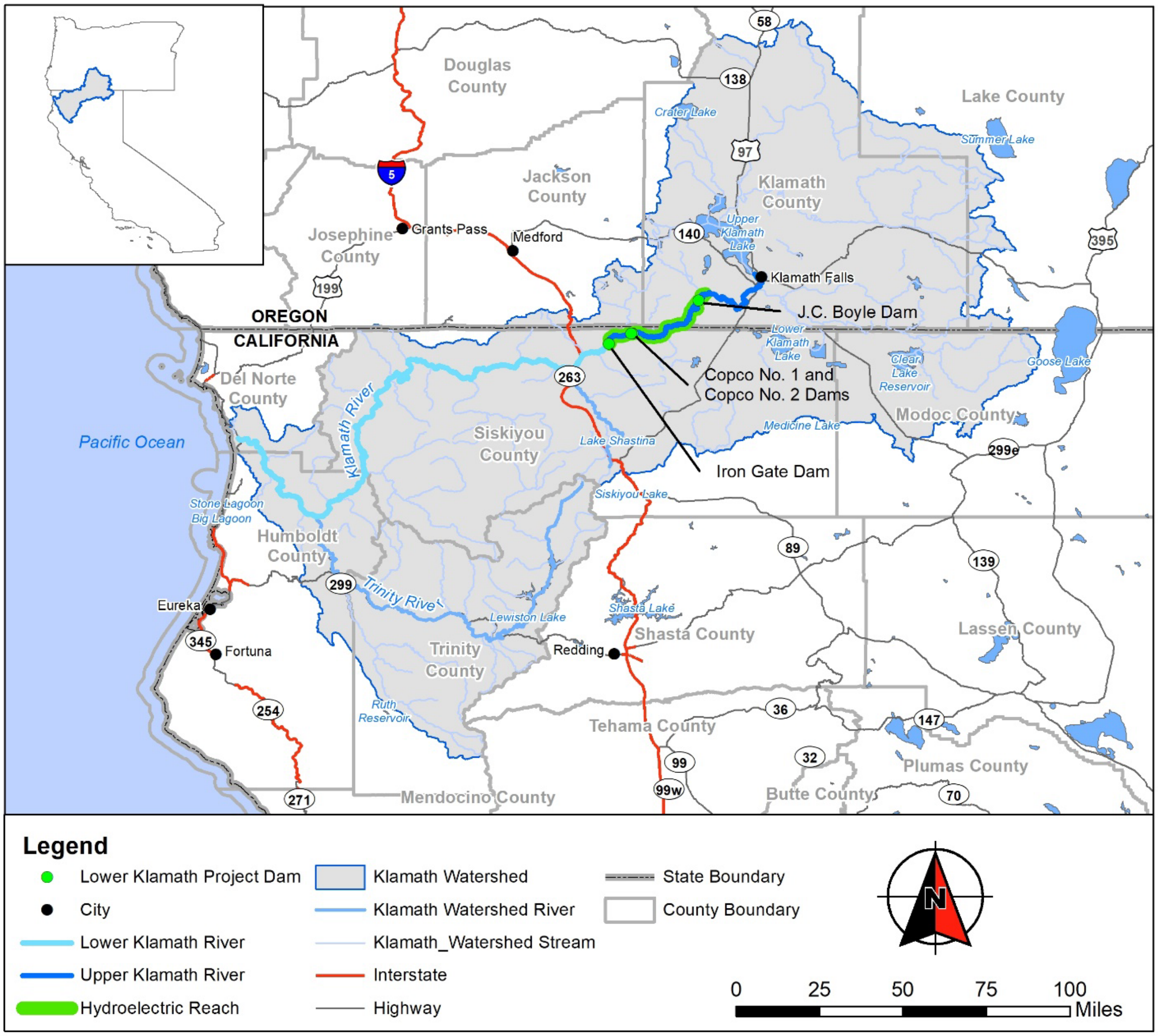

Figure 1-1. Lower Klamath Project area (Source: staff)

Under the Commission’s regulations at 18 Code of Federal Regulations (C.F.R.) § 6.1 (2021), an application for surrender of a project license, other than a minor license or transmission line, must be filed by the licensee in the same manner as an application for license. Pursuant to 18 C.F.R. § 6.2, a project license may be surrendered only when the licensee has fulfilled the obligations under the license as prescribed by the Commission and project lands are restored to a satisfactory condition.

PacifiCorp had previously filed an application to relicense the Klamath Hydroelectric Project on February 25, 2004. In November 2007, Commission staff issued a final environmental impact statement (EIS) for the license application, analyzing various alternatives, including decommissioning and removing the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments, but ultimately recommended issuing a new license that included these developments with staff-recommended mitigation and resource agency mandatory conditions. However, PacifiCorp determined that implementing those conditions, to include complying with mandatory fishway prescriptions, would mean operating the project at a net loss. Thereafter, PacifiCorp entered into negotiations with several resource agencies, Tribes, and other entities to evaluate alternatives to project relicensing.

In February 2010, PacifiCorp and 47 other parties, including the States of Oregon and California and Interior, executed the Klamath Hydroelectric Settlement Agreement (KHSA), which provided for decommissioning and removing the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments, contingent on the passage of federal legislation and approval by the Secretary of the Interior. However, the necessary legislation was never passed.

On April 6, 2016, PacifiCorp, the States of Oregon and California, Interior, U.S. Department of Commerce's National Marine Fisheries Service (NMFS), the Yurok Tribe, the Karuk Tribe, and other entities signed the amended KHSA. On May 6, 2016, PacifiCorp filed the amended KHSA with the Commission. On June 16, 2016, the Commission stayed the relicensing proceeding for the Klamath Hydroelectric Project No. 2082.[21]

On September 23, 2016, PacifiCorp and the Klamath River Renewal Corporation (KRRC) filed an amendment and transfer application with the Commission to: (1) amend the Klamath Hydroelectric Project No. 2082 license to administratively remove the four developments to be decommissioned and place those developments into a new license that would become the Lower Klamath Project; and (2) transfer the license for the Lower Klamath Project from PacifiCorp to KRRC. On the same day, KRRC filed the original application to surrender the Lower Klamath Project license and remove the four developments. On March 15, 2018, the Commission approved the proposed amendment to administratively separate the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments and create the Lower Klamath Project (figure 1-1).[22] On July 16, 2020, the Commission approved a partial transfer of the license for the Lower Klamath Project to KRRC, contingent on PacifiCorp remaining on as a co-licensee.[23]

On November 17, 2020, KRRC and PacifiCorp filed an amended application for surrender of license and removal of project works for the Lower Klamath Project. The November 17, 2020, filing includes a Memorandum of Agreement (MOA) entered into by PacifiCorp, KRRC, the Karuk Tribe, the Yurok Tribe, and the States of California and Oregon, that reflects the parties' commitment to surrender the project. It also includes revised exhibits, a revised construction schedule, revised costs, and a revised environmental report. The November 17, 2020, filing also informed the Commission that

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[21] *PacifiCorp,* 155 FERC ¶ 61,271 (2016).

[22] *PacifiCorp,* 162 FERC ¶ 61,236 (2018).

[23] *PacifiCorp,* 172 FERC ¶ 61,062 (2020) (July 16 Partial Transfer Order).

KRRC and PacifiCorp were not accepting co-licensee status, as approved by the Commission's July 16, 2020, order, and would be filing a new transfer application by January 16, 2021. A new application to transfer the Lower Klamath Project from PacifiCorp to KRRC, the State of Oregon, and the State of California as co-licensees was filed on January 13, 2021, and approved on June 17, 2021, under P-14803-004.[24]

In the amended surrender application, KRRC proposes to decommission and remove most project facilities and to implement 16 management plans that detail the specific methods that would be used to: draw down the four reservoirs; remove the dams and associated facilities; restore lands currently occupied by the dams, reservoirs, and other facilities; and minimize adverse effects on environmental resources. PacifiCorp and KRRC filed the final management plans on February 26, 2021. Subsequently, revised plans were filed on December 14, 2021.

1.2 ROLES OF THE COMMISSION AND COOPERATING AGENCIES

The Commission's staff prepared this EIS to assess the environmental effects associated with decommission and removal of project facilities proposed by KRRC and PacifiCorp in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended. The U.S. Army Corps of Engineers (Corps) and U.S. Environmental Protection Agency (EPA) are cooperating agencies assisting in the preparation of the EIS because they have jurisdiction by law or special expertise with respect to environmental effects associated with KRRC's and PacifiCorp's proposal. The roles of the cooperating agencies in the proposed project review process are described below.

The Corps is a federal agency within the U.S. Department of Defense with jurisdictional authority pursuant to section 404 of the Clean Water Act[25] (CWA), which governs the discharge of dredged and/or fill material into waters of the United States. Because the Corps would need to evaluate the proposed action to render a decision on KRRC's section 404 permit application and must comply with the requirements of NEPA before issuing permits under the CWA, it has elected to participate as a cooperating agency in the preparation of this EIS. The Corps would adopt the EIS pursuant to the NEPA Implementing Regulations for adoption of an EIS 40 C.F.R. § 1506.3 if, after its independent review of the document, it concludes that the EIS satisfies the Corps' comments and recommendations. The proposed project occurs within the San Francisco and Portland Districts of the Corps. The primary decisions to be made by the Corps include issuance of a section 404 permit for aquatic resource effects associated with the

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[24] *PacifiCorp, Klamath River Renewal Corporation, State of Oregon and State of California*, 175 FERC ¶ 61,236 (2021). The transfer would not be effective unless the Commission approves the license surrender and the transferees accept the license for the Lower Klamath Project.

[25] 33 U.S.C. § 1344.

proposed action’s pre-drawdown work, discharge of fill materials from drawdown (sediment evacuation from the reservoirs), post-drawdown restoration, and decommissioning and removal of facilities. This EIS contains information needed by the Corps to reach decisions on these issues. Through the coordination of this document, the Corps would obtain the views of the public and natural resource agencies prior to reaching decisions on the proposed project. As an element of its review, the Corps must consider whether a proposed project avoids, minimizes, and compensates for effects on existing aquatic resources, including wetlands, to strive to achieve the national regulatory goal of no net loss of values and functions. Based on its participation as a cooperating agency and its consideration of the final EIS (including responses to public comments), the Corps would issue a record of decision to formally document its decision on the proposed action.

EPA is serving as a cooperating agency (as defined in 40 C.F.R. § 1501.8(a)) for the Commission’s Lower Klamath River dam removals and associated restoration activities. As such, EPA participates in interagency coordination meetings and the public scoping process and reviews draft technical reports and early coordination documents, particularly as related to its areas of expertise in water quality, air quality, and environmental justice analyses.

EPA’s status as a cooperating agency does not affect its independent responsibilities pursuant to section 309, Policy Review, of the Clean Air Act[26] to review and comment publicly on all draft EISs or other NEPA documents and does not imply endorsement of the proposed project.

1.3 PURPOSE AND NEED

The Commission must decide whether to approve the licensees’ application to surrender the license for and decommission the Lower Klamath Project and decide what conditions should be included in any surrender order issued. In addition to power and development, under the FPA the Commission considers a broad range of public interest factors, including the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat); the protection of recreational opportunities; and the preservation of other aspects of environmental quality.

The applicants request surrender and decommissioning of the Lower Klamath Project to provide for the timely[27] improvement of water quality and to address system-wide limiting factors including a lack of fish passage, high summer and fall water

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[26] 42 U.S.C. §7401 et seq.

[27] The Yurok Tribe, Karuk Tribe, and numerous other commenters expressed an urgent need for rapid approval and implementation of dam removal to protect Klamath salmon runs from deteriorating water quality conditions and increased disease incidence.

temperatures, blue-green algae blooms, disease incidence, impaired sediment supply and transport. The objectives of the proposed action include:

1. Advance the long-term restoration of the natural fish populations in the Klamath River Basin, with particular emphasis on restoring the salmonid fisheries used for commerce, recreation, subsistence, and Tribal cultural purposes.
2. Improve the long-term water quality conditions associated with the Lower Klamath Project, including water quality impairments due to the bacterium *Microcystis aeruginosa* and associated toxins, water temperature, and levels of biostimulatory nutrients.
3. Ameliorate conditions underlying high disease rates among Klamath River salmonids.
4. Restore anadromous fish passage to viable habitat currently made inaccessible by the Lower Klamath Project dams.

In accordance with NEPA and the Commission's regulations (18 C.F.R. pt. 380), this EIS assesses the effects associated with the proposed surrender and decommissioning of the project, evaluates feasible alternatives to licensees' proposed action, and makes recommendations to the Commission on whether to approve the licensees' application, and if approved, recommends conditions to become part of any surrender order issued.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 C.F.R. §§ 6.1) require that applicants consult with appropriate resource agencies, Tribes, and other entities before filing an application for surrender of license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act,[28] the Endangered Species Act[29] (ESA), the National Historic Preservation Act[30] (NHPA), and other federal statutes. A detailed discussion of these federal environmental laws is provided in appendix B. Pre-filing consultation must be completed and documented according to the Commission's regulations.

1.4.1 Comments on the Application

Prior to filing its amended surrender application on November 17, 2020, PacifiCorp, KRRC, and several governmental agencies conducted public consultation to identify issues of concern pertaining to the proposed action. Consultation regarding many of the issues associated with the proceeding began during PacifiCorp's pre-filing activities for its application to relicense the Klamath Hydroelectric Project No. 2082,

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[28] 16 U.S.C. § 661 et seq.

[29] 16 U.S.C. § 1536.

[30] 54 U.S.C. § 306108.

which was filed on February 25, 2004. The Commission then conducted public scoping prior to preparing its 2007 EIS on PacifiCorp's licensing proposal and alternatives to the proposed action including dam removal. Public scoping was also conducted before preparing the U.S. Department of the Interior (Interior) and California Department of Fish and Game (California DFG) (Interior and California DFG, 2012) EIS/EIR, Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report, and the California State Water Resources Control Board's (California Water Board) EIR supporting its water quality certification (WQC) for the proposed action (California Water Board, 2020b).

Numerous comments both in support of and opposition to the proposed surrender and removal of the four dams followed the Commission's October 5, 2017, notice soliciting comments, motions to intervene and protests, on the original transfer application filed on September 23, 2016.[31] While these comments were not specific to the transfer proceeding, the Commission recognized those comments in its July 16, 2020, Partial Transfer Order. These comments identified potential effects on water quality, salmon, Tribal communities, recreation, water storage for irrigation and fighting fires, homes and private wells, and electricity costs.

On December 16, 2020, the Commission issued a notice of application for surrender of license, soliciting comments, motions to intervene, and protests. The notice set February 15, 2021, as the deadline for filing comments on the amended surrender application. An erratum was subsequently issued that set February 16, 2021, as the deadline for filing comments. The following entities and 37 members of the public filed comments in response to the Commission's notice:

Commenting Entity	**Date filed**
California Department of Forestry and Fire Protection	January 14, 2021
Shasta Indian Nation	January 19, 2021
Senators Wyden, Merkley, and Feinstein and Congressman Huffman	January 28, 2021
Copco Lake Fire Protection Board	February 12, 2021
Oregon State Rep. E. Werner Reschke	February 16, 2021
American Whitewater	February 16, 2021
Upper Klamath Outfitters Association	February 16, 2021
California Natural Resources Agency	February 16, 2021
Siskiyou County Water Users Association	February 3, 2021

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[31] The original surrender application was also filed on September 23, 2016, with a number of supplements following that initial filing.

Commenting Entity	**Date filed**
County of Siskiyou, California	February 9, 2021
Del Norte County, California	February 10, 2021
Pacific Coast Federation of Fishermen’s Association	February 10, 2021
Institute for Fisheries Resources	February 10, 2021
Copco Fire Protection District	February 10, 2021
City of Yreka, California	February 11, 2021
Hoopa Valley Tribe	February 11, 2020
Karuk Tribe	February 12, 2021
American Rivers	February 12, 2021
Yurok Tribe	February 12, 2021
County of Humboldt	February 12, 2021
Salmon River Restoration Council	February 16, 2021
Klamath Water Users Association	February 16, 2021
Copco Lake Community Club	February 16, 2021
Whale and Dolphin Conservation	March 9, 2021

Commission staff received additional public comments after the conclusion of the comment period. All comments received in response to the December 16, 2020, notice, are addressed in this draft EIS.

In letters filed March 5, 2021, the Corps (letter dated January 25, 2021) and EPA requested cooperating agency status. On July 13, 2021, the Commission granted cooperating agency status to both the Corps and EPA.

1.4.2 Scoping

On June 17, 2021, the Commission issued a notice of intent to prepare an EIS for the proposed Lower Klamath Project surrender and removal, request for comments on environmental issues, schedule for environmental review, and notice of public virtual scoping sessions. A scoping document (SD1) for the Lower Klamath Project license surrender application was distributed to interested agencies and others on the same date as the notice. The notice was published in the *Klamath Falls Herald and News* on July 2, 2021, and the *Siskiyou Daily News* on July 7, 2021. Four virtual scoping meetings were held on July 20 (two meetings), July 21, and July 22, 2021, where oral comments on the project were sought. A court reporter recorded all comments and statements made at the scoping meetings, and these comments and statements are part of the Commission’s public record for the project.

Any person who was unable to attend a scoping meeting, or desired to provide further comment, was encouraged to submit written comments and information to the Commission by August 19, 2021. In addition to comments provided at the scoping meetings, the following entities and 70 members of the public provided written comments:

Commenting Entity	**Date Filed**
Siskiyou County Water Users	August 16, 2021
Klamath River Renewal Corporation	August 18, 2021
Trout Unlimited and Oregon and California Councils of Trout Unlimited	August 19, 2021
American Whitewater	August 19, 2021
U.S. Department of the Interior	August 19, 2021
Humboldt County	August 19, 2021
Karuk Tribe	August 19, 2021
Upper Klamath Outfitters Association	August 19, 2021
USDA Forest Service	August 19, 2021
State of Oregon Departments of Environmental Quality, Fish and Wildlife, and Water Resources	August 19, 2021
Klamath Water Users Association	August 19, 2021
U.S. Environmental Protection Agency	August 19, 2021
California State Water Resources Control Board	August 19, 2021
California Natural Resources Agency	August 19, 2021
Oregon Wild	August 19, 2021
Orca Salmon Alliance	August 19, 2021
Representative Doug LaMalfa	August 20, 2021
Yreka City	August 20, 2021
Pacific Coast Federation of Fishermen’s Associations and Institute for Fisheries Resources	August 20, 2021
Wildlands Network	August 20, 2021
Yurok Tribe	August 20, 2021
Del Norte County	August 26, 2021
Northern California Council, Fly Fishers International Inc.	November 1, 2021

Commission staff received additional public comments after the conclusion of the initial scoping period. All of the comments received in response to the June 17, 2021, notice, through December 31, 2021, are addressed in the draft EIS.

1.4.3 Interventions

In response to the December 16, 2020, notice, the following entities filed notice of intervention or motions to intervene:

Intervenor	**Date filed**
California State Water Resources Control Board	December 17, 2020
National Marine Fisheries Service	December 18, 2020
Kikaceki Land Conservancy	January 15, 2021
Shasta Indian Nation	January 19, 2021
Christopher Morgan	January 28, 2021
Siskiyou County Water Users Association	February 3, 2021
Mark and Lisa Fischer	February 3, 2021
Patricia Grieb	February 3, 2021
Patricia Utz	February 3, 2021
Loy and John Beardsmore	February 8, 2021
Oregon Water Resources Department	February 9, 2021
Oregon Department of Environmental Quality	February 9, 2021
Oregon Department of Fish and Wildlife	February 9, 2021
Siskiyou County, California	February 9, 2021
Pacific Coast Federation of Fishermen's Association and Institute for Fisheries Resources	February 10, 2021
Copco Fire Protection District	February 10, 2021
Del Norte County, California	February 10, 2021
Susan Miller	February 10, 2021
Barbara Austin	February 11, 2021
City of Yreka, California	February 11, 2021
Chrissie Reynolds	February 11, 2021
U.S. Department of Agriculture, Forest Service	February 11, 2021
Hoopa Valley Tribe	February 11, 2021
Humboldt County, California	February 12, 2021

Intervenor	**Date filed**
Yurok Tribe	February 12, 2021
Oregon Public Utility Commission	February 12, 2021
U.S. Department of the Interior	February 12, 2021
Karuk Tribe	February 12, 2021
American Rivers, California Trout, Northern California Council of Fly Fishers International, Salmon River Restoration Council, Sustainable Northwest, and Trout Unlimited	February 12, 2021
Copco Lake Fire Protection Board	February 12, 2021
Salmon River Restoration Council	February 16, 2021
Nora and Clancy Grant	February 16, 2021
American Whitewater	February 16, 2021
Upper Klamath Outfitters Association	February 16, 2021
Jan and Paris Hamilton	February 16, 2021
Copco Lake Community Club	February 16, 2021
Anthony Intiso	February 16, 2021
California Natural Resources Agency, California Department of Water Resources, and California Department of Fish and Wildlife	February 16, 2021
Klamath Waters Users Association	February 16, 2021
Helen and George Paul	February 16, 2021
Raymond Austin	February 19, 2021
Jerry Bacigalupi	February 22, 2021
Martha and Joseph Guevara	March 1, 2021
Rex Cozzalio	April 5, 2021
Lynda King-Clegg	May 4, 2021
Suzanne Perlick	August 19, 2021
Carole Perlick	August 19, 2021
Robert Perlick	August 19, 2021
Tim Perlick	August 19, 2021
Holly Lacy	August 19, 2021
Lisa D’Aurelio	August 20, 2021

Intervenor	Date filed
Jean Perlick	August 20, 2021
Robert Perlick, Jr.	August 20, 2021
Tim Heying	August 20, 2021
Anette Heying	August 20, 2021

After the conclusion of the intervention period, Commission staff received late motions to intervene, which were all granted pursuant to notices issued by the Commission's Office of the Secretary, and are considered in this draft EIS.

1.4.4 Summary of Comments Received

In addition to the commenting entities listed above, 100 individuals with no agency or non-governmental organization (NGO) affiliation filed comments on the application or scoping comments. In addition, representatives from NMFS, the U.S. Department of the Interior, Fish and Wildlife Service (FWS), Trout Unlimited, Pacific Coast Federation of Fishermen's Associations, Sustainable Northwest, Save California Salmon, Hoopa Valley and Yurok Tribal members, and seven individuals provided verbal comments during the virtual scoping meetings, all supporting dam removal. All of these comments are considered in this draft EIS regardless of intervenor status.

Many alternatives were suggested by commenters, including: (1) providing fish passage with dams in place; (2) removing one or more dams and providing fish passage at the other dams; (3) removing the dams one at a time and assessing the benefits achieved before proceeding to removing the next dam; (4) conducting an experimental drawdown to evaluate the benefits of draining the reservoirs; (5) repurposing the reservoirs for environmental purposes such as providing flushing flows, modifying flows to better support different life stages of salmon, and/or providing flood control; (6) establishing additional reliable storage facilities and implementing juniper removal projects to reduce water loss; (7) increasing flows provided from sources with good water quality; (8) reducing predator abundance, or restricting/banning commercial fishing; (9) building more hatcheries; (10) improving water quality via treatment; and (11) retaining the dams for another 50 years and developing a new plan. We evaluate these alternatives in appendix A, *Alternatives, Information, and Analyses Submitted During Scoping.* We find that many of these approaches would cause additional environmental effects or would face substantial technological, logistical, or regulatory obstacles. In addition, we find that none of these alternatives would meet the need to address the factors that are affecting the Klamath River salmon runs in a timely enough manner to reduce the risk of their extinction.

Commenters also expressed concerns about potential adverse effects of the proposed action. We provide responses to these concerns in appendix A, *Alternatives, Information, and Analyses Submitted During Scoping.* Concerns raised include effects on consumptive water uses, flooding, and navigation; effects on aquatic biota and fisheries, including Chinook salmon, coho salmon, endangered Lost River and shortnose suckers, other fish and wildlife species, and wildlife refuges; the adequacy of measures proposed to restore vegetation on formerly inundated lands; effects on riverine and reservoir-based recreation; effects on local property owners' waterfront access, wells, firefighting/prevention, slope stability, reservoir aesthetics, and property values, as well as effects on traffic, emergency response times, air quality, and noise during deconstruction activities; effects of dewatering on culturally important sites; and socioeconomic effects on disadvantaged communities. We evaluate all of these concerns in this EIS. We find that most of these concerns are adequately addressed by KRRC's proposed management plans, and we recommend modifications to some of the plans to further reduce adverse effects associated with the proposed action.

1.5 TRIBAL CONSULTATION

Efforts to consult with the Tribes began after the filing of the original surrender application on September 23, 2016. By letters dated October 18 and 26, 2017, Commission staff initiated consultation with participating Tribes. This was followed by Tribal consultation meetings held on January 16-19, and on February 5, 2018.[32] Consulted Tribes included the Hoopa Valley Tribe, Karuk Tribe, Yurok Tribe, Klamath Tribes, Modoc Tribe, Quartz Valley Indian Community of the Quartz Valley Reservation of California, Resighini Rancheria, Confederated Tribes of Siletz Indians of Oregon, Trinidad Rancheria, Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes of the Grand Ronde Community of Oregon, Cow Creek Tribes of the Warm Springs Reservation of Oregon, Elk Valley Rancheria (California), Pit River Tribe (California), and the Tolowa Dee-Ni Nation.

By letter filed June 20, 2019, the Yurok Tribe requested a second Tribal meeting with Commission staff. Commission staff accepted the request and, on July 9, 2019,[33] met with representatives of the Yurok Tribe. During the meeting, the Yurok Tribe highlighted the extensive record that already exists on dam removal and expressed concern of the magnitude of fish disease occurring in the Klamath River. The Yurok Tribe reiterated its desire to restore the fishery and to remove the dams. Subsequently, on August 5, 2019, the Yurok Tribe filed comments in support of KRRC's September 2016 surrender application.

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[32] The Tribal consultation meetings were held with the Hoopa Valley Tribe, Karuk Tribe, Quartz Valley Indian Community of the Quartz Valley Indian Reservation of California, Klamath Tribes, Yurok Tribe, and Modoc Nation.

[33] Public notice of this meeting was issued on June 25, 2019. A transcript of the meeting was filed on July 9, 2019.

Upon staff's notice of intent to prepare an EIS, issued on June 17, 2021, the Yurok Tribe once again requested to meet with Commission staff. In this request,[34] the Yurok Tribe requested government-to-government consultation and to meet with the Chairman of the Commission, to discuss: (1) Commission staff's proposed NEPA schedule, its effect on the project timeline for dam removal, and potential ways to streamline the review process; (2) its request to become a cooperating agency; (3) a scheduling Memorandum of Understanding to coordinate federal agency permitting processes; and (4) additional ways the Yurok Tribe may assist Commission staff in its review.

In addition to providing written comments, representatives of the Yurok Tribe participated in virtual scoping sessions hosted by Commission staff. During the July 22, 2021, scoping meeting, the Vice-Chair of the Yurok Tribe, Mr. Frankie Myers, provided comments requesting the Commission expedite the NEPA schedule, rely on the existing record to carry out its analysis, and grant cooperating agency status to the Yurok Tribe.[35]

By letter dated August 23, 2021, the Chairman of the Commission accepted the Yurok Tribe's request for government-to-government consultation. A meeting among representatives of the Yurok Tribe and Commission staff was held on October 11, 2021, to discuss the Yurok Tribe's above-mentioned concerns.

Other correspondence regarding the project, including motions to intervene were received from the Hoopa Valley Tribe (filed October 18, 2017; February 11, 2021; February 26, 2021), the Karuk Tribe (filed February 12, 2021), and the Shasta Indian Nation (filed January 19, 2021). General Tribal positions regarding the project are summarized in appendix K, S*ummary of Tribal Views on Dam Removal*.

Consistent with the Commission's policy statement on consultation with Tribes,[36] the Commission acknowledges that it has a trust responsibility to Tribes and endeavors to work with Tribes on a government-to-government basis to address the effects of proposed projects on Tribal rights and resources through consultation. The Commission's status as an independent regulatory agency places some limitations on the nature and type of consultation that the Commission may engage in during contested proceedings. Nevertheless, the Commission endeavors, to the extent authorized by law, to reduce procedural impediments to working directly and effectively with Tribal governments.

Commission staff considered this Tribal consultation history as well as other comments received by the Tribes in developing this EIS.

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[34] Dated July 21, 2021, and filed on August 31, 2021.

[35] See the transcripts filed on August 5, 2021.

[36] Policy Statement on Consultation with Indian Tribes in Commission Proceedings, Order No. 635, 104 FERC ¶ 61,108 (2003). The policy statement is codified at 18 C.F.R. 2.1c.

2.0 PROPOSED ACTION AND ALTERNATIVES

This draft EIS analyzes the effects of project surrender and decommissioning and recommends conditions for surrender of the project license. We consider three alternatives: (1) the proposed action (KRRC and PacifiCorp's proposal); (2) the proposed action with staff modifications; and (3) no action (continued project operation with no changes). Other alternatives submitted during scoping include options for retaining one or more of the reservoirs with or without implementing various approaches to achieve fish passage; removing the reservoirs sequentially; conducting experimental drawdowns to verify anticipated environmental benefits; altering the operation of the reservoirs to improve flood control or achieve environmental benefits; and implementing alternative methods for achieving water quality objectives including releasing cooler water from other storage facilities, developing additional water storage facilities, reducing predator abundance or restricting commercial fishing, and building more fish hatcheries. We evaluated these alternatives and found that many of these approaches would cause additional environmental effects or would face substantial technological, logistical, or regulatory obstacles. We also found that none of these alternatives would meet the need to address the factors that are affecting the Klamath River salmon runs in a timely enough manner to reduce the risk of their extinction. Our evaluation of the submitted alternatives is provided in appendix A, which also includes a summary of information and analyses submitted during scoping.

2.1 PROPOSED ACTION

2.1.1 Facilities to be Removed, Modified, or Constructed

The action proposed by KRRC and PacifiCorp includes the deconstruction of the J.C. Boyle Dam and Powerhouse, Copco No. 1 Dam and Powerhouse, Copco No. 2 Dam and Powerhouse, and Iron Gate Dam and Powerhouse, as well as associated features. Associated features vary by development but generally include powerhouse intake structures, embankments, sidewalls, penstocks and supports, decks, piers, gatehouses, fish ladders and holding facilities, pipes and pipe cradles, spillway gates and structures, diversion control structures, aprons, sills, tailrace channels, footbridges, powerhouse equipment, distribution lines, transmission lines, switchyards, original cofferdams, portions of the Iron Gate Fish Hatchery, residential facilities, and warehouses. Reservoir drawdown and facility removal would be completed within an approximately 20-month period. The methods to be used during facilities drawdown and removal are described in the revised Definite Plan (filed as appendix A-1) of their November 17, 2020,[37] amended

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[37] Note: Dates shown with hyperlinks provide access to the relevant filing(s).

surrender application, and detailed engineering specifications were filed as CEII[38] on February 26, 2021.

While most of the construction work would occur within the project boundary, some would take place outside the project boundary. Specific instances of work to be performed outside the project boundary include: (1) road surface improvements prior to, during, and after construction (Copco Road, Ager-Beswick Road, and Daggett Road); and (2) bridge strengthening to increase load-bearing capacity due to anticipated construction vehicle loads (Copco Road bridge over Fall Creek and Copco Road bridge over Dry Creek). Section 2.1.1.2 discusses the proposed road, culvert, and bridge modifications to be conducted within and outside the project boundary.

2.1.1.1 Laydown Areas

Laydown/staging areas are proposed near J.C. Boyle Dam, J.C. Boyle Canal Spillway, J.C. Boyle Powerhouse, Copco No. 1 Dam and Powerhouse, Copco No. 2 Powerhouse, and Iron Gate Dam and Powerhouse. The location of these areas is shown in the Construction Management Plan in the Oregon Traffic Management Plan (appendix A) in figures B2 and B3 and in the California Traffic Management Plan (appendix B) in figures C2 and C3.

2.1.1.2 Road, Culvert, and Bridge Modifications

A variety of roadwork improvements and modifications are proposed to accommodate the anticipated increased construction traffic and heavy equipment movement on local roads. This work includes roadway surface modifications and improvements, culvert replacements, bridge reinforcements to accommodate heavy equipment with increased live loads, and bridge abutment monitoring after drawdowns are completed to check for erosion scour. These modifications are detailed in the Oregon Traffic Management Plan in table 3-1 (Potential Roadway and Access Improvements) and in the California Traffic Management Plan in table 3-1 (Preemptive Roadway Work), table 3-2 (Potential Roadway and Access Improvements), table 3-3 (Detailed Copco Road Potential Construction Improvements), and table 3-4 (Existing Bridge Status and Proposed Actions). Roadwork would occur on Green Springs Highway (Oregon 66), Keno Worden Road, Topsy Grade Road, J.C. Boyle Dam Access Road, J.C. Boyle Powerhouse Road, J.C. Boyle Disposal Access Road, Copco Road, Ager Road, Ager-Beswick Road, Copco Access Road, Mirror Cove Boat Ramp Access Road, and Daggett Road. Culvert replacement would occur for Scotch Creek, Camp Creek, and Fall Creek. Bridge abutment scour monitoring would occur for the Spencer Bridge, Copco Road

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[38] CEII is information related to or proposed to critical electric infrastructure, generated by or provided to the Commission or other Federal agency other than classified national security information, that is designated as critical electric infrastructure information by the Commission or the Secretary of the Department of Energy pursuant to section 215A(d) of the FPA.

Bridge near the Copco Lake Fire Department on the eastern side of Copco Reservoir, and Jenny Creek Bridge. The timber bridge downstream of J.C. Boyle Dam would be removed after construction is complete. The Dry Creek Bridge and Fall Creek Bridge at Copco Road would be temporarily strengthened to accommodate increased live loads during construction. The Daggett Road Bridge would be replaced with a new modular steel bridge located upstream of the existing bridge.

2.1.1.3 Recreational Facility Removals and/or Modifications

Many existing recreational facilities would be removed once the reservoirs are drawn down because the recreational use would shift from reservoir-based activities to riverine uses. Details of the disposition of the recreational facilities currently associated with the project are contained in the Recreation Facilities Plan (KRRC, 2021a, table 4-1, *Future Disposition of Recreational Sites within the FERC Project Boundary*). Facilities that would be completely removed include Pioneer Park East, Pioneer Park West (with the exception of the parking lot), Mallard Cove, Copco Cove, Overlook Point, Wanaka Springs Day Use Area, Camp Creek Day Use Area and Campground, Juniper Point Day Use Area and Campground, Mirror Cove Day Use Area and Campground, Jenny Creek Day Use Area and Campground, and Long Gulch Day Use Area and Campground.

Most of the facilities, but not all, would be removed at the Topsy Campground and Fall Creek Day Use Area. At some of those sites, some recreational improvements or additions may be implemented, and the sites would continue to be used for recreational purposes. A new Pioneer Park West Recreation Area, tailored to riverine-based recreational use activities, may be constructed in the vicinity of the impoundment-based recreational facilities that are being removed (see section 2.1.2.13 below). A portion of the Falls Creek Trail would be rerouted due to upgrades at the Fall Creek Hatchery.

Boat launches would be removed at the Topsy Campground, Mallard Cove, Copco Cove, Camp Creek, Mirror Cove, and Long Gulch sites. The river access ramp at the Fall Creek site would be improved, and a new river access ramp would be installed at the Iron Gate Hatchery Day Use Area, which would be retained. The existing non-project boat launches at Keno Dam located upstream of J.C. Boyle Reservoir and the KRCE Campground and Klamathon Bridge boat launches located downstream of Iron Gate Dam would remain as active launch sites.

Dry hydrants would be installed at the site of the future relocated Pioneer Park West Recreation Area, and at Deer Creek, Beaver Creek, Fall Creek Trail, and the Jenny Creek Day Use Area site.

2.1.2 Proposed Environmental Measures

The proposed action includes measures to restore land occupied by existing facilities and reservoirs and to minimize adverse effects on environmental resources, which are detailed in the 16 management plans listed in table 2.1-1 and described below. These plans were initially filed on February 26, 2021, and in that filing KRRC notes that it has continued to consult with the relevant agencies to refine its management plans to address the requirements of the WQCs, and filed a revised version of 15 of the 16 management plans on December 14, 2021, documenting changes made as an outcome of consultation to date, and committing to ongoing consultation to further refine the management plans. KRRC intends to file an updated Historic Properties Management Plan (HPMP) by March 31, 2022.

While most of the work proposed in the management plans would occur within the project boundary, some work would occur outside the boundary. This work includes: (1) road work discussed in section 2.1.2 (above) and section 2.1.2.2 (below) as detailed in the Oregon and California Transportation Management Plans; (2) modifications to the Fall Creek Hatchery as discussed in section 2.1.2.10 as detailed in the Hatchery Management and Operation Plan; (2) installation of new dry hydrants along Iron Gate/Copco Road at Jenny Creek and Fall Creek and along Copco Road at Beaver Creek and Deer Creek as discussed in section 2.1.2.15 and detailed in the Fire Management Plan (FMP); and (3) installation of a fire monitoring detection system that includes the installation of new detection cameras at two existing fire outlook posts and installation of cameras at two new sites as discussed in section 2.1.2.15 and detailed in the FMP.

Table 2.1-1. Management plans and subplans proposed for implementation by KRRC (Source: staff)

Management Plan	**Subplan(s)**
Reservoir Drawdown and Diversion Plan (Exhibit K)	Appendix A - California Reservoir Drawdown and Diversion Plan Appendix B - California Slope Stability Monitoring Plan Appendix C - Oregon Reservoir Drawdown and Diversion Plan
Construction Management Plan (Exhibit B)	Appendix A - Oregon Traffic Management Plan Appendix B - California Traffic Management Plan Appendix C - Emergency Response Plan Appendix D - Use and Occupancy Plan for Bureau of Land Management Lands Appendix E - Construction Camp Plan
Health and Safety Plan (Exhibit E)	Appendix B - Site Specific Health and Safety Plan Appendix C - Public Safety Plan
Remaining Facilities Plan (Exhibit I)	Appendix A - California Remaining Facilities Plan Appendix B - Oregon Remaining Facilities and Operations Plan

Management Plan	**Subplan(s)**
Erosion and Sediment Control Plan (Exhibit C)	Appendix A - Oregon Erosion and Sediment Control Plan
Waste Disposal and Hazardous Materials Management Plan (Exhibit N)	Appendix A - California Hazardous Materials Management Plan Appendix B - California Waste Disposal Plan Appendix C - Oregon Waste Disposal and Hazardous Materials Management Plan Appendix D - Oregon Spill Prevention, Control, and Countermeasure Plan
Water Quality Monitoring and Management Plan (Exhibit O)	Appendix A - Oregon Water Quality Management Plan Appendix B - California Water Quality Monitoring Plan Appendix C - Quality Assurance Project Plan
Sediment Deposit Remediation Plan (Exhibit L)	Appendix A - California Sediment Deposit Remediation Plan Appendix B - Del Norte Sediment Management Plan
Aquatic Resources Management Plan (Exhibit A)	Appendix A - Spawning Habitat Availability Report and Plan Appendix B - California AR-6 Adaptive Management Plan-Suckers Appendix C - Fish Presence Monitoring Plan Appendix D - Tributary-Mainstem Connectivity Plan Appendix E - Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan Appendix F - Oregon AR-6 Adaptive Management Plan-Suckers
Hatcheries Management and Operations Plan (Exhibit D)	Appendix C - Water Quality Monitoring and Protection Plan
Reservoir Area Management Plan (Exhibit J)	Appendices B through M provide discussions of a variety of associated topics
Terrestrial and Wildlife Management Plan (Exhibit M)	Appendix A - California Terrestrial and Wildlife Management Plan Appendix B - Oregon Terrestrial and Wildlife Management Plan

Management Plan	Subplan(s)
Recreation Facilities Plan (Exhibit H)	No subplans
Historic Properties Management Plan (Exhibit F - filed February 26, 2021)	Appendix C - Monitoring and Inadvertent Discovery Plan Appendix D - Looting and Vandalism Prevention Plan
Water Supply Management Plan (Exhibit P)	Appendix A - California Water Supply Management Plan Appendix B - California Public Drinking Water Management Plan Appendix C - Oregon Groundwater Well Management Plan Appendix D - Fire Management Plan
Interim Hydropower Operations Plan (Exhibit G)	Appendix A - Agreement for Operation and Maintenance

Note: The current versions of the plans were filed on December 14, 2021, except for the HPMP, which was not included in that filing; KRRC intends to file a revised version of the HPMP by March 31, 2022.

2.1.2.1 Reservoir Drawdown and Diversion Plan (Exhibit K)

The Reservoir Drawdown and Diversion Plan outlines the proposed drawdown methods, procedures, schedules, and monitoring efforts included as part of the proposed action. The Reservoir Drawdown and Diversion Plan includes the following subplans: California Reservoir Drawdown and Diversion Plan (appendix A); California Slope Stability and Monitoring Plan (appendix B); and Oregon Reservoir Drawdown and Diversion Plan (appendix C). Although the subplans are state-specific, the overall plan applies to both states. The subplans plans are discussed in the following section.

California and Oregon Reservoir Drawdown and Diversion Plans

The California and Oregon Reservoir Drawdown and Diversion Plans describe the proposed drawdown methods, procedures, schedules, and monitoring measures that KRRC would implement to accomplish drawdown of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Reservoirs as part of the proposed action. The plans describe: (1) minimum flows to be maintained below Iron Gate Dam; (2) deconstruction activities to be performed prior to drawdown; (3) maximum drawdown rates; (4) discharge capacities of outlet works and spillways to be used during drawdown; (5) the results of slope stability analyses for each reservoir; (6) descriptions of drawdown and diversion procedures; (7) implementation schedules; (8) flood frequency analyses; (9) projected variations in reservoir levels during drawdown under a range of hydrological conditions;

(10) methods to be used for reservoir level and slope stability monitoring; and (11) post-drawdown activities.

California Slope Stability Monitoring Plan

The California Slope Stability Monitoring Plan identifies reservoir slopes and other areas within the limits of work in California prone to instability and describes KRRC's proposed methods for monitoring for instability during drawdown and dam removal under the proposed action. The subplan also describes KRRC's measures to address instability and discharges that violate water quality standards. KRRC's measures are also intended to protect private property, structures, and cultural sites.

2.1.2.2 Construction Management Plan (Exhibit B)

The Construction Management Plan describes measures KRRC proposes to implement as part of the construction phase. The plan includes the following subplans: Oregon Traffic Management Plan (appendix A); California Traffic Management Plan (appendix B); Emergency Response Plan (appendix C); Use and Occupancy Plan for BLM Lands (appendix D); and Construction Camp Plan (appendix E). As the plan titles indicate, the traffic management plans are state-specific. The Emergency Response and Construction Camp plans apply to both states. The Use and Occupancy Plan only applies to BLM lands in California.

The traffic plans for each state were developed to maintain efficient and safe movement of vehicles throughout the construction zones and construction activities in each state. Implementation of the plans is intended to prevent unreasonable traffic delays and maintain acceptable levels of service; traffic circulation; and safety on state, county, and private roadways used during construction.

The purpose of the Emergency Response Plan is to define roles, responsibilities, and procedures to be followed in the event of an emergency during implementation of the proposed action. The plan is intended to minimize hazards to employees, the public or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous materials, waste or constituents to air, soil, surface water or groundwater. The plan was designed to incorporate flexibility to tailor an appropriate response to meet a particular emergency.

The Use and Occupancy Plan for BLM Lands defines coordination requirements, responsibilities, and procedures to be followed on federal lands administered by BLM that are located in the State of California, during implementation of the proposed action. The plan characterizes expectations for construction activities along BLM land and roads. The plan was designed to incorporate BLM guidelines that KRRC would meet prior to, during, and after construction.

The Construction Camp Plan designates the camp locations for temporary offices, housing, laydown areas, and storage facilities, as well as the approximate arrangement planned as part of the proposed action.

2.1.2.3 Health and Safety Plan (Exhibit E)

The Health and Safety Plan identifies measures related to risks, contractor coordination, site security, traffic, pedestrian management, training requirements, and accident and incident reporting that KRRC proposes to implement as part of the proposed action. The plan includes the following subplans: Site Specific Health and Safety Plan (appendix B) and Public Safety Plan (appendix C). Appendix A includes KRRC construction safety policies for KRRC employees and project contractors employed by KRRC to implement the proposed action. The overall plan and subplans apply to activities in both states.

The site-specific plan details health and safety concerns that may vary from site to site. The Public Safety Plan describes the type of hazards and identifies measures KRRC would implement to reduce the risk of injury to the public as a result of the proposed action. The plan is intended to provide an important reference resource for on-site personnel to implement the measures as well as monitor their continued effectiveness during construction. The plan also provides the necessary accident and incident reporting protocols required by 18 C.F.R. pt. 12.

2.1.2.4 Remaining Facilities Plan (Exhibit I)

The Remaining Facilities Plan identifies measures that KRRC proposes to implement to protect water quality conditions associated with non-operational structures that would remain on-site following completion of the proposed action. The plan includes two subplans: California Remaining Facilities Plan (appendix A) and Oregon Remaining Facilities Plan (appendix B). The overall plan applies to facilities in both states.

Although most of the existing physical project facilities would be removed, some facilities are planned to remain in their entirety or partially. The state-specific plans list the facilities to remain in some form once the proposed work is complete in each state, the extent to which those facilities would remain, and the final site conditions surrounding those facilities. The plans also describe measures to be taken to control erosion and sediment transport in the vicinity of the remaining facilities and surveys of any hazardous materials associated with those facilities.

2.1.2.5 Erosion and Sediment Control Plan (Exhibit C)

The Erosion and Sediment Control Plan identifies best management practices (BMPs) that KRRC proposes to implement to minimize pollution from sediment erosion caused by removal of the facilities and restoration activities. The plan includes one subplan: Oregon Erosion and Sediment Control Plan (appendix A). The overall plan applies to lands in both states.

The overall plan identifies BMPs to address potential effects associated with implementing the proposed action. KRRC has established, and would implement, erosion and sediment control BMPs to minimize pollution from sediment erosion caused by facilities removal and restoration activities. The Oregon subplan identifies measures KRRC would implement to minimize erosion and sediment runoff to protect water quality at disposal sites. The Oregon Erosion and Sediment Control Plan measures are limited to the following disposal sites associated with the J.C. Boyle Development: Scour Hole Disposal Site; Left Bank Disposal Site; Right Bank Disposal Site; and the J.C. Boyle Powerhouse and Tailrace Disposal Site.

2.1.2.6 Waste Disposal and Hazardous Materials Management Plan (Exhibit N)

The Waste Disposal and Hazardous Materials Management Plan identifies measures that KRRC proposes to implement to manage hazardous and solid wastes. The overall plan applies to facilities in both states, while the subplans are state-specific. The plan includes the following subplans: California Hazardous Materials Management Plan (appendix A); California Waste Disposal Plan (appendix B); Oregon Waste Disposal and Hazardous Materials Management Plan (appendix C); and Oregon Spill Prevention, Control, and Countermeasure Plan (appendix D).

The overall plan describes measures to manage the disposal of solid and hazardous wastes that KRRC would implement as part of the proposed action. The state-specific plans address hazardous waste management according to each state's regulations.

2.1.2.7 Water Quality Monitoring and Management Plan (Exhibit O)

The Water Quality Monitoring and Management Plan describes the measures that KRRC proposes to implement to confirm when exceedances of water quality standards caused by the proposed action have ceased. The plan includes three subplans: Oregon Water Quality Management Plan (appendix A); California Water Quality Monitoring Plan (appendix B); and Quality Assurance Project Plan (appendix C). The Quality Assurance plan applies to both states. Collectively, these plans include provisions for: (1) continuous monitoring of temperature, conductance, pH, dissolved oxygen, turbidity, and river flow; (2) collection and analysis of water quality grab samples; (3) sediment sampling for 17 potential contaminants pre-drawdown at sites not previously monitored and post-drawdown; (4) sediment survey mapping following drawdown at J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs; and (5) bathymetric surveys from Iron Gate Dam site to Cottonwood Creek 12- and 24 months following drawdown. Table 2.1-2 provides the proposed locations for continuous monitoring, grab sampling, and sediment quality sampling. Table 2.1-3 provides the constituents, frequency, and schedule for this sampling.

Table 2.1-2. Proposed continuous water quality monitoring, water grab sampling, and sediment grab sampling locations (Source: KRRC, 2021b, as modified)

		Water Quality Grab Sampling			
Location	**Continuous Water Monitoring**[a]	**General Parameters**	**Suspended Sediment**	**Other**	**Sediment Grab Sampling**[b]
Klamath River 1.3 miles below Keno Dam (at USGS gage no. 11509500)	OR/CA	OR/CA	OR	OR/CA	---
Klamath River 5 miles below J.C. Boyle Dam (at USGS gage no. 11510700)	OR/CA	OR/CA	OR	OR/CA	---
Klamath River upstream of Copco No. 1 Reservoir, downstream of Shovel Creek	---	CA	CA	CA	CA: Pre/Post
Three locations in the Copco No. 1 Reservoir footprint	---	---	CA	---	CA: Reclamation/Post [c]
Klamath River downstream of Copco No. 2 Powerhouse [d]	CA	CA	CA	CA	CA: Pre/Post
Three locations in the Iron Gate Reservoir footprint	---	---	CA	---	CA: Reclamation/Post [c]
Iron Gate fish hatchery day use area recreation site (modified)	---	---	---	---	---
Klamath River at USGS gage no. 11516530 below Iron Gate Dam	CA	CA	CA	CA	CA: Pre/Post [e]
Klamath River at or near Walker Bridge [f]	CA	---	---	---	---

		Water Quality Grab Sampling			
Location	**Continuous Water Monitoring**[a]	**General Parameters**	**Suspended Sediment**	**Other**	**Sediment Grab Sampling**[b]
Klamath River at USGS gage no. 11520500 near Seiad Valley	CA	CA	CA	CA	---
Klamath River at or near USGS gage no. 11523000 at Orleans	CA	CA	CA	CA	CA: Pre/Post [e]
Klamath River at or near USGS gage no. 11530500 near Klamath	CA	CA	CA	CA	---/---
Klamath Estuary	CA	CA [g]	CA	CA	CA: Reclamation/Post[g]

Notes: Klamath River; OR indicates sampling location per Oregon Water Quality Management Plan; CA indicates sampling location per California Water Quality Monitoring Plan; --- indicates not applicable.

[a] The six gage sites would automatically transmit and store data in an online database, and the data at the other three sites would be downloaded monthly.

[b] “Pre” indicates pre-drawdown, “Post” indicates post-drawdown; U.S. Bureau of Reclamation (Reclamation) indicates existing conditions (pre-drawdown) were previously sampled by Reclamation in 2009 and 2010 (Benninger et al., 2011); therefore, pre-drawdown sampling is not needed.

[c] If terracing does not occur at the previously sampled location, move sample location to a location with terraced sediments.

[d] At or upstream of the Klamath River Daggett Road Bridge crossing, which is about 0.4 mile downstream of Copco No. 2 Powerhouse.

[e] At or near the USGS gage.

[f] Walker Bridge is just downstream of the town of Klamath River, California.

[g] Five sample locations with two in the upper estuary and three in the marine-dominated estuary to match previously sampled locations by Reclamation (Benninger et al., 2011).

Table 2.1-3. Proposed water quality sampling regime constituents, frequency, and schedule (Source: KRRC, 2021b, as modified)

Sampling Regime	Constituents	Frequency and Schedule
Continuous Water Monitoring	Water temperature, conductance, pH, dissolved oxygen (concentration and percent saturation), turbidity, (and river flow at OR sites)	15-minute intervals from at least one year prior to drawdown until the applicable regulatory agencies approve the KRRC's request to discontinue monitoring.[a]
Water Quality Grab Sampling	General parameters: nitrogen (ammonia, nitrate, nitrite, and total), phosphorus (orthophosphate, particulate organic, and total), carbon (dissolved organic and particulate) at all sites; settleable solids, and turbidity at all CA sites; methylmercury only at sites downriver from Copco No. 1 Dam site[b]; and aluminum (particulate and dissolved) only at sites downstream of the Iron Gate Dam. [c]	Monthly at about the same time of day from at least one year prior to drawdown until the applicable regulatory agencies approve the KRRC's request to discontinue monitoring.[a,d]
	Suspended sediment concentrations	OR: Every two weeks for at least one year prior to initiation of drawdown through September of the drawdown year then monthly until the applicable regulatory agencies approve the KRRC's request to discontinue monitoring.[a,d] CA: Monthly for at least one year prior to initiation of drawdown, then every two weeks until the applicable regulatory agencies approve the KRRC's request to discontinue monitoring.[a,d]

Sampling Regime	Constituents	Frequency and Schedule
	Other: chlorophyll-*a* (OR & CA), microcystin (CA only)	OR: Same as general parameters above.[a,d] CA: Monthly beginning May 1 following initiation of drawdown, continuing annually (May–October) until the applicable regulatory agencies approve the KRRC's request to discontinue monitoring.[a,d]
Sediment Grab Sampling	Arsenic, lead, copper, nickel, iron, aluminum, dioxin, cyanide, mercury, ethyl benzenes, total xylenes, Dieldrin, DDT (4,4'-dichlorodiphenyltrichloroethane), DDD (4,4'-dichlorodiphenyldichloroethane), TCDD (2,3,7,8-tetrachlorodibenzodioxin), DDE (4,4'-dichlorodiphenyldichloroethylene), and PECDF (2,3,4,7,8-pentachlordibenzofuran)	Prior to drawdown (if not previously sampled by Reclamation) and within 12 to 24 months of completion of drawdown.

Notes: OR indicates sampling location per Oregon Water Quality Management Plan; CA indicates sampling location per California Water Quality Monitoring Plan.

[a] KRRC proposes to conduct the continuous monitoring and the water quality grab sampling at Oregon (OR) sites for 48 months following the initiation of drawdown and at California (CA) sites for 36 months following the initiation of drawdown.

[b] Only sample sites from Klamath River downstream of Copco No. 2 Powerhouse through Klamath Estuary.

[c] Only sample sites from Klamath River USGS gage below Iron Gate Dam to Klamath Estuary.

[d] Attempt to collect the samples at about the same time of day each month.

2.1.2.8 Sediment Deposit Remediation Plan (Exhibit L)

The Sediment Deposit Remediation Plan identifies the measures KRRC proposes to implement to monitor the deposition of sediments along the Klamath River, immediately north and south of the Klamath estuary, and at the Crescent City Harbor. The Sediment Deposit Remediation Plan includes the following subplans: California Sediment Deposit Remediation Plan (appendix A) and Del Norte Sediment Management Plan (appendix B).

California Sediment Deposit Remediation Plan

The California Sediment Deposit Remediation Plan describes the measures KRRC proposes to implement to assess and remediate sediment deposits attributed to reservoir drawdown activities along the Klamath River from Iron Gate Dam to the mouth of the Klamath estuary. KRRC would assess sediment deposits on parcels with a current or potential residential or agricultural land use, for which the property owner has notified KRRC of a sediment deposit that may be associated with reservoir drawdown activities. If the deposit appears to be consistent with the physical sediment properties of project reservoirs, KRRC would test sediment for arsenic to compare with background levels in the vicinity or remediate the deposits without testing. If the concentration of arsenic in the deposited sediments exceeds local background levels and human health residential screening levels established by EPA or the California EPA, KRRC would remediate the deposited sediments to local background levels through removal of the deposited sediments or soil capping, if sediment removal is infeasible or poses a greater risk than soil capping.

If a reported sediment deposit does not require remediation, KRRC would notify the property owner and submit a report to the Commission and the California Water Board. At a minimum, the report would include location of reported deposit, a summary of actions taken, and support for determination that no further action is needed.

If a reported sediment deposit requires remediation, KRRC would submit a remediation plan to the California Water Board within 14 days for review and approval. KRRC would provide a report to the property owner, the Commission, and the California Water Board within 30 days of completing remediation activities. The report would include the location of the remediation, a summary of action(s) taken, including the quantity of soil removed or area capped, and support for the determination that no further remediation is needed.

Del Norte Sediment Monitoring Plan

The Del Norte Sediment Management Plan describes the methodology and procedures KRRC proposes to implement within Del Norte County to quantify the potential effects of sediment releases during the proposed action and establish the measures it would implement to address those effects.

To quantify the potential effects on Crescent City Harbor from the proposed action, KRRC proposes to monitor the movement of sediment between the mouth of the Klamath River and the harbor by: (1) conducting baseline bathymetric surveys prior to drawdown; (2) monitoring ocean currents during drawdown; and (3) conducting bathymetric surveys after drawdown. If KRRC determines that the proposed action has adversely affected Crescent City Harbor, it would bear the proportional and incremental cost incurred by the County and/or the Harbor District of dredging and removing such sediment.

The costs of performing quantitative sedimentation monitoring at the Lower Klamath River boat ramps of Township and Roy Rook would exceed the costs to maintain the ramps by removing sediment. Therefore, KRRC would make the conservative assumption that sediment deposited during the drawdown year and the following year is a result of the proposed action. KRRC would pay $3,500 per boat ramp per year for maintenance and sediment removal during the drawdown year and the following year, for a total cost not to exceed $14,000.

2.1.2.9 Aquatic Resources Management Plan (Exhibit A)

The Aquatic Resources Management Plan describes the following measures KRRC proposes to implement to manage aquatic resources in a manner that is consistent with the overall goals and objectives of the proposed action. The plan includes the following subplans: Spawning Habitat Availability Report and Plan (appendix A); California AR-6 Adaptive Management Plan-Suckers (appendix B); Fish Presence Monitoring Plan (appendix C); Tributary-Mainstem Connectivity Plan (appendix D); Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan (appendix E); and Oregon AR-6 Adaptive Management Plan-Suckers (appendix F). As noted in the titles, some of the subplans are state-specific; the overall plan applies to both states. The following sections discuss the subplans.

KRRC would assemble an Aquatic Resources Group for the purpose of consultation on implementing the Aquatic Resources Management Plan. The work group would include representatives from KRRC, California DFW, Oregon DFW, NMFS, FWS, the California Water Board, the BLM-Klamath Falls Field Office, the Yurok Tribe, the Karuk Tribe, and the Klamath Tribes. Each member would designate a lead who would represent it at work group meetings and serve as its primary contact for all related matters.

Updated Spawning Habitat Availability Report and Plan

KRRC would conduct field surveys and remote sensing efforts prior to and following reservoir drawdown to evaluate and quantify the amount of spawning habitat available to adult anadromous salmonids. KRRC would conduct initial foot surveys on Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek and with an unmanned aerial vehicle surveys (and if necessary, boat and/or global positioning system surveys) on the mainstem Klamath River between Iron Gate Dam (river mile [RM] 193.1) and Keno Dam (RM 239.2).

During the initial tributary survey, KRRC would survey Shovel and Spencer Creeks from their mouths upstream for 2 miles, and Jenny and Fall Creeks from their mouths upstream to the first natural fish passage barrier. If the target tributary spawning habitat quantity of 4,700 square yards is documented at any time during the initial tributary survey, the survey would cease and be considered completed. If the initial survey does not result in the identification of 4,700 square yards of spawning habitat, KRRC would conduct a follow-up survey of the remainder of Shovel and Spencer Creeks upstream to the first natural barrier. If the tributary target is still not met after the follow-up survey, KRRC would survey additional tributaries within the hydroelectric reach that are anticipated to support steelhead following dam removal. These tributaries include Camp, Scotch, Dutch, Deer, and Beaver Creeks.

For the Klamath River and each tributary surveyed, KRRC would update the Spawning Habitat Availability Report and Plan to include a summary description of survey conditions, typical reach characteristics, total spawning habitat available, and any human-made fish migration barriers encountered during the survey. Data collected on each individual spawning habitat patch documented during the surveys, including patch dimensions, area, and spatial location information would be included in an appendix.

If, based on the surveys, one or more of the plan’s target metrics have not been met, KRRC would, in consultation with the Aquatic Technical Work Group, determine if gravel augmentation or other actions to improve spawning and rearing habitat are appropriate.

Listed Sucker Salvage

KRRC implemented a sucker sampling program in coordination with FWS, Oregon Department of Fish and Wildlife (Oregon DFW), California Department of Fish and Wildlife (California DFW), and U.S. Department of Interior, Geological Survey (USGS) from 2018 through 2020 in the J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs. Sampling involved placing trammel nets in the reservoirs; electrofishing was used in the Klamath River reaches entering the reservoirs and to augment trammel net sampling.

Based on population estimates and collection efficiencies from this sampling program, KRRC developed its approach for translocating listed suckers from the project reservoirs to other suitable habitats. Prior to reservoir drawdown, KRRC would capture adult listed suckers in J.C. Boyle Reservoir using similar methods as those employed for the sampling effort. KRRC would then translocate these captured suckers to the Klamath National Fish Hatchery, the Klamath Tribe’s sucker rearing facility, Tule Lake Sump 1a, and possibly other translocation sites that may be identified based on further planning and agreement with FWS, Oregon DFW, California DFW, and KRRC.

KRRC anticipates salvaging up to 300 listed suckers from J.C. Boyle Reservoir over 7 days based on sampling catch efficiencies. The 300 listed suckers would equate to between 11 and 35 percent of the mean population estimates calculated for J.C. Boyle Reservoir.

In addition, KRRC anticipates salvaging up to 300 listed suckers from Copco No. 1 Reservoir (also known as Copco Lake) and Iron Gate Reservoir over 7 days based on sampling catch efficiencies. The 300 listed suckers would equate to between 8 and 22 percent of the mean population estimates calculated for Copco No. 1 and Iron Gate Reservoirs.

Anadromous Fish Presence Monitoring

KRRC would monitor anadromous fish presence within the hydroelectric reach of the project following dam removal. Fish presence monitoring would be conducted at: (1) the Camp-Scotch Creek complex, Jenny Creek, and Beaver Creek channel lengths within the former reservoir footprints; and (2) the mainstem Klamath River from RM 291.6 to the confluence with Shovel Creek.

Tributary-Mainstem Connectivity Monitoring

Fish passage barriers may develop within and downstream of the hydroelectric reach as a result of sediment evacuation during reservoir drawdown and dam removal, or after dam removal when the Klamath River flows freely allowing for active sediment transport of residual reservoir sediments. KRRC predicts up to 1.5 feet of sediment would be deposited in the Klamath River from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1) following reservoir drawdown based on hydraulic and sediment transport modeling completed by the U.S. Bureau of Reclamation (Reclamation). Areas downstream of Cottonwood Creek are expected to have only minor deposition with deposits less than 0.25 feet.

KRRC would monitor fish passage and potential fish barrier formation along the 8-mile reach of the mainstem Klamath River from the downstream side of the Iron Gate Dam footprint (RM 193.1) to Cottonwood Creek (RM 185.1), at the confluence locations of the five fish-bearing streams within the reach (Bogus, Dry, Little Bogus, Willow, and Cottonwood Creeks), and at the Shovel Creek confluence with the Klamath River upstream of Copco No. 1 Reservoir. In dam removal year 2, monitoring would occur in the spring and after drawdown has been completed. Monitoring would also be conducted in the fall of dam removal years 2 and 3, “after the rainy season” (likely between June 15 and July 31, depending on weather forecasts) in years 3 and 4. Additional monitoring would be conducted following the first five-year or greater flow event to occur following drawdown if such event occurs within five years of drawdown.

If fish passage barriers are identified, KRRC would use the adaptive management framework set forth in section 6.2.9 of the Reservoir Area Management Plan to interpret monitoring data and take adaptive management actions, including the correction of tributary confluence blockages, when necessary.

Juvenile Salmonid Relocation

Based on monitoring data and criteria specified in the Juvenile Salmonid Relocation, KRRC would determine if capture and relocation efforts are required. KRRC would monitor: (1) suspended sediment concentrations (SSCs) in the mainstem Klamath River using two USGS water quality monitoring gages[39]; and (2) water temperature at 13 tributary confluences[40] using underwater temperature data loggers. Additionally, KRRC staff would record observations of fish in the tributary and the thermal mixing zone, (i.e., thermal refugia) when temperature loggers are being offloaded at each of the tributaries. The observations would focus on estimated fish densities and fish behavior, including lethargy; increased agonistic behavior; excessive gill flaring; unusual swimming patterns; and visible signs of disease, injury, or mortality.

If a decision would be made to capture and relocate juvenile salmonids, KRRC would relocate collected juvenile salmonids to suitable relocation sites based on the species, life stage, and location of collection. KRRC would use seines, backpack electrofishing equipment, and fyke nets as its primary fish capture equipment.

Relocation sites were selected for each tributary in consultation with the Aquatic Technical Work Group.[41] If necessary, KRRC would select additional relocation sites, in consultation with the Aquatic Resources Group, based on the criteria used to identify the initial relocation sites. If capture and relocation would be warranted, KRRC would perform a reconnaissance survey of the identified relocation site(s) prior to relocation to ensure habitat conditions and capacity are suitable for the anticipated number of relocated fish.

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[39] Suspended sediment would be monitored at the USGS Klamath River Below Iron Gate Dam CA gage (No. 11516530) and USGS Klamath River Near Seiad Valley CA gage (No. 11520500).

[40] The following tributaries would be monitored: Seiad Creek (RM 131.9), Grider Creek (RM 132.1), Walker Creek (RM 135.2), O’Neil Creek (RM 139.1), Tom Martin Creek (RM 144.6), Scott River (RM 145.1), Horse Creek (RM 149.5), Beaver Creek (RM 163.3), Humbug Creek (RM 173.9), Shasta River (RM 179.3), Cottonwood Creek (RM 185.1), Dry Creek (RM 190.9), and Bogus Creek (RM 192.6).

[41] KRRC assembled an Aquatic Technical Work Group during development of the Aquatic Resources Management Plan, consisting of fisheries scientists from California DFW, Oregon DFW, NMFS, FWS, the California Water Board, BLM, the Yurok Tribe, and the Karuk Tribe.

2.1.2.10 Hatcheries Management and Operations Plan (Exhibit D)

The purpose of the Hatcheries Management and Operation Plan is to provide capacity for fish propagation during dam removal and for repopulation of new habitat, using appropriate fish stocks, when dam removal is complete. The plan describes KRRC's plans to construct, modify, operate, maintain, and transfer ownership of the Fall Creek Hatchery Facility, while retiring Iron Gate Hatchery. There is one subplan: Water Quality Monitoring and Protection Plan (appendix C). The hatcheries are both located in California.

KRRC would construct upgraded facilities at the Fall Creek Hatchery Facility, and California DFW would operate the hatchery. KRRC expects that California DFW would continue to operate the Fall Creek Hatchery Facility for eight years following Iron Gate Dam removal, pursuant to the KHSA. The hatchery design is 100 percent complete, and production goals are shown in table 2.1-4.

Table 2.1-4. Fall Creek Hatchery fish production goals (Source: Hatcheries Management and Operations Plan filed on February 26, 2021)

Species (Juvenile Life History)	Adult Return Date[a]	Incubation Start Date	Incubation Start Number	Target Release Dates	Release Number	Release Size (Fish per Pound)
Coho (yearling)	Oct–Dec	Oct–Mar	120,000	Mar 15–May 1	75,000	10
Chinook (smolts)	Oct–Dec	Oct–Mar	4.5 million[b]	Pre-Mar 31	1,250,000	520
Chinook (smolts)	Oct–Dec	Oct–Mar	--	May 1–June 15	1,750,000	90–100
Chinook (yearling)	Oct–Dec	Oct–Mar	--	Oct 15–Nov 20	250,000	10

[a] Adult trapping period from Iron Gate Fish Hatchery data.

[b] Estimated total green egg requirement at spawning.

The Iron Gate Fish Hatchery facilities, including the fish hatchery, warehouse, hatchery building, fish-rearing ponds, visitor information center, and employee residences would be transferred to the State of California. California DFW would relocate all aquaculture production (adult holding, spawning, egg incubation, fish production) to the Fall Creek Hatchery Facility, which would effectively remove all potential Iron Gate water use and effluent concerns.

2.1.2.11 Reservoir Area Management Plan (Exhibit J)

The Reservoir Area Management Plan (RAMP) describes the measures proposed for restoration, monitoring, and adaptive management of the exposed reservoir bottoms and surrounding areas disturbed as part of the proposed action. The plan has no specific subplans but includes appendices B through H that discuss specific topics as summarized below.

Upland Restoration Measures

KRRC would regrade upland areas (depicted in the dam demolition design drawings), including recontouring to neighboring conditions as applicable. KRRC would install temporary and permanent sediment and erosion control BMPs, including weed-free straw mulch, silt fence, and silt socks per a site-specific stormwater pollution prevention plan (SWPPP) which KRRC would develop as part of its application for a California National Pollutant Discharge Elimination System (NPDES) general permit. Revegetation in upland areas within the existing reservoirs would include hydroseeding with regionally appropriate upland native seed mixes and bare root plantings. Restoration of areas temporarily disturbed during construction activities and located outside of the reservoir area footprints are discussed in other plans, as follows:

Disposal Sites for Placement of Embankment or Concrete Material: For details regarding disposal site construction and rehabilitation (including with respect to the J.C. Boyle scour hole, powerhouse and tailrace), see the Oregon Waste Disposal and Hazardous Materials Management Plan, Oregon Erosion and Sediment Control Plan, and Bureau of Land Management Use and Occupancy Plan with respect to disposal sites in Oregon, and the California Waste Disposal Plan and SWPPP with respect to disposal sites in California.

Staging Areas and Temporary Access Road Areas Adjacent to Demolition Sites: For details regarding rehabilitation of these areas, see the 1200-C Permit and Bureau of Land Management Use and Occupancy Plan with respect to areas in Oregon and the Reservoir Drawdown and Diversion Plan and SWPPP with respect to areas in California.

Hydropower Infrastructure Demolition Areas: For details regarding demolition area rehabilitation, see the 1200-C Permit and the Oregon Remaining Facilities Plan with respect to locations in Oregon and the California Remaining Facilities Plan and SWPPP with respect to locations in California. Details on the demolition of structures is contained within the Definite Decommissioning Plan.

J.C. Boyle Power Canal: For details regarding power canal rehabilitation, see the Bureau of Land Management Use and Occupancy Plan.

J.C. Boyle Penstock Roads: For details regarding rehabilitation of the penstock access roads, see the Bureau of Land Management Use and Occupancy Plan.

Former Recreation Areas: For details regarding recreation area construction and rehabilitation, see the Recreation Facilities Plan, Oregon Remaining Facilities Plan, and

1200-C Permit with respect to recreation areas in Oregon, and the Recreation Facilities Plan, California Remaining Facilities Plan, and SWPPP with respect to recreation areas in California.

Dam Footprints

Following removal of the dams, KRRC would configure the Klamath River channel within the former dam footprints to match its pre-dam dimensions as closely as practicable. Pre-dam channel morphology was determined from historical photographs taken prior to and during construction. In general, KRRC would achieve pre-dam configurations by blending the post-removal river contours to upstream and downstream contours.

Assisted Sediment Evacuation

A primary objective during the reservoir drawdown period would be to expedite the erosion and transport of reservoir sediments that are deposited in the historical river channel and to stabilize adjacent sediments to limit the erosion in future years. For a median water year, hydraulic modeling predicts that approximately half of the stored sediment would naturally erode and vacate the reservoir area. Where needed, KRRC would use additional methods to assist sediment evacuation during drawdown as described below to maximize the amount of sediment mobilized during drawdown. The assisted sediment evacuation work window would be limited to January 1–March 15 of the drawdown year.

KRRC would use sediment jetting with an airboat- or barge-mounted water jet to expedite the evacuation of sediments in the historical river channel within the Copco No. 1 and Iron Gate Reservoirs. Sediment jetting would occur as conditions allow, predicated by hydrologic conditions of the drawdown year, and would be primarily focused on high-priority tributaries and the mainstem channel margins, with work occurring at low-priority tributaries as conditions and time allow. If airboat sediment jetting becomes infeasible because of hydrologic conditions, KRRC would mount pump and hose apparatus on side-by-side utility terrain vehicles for land-based applications.

During reservoir drawdown, and if access allows, KRRC would grade reservoir sediment using machinery such as small excavators to promote evacuation by water flowing in the tributaries and mainstem river. Culturally sensitive areas would be designated by KRRC prior to drawdown to ensure machinery does not enter these areas. KRRC would perform area grading between January 1 and March 15 of the drawdown year and would only grade depositional surface sediment and would not extend below the historical pre-dam ground surface.

The assisted sediment evacuation methods referenced above rely on flowing water in either the river or a tributary to transport sediment away from the site. KRRC would therefore attempt to locate all application sites either directly adjacent to, or upslope and draining to, a tributary and/or the mainstem of the Klamath River. As the reservoir pool lowers, the tributary or river would transport both the delta sediment referenced above as well as incoming sediment from active, assisted sediment evacuation sites. Thus, the volume (load) of sediment being eroded and carried downstream in the tributary or mainstem would increase as the reservoir pool lowers and the cumulative volume of sediment from sources upslope and upstream increases.

Adequate flows in the tributaries and the main river channel within reservoir areas are critical for active sediment evacuation activities. Active measures to increase discharge in the river are infeasible. However, the channels of the tributaries are relatively small, and KRRC may use pumps and temporary pipelines to convey water into the tributary channel. The augmented flow would boost the ability of the tributary to transport sediment downstream to its confluence with the larger Klamath River where river flows would be sufficient to entrain and transport that sediment out of the reservoir footprint.

Planned locations for assisted sediment evacuation were ranked as primary or secondary. Primary locations include active sediment evacuation sites along the main channel, riparian/floodplain, and high-priority tributary channels. Secondary locations include other tributary confluences. At primary locations, sediment would be evacuated along the main channel, riparian/floodplain, and tributary channels. Secondary locations focus on tributary connectivity, and sediment evacuation would be confined within the channel. The RAMP identifies three primary and four secondary locations at Copco No. 1 and three primary and three secondary locations at Iron Gate.

Tributary Connectivity Within Reservoir Footprints

The expanded and connected tributary confluences at the reformed mainstem channel within the former reservoir footprint would allow for a range of dynamic geomorphic processes to support resilient habitat structure and fish passage conditions. KRRC would perform select grading as needed to: (1) remove unnatural, erosion-resistant deposits that create fish passage barriers (such as the coarse delta deposits at Jenny Creek and the Camp Creek complex); and (2) stabilize unevaluated sediment at vulnerable high-sediment-yield locations.

Additional grading could occur at select locations to enhance wetland and/or floodplain connectivity where appropriate. In addition, KRRC may use selective grading to opportunistically lay back tributary channel banks (e.g., 3H:1V slopes on alternating banks) to mimic reference channel geometries and support revegetation. Areas for selective bank grading would be identified and prioritized based on the location of other restoration actions and would depend on observed and monitored post-drawdown conditions.

As reservoir water surfaces are lowered during drawdown and beyond, priority tributaries would be further exposed, creating longer reaches of free-flowing water conditions. Newly exposed tributaries would flow over depositional areas of fine sediment that would likely be transported downstream during and following reservoir drawdown; however, some larger sediment and debris may create fish passage barriers or unnatural discontinuities in the longitudinal profile. To rectify this, KRRC would use light machinery and manual labor to move materials and enhance access and longitudinal connectivity of the tributaries with the mainstem Klamath River and add pieces of large wood to tributaries either in the channel or on the floodplain/terrace to promote habitat complexity.

Another aspect of tributary connectivity is volitional fish passage. Many of the tributaries have road crossings at the reservoir water surface with culverts and stream crossings that do not allow volitional fish passage. KRRC would replace the Copco Road culverts at Camp and Scotch Creeks, as well as the Daggett Road crossing of Fall Creek, to allow fish passage upstream of the roadway. In addition, KRRC would remove historical tributary crossings of Long Gulch in the Iron Gate Reservoir inundation zone.

Riverbank Stability and Channel Fringe Complexity

Lack of roughness along channel margins results in higher-than-normal near-bank velocity and shear stress. This increase in active channel margin energy negatively affects aquatic species by requiring increased energy for migration and holding while also transporting desired gravels and materials that otherwise form depositional features downstream. Velocity shadows created by streambank complexity (i.e., vegetation, root wads), large wood, and boulders create regions of complex hydraulic interactions that provide resting zones, feeding seams, cover, and velocity refugia during high flow. Channel fringe complexity is best improved through the strategic addition of large wood and the establishment of riparian vegetation. Priority tributary reaches that would benefit from these treatments are typically single thread, where the channel is laterally confined. In addition, bank roughness can improve bank stability and reduce unnatural erosion that degrades water quality.

KRRC would place 100 to 1,000 pieces of large wood using a combination of ground and aerial helicopter methods based on the specific location and post-drawdown conditions. Placement of large wood habitat features in high-priority tributaries would (1) provide cover, shade, velocity refuge, and foraging areas for fish and other aquatic species; and (2) create in-channel hydraulic complexity, including connectivity with floodplains, roughness, and flow guidance to enhance and encourage sediment transport and volitional fish passage. On-site field representatives would define the exact geographic locality, arrangement, and architecture of each large wood complex during implementation. Density would be based on field observations and would be consistent with the Southern Oregon Northern California Coast Coho Salmon Recovery Plan. No artificial anchoring would be used to ballast wood elements; during larger storm events, pieces of large wood may shift within the tributary corridor and reservoir area, much like large wood movements in natural systems. Cultural resources would be evaluated and considered by KRRC for specific wood design locations, and any ground disturbance during implementation activities would be coordinated with cultural specialists or on-site Tribal monitors.

There are two main risk considerations for large wood: public safety and property protection. The main public safety concern is boater safety because the Klamath River would be used for whitewater kayaking, rafting, and fishing. Because boater use primarily occurs on the mainstem of the Klamath River, rather than the tributaries where large wood would be located, KRRC categorized the project area as a relatively low public safety risk based on hydraulic conditions for both the 10- and 25-year event. In addition, the risk of property damage for the project area is also considered low based on the following conditions: (1) the limited number of in-channel structures, including existing bridges and future recreational boat docks; (2) the limited number of structures located in the floodplain immediately downstream of the dams; and (3) reservoir footprints would remain open space after revegetation is completed.

In addition to large wood, KRRC would install willow baffles and boulder clusters along the high-priority tributaries[42] (see figures 5-7, 5-8, and 5-9 in the RAMP). Willow baffles are live roughness elements installed on the floodplain to reduce flow velocities and trap fine sediment. Willow baffles are "hedges" of willow poles planted perpendicular to the flow direction. The poles are densely planted in trenches that are backfilled with soil and small rocks to provide some initial resistance to flow. Willow baffles would be approximately 15 to 30 feet long and be spaced between 60 to 120 feet apart adjacent to the channel. Willow baffles are proposed as short-term measures to help stabilize newly exposed channel overbank areas until riparian revegetation establishes.

KRRC would install small clusters of locally sourced, oversized boulders (approximately 2 to 6 feet in diameter) at select locations along high-priority tributaries to enhance instream habitat. KRRC would use clusters of 3 to 10 boulders to break up high-flow fields, encourage site-scale sediment sorting, and provide resting for migrating adult anadromous fish. Generally, KRRC would locate boulder clusters to preserve existing riffles or to provide velocity shelter in predicted high velocity areas. Denser boulder fields (up to 12 boulders, depending on tributary size) may be installed adjacent to near-channel wetlands to locally elevate water levels and enhance connectivity. Boulder clusters would be placed using wheeled equipment in readily accessible areas. The number and size of boulders would vary depending on location and function.

Wetland Preservation and Restoration

Three key types of wetlands and potential wetlands are located in the area; these wetlands are differentiated by their source hydrology.

<u>Reservoir-Independent Wetlands</u>: Existing wetlands that are not anticipated to be affected by drawdown are termed "reservoir-independent wetlands." These wetlands likely have hydrologic inputs other than from the reservoir. If restoration enhancement or

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[42] High priority tributaries include Spencer Creek (J.C. Boyle); Beaver Creek (Copco No. 1); and Jenny Creek, Scotch Creek, and Camp Creek (Iron Gate).

construction activities were needed to occur in the vicinity of reservoir-independent wetlands, KRRC would install a 20-foot buffer fence to avoid effects on these areas (i.e., the placement of dredge or fill material). KRRC has mapped and the Corps has provided a preliminary jurisdictional determination.

Reservoir-Dependent Wetlands: Existing fringe wetlands or wetlands that are hydrologically connected to the reservoir are termed "reservoir-dependent wetlands." These wetlands would likely be desiccated over time from drawdown activities; however, these areas may provide source materials (seeds or woody stem cuttings) for wetland creation sites. These areas do not require the installation of a 20-foot buffer, but KRRC would direct construction activities away from these sites to the extent practicable.

Potential Wetlands: KRRC would use aerial data collection methods after drawdown within the reservoir footprints to identify depressional features and hillslope seep or spring-fed areas with a high potential for wetland creation. If located within the high-priority tributary restoration zones, these areas may be graded to enhance the topography, foster wetland hydrology and the survival of hydrophytic vegetation. If these areas are located outside priority tributary restoration zones, KRRC would delineate them and plant hydrophytic vegetation as appropriate.

Revegetation

KRRC would implement the following framework in revegetation design: (1) develop an additive layering system for each broad vegetation community type where woody species plantings are imbedded within a native-seeded matrix; (2) provide flexibility to respond to unfolding field conditions and minor variations in the landscape such as remnant wetland/riparian vegetation, post-drawdown soil conditions, microtopography, soil moisture, seeps, rocky areas, and drainages within each planting zone; (3) support revegetation post-drawdown as well as short- and long-term adaptive management efforts; (4) use inexpensive and robust, locally sourced plant material in the form of seed, cuttings, and bare root stock that are easily transported, are expected to establish well under difficult environmental conditions, cost less per plant than container plants, and reduce the likelihood of spreading pathogens such as phytophthora; (5) plant bare root woody species in dense clusters within the seeded matrix to increase survival rates, and create island patches of trees and shrubs that would accelerate structural diversity and community development; (6) use existing adjacent vegetation cover types and post-drawdown topography and soil conditions to guide revegetation efforts; (7) allow for modifications to planting densities within an area while adhering to the total quantity of plant material being installed and managed to better mimic the subtle changes in densities across communities and the vegetation strata (tree, shrub, groundcover) within those communities; and (8) opportunistically incorporate salvaged wetland vegetation (sod, plugs or woody vegetation).

KRRC would achieve revegetation of the exposed reservoir footprints through a combination of invasive exotic vegetation control, seeding native herbaceous and woody species, using pole cuttings and bare root trees and shrubs, and natural recruitment of vegetation. KRRC plans to use supplemental irrigation in the newly established riparian areas of Iron Gate and Copco No. 1, as needed, and strategically place fencing around high-priority tributary restoration areas to prevent livestock grazing.

Seeding

KRRC expects revegetation activities to establish seven vegetation communities in the former reservoir footprints: riparian—mainstem, riparian—tributary, palustrine wetland, oak woodland, chaparral, grassland, and yellow pine forest. Anticipated acreages of restored vegetation by community type and reservoir are presented in table 2.1-5. The RAMP identifies four seed mixes proposed for broadcast spreading on exposed reservoir beds: a pioneer upland mix (22 species), a pioneer wetland/riparian mix (10 species), an upland diversity mix (17 species), and a wetland diversity mix (18 species). All seed mixes would be composed of native species; KRRC has been collecting locally sourced seeds since 2018. KRRC has contracted with nurseries to amplify seed stock by planting collected seeds in controlled conditions and harvesting seed heads for use in restoration efforts. As of fall 2020, KRRC had collected native, locally sourced seed for 25 species and expects current contracts to produce a minimum of 43,000 pounds of seed from 28 species, providing enough seed to complete at least two applications at 80 seeds per square foot (about 22 pounds of seed per acre). KRRC anticipates applying between 32,000 and 90,000 pounds of seed (16 and 46 pounds per acre) to the restoration area over the course of two seedings. Most of the seeding would be by hand using belly grinders or other manual methods. In areas with challenging access, aerial seeding with helicopters, drones and/or fixed-wing aircraft may be used.

Table 2.1-5. Total habitat acreage anticipated to be present and associated planting densities of herbaceous and woody materials for each project facility reservoir footprint, post-dam removal (Source: KRRC, 2021c; staff)

Reservoir	**Riparian/ Mainstem (acres)**	**Riparian/ Tributary (acres)**	**Dry Uplands[a] (acres)**	**Palustrine Wetlands (acres)**	**Total (acres)**	**Proposed Herbaceous Planting Density (plants/acre)[b]**	**Proposed Woody Planting Density (plants/acre)[c]**
J.C. Boyle	40.6	15.1	197.1	5.8	258.6	17.3	151.6
Copco	82.4	53.0	719.5	7.5	862.4	6.8	133.9
Iron Gate	85.2	30.5	715.0	5.9	836.6	4.2	140.9

[a] Dry uplands include Oak woodland, Chaparral, Grassland, and Yellow pine forest. The final distribution and acreages of these four cover types would be determined and laid out post-drawdown when final post-drawdown conditions become visible.

[b] Density of herbaceous plants include bare root herbaceous plants identified in the RAMP divided by total acres of revegetation at the reservoir.

[c] Woody plants include the number of cuttings, pole cuttings, bare root shrubs, and bare root trees identified in the RAMP divided by total acres of revegetation at the reservoir.

As described in the RAMP, in addition to seeding, KRRC proposes to use 260,000 bare root plants, (including 33 species), 2,300 pole cuttings[43] (cottonwood and willow species), and 25,750 live stakes (7 species). KRRC proposes to plant trees and shrubs (bare root and pole cuttings) in distinct clusters (facilitation patches), with specifications outlined in an annual planting plan. KRRC anticipates that planting in dense clusters, as opposed to spreading out the plants, would lower the density per acre and is preferred because high density patches more closely mimic early plant successional patterns. KRRC expects this planting strategy to increase overall survival rates of plants due to facilitation mechanisms common to ecosystems in extreme climatic conditions. The RAMP provides reservoir-specific species lists and describes how plant stock would be allocated among the three reservoir areas. Table 2.1-5 provides proposed planting densities for herbaceous and woody plants.

The RAMP includes several measures to facilitate successful seeding and planting, including mulching, irrigation, and fencing. Where access is feasible, KRRC proposes to apply native straw mulch or sterile wheat mulch as a seeding mulch on bare soils and exposed sediment. KRRC conducted outdoor seed germination tests and found that straw mulch greatly improved seed germination and survival by providing thermal protection during cold nights and retaining moisture in the soil. KRRC proposes to procure mulch in advance of placement to monitor for the presence of unwanted weedy species. KRRC plans to apply the mulch with a native seed mix made up of early successional species after drawdown in select areas. KRRC is also considering using other types of mulch such as wood chips or shavings and pine needle shavings for adaptive management of strategic locations.

KRRC proposes to install irrigation systems as needed in the riparian areas of Iron Gate (approximately 109 acres) and Copco No. 1 (approximately 98 acres) to increase likelihood of seeding success, facilitate establishment of native vegetation, and promote stabilization of the floodplain of the Klamath River and its tributaries within the project area post-drawdown. KRRC also proposes to provide irrigation to south-facing slopes with lower soil moisture, as needed to meet vegetative success criteria and achieve sediment stabilization. Water used for irrigation would be pumped directly from the Klamath River or tributaries, with diversion points being determined at a later time as needed. Water rights would be obtained by KRRC, and diversions would comply with all local permitting conditions.

The RAMP includes strategic use of temporary fencing to exclude livestock at priority tributary restoration sites to prevent browsing of newly planted vegetation. While fencing is constrained by construction access, flooding, and cost-effectiveness, exclusion zones would be created around each of the proposed restoration areas rather

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[43] Pole cuttings are 1.5-to-3-inch diameter and 10-foot-long (or longer) sections of dormant trees that are cut and replanted. When planted, the leaf nodes on the cutting generate roots and establish new saplings.

than protecting individual plants with tubes. Fencing of stream crossing areas would be minimized.

Herbicide Use

KRRC proposes to only use herbicides to control invasive species that are not suited to mechanical removal techniques, and only use herbicides that have been approved for use by BLM, California DFW, Oregon DFW, California Water Board, Oregon Water Resources Department (Oregon WRD), FWS, NMFS, and Native American Tribes. Spot spaying would be used most often, but broadcast spraying herbicides using booms mounted on ground-based vehicles would occur with the following restrictions: no broadcast spraying within 100 feet of open water when wind velocity exceeds 5 miles per hour (mph); no broadcast spraying when wind velocity exceeds 10 mph; no spraying if precipitation is occurring or is imminent (within 24 hours); and no spraying if air turbulence is sufficient to affect the normal spray pattern. All herbicides would be applied according to label specifications and by a California and Oregon Qualified Applicator licensee and approved by EPA. Herbicides would be formulated to minimize effects on native plants, using the least amount necessary and covering the minimum area necessary for effective control, and application would be designed to minimize contamination of waterways. When necessary, target plant populations that are close to water would be treated with AquaNeat®, an herbicide designed for use in aquatic environments and approved by EPA for use in or near water. Herbicides would be mixed over impervious areas with appropriate spill containment and more than 150 feet from any natural waterbody to minimize the risk of an accidental discharge, and spray tanks would be washed more than 300 feet away from surface water.

Also, KRRC would apply buffers for herbicide application around streams, as specified according to chemical and stream type in table C-2 of the RAMP, which generally provides for a 100-foot buffer around perennial streams and wetlands and flowing intermittent streams, and a 50-foot buffer around dry intermittent streams, wetlands, and roadside ditches. KRRC would check that all equipment is free from leaks and operating as intended and implement an herbicide safety/spill response plan to reduce likelihood of spills, misapplication, potential for unsafe practices, and to take remedial actions in the event of spills. Lastly, KRRC would consider surrounding land use and site characteristics before using aerial spraying, avoid aerial spraying near agricultural or densely populated areas, and comply with herbicide-free buffer zones to ensure that drift would not affect crops or nearby residents/landowners. A complete list of these and other BMPs that KRRC proposes to manage herbicide use is in table C-1 of the RAMP.

Monitoring and Adaptive Management Plan

KRRC’s Reservoir Management Plan describes proposed measures for riparian and upland revegetation, invasive exotic vegetation control, residual reservoir sediment stability, priority tributary restoration, for process-based restoration of the Klamath River, and dam- and reservoir footprint restorations. After initial establishment, monitoring and adaptive management activities would rely on a process-based approach. The plan identifies the key monitoring metrics that would guide monitoring and adaptive management and are tied to the goals of the proposed action.

An adaptive monitoring approach is employed using the feedback loop of either achieving or trending towards success criteria. The monitoring timeline is anticipated to be five years. Within this context, monitoring elements may be removed if end-of-monitoring success criteria are achieved, and/or the approach may be modified if the monitoring program indicates success criteria are not being met or restored vegetation is not developing along desired trajectories.

KRRC proposes to monitor the success of revegetation efforts by comparing monitoring data to data collected at reference sites in areas adjacent to the reservoirs with a similar desired vegetation community type. KRRC would survey plots in adjacent upland and riparian reference sites in the spring and summer prior to dam removal (2022). Table 2.1-6 provides the proposed number of reference plots that would be used by vegetation community type.

Table 2.1-6. Number of proposed reference plots to be sampled by landform, vegetation community near J.C. Boyle and Iron Gate (Source: KRRC, 2021d)

Landform	**Vegetation Community**	**Number of Plots**[a]	
		J.C. Boyle	**Iron Gate**
Riparian	Mainstem	6	9
	Tributary	4	9
Upland	Oak woodland	0	11
	Chaparral[b]	6	11
	Grassland[b]	0	13
	Ponderosa pine woodland	7	0
	Palustrine wetland	4	4
	Total Plots	27	47

[a] Plot numbers may be reduced if data analysis reveals no differences based on reservoir.

[b] Chaparral and grassland habitats are anticipated to occupy the largest area within the reservoirs post-dam removal.

Data collected at the reference sites would include species richness (number of species), tree and shrub density (stems per unit area), percent of vegetation cover, and percentage of non-native species relative to native species. These surveys would set thresholds for success to be used during the five-year monitoring period, which would commence following two years of planting after reservoir drawdown.

Table 2.1-7 provides KRRC's proposed success criteria for each metric. Table 2.1-8 provides KRRC's proposed stratification of monitoring plots by reservoir and vegetation community. The RAMP includes specific details regarding the establishment of monitoring plots and data collection. Quantitative monitoring would occur once annually during late spring/early summer. Qualitative monitoring would also occur using photo points established at all monitoring plots. KRRC would survey treatment plots in the reservoirs annually for five years regardless of meeting revegetation criteria goals. However, many treatment plots would be established where possible in the reservoir footprints prior to the start of surveying for adaptive management purposes and to help develop the five-year Maintenance Plan.

Table 2.1-7. Revegetation success criteria for upland and riparian restoration efforts, years 1-5 (Source: KRRC, 2021d)

Metric	Habitat	Year 1	Year 2	Year 3	Year 4	Year 5
Species Richness	Upland	50%	55%	60%	65%	70%
	Riparian	50%	60%	70%	80%	85%
Tree and Shrub Density	Upland	50%	55%	60%	65%	70%
	Riparian	50%	60%	70%	80%	85%
Vegetation Cover	Upland	15%	25%	45%	60%	80%
	Riparian	40%	50%	60%	70%	80%
Relative Frequency of Non-Native Species	Upland	25%	40%	55%	70%	90%
	Riparian	25%	40%	55%	70%	90%

The RAMP includes remedial actions that KRRC proposes to implement if monitoring indicates revegetation measures are not meeting success criteria. Remedial actions would be determined in consultation with resource management agencies and include reseeding, replanting, increased mulch or irrigation, and invasive species control. If, by the end of the third year of monitoring, monitoring determines that treatment areas are not on an adequate positive ecological trajectory to meet the year 5 monitoring success criteria, KRRC intends to undertake adaptive management in consultation with the Commission and state and federal agencies, to correct deficiencies in site performance. Potential factors that would influence lower than expected performance results include unanticipated restoration site conditions, drought, or other environmental conditions. Potential adaptive management options are discussed in the RAMP and include modification of success criteria to better match post-drawdown conditions (KRRC, 2021c).

Table 2.1-8. Proposed number of revegetation monitoring plots by habitat type and treatment for each project facility reservoir footprint (Source: KRRC, 2021c)

Landform	Habitat Type	Treatment	Number of Plots[a] J.C. Boyle	Copco	Iron Gate
Riparian	Main Stem	Seeded/planted	5	8	8
	Tributary	Seeded/planted	4	7	6
	Control	No Treatment	6	9	9
Upland	Oak woodland	Seeded/planted	0	4	8
	Chaparral[b]	Seeded/planted	6	11	11
	Grassland[b]	Seeded only	6	14	13
	Yellow pine forest	Seeded/planted	6	4	0
	Palustrine wetland[c]	Seeded/planted	4	4	4
	Control	No Treatment	6	9	9
		Total Plots: 181	43	70	68

[a] Plot numbers may be reduced if data analysis reveals no differences based on reservoir; Copco and Iron Gate are very similar and may not require independent sampling. If data analysis across all habitat types shows that there are no differences among reservoirs, a subset of plots would be randomly selected in each reservoir for ongoing, future monitoring efforts.

[b] Chaparral and grassland habitats are anticipated to occupy the largest area within the reservoir footprints.

[c] Palustrine wetlands have the fewest plots because the total area anticipated to become palustrine wetlands is low.

2.1.2.12 Terrestrial and Wildlife Management Plan (Exhibit M)

KRRC filed separate Terrestrial and Wildlife Management Plans (TWMPs) for Oregon and California. Each plan includes measures that would be implemented within the limits of work and access within each state. The TWMPs identify measures KRRC proposes to implement and protect known or potential species present with special status (state or federally protected). Additional measures are outlined in the plans for non-listed bats, nesting birds, and other species. KRRC proposes to use designated biologists with appropriate species-specific qualifications for proposed management measures, and to provide biological resource awareness training to all construction personnel and on-site biologists, including information about exotic species and decontamination measures. The plan includes two state-specific subplans: California TWMP (appendix A) and Oregon TWMP (appendix B). Appendix C presents a Bald Eagle Monitoring Plan Status Update. The overall plan and subplans address various species and topics as discussed in the following sections.

Western Pond Turtle

KRRC would conduct preconstruction Visual Estimation Surveys (VES) for western pond turtle within the immediate work zone and adjacent work area no more than 24 hours prior to the commencement of construction activities that require heavy equipment operation in California and prior to in-water work events in Oregon. Upon discovery of a western pond turtle in a work zone, KRRC would alert work crews and attempt to relocate the individual out of harm's way and, if deemed prudent based on the nature of the work and the risk to the individual, transfer the individual to an agreed-upon relocation area.

In addition to preconstruction surveys, KRRC would conduct VES surveys during the winter and spring of the reservoir drawdown year to identify any stranded or otherwise affected western pond turtle. The specific survey dates and frequency of surveys would be determined during protocol development. KRRC would survey suitable western pond turtle habitat within the reservoirs' normal operating pool elevation and habitats that become exposed during drawdown to the extent practicable based on safety considerations and the ability to access the habitat based on terrain conditions. KRRC would conduct a final survey for stranded or otherwise affected western pond turtles within 30 days of when the Klamath River lowers to, and occupies, its original 100-year flood channel. Upon western pond turtle observation during a reservoir drawdown VES survey, KRRC representatives would use their best professional judgment to determine if an individual should be relocated to an area with access to suitable habitats, another water source, or the agreed-upon relocation areas. KRRC's TWMP for California identifies relocation habitats upstream and downstream of the reservoirs on the banks of the Klamath River; relocation habitats in Oregon would be determined by Oregon DFW. Additional management measures for entrapment and exclusion measures around construction areas are detailed below.

Non-listed Reptiles and Amphibians

VES surveys for non-listed reptiles and amphibians would occur concurrently with surveys for western pond turtles. In addition, construction personnel would be trained on avoidance and minimization measures as described above. If KRRC observed native reptiles or amphibians in the limits of work and access during a western pond turtle survey or during construction activities, the reptile or amphibian would be avoided and encouraged to leave the area on their own. If the amphibian or reptile are not capable of leaving the work area of its own volition or did not promptly leave the work area, KRRC would attempt to relocate the individual outside the work area, to the extent practicable.

Native Nesting Birds

KRRC would conduct preconstruction VES for native nesting birds (including special status species and non-listed species) if habitat removal activities are scheduled to occur during the primary nesting period of April 1 to July 31. These surveys would focus on identifying potential nesting habitats located in areas where construction and restoration crews would remove trees and vegetation. These surveys would determine if any birds are nesting and may potentially be affected by habitat removal. The survey protocol would consist of walking evenly spaced transects, which maximize visual survey coverage of the work area. These surveys would be completed in the mornings after sunrise, no more than one week prior to habitat disturbance. KRRC would scan brush, grassland, and canopy for nests and avian nesting behavior. If KRRC observes a nest in the nesting period, subsequent surveys may occur prior to construction to monitor the nest for activity or to further determine status (e.g., eggs have hatched, nestlings present). A nest with eggs, chicks, or nestlings would be considered active.

To avoid disturbance to nesting birds, KRRC would use its professional judgment to implement the following management measures in respect of nests identified during a survey: (1) limit vegetation removal and trimming to areas where construction or restoration actions (ground disturbance) are occurring; (2) limit vegetation removal/trimming (other than willow cutting and harvesting) to September 1 to April 1 (outside the nesting season), if practicable; (3) limit willow cutting harvesting to September 1 to January 31, if practicable; (4) leave transmission/distribution poles with active osprey nests in place and insert nest deterrents prior to nesting season (March–September); (5) observe active osprey nest during construction to determine if birds are exhibiting stress behaviors; (6) if birds are exhibiting stress behaviors, establish a set-back for construction actions, if practicable, given other factors including the construction schedule and nature of construction; and (7) alter the timing of construction activity if practicable given other factors including the construction schedule.

Northern Spotted Owl

A northern spotted owl activity center is located about 1.3 miles southeast of the eastern end of Copco No. 1 Reservoir. KRRC would require helicopter flight paths to stay at least 1 mile away from the center during all work activities to prevent disturbance. KRRC would also apply a 1-mile buffer restricting helicopter flights around other suitable nesting, roosting, or foraging habitat, as identified in the FWS Relative Habitat Suitability mapping layer. If helicopter flight paths cannot avoid the areas that support nesting, roosting, and foraging habitat, then KRRC would conduct additional surveys.

If northern spotted owls were observed within the limits of work and access, KRRC would determine, in coordination with California DFW and/or Oregon DFW and FWS, the best management measures, which may include disturbance buffers and avoidance of key areas. Such measures would be coordinated so as not to unduly interfere with the dam removal construction and restoration schedule.

Gray Wolf

To KRRC's knowledge, gray wolves do not currently rendezvous or den in the TWMP boundaries; however, previous observations have documented wolves in the surrounding counties. KRRC would contact California DFW prior to preconstruction activities to determine if there is potential wolf activity in the area where construction would occur. During proposed action activities, California DFW would provide KRRC with information regarding gray wolves' status. If KRRC observes gray wolves within the TWMP boundaries, a KRRC representative would immediately contact California DFW.

If gray wolves, rendezvous sites, or denning sites are observed, KRRC would coordinate with California DFW's wolf biologist to determine best management measures, which may include reduced driving speeds, signage on haul roads, limited operating periods, disturbance buffers, and avoidance of key areas.

Bats

KRRC has conducted bat occupancy surveys at facilities that would be affected by the proposed action. This included emergence surveys, acoustic surveys, and inspections for bats using project structures like buildings, bridges, and diversion tunnels. Seventeen structures were confirmed to have bat activity associated with them.

KRRC would conduct a visual survey for bats or signs of recent use prior to structure and tree removing construction activities to determine if the facility or tree is subject to the below considerations.

KRRC would implement structure removal activities that consider seasonal bat behavior to minimize potential effects on bats in their maternity colonies, bat pups, roosting, and hibernating bats. Preferred dates for structure removal are March 1 to April 15, and September 1 to October 15.

If bat-containing building removal cannot occur during these periods, removal would occur when nighttime temperatures are above 45 degrees Fahrenheit (°F), or at such other time determined in consultation with California DFW.

If KRRC detects bats in a human-made structure, removal would occur in two phases:

- <u>Phase 1</u>: Construction staff would remove portions of the structure (windows, roofs, siding/walls) to alter the temperature, ambient light, and natural airflow. The structure would be left undisturbed overnight to allow bats to vacate.

- Phase 2: Construction staff would demolish the structure the following day (or following night if removal does not occur between March 1 to April 15 or September 1 to October 15).

Likewise, if KRRC detects bats in trees designated for removal, construction staff would remove these trees in two phases. Staff would remove tree branches in the initial phase. The tree would then be left undisturbed overnight to allow bats to vacate. Construction staff would fell the tree on the following day. Alternative tree removal protocol includes allowing a felled tree to remain in place for 24 hours prior to chipping or removal. Construction staff would follow either of these tree removal protocols when feasible.

Structures that would remain intact include portal outlets, tunnels, and other water conveyance structures. These structures would be permanently closed and barricaded with concrete rubble, earth fill, and/or steel plates when evening temperatures are above 45°F.

KRRC would install (as a discretionary enhancement measure) bat boxes and/or condos, pursuant to subsequent agreement with state and federal agencies. KRRC expects the bat boxes and/or condos to be provided and installed at least three months prior to full or partial structure demolition.

Entrapment and Exclusion

KRRC would fence construction areas that could entrap wildlife such as trenches or open pipes, when feasible. In addition, it would implement additional exclusion fencing or other appropriate measures in coordination with California DFW or Oregon DFW to reduce the likelihood that special status species access areas within the TWMP boundaries. KRRC would make daily observations of the fenced areas and fencing for any entrapped species. Construction crews would place escape ramps in any excavated open hole or trench left open overnight. All constructed holes or trenches would be inspected daily for entrapped wildlife throughout the construction period and prior to fill. Any wildlife discovered would first be allowed to escape voluntarily. If an entrapped individual did not voluntarily escape, KRRC would use its best professional judgment in removing and relocating the entrapped individual, if practicable.

Herbicide Application

KRRC may apply EPA-, California Department of Pesticide Regulation-, and Oregon Department of Pesticide Regulation-approved herbicides to control the spread of invasive exotic vegetation within the TWMP boundaries, as needed. KRRC would apply all approved herbicides according to labeling directions. The RAMP identifies KRRC’s management measures to avoid effects from herbicide application on special status species.

Wetland Buffer

Non-dam removal construction activities (e.g., staging areas, temporary spoils, and construction trailer sites) may occur near wetland habitats. KRRC would review construction designs and delineated wetland locations within the limits of work and access to determine if any temporary construction sites are near existing non-reservoir-dependent wetlands. If temporary construction sites were near non-reservoir-dependent wetlands, KRRC would establish wetland buffers that meet all applicable legal requirements prior to the start of construction activities. Independent of the legal requirements, the wetland buffer established by KRRC would be a minimum of 20 feet to minimize unnecessary effects on wetlands. KRRC would demarcate the wetland buffer with flagging or fencing, as needed.

Eagle Conservation Plan

KRRC submitted a draft Eagle Conservation Plan, the foundational component of an Eagle Act Permit package, to FWS on September 14, 2021. Following the submittal, FWS provided comprehensive comments and guidance regarding both the Eagle Conservation Plan and completion of the Eagle Act Permit package. In addition, FWS held a Zoom meeting with KRRC on November 15 and 23, 2021, to discuss the approach for the effects analysis and overall value of proposed mitigation actions. KRRC is incorporating FWS' guidance and comments into the draft Eagle Conservation Plan and expected to submit a revised plan and Eagle Act Permit application to FWS in December 2021; KRRC has not provided an update on the status of this plan since December 2021.

Reporting

KRRC would provide monthly status reports no later than 10 days after the end of each month during the year of reservoir drawdown, the drawdown year, and one year following drawdown; monthly reports in subsequent years would only occur in months when there is potential for disturbance to species covered in the TWMPs. Monthly reports would cover the following:

1. Western pond turtle survey methods and results, including western pond turtle observations, weather conditions during surveys, frequency and duration of survey efforts to date, actions taken to rescue/relocate western pond turtle (including the number of western pond turtle relocated and which relocation area they were released), and data collected on handled individuals.
2. Willow flycatcher survey methods and results, including detections, weather conditions during surveys, survey efforts to date, nesting or occupied status of habitat surveyed, any California DFW coordination to date and measures implemented.
3. Avian nesting survey methods and results, including weather conditions during surveys, survey efforts to date, duration of surveys, any active or inactive nests

encountered, any California DFW coordination to date and measures implemented.

4. Bat visual survey results including weather conditions during surveys, measures taken to exclude bats from facilities prior to removal and removal activities.
5. Incidental special status species observations made during VES surveys.
6. Location of wetland buffers.
7. Crew training completed to date.

KRRC would provide annual status reports by January 30 of every year to the Commission, FWS, and California DFW, and Oregon DFW detailing the application of management measures, construction status, and agency consultation. Annual reporting would occur from the year prior to drawdown through the FERC-issued final surrender order year. Additionally, KRRC would submit a western pond turtle rescue and relocation report to the resource agencies 60 days after completing post-drawdown surveys, which would identify relocation areas with suitable habitat and detail survey methods, timing, and frequency. Lastly, KRRC would submit a western pond turtle final compliance report focused on survey results and relocations to the California Water Board and California DFW within 60 days of the post-drawdown surveys. KRRC would also submit a western pond turtle final compliance report to the resource agencies, including the Commission and Oregon DEQ, within 30 days of completing the proposed action, which would identify all activities that took place as a part of pre-and post-construction surveys for western pond turtle.

2.1.2.13 Recreation Facilities Plan (Exhibit H)

The Recreation Facilities Plan addresses measures with respect to existing facilities and describes potential recreation enhancements that may be undertaken at the request of or by the successor landowners (which are expected to be the States of California and Oregon). The plan includes no subplans and applies to recreation facilities located in both states. The discussion below provides more details.

Recreation Sites to be Removed

KRRC would remove 11 sites, consisting of 5 combination day use area/campground sites and 6 day use areas. Removed site amenities would include picnic areas, boat launches, restrooms, fishing docks, campsites, interpretive signs, hiking trails, a dump station, and swimming areas. These amenities currently provide opportunities for picnicking, boating, fishing, camping, hiking, swimming, sightseeing, recreational vehicle camping, and group camping. The removed recreation sites would be located a substantial distance (approximately 300 to 5,500 feet) from the river once the reservoirs are drawn down. Table 2.1-9 shows the proposed disposition of existing recreation sites within the project boundary.

Table 2.1-9. Proposed disposition of existing recreation sites within the FERC project boundary (Source: KRRC, 2021a)

Site Name (Landowner)	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition	Schedule
J.C. Boyle Development				
Pioneer Park East (PacifiCorp - Parcel B lands)	Interpretive signs, car-top boat launch	Fishing, boating	Remove.	Remove after reservoir drawdown.
Pioneer Park West (PacifiCorp - Parcel B lands)	Picnic areas, car-top boat launch, informational signs, restrooms	Picnicking, fishing, boating	Remove except for parking area.	Remove after reservoir drawdown.
Topsy Campground (BLM) (non-project recreation site)	Campsites, RV dump station, day use areas, boat launch with dock, accessible fishing pier, restrooms	Camping, RV camping, boating, fishing, picnicking	Remove all permanent water-based improvements (boat launches, floating dock, fishing pier). Retain camping/ day use facilities for BLM future management.	Remove boat ramp prior to reservoir drawdown.
Copco No. 1 and No. 2 Development				
Mallard Cove (PacifiCorp - Parcel B Lands)	Picnic area, restrooms, boat launch with boarding dock, interpretive signs	Picnicking, boating, fishing, informal camping	Remove.	Remove after reservoir drawdown.

Site Name (Landowner)	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition	Schedule
Copco Cove (PacifiCorp - Parcel B Lands)	Picnic area, restrooms, boat launch with boarding dock, interpretive signs	Picnicking, boating, fishing, informal camping	Remove.	Remove after reservoir drawdown.
Iron Gate Reservoir Development				
Overlook Point (PacifiCorp - Parcel B Lands)	Restrooms, picnic sites	Picnicking, sightseeing (of reservoir)	Remove.	Remove after reservoir drawdown.
Wanaka Springs Day Use Area (PacifiCorp - Parcel B Lands)	Picnic areas, fishing dock, restrooms, trail to the site of Wanaka Springs, interpretive signs	Picnicking, fishing, hiking, informal camping	Remove.	Remove after reservoir drawdown.
Camp Creek Day Use Area and Campground (PacifiCorp - Parcel B Lands)	Campsites, boat launch, boarding and fishing docks, swimming area, RV dump station, interpretive display, restrooms	Developed camping, RV camping, boating, fishing, education, swimming	Remove.	Remove after reservoir drawdown.

Site Name (Landowner)	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition	Schedule
Juniper Point Day Use Area and Campground (PacifiCorp - Parcel B Lands)	Campsites, fishing dock, restrooms interpretive signs	Developed camping, fishing	Remove.	Remove after reservoir drawdown.
Mirror Cove Day Use Area and Campground (PacifiCorp - Parcel B Lands)	Campsites, picnic sites, boat launch, restroom, fishing dock	Picnicking, developed camping, boating, group camping, waterskiing, fishing	Remove.	Remove after reservoir drawdown.
Fall Creek Day Use Area (PacifiCorp - Parcel B Lands)	Picnic area, boat launch access, restrooms	Picnicking, boating	Remove.	Remove after reservoir drawdown.
Fall Creek Trail (PacifiCorp - Parcel B Lands) (non-project recreation site)	Hiking trail	Hiking	Remain; this will be associated with the Fall Creek Development of Project No. 2082. A portion of the trail would be relocated around the updated Fall Creek Hatchery.	Relocation to occur after hatchery construction has been completed.
Jenny Creek Day Use Area and Campground (PacifiCorp - Parcel B Lands) (non-project recreation site)	Campsites, restrooms, hiking trails	Picnicking, fishing, developed camping	Remove.	Remove after reservoir drawdown.

Site Name (Landowner)	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition	Schedule
Long Gulch Day Use Area and Campground (PacifiCorp - Parcel B Lands) (non-project recreation site)	Picnic sites, boat launch, restrooms	Picnicking, boating, informal camping	Remove.	Remove after reservoir drawdown.

Recreation Safety

The Recreation Facilities Plan also describes measures KRRC would implement as part of the proposed action to protect visitor safety during deconstruction activities and to provide advance signage at existing recreation facilities identified for removal and a community notification procedure.

Potential New River Recreation Sites

KRRC would work with California and Oregon to develop potential river recreation sites described in table 2.1-10, if the states commit to funding for construction, operation, and maintenance per implementing agreements. At new or modified recreation facilities with river access for boats, KRRC would provide public education signage regarding aquatic invasive species and proper boat cleaning at established public boat access locations or visitor information kiosks in the vicinity. KRRC would install and maintain temporary boat cleaning stations at project boat ramps for the removal of aquatic invasive species.

Table 2.1-10. Recreation enhancement opportunities within the FERC project boundary (Source: KRRC, 2021a)

Site Name	Added or Modified Amenities	Expected Recreation Opportunities
New River Access Sites		
Pioneer Park West	• Improve existing access road • Parking area for 21 vehicles (including 2 spaces for Americans	• Informal shoreline recreation • Whitewater boating • Fishing • Boating

Site Name	Added or Modified Amenities	Expected Recreation Opportunities
	with Disabilities Act[44] accessible parking) • 4 commercial vehicle pull-through parking spaces • Universally accessible vault toilet • Garbage facilities • Water spigot • Kiosk with angler box • Informational kiosk • 6 picnic sites • 2 river viewing areas • Trail to the boat launch from parking area • Boat launch staging area and vehicle turnaround • 2-lane boat launch • Removal of in-water concrete piers	• Picnicking/day use • Informal shoreline recreation
Moonshine Falls[a]	• Access road improvements • Parking area for 15 vehicles including 1 space for ADA-accessible parking) • 3 commercial vehicle pull-through parking spaces • Universally accessible vault toilet • Garbage facilities • Water spigot • Kiosk with angler box • 1 picnic site • River view point with benches • Trail to the boat launch	• Whitewater boating • Fishing • Boating • Picnicking/day use

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[44] 29 C.F.R. pt. 1630.

Site Name	Added or Modified Amenities	Expected Recreation Opportunities
	• Boat launch staging area and vehicle turnaround • Boat launch drop off/staging area • Boat slide and accompanying ramp down to the river's edge • Gravel beach	
Copco Valley[a]	• New access road off the existing Copco Cove access road • Parking area for 54 vehicles (including 2 spaces for ADA-accessible parking) and 7 trailer pull-outs • Universally accessible vault toilet • Garbage facilities • Kiosk with angler box • Water spigot • 5 picnic sites • 2 designated dispersed river access sites and gravel connector trail • 4-lane paved boat ramp • Boat launch staging area • Hand-launching area/beach	• Whitewater boating • Fishing • Boating • Picnicking/day use • Informal shoreline recreation
Copco No. 2 Powerhouse[a]	• Widened access road off Daggett Road • Parking area for 40 vehicles (including 2 spaces for ADA-accessible parking) and 4 pull-through spaces for vehicles with trailers • Universally accessible vault toilet • Garbage facilities • Water spigot	• Whitewater boating • Fishing • Boating • Picnicking/day use • Informal shoreline recreation

Site Name	Added or Modified Amenities	Expected Recreation Opportunities
	• 4 picnic sites • Viewpoint with bench • Staging area with bench and kiosk with angler box • Shoreline trail from boat slide to Daggett Road • Boat slide to launch at edge of river • Boat slide staging area	
Iron Gate[a]	• Parking area for 18 vehicles (including 2 spaces for ADA-accessible parking) and 5 vehicles with trailers • Universally accessible vault toilet • Garbage facilities • Kiosk with angler box • Water spigot • 5 picnic sites • Trails to picnic sites • Regrade river's edge/beach • Paved 4-lane boat launch • Launch staging area • Retain existing vegetation	• Whitewater boating • Fishing • Boating • Informal shoreline recreation
Vegetation Removal		
Copco No. 2 Bypassed Reach	• In-channel vegetation removal	• Whitewater boating

[a] Additional planning is underway, and this site may be reduced in size and amenities to minimize footprint (avoid cultural resources and minimize potential environmental effects) and lower maintenance costs.

2.1.2.14 Historic Properties Management Plan (Exhibit F)

The Lower Klamath Project area of potential effects (APE) contains 93 identified archaeological sites, numerous historic structures, and five historic districts. Many of these cultural resources are listed or potentially eligible for listing on the National Register. The HPMP as filed on February 26, 2021, includes measures proposed to support the following goals: (1) support management of historic properties within the project's APE; (2) follow Commission requirements for the identification, evaluation, and treatment of historic properties potentially affected by the project; (3) follow applicable federal and state laws and regulations regarding the management of historic properties, including section 106 of the NHPA, as amended; (4) satisfy the stipulations of a pending agreement document; (5) satisfy the commitments to mitigation developed under California's Assembly Bill 52; (6) ensure appropriate interagency coordination of activities that have the potential to affect historic properties in the APE; (7) establish a process for consulting with agencies, Native American Tribes, local jurisdictions, other interested parties, and the public during the implementation of the HPMP; and (8) establish procedures for properly protecting and managing historic properties for the duration of the license surrender process. The plan includes two subplans: Monitoring and Inadvertent Discovery Plan (appendix C) and Looting and Vandalism Protection Plan (appendix D). Appendix A includes maps of the APE/area of direct impacts (ADI), and appendix B presents a Historic Context Report. The plan and subplans apply to cultural sites in both states. KRRC intends to file an updated HPMP by March 31, 2022.

2.1.2.15 Water Supply Management Plan (Exhibit P)

The Water Supply Management Plan identifies measures to protect water supply and beneficial uses that KRRC would implement as part of the proposed action. The plan includes the following subplans: California Water Supply Management Plan (appendix A); California Public Drinking Water Management Plan (appendix B); Oregon Groundwater Well Management Plan (appendix C); and FMP (appendix D). The FMP applies to both states. The subplans are discussed in more detail below.

California Water Supply Management Plan

The California Water Supply Management Plan describes the measures KRRC proposes to implement to protect water supplies and beneficial uses of waters in California affected by the proposed action. Water supplies and beneficial uses subject to this plan include non-potable surface water diversions sourced from the Klamath River downstream of Iron Gate Dam and groundwater within the immediate surrounding vicinity of Copco No. 1 Reservoir.

During the pre-drawdown period, KRRC would contact each water right holder and determine if the diverter is interested in having their system evaluated for potential effects. During drawdown and up to two years following drawdown, if an adverse effect is reported, KRRC would investigate and implement measures (e.g., repairs to pumps and sediment clearing) to allow the water right holder to divert water in the same manner and quantity as before drawdown. In addition, KRRC would submit an annual water supply management report to the Commission and the California Water Board beginning one year prior to and for two years following completion of drawdown. At a minimum, the annual report would include: (1) a map presenting the location of potentially affected points of diversion; (2) a description of the potential adverse effects from drawdown; (3) a list of water rights holders who agreed to have a technical evaluation; and (4) a description of the measures implemented, or to be implemented, to address the potential adverse effects from drawdown.

For groundwater wells affected in California, KRRC would submit an annual water supply management report to the Commission and the California Water Board. At a minimum, the report would include: (1) documentation of groundwater well monitoring results including time series of water levels, trend analyses, and relationships of the identified trends to the proposed action; (2) a map of participating groundwater wells; and (3) mitigation actions to address effects on groundwater.

California Public Drinking Water Management Plan

The California Public Drinking Water Management Plan describes the measures KRRC proposes to implement to protect public drinking water supplies in California as part of the proposed action. Public drinking water supplies subject to this plan include drinking water sourced from the Klamath River below Iron Gate Dam and the City of Yreka’s water supply diverted from Fall Creek.

KRRC expects the proposed action to affect the raw infiltration gallery currently serving the Collier Rest Area during the initial drawdown phase and for up to two years following drawdown. To mitigate effects on water supply delivery, KRRC would supplement the facility with a 32,000-gallon water supply storage tank. KRRC expects the storage tank would provide sufficient drinking water to the Collier Rest Area for one to three days depending on usage by the public, and KRRC would provide additional deliveries of potable water as needed. Following completion of the proposed action operation of the raw infiltration gallery would commence.

To avoid damage following reservoir drawdown, KRRC proposes to replace the City of Yreka’s existing water supply pipeline that traverses beneath the north end of the Iron Gate Reservoir. Prior to drawdown, KRRC would temporarily reroute the pipeline across the Daggett Road Bridge until the new pipeline is installed. KRRC would coordinate with the City of Yreka to provide an uninterrupted water supply during replacement, and the estimated water delivery outage timeframe would be agreed upon between the City of Yreka and KRRC prior to construction. KRRC notes the proposed action would not modify the City of Yreka’s water supply diversion and existing water rights on Fall Creek. Following the removal of the Iron Gate facility, KRRC would excavate a new trench into the riverbed and bury the new pipeline at a depth that would prevent scour up to the 500-year flood event.

Oregon Groundwater Well Management Plan

The Oregon Groundwater Well Management Plan describes the measures KRRC would implement to protect groundwater supplies potentially affected by the proposed action in Oregon. For groundwater wells affected in Oregon, KRRC would submit an annual compliance report to the Commission and the Oregon DEQ by April 1 for the preceding year in which activities are performed. At a minimum, the report would include: (1) efforts undertaken by KRRC including well installations, field activities, and outreach efforts; and (2) monitoring results.

Fire Management Plan

The FMP describes the measures KRRC would implement to mitigate for the effects of the proposed action on fire prevention and suppression. The objectives of the plan are to (1) prevent or control any fire caused by construction or habitat restoration activities, and (2) avoid a net reduction in firefighting resources or an increase in the fire ignition risk from the loss of the project reservoirs.

To prevent or control any fire caused by construction or habitat restoration, the FMP requires KRRC to use BMPs and comply with regulations to prevent and control fire risk associated with deconstruction activities.

To avoid a net diminution in firefighting resources or an increase in the fire ignition risk as a result of the loss of the project reservoirs, KRRC would implement the following measures: (1) install monitored detection system cameras in a 570 square-mile area around the project; (2) construct ramps for fire trucks to access the river as well as install dry hydrants for ground crews; (3) purchase dip tanks and maintain aerial river access sites for helicopter crews; and (4) purchase equipment to assist the local communities with providing defensible space and to reduce the risk of structure fires.

2.1.2.16 Interim Hydropower Operations Plan (Exhibit G)

The Interim Hydropower Operations Plan identifies that, after license transfer and until drawdown and dam removal are initiated, KRRC would implement the "Agreement for Operation and Maintenance of the Lower Klamath Project between the Klamath River Renewal Corporation and PacifiCorp" (appendix A to the plan), for purpose of such operation and maintenance. The agreement details actions to be taken by both KRRC and PacifiCorp.

2.1.3 Air Quality and Noise Measures

California Water Board (2020a) states that KRRC has agreed to implement the following measures to protect air quality and limit noise during project deconstruction:

AQ-1 Off-Road Construction Equipment Engine Tier

For the construction activities occurring within California, any off-road construction equipment (e.g., loaders, excavators) that are 50 horsepower or greater must be equipped with engines that meet the EPA Tier 4 Final emissions standards for off-road compression-ignition (diesel) engines, unless such an engine is not available for a particular item of equipment. To the extent allowed by the California Air Resources Board (CARB) Off-Road Diesel Fueled Fleets regulations, Tier 3 and Tier 4 interim engines would be allowed when the contractor has documented, with appropriate evidence, that no Tier 4 Final equipment or emissions equivalent retrofit equipment is available or feasible (CARB, 2016). Documentation may consist of signed statements from at least two construction equipment rental firms.

AQ-2 On-Road Construction Equipment Engine Model Year

Any heavy-duty on-road construction equipment must be equipped with engines that meet the model year 2010 or newer on-road emission standards.

AQ-3 Heavy-Duty Trucks Engine Model Year

Any heavy-duty trucks used to transport materials to or from the construction sites must be equipped with engines that meet the model year 2010 or later emission standards for on-road heavy-duty engines and vehicles. Older model engines may also be used if they are retrofitted with control devices to reduce emissions to the applicable emission standards.

AQ-4 Blasting-Related Dust Control Measures

Dust control measures would be incorporated to the maximum extent feasible during blasting operations at Copco No. 1 Dam. The following control measures would be used during blasting activities as applicable: conduct blasting on calm days to the extent feasible; consider wind direction with respect to nearby residences; and design blast stemming to minimize dust and control fly rock.

AQ-5 General Construction Dust Control Measures

To reduce fugitive dust emissions, the following additional measures shall be implemented:

- Water all exposed surfaces as appropriate to control fugitive dust through sufficient soil moisture. Under normal dry-season conditions this is generally a minimum of two times daily. Watering of exposed surfaces is not necessary when soils are already sufficiently wetted (e.g., during rain). Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.
- Install stabilized construction entrances where appropriate, to include geotextile fabric and/or coarse rock to manage the amount of soil tracked onto paved roadways by motor vehicle equipment, and suspended in runoff, from the active construction sites.

Noise and Vibration Control Plan

The Noise and Vibration Control Plan (NVCP) (Definite Plan – appendix O5) would minimize short-term outdoor noise effects and specifies that a final NVCP, with additional details, would be required of the construction contractor. The final NVCP would identify measures that would be implemented to reduce potential noise effects to the degree feasible.

ENR-1 Purchase of Carbon Offsets

Prior to the start of pre-dam removal activities and any construction activities, KRRC would purchase and retire carbon offsets for the estimated 20,128 metric tons of carbon dioxide equivalents (MTCO2e) of construction greenhouse gas (GHG) emissions that would be generated by the proposed action. The carbon offsets must meet the requirements of California Environmental Quality Act (CEQA) Guidelines, section 15126.4(C)(3), and represent reductions actually achieved (not based on maximum permit levels), not already planned or required by regulations or policy (i.e., not double counted), readily accounted for through process information and other reliable data, acquired through legally binding commitments/agreements, verified through the accurate means by a reliable third party, and will remain as GHG reductions in perpetuity.

2.2 MANDATORY CONDITIONS

The following final WQC conditions were issued by the California Water Board and the Oregon Department of Environmental Quality (Oregon DEQ). The full text of the certification conditions from these agencies is provided in appendices D and E.

2.2.1 Conditions of the California Water Board's 401 Water Quality Certification (issued April 7, 2020)

- Condition 1: Submit a water quality management plan to the California Water Board for review and approval.
- Condition 2: Thirty-two months following the beginning of drawdown, submit an assessment of whether project activities are anticipated to result in exceedance of a water quality objective(s) beyond 36 months following the beginning of project drawdown. If the assessment indicates a high risk of continued exceedance beyond this timeline, consult with staff from the California Water Board and North Coast Regional Water Quality Control Board (NCRWQB) regarding the development of a proposal for actions to address the anticipated exceedance(s).
- Condition 3: Submit a reservoir drawdown and diversion plan to the California Water Board for review and approval.
- Condition 4: Perform arsenic assessment and remediation (if appropriate) of visibly obvious sediment deposits along the Klamath River from below

Iron Gate Dam to the mouth of the Klamath estuary that may have been deposited during reservoir drawdown activities.

- Condition 5: Submit an anadromous fish presence monitoring plan to the California Water Board for review and approval.
- Condition 6: Implement the following aquatic resource measures as proposed in appendix I of the 2018 Definite Plan as modified by in this condition: (1) tributary-mainstem connectivity monitoring for adult and juvenile salmon; (2) spawning habitat availability report and plan; (3) overwintering juvenile salmonid salvage and relocation efforts; (4) rescue and relocation of juvenile salmonids and Pacific lamprey from tributary confluence areas; (5) the Iron Gate Hatchery management measure; (6) California suckers adaptive management plan; and (7) mussel translocation as modified in KRRC's October 10, 2018, letter to the California Water Board.
- Condition 7: Submit a remaining facilities plan to the California Water Board for review and approval that describes all project facilities that would not be removed and proposed measures to mitigate any potential effect of the remaining facilities to water quality.
- Condition 8: Submit a report that: (1) identifies all drinking water supplies sourced from the Klamath River that may be impacted by the project; (2) describes measures the licensee will implement to protect each potentially affected water supply and why such measures are sufficient to protect the drinking water supplies; and (3) documents consultation with the applicable water supplier and how any comments made on the proposed measures were addressed in the report. In addition, prior to initiating drawdown, construct a replacement pipe for the City of Yreka's current water supply pipeline and limit any interruption to water delivery to a maximum of 12 hours.
- Condition 9: In the event chemical vegetation control is proposed to control algae or aquatic weeds, consult with staff from the Corps, California DFW, NCRWQB, and the California Water Board and submit a proposal for review and approval.
- Condition 10: Comply with the terms and conditions in the California Water Board's NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities during the life of the project. For any ground-disturbing activities that could impact water quality (including beneficial uses) that are neither addressed by the Construction General Permit nor addressed in other conditions of this certification, prepare site-specific water quality monitoring and protection plans for approval by the California Water Board.

- Condition 11: Submit a waste disposal plan to the California Water Board for review and approval that describes how the licensee will manage and dispose of all non-hazardous wastes generated as part of the project to protect water quality.
- Condition 12: Submit a hazardous materials management plan to the California Water Board for review and approval.
- Condition 13: Submit a hatcheries management and operations plan to the California Water Board for review and approval.
- Condition 14: Submit a restoration plan to the California Water Board for review and approval to include material elements of the restoration plan presented in section 6 of the 2018 Definite Plan and additional measures to restore lands in the reservoir footprints, establish native vegetation cover, ensure floodplain connectivity, provide for no net loss of wetland or riparian habitat, protect water quality during restoration activities, and increase the abundance of large woody material in the hydroelectric reach.
- Condition 15: Implement the following measures to protect water supply and beneficial uses: (1) Surface Water Diversions: (a) identify all points of diversion on the Klamath River; (b) contact all California water rights holders with points of diversion on the Klamath River to determine whether the water right holder is interested in working with the licensee to evaluate potential project impacts to the water right holder; (c) if potential impacts are identified and if the water right holder is interested in working with the licensee, provide temporary accommodations (e.g., replacement water, settling basins) to address potential impacts; (d) following dam removal, investigate any adverse impact due to dam removal and implement measures to reduce impacts and allow the water right holder to divert water in the same manner (e.g., amounts, suitable quality, and timing) as before dam removal; (2) Groundwater: At least two months prior to commencing drawdown activities, monitor groundwater levels at a minimum of 10 locations within 2.5 miles of the California reservoirs and continue to monitor groundwater levels, at least monthly for at least two years following completion of drawdown; and (3) Reporting: The year prior to and annually for the first two years following drawdown, submit a water supply management report that documents activities required by this condition. The first report must also include a list and map of locations where fire trucks and/or helicopters may access the Klamath River and its tributaries for residential fire protection efforts in the hydroelectric reach.
- Condition 16: Submit an amphibian and reptile rescue and relocation plan to the California Water Board for review and approval.

- Condition 17: Submit a bald and golden eagle management plan for review and approval.
- Condition 18: Submit a slope stability monitoring plan to the California Water Board for review and approval.
- Condition 19: Submit a recreation facilities plan to the California Water Board for review and approval, including identification of all recreation facilities that would be removed, modified, maintained, or added following dam removal and plans to facilitate transfer of ownership and/or operation of such facilities, measures to monitor and protect water quality, measures to control aquatic invasive species, and posting signage for at recreation facilities for water quality impairments (e.g., *E. coli* or fecal coliform and microcystin toxin).
- Condition 20: Submit an interim hydropower operations plan to the California Water Board for review and approval if drawdown activities are not initiated within 24 months after the surrender order is issued. Dam removal must be initiated no later than five years following issuance of the license surrender order unless the licensee can demonstrate to the California Water Board that the delay is due to factors outside the licensee's control.
- Condition 21: Prior to changing any water diversion for implementation of the project, consult with California Water Board staff regarding potential modifications to or transfer of state-issued water right permits and licenses and follow the procedures for any such modification, as described in the California Water Code and in California Code of Regulations, title 23.
- Condition 22: To ensure that the requirements of the certification ultimately meet Tribal CWA standards, submit the 32-month report on anticipated compliance under Compliance Schedule (Condition 2) to the Hoopa Valley Tribe and any other Native American Tribes that have obtained treatment as a state status. Submit to the Hoopa Valley Tribe, and any other Tribe that has subsequently obtained treatment as a state status, any request to end or modify monitoring under Water Quality Monitoring and Adaptive Management (Condition 1) at the location(s) closest to or within that Tribe's reservation.
- Condition 23: For any condition that requires consultation with specific agencies, consult with additional parties (including, through "good neighbor" agreements or through consultation commitments under the KHSA).

2.2.2 Conditions of Oregon DEQ’s 401 Water Quality Certification (issued September 7, 2018)

- Condition 1: Notify Oregon DEQ if the Commission authorizes modification to the proposed action to allow Oregon DEQ to determine whether such changes may affect compliance with water quality standards that may require amendment of this certification.
- Condition 2: Submit a water quality management plan to Oregon DEQ for review and approval.
- Condition 3: If water quality monitoring demonstrates that project actions may contribute to exceedances of the applicable water quality standards more than 24 months after drawdown, Oregon DEQ may require the licensee to develop an adaptive management plan in consultation with Oregon DEQ, which includes alternative measures, an assessment of impacts, and a schedule to achieve compliance.
- Condition 4a: Provide or maintain fish passage at all artificial obstructions created or affected by the proposed action.
- Condition 4b: Implement Aquatic Resource Measure AR-6 presented in appendix H of the Technical Support Document (KRRC, 2017) to mitigate project effects on adult Lost River sucker and shortnose sucker in J.C. Boyle Reservoir prior to drawdown.
- Condition 4c: Conduct western pond turtle abundance and overwintering studies and implement mitigation actions as deemed warranted by Oregon DEQ to reduce potential impacts to western pond turtle populations prior to drawdown of J.C. Boyle Reservoir.
- Condition 4d: Decommission the Lower Klamath Project on-site septic systems proposed for removal in accordance with Oregon Administrative Rule Chapter 340, Division 71.
- Condition 4e: Register with Oregon DEQ for coverage under NPDES general permit 1200-C before any construction activities occur that cumulatively disturb more than 1 acre of and may discharge stormwater to surface waters of the state.
- Condition 5: Submit a reservoir drawdown and diversion plan to Oregon DEQ for review and approval.
- Condition 6: Submit a RAMP to Oregon DEQ for review and approval to include performance criteria and monitoring for (1) unobstructed stream continuity; (2) fish passage; (3) sediment stability; and (4) invasive exotic vegetation abatement and native vegetation cover establishment.

- Condition 7: Submit a remaining facilities and operations plan to Oregon DEQ for review and approval that describes all project facilities that would not be removed and proposed measures to mitigate any potential effect of the remaining facilities to water quality.
- Condition 8: Submit an erosion and sediment control plan to Oregon DEQ for review and approval.
- Condition 9: Submit a waste disposal and management plan to Oregon DEQ for review and approval.
- Condition 10: Submit a spill prevention, control, and countermeasure plan to Oregon DEQ for review and approval.
- Condition 11: Submit an annual compliance report to Oregon DEQ by April 1 for the preceding year in which activities are performed pursuant to conditions required by the certification.

2.2.3 NMFS Biological Opinion Terms and Conditions (filed December 20, 2021)

The biological opinion (BiOp) issued by NMFS on December 17, 2021, requires the following reasonable and prudent measures for Southern Oregon/Northern California Coasts (SONCC) coho salmon evolutionarily significant unit (ESU) and Southern distinct population segment (DPS) of eulachon:

1. Monitoring and reporting on water quality and incidental take of coho salmon and eulachon in the Klamath River mainstem related to the proposed action.
2. Minimizing incidental take associated with invasive and exotic vegetation management.
3. Ensuring that real-time project decisions use the best available technical information during implementation and maintenance of the proposed action.
4. Monitoring mainstem coho salmon spawning to ensure that there is no exceedance of NMFS’ anticipated incidental take of coho salmon embryos and pre-emergent fry in redds.

For the Southern Resident killer whales, NMFS requires the following reasonable and prudent measures:

1. Monitoring and reporting on water quality and incidental take of Southern Resident killer whales as it relates to effects on Chinook salmon.
2. Minimizing incidental take of Southern Resident killer whales by ensuring that both hatchery and wild Chinook salmon production and survival meet NMFS’ assumptions.
3. Ensuring that real-time project decisions use the best available technical information during implementation and maintenance of the proposed action.

4. Monitoring sediment deposition to ensure that there is no exceedance of the expected amount or incidental take of Southern Resident killer whales as a result of mortality of Chinook salmon embryos and pre-emergent fry in redds.

The NMFS BiOp also includes two general reasonable and prudent measures, which require that:

1. Any surrender order issued, or other authorization for the amended surrender application, be subject to the reasonable and prudent measures and terms and conditions of its incidental take statement.
2. Any surrender order issued, or other authorization for the amended surrender application for the proposed project, include a reopener clause providing for the possible amendment of the order or other authorization to incorporate any reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions resulting from any reinitiated consultation on the authorized action.

2.2.4 FWS Biological Opinion Terms and Conditions (filed December 22, 2021)

The BiOp issued by FWS on December 22, 2021, requires that:

1. Any surrender order issued, or other authorization for the amended surrender application, be subject to the reasonable and prudent measures, terms and conditions, and monitoring requirements of its incidental take statement.
2. Any surrender order issued, or other authorization for the amended surrender application for the proposed project, include a reopener clause providing for the possible amendment of the order or other authorization to incorporate any reasonable and prudent alternatives, reasonable and prudent measures, terms and conditions, and monitoring requirements resulting from any reinitiated consultation on the authorized action.
3. KRRC and its contractors and agents ensure compliance with the criteria and guidelines specified in its biological assessment (BA) and the FWS BiOp and Incidental Take Statement for the capture, translocation, and monitoring of Lost River and shortnose sucker to minimize incidental take from the capture and translocation.

2.3 PROPOSED ACTION WITH STAFF’S MODIFICATIONS

This section describes staff modifications to the proposed action, based on recommendations made in response to scoping, and staff’s analysis of the effects of the proposed action.

- Require that all consultations, final management plans, delineations, pre-drawdown mitigation measures, agreements, wetland delineations, and certifications, must be completed before any surface disturbance commences.

- Modify the Construction Management Plan to include measures AQ-1 through AQ-5 to minimize effects of deconstruction activities on air quality, measure ENR-1 to purchase carbon offsets, and the NVCP. These measures, which KRRC has agreed to implement, are described in section 2.1.3.
- Specify measures in the California Slope Stability Monitoring Plan (a subplan of the Reservoir Drawdown and Diversion Plan) about repairs and replacements of private property to be implemented if any reported structural damage to properties abutting Copco No. 1 Reservoir is found to be related to the drawdown, following monitoring and inspection.
- Extend the planned LiDAR monitoring of the reservoir and embankment rim for six months after completion of the drawdown—at a reduced survey interval of once per month and limited to 1,780-linear-foot long segments of the Copco No. 1 Reservoir rim identified to be potentially affected by slope failure. The rationale for limiting this measure to Copco No. 1 Reservoir is discussed in section 3.1, *Geology and Soils*.
- Modify the Del Norte Sediment Management Plan (a subplan of the Sediment Deposit Remediation Plan) to require that Del Norte County be reimbursed by KRRC for any increase in the cost of maintaining the Klamath River boat ramps in an operable condition that is attributable to sediment deposited as a result of the proposed action.
- Modify the Water Quality Monitoring and Management Plan to include submittal of all reports and correspondence to Native American Tribes that have obtained CWA treatment as a state status.
- Modify the Aquatic Resource Management Plan to include translocation of freshwater mussels as modified in KRRC's October 10, 2018, letter to the California Water Board.
- Modify the Hatchery Management and Operations Plan to clarify whether and when ownership would be transferred to California DFG or another entity.
- Modify the RAMP to include two periods of vegetation sampling each year. One sampling period should occur in late spring/early summer as proposed. The second sampling period should occur in late fall, but prior to the onset of woody vegetation dormancy.
- Modify the RAMP to include detailed pre-work maps that identify areas of grading, water runoff control measures, planting, seeding, mulching, and irrigation areas. These maps should include final limits of work zones, delineated wetlands within areas of proposed disturbance, the reservoir

footprints, the J.C. Boyle canal and scour hole, and all areas of temporary disturbance where revegetation activities would occur.

- Develop an eagle conservation plan that includes occupancy and nest productivity surveys; timing restrictions on vegetation clearing and construction noise; monitoring of active eagle nests; coordination with FWS, California DFW, and Oregon DFW; and reporting as described in California Water Board WQC condition 17.
- Modify the California and Oregon TWMPs to include: (1) additional criteria for the potential removal of structures containing bats between April 16 and August 31. If it is necessary to remove structures during this period, conduct surveys to determine whether the structure is occupied as a maternity roost and prohibit removal of structures with maternity roosts. In the absence of maternity roosts, only remove structures when bats are active (i.e., at night) and when less than 0.5 inch of rain is predicted within the following 24 hours; (2) use of bat gates to close portal outlets, tunnels, and other water conveyance structures; and (3) require staff entering areas with potential bat activity to follow the National White-Nose Syndrome Decontamination Protocol (WNS Response Team, 2020).
- Modify the Recreation Facilities Plan to include: (1) removal or fragmentation of remaining construction-related debris in the river at the Sidecast Slide location and encroaching vegetation growth within the river channel in the Copco No. 2 bypassed reach that create hazardous boating conditions; (2) developing a plan for funding the construction and maintenance of the potential access sites described in the Recreation Facilities Plan and file a revised Recreation Facilities Plan with the Commission to include, at a minimum, development of the planned access points that are within the existing reservoir footprints; (3) consulting with UKOA to schedule construction activities and access restrictions to minimize adverse effects on whitewater boating; and (4) adding signage related to recreation site closures in Spanish and Hmong.
- Prepare a supplemental HPMP in consultation with the Oregon SHPO, California SHPO, participating Tribes, and other appropriate agencies and organizations to address the following: (1) the results of Phase II archaeological studies, (2) the results of additional surveys and evaluations of historic structures; (3) the results of the pending traditional cultural properties (TCP) studies and Tribal consultation; (4) identification of specific effects on all historic properties, and resource-specific measures to resolve effects determined to be adverse; and (5) additional items identified by the Commission as requiring clarification.
- Modify the Reservoir Area Management Plan to incorporate the pre- and post-drawdown requirements for cultural resources inspections, surveys,

evaluations, mitigation, and management as specified in the HPMP. Additionally, should ground conditions permit access for depositional sediment grading during reservoir drawdown, include provisions in the Reservoir Area Management Plan for a cultural monitor to be present to ensure that if any cultural resources are identified on the historical pre-dam ground surface, grading stops and the measures outlined in appendix C, section 7.1 of the HPMP (Monitoring and Inadvertent Discovery Plan, Procedures) are closely followed within 48 hours. These protocols include, but are not limited to: (1) notifying the team supervisor of any discovery of cultural or archaeological resources, (2) suspending work within 100 feet of the find in all non-dewatering situations, (3) completing an initial assessment of the discovery, (4) notifying the Commission, SHPO, and participating Tribes of the find, and (5) consulting with these entities to determine and implement agreed-upon treatment measures for discoveries that are potentially eligible for listing on the National Register.

- Modify the Sediment Deposit Remediation Plan, the Water Supply Management Plan, the Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services to include a public outreach component that specifically addresses communication with environmental justice communities.
- Modify the Fire Management Plan (a subplan of the Water Supply Management Plan) in consultation with the California Department of Forestry and Fire Protection, Oregon Department of Forestry, and the Fire Safe Council of Siskiyou County to address the following issues raised by stakeholders:
    1. Insufficient stream depth and lift requirements at proposed locations for dry fire hydrants;
    2. Location of dry fire hydrants on blind corners;
    3. Lack of suitable locations for fire trucks to turn around near dry fire hydrants;
    4. Lack of any proposed river access boat ramps within the Copco No. 1 Reservoir area;
    5. Identification of the entity that would be responsible for storage, deployment, and refill of portable water tanks; and
    6. The potential need to install additional water sources (such as dip tanks) to address the potential filling of existing dip sites by gravel transported from the reservoirs.

2.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, the Lower Klamath Project would continue to operate as it does today, under the terms and conditions of the existing license. There would be no disturbance of existing environmental conditions at the site, and there would be no new environmental protection, mitigation, or enhancement measures. The project dams would remain in place. The no-action alternative represents existing conditions and serves as the baseline for evaluating the effects of the licensee's proposed action.

The no-action alternative would not address the water quality and disease issues which, when combined with the ongoing trends of increased temperatures and reduced amount of precipitation falling as snow, pose a substantial risk to the survival of one of the few remaining Chinook salmon populations in California that still sustain important commercial, recreational, and Tribal fisheries.

If hydropower generation were to continue under the no-action alternative, the Commission's relicensing proceeding would resume, and the Commission would ultimately have to determine whether and under what conditions to relicense the project. The current licensee, PacifiCorp, has decided not to seek a license for the project, and no other entity has come forward to continue operating the project for hydropower generation. Until a surrender order is issued, the project features would be maintained and operated by KRRC and the states. Ultimately, the project would have to be either relicensed or decommissioned because perpetual annual licensing is not authorized under the FPA.

The existing license for the 163-megawatt (MW) project requires PacifiCorp to:

- Regulate the water level upstream of Keno Dam in accordance with the agreement with Reclamation (Article 55, 1965 amended license).
- Operate the J.C. Boyle (formerly Big Bend) Development such that the rise or fall of the river is increased or decreased gradually at a rate not to exceed 9 inches per hour at a point 0.5 mile below the J.C. Boyle Powerhouse, subject to Commission review and adjustment from time to time, after notice and opportunity for hearing (Article 36, 1957 amended license).
- Release the following minimum flows downstream of Iron Gate Dam: September 1 through April 30, 1,300 cubic feet per second (cfs); May 1 through May 31, 1,000 cfs; June 1 through July 31, 710 cfs; and August 1 through August 31, 1,000 cfs (Article 52, 1961 amended license).
- Restrict changes of release rates to not more than 250 cfs per hour or a 3-inch change in river stage per hour, whichever produces the least change in stage as measured at a gage located not less than 0.5 mile downstream of Iron Gate Dam (Article 52, 1961 amended license).
- Construct, maintain, and operate permanent wildlife facilities and protective devices including, but not limited to, deer protective fences, and

comply with such reasonable modification in project structures and operation in the interest of wildlife as may be prescribed hereafter by the Commission upon the recommendation of Interior and California DFG [now California DFW] (Article 53, 1961 amended license).

- Reimburse California DFG for 80 percent of the combined annual cost of operation and maintenance of the Iron Gate Hatchery and of the permanent fish trapping, collecting, holding, and spawn-taking facilities and appurtenances constructed at Iron Gate Dam. If the licensee and California DFG fail to agree on the amount to be paid by the licensee for this purpose, the Commission reserves the right to determine the amount of such annual payment, after notice and opportunity for hearing (Article 50, 1963 amended license).
- Construct, operate, and maintain fishways at the J.C. Boyle (formerly Big Bend) Diversion Dam, screens at the intake for the J.C. Boyle conduit, and deer escape facilities in and around the open portions of the J.C. Boyle conduit (Article 32, 1957 amended license).
- Maintain in the natural channel of the Klamath River immediately below the J.C. Boyle Diversion Dam a reasonable minimum flow consistent with the primary purpose of the project to be fixed hereafter by the Commission after notice to interested parties and opportunity for rehearing (Article 34, 1957 amended license). This minimum flow was later set by the Commission at 100 cfs, released at the dam according to exhibit B of the license application.

2.5 REASONABLY FORESEEABLE TRENDS AND PLANNED ACTIONS

Prior to discussing the various resources in the project area, it is important to understand the reasonably foreseeable environmental trends and planned actions as part of the baseline for the affected environment. This includes the trends and actions for which there are existing decisions, formal proposals, or funding, or are highly probable based on known opportunities or trends. Within the next 25 years, the reasonably foreseeable trends or planned actions in the project area include:

- Other restoration activities, including fish passage and habitat enhancement;
- Implementation of total maximum daily loads (TMDLs) for Oregon and California;
- Klamath River flows required by the FWS and NMFS BiOps and required by court order (U.S. District Court 2017);
- Forestry practices and increasing wildfire; and
- Agricultural practices.

A summary of these trends and actions is provided below. The California Water Board (2018) Draft EIR, in table 3.24-1, provides a more comprehensive list of the reasonably foreseeable actions associated with the proposed project.

Additionally, the KHSA included over 20 interim measures that have been implemented by PacifiCorp since 2010 to assess and address environmental conditions and improve fisheries prior to dam removal. The KHSA defines the interim period as the period between the date that the KHSA was originally executed (February 18, 2010) and the decommissioning of the dams, which would occur once there has been a physical disconnection of the facility from PacifiCorp's transmission grid. The KHSA measures and their implementation status are listed in table 2.5-1.

Lastly, climate change in the Klamath River Basin is discussed in section 3.2, *Water Quantity*, and section 3.3, *Water Quality*; predicted climate change effects on federally listed species are described in section 3.6, *Threatened and Endangered Species*.

Table 2.5-1. Implementation status of KHSA interim measures (Source: California Water Board, 2020a)

Interim Measure	Description	Status
IM1 – Interim Measures Implementation Committee	The Interim Measures Implementation Committee comprises representatives from PacifiCorp, other parties to the KHSA (as amended on November 30, 2016), and non-signatory representatives from the California Water Board and Regional Water Board (see KHSA, appendix B, section 3.2). The purpose of the committee is to advise on implementation of the Non-Interim Conservation Plan Interim Measures set forth in appendix D of the amended KHSA.	Ongoing
IM2 – California Klamath Restoration Fund/Coho Enhancement	PacifiCorp would fund actions to enhance survival and recovery of coho salmon, including habitat restoration and acquisition.	Ongoing
IM3 – Iron Gate Turbine Venting	PacifiCorp shall implement turbine venting on an ongoing basis beginning in 2009 to improve dissolved oxygen concentrations downstream of Iron Gate Dam.	Construction complete, implementation ongoing

Interim Measure	Description	Status
IM4 – Hatchery and Genetics Management Plan (See also IM19 and IM20)	PacifiCorp would fund the development and implementation of a hatchery and genetics management plan for the Iron Gate Hatchery.	Plan development is complete, implementation ongoing
IM5 – Iron Gate Flow Variability	PacifiCorp and Reclamation would annually evaluate the feasibility of enhancing fall and early winter flow variability to benefit salmonids downstream from Iron Gate Dam. In the event that fall and early winter flow variability can feasibly be accomplished, PacifiCorp would develop and implement flow variability plans. This IM would not adversely affect the volume of water available for Reclamation’s Klamath Irrigation Project or wildlife refuges.	Complete
IM6 – Fish Disease Relationship and Control Studies	PacifiCorp has established a fund to study fish disease relationships downstream from Iron Gate Dam. PacifiCorp would consult with the Klamath River Fish Health Workgroup regarding selection, prioritization, and implementation of such studies.	Ongoing
IM7 – J.C. Boyle Gravel Placement and/or Habitat Enhancement	PacifiCorp would provide funding for the planning, permitting, and implementation of gravel placement or habitat enhancement projects, including related monitoring, in the Klamath River upstream of Copco No. 1 Reservoir.	Ongoing
IM8 – J.C. Boyle Bypass Barrier Removal	PacifiCorp would remove the sidecast rock barrier approximately 3 miles upstream of the J.C. Boyle Powerhouse in the bypassed reach to improve upstream fish passage.	Complete
IM9 – J.C. Boyle Powerhouse Gage	Upon the effective date, PacifiCorp shall provide USGS with continued funding for the operation of the existing gage below the J.C. Boyle Powerhouse.	Ongoing

Interim Measure	Description	Status
IM10 – Water Quality Conference	PacifiCorp shall provide one-time funding of $100,000 to convene a basin-wide technical conference on water quality within one year from the effective date of the KHSA.	Complete
IM11 – Interim Water Quality Improvements	PacifiCorp shall spend up to $250,000 per year to be used for studies or pilot projects developed in consultation with the Implementation Committee to improve interim water quality in the Klamath River.	Studies and pilot projects ongoing
IM12 – J.C. Boyle Bypassed Reach and Spencer Creek Gaging	PacifiCorp shall install and operate stream gages at the J.C. Boyle bypassed reach and at Spencer Creek.	Complete
IM13 – Flow Releases and Ramp Rates	PacifiCorp would maintain current operations including instream flow releases of 100 cfs from J.C. Boyle Dam to the J.C. Boyle bypassed reach and a 9-inch per hour ramp rate below the J.C. Boyle Powerhouse prior to transfer of the J.C. Boyle facility.	Ongoing
IM14 – 3,000 cfs Power Generation	Upon approval by Oregon Water Resources Department, PacifiCorp would continue maximum diversions of 3,000 cfs at J.C. Boyle Dam for power generation.	Ongoing
IM15 – Water Quality Monitoring	PacifiCorp shall fund long-term baseline water quality monitoring to support dam removal, nutrient removal, and permitting studies, and also will fund blue-green algae and blue-green algae toxin monitoring as necessary to protect public health. Funding of $500,000 shall be provided per year. The funding shall be made available beginning April 1, 2010, and annually on April 1.	Ongoing

Interim Measure	Description	Status
IM16 – Water Diversions	PacifiCorp shall seek to eliminate three screened diversions from Shovel (2) and Negro (1) Creeks and shall seek to modify its water rights as listed above to move the points of diversion from Shovel and Negro Creek to the mainstem Klamath River.	To be implemented
IM17 – Fall Creek Flow Releases	PacifiCorp would continue to provide a continuous flow release to the Fall Creek bypassed reach targeted at 5 cfs.	Ongoing
IM18 – Hatchery Funding	PacifiCorp shall fund 100 percent of Iron Gate Hatchery operations and maintenance necessary to fulfill annual mitigation objectives developed by the California DFW in consultation with NMFS and consistent with existing FERC license requirements.	Ongoing
IM19 – Hatchery Production Continuity	PacifiCorp will begin a study to evaluate hatchery production options that do not rely on the current Iron Gate Hatchery water supply. Based on the study results, and within six months following KRRC's acceptance of the FERC surrender order, PacifiCorp will propose a post-Iron Gate Dam Mitigation Hatchery Plan to provide continued hatchery production for eight years after the removal of Iron Gate Dam.	Ongoing
IM20 – Hatchery Funding After Removal of Iron Gate Dam	After removal of Iron Gate Dam and for a period of eight years, PacifiCorp shall fund 100 percent of hatchery operations and maintenance costs necessary to fulfill annual mitigation objectives developed by California DFW in consultation with NMFS.	To be implemented

2.5.1 Restoration Activities

Aquatic habitat restoration, flow enhancements, and water quality improvement projects on the Klamath River and its tributaries are anticipated to directly improve conditions for aquatic species, especially for overwintering juvenile salmonids. This may include the placement of off-channel habitat features, floodplain restoration, additions of woody debris, increases in stream flow, and improved water quality. California Water Board (2018) identified approximately 25 projects that would have a combined beneficial effect. For example, the Mid-Klamath Tributary Fish Passage Improvement Project would improve juvenile and adult salmonid fish passage at over 70 fish barriers in tributaries of the Middle Klamath River from the Trinity River upstream to Cottonwood Creek. The project also includes habitat assessment, fish presence surveys, and the installation of woody debris to enhance complexity of cold-water refugia sites (California DFW, 2020). Additionally, since 2013, Reclamation has provided funding of approximately $500,000 annually as part of its Klamath River Coho Restoration Grant Program for various habitat improvement programs. There are also numerous ongoing habitat restoration projects under the Trinity River Restoration Program, with Reclamation and BLM acting as lead agencies. California DFW is conducting various restoration, monitoring, and management activities in tributaries downstream of Iron Gate Dam, including Bogus Creek, Shasta River, Scott River, Humbug Creek, Beaver Creek, Horse Creek, and Fort Goff Creek. Other agency programs and initiatives would also fund watershed protection and flow enhancements, including the California Wildlife Conservation Board' Proposition 1 Stream Flow Enhancement Program; Reclamation's Long-Term Plan to Protect Adult Salmon in the Lower Klamath River; and the Sustainable Groundwater Management Act. These and other proposed habitat restoration and flow enhancement programs/projects are expected to result in long-term, beneficial cumulative effects on water quality and aquatic resources.

2.5.2 Total Maximum Daily Loads

For waterbodies with impaired water quality (i.e., 303[d]-listed waterbodies), TMDLs must be developed by the State to protect and restore beneficial uses of water. TMDLs (1) estimate the water body's capacity to assimilate pollutants without exceeding water quality standards; and (2) set limits on the amount of pollutants that can be added to a water body while still protecting identified beneficial uses. Oregon DEQ (2019) and the California (NCRWQCB, 2010) have cooperated on the development of TMDLs for the impaired water bodies of the Klamath Basin. These TMDLs address nutrients; dissolved oxygen; and organic matter and related targets. The TMDLs are designed to reduce the effects of advanced eutrophication driven by land disturbing activities, the presence of reservoirs, flow alterations, and direct inputs of pollutants. TMDLs also set temperature standards for various portions of the Upper Klamath River and its tributaries at levels intended to protect cold-water fish species like salmon that cannot survive high water temperatures. Further discussion of TMDLs is provided below in section 3.3, *Water Quality*.

Long-term water quality improvements in the Klamath Basin in Oregon and California that reduce pollutants towards the load allocations established in the TMDLs are foreseeable through a variety of measures, including restoration activities as discussed above. Also, for example, the South Suburban Sanitary District in Klamath Falls wastewater treatment facility is considering upgrades and process modifications to comply with the TMDL requirements. However, the amount of probable financial resources is likely insufficient to implement the extensive efforts required to achieve the TMDL targets (Congressional Research Service, 2012). While the implementation of TMDLs is expected to result in improved water quality over time, the specific implementation measures are not fully known. Therefore, the timeframe and extent to which the TMDL allocations can be met through future water quality improvements is uncertain.

2.5.3 Klamath River Flow Requirements

Water quality and aquatic habitat in the Klamath River would continue to be affected by the flow requirements of Reclamation's Klamath Irrigation Project (also known as the Klamath Project), which supplies irrigation water for agricultural uses in the Upper Klamath Basin. Reclamation's operations are subject to flows specified by FWS (2019a) and NMFS (2019a) BiOps, as well as court-ordered releases of additional winter-spring flushing flows and emergency dilution flows (U.S. District Court 2017). The BiOps prioritize a volume of water set aside in an environmental water account for releases in the spring, and minimum daily flow targets in April through June to meet ecological base flows for coho salmon fry and juveniles. The 2017 court-ordered flushing flows are released from Iron Gate Dam to reduce *C. Shasta* infection among coho salmon; flushing flows are designed to dislodge and flush out polychaete worms that host *C. Shasta* in the river. Emergency dilution flows were developed to reduce *C. Shasta* infections in coho salmon if certain disease thresholds in the Klamath River are exceeded.

Reclamation has reinitiated consultation with both FWS and NMFS on the operation of the Klamath River Project from April 1, 2020, through March 31, 2024, and proposed an Interim Operations Plan with certain deviations from that analyzed in the 2019 BiOps to provide additional flows in the Klamath River for listed species. NMFS agreed with Reclamation's conclusion that implementation of the proposed Interim Operations Plan would result in reduced effects from those previously analyzed in the NMFS 2019 BiOp and, therefore, is expected to be consistent with NMFS' determinations that Klamath Irrigation Project operations are not likely to jeopardize the continued existence of SONCC coho salmon or destroy or adversely modify its designated critical habitat (NMFS, 2020c, as cited in NMFS, 2021b). Ultimately, Reclamation's Klamath Irrigation Project operations would improve aquatic habitat and enhance water quality by providing flows less favorable to phytoplankton or periphyton, which would limit habitat suitable for fish parasites (e.g., *C. shasta*). The court-ordered increase in the frequency of higher flushing flows and emergency dilution flows between November and June would increase turbulent flows in the Klamath River, reducing the extent of slow-water habitat that favors algal growth.

Reclamation is coordinating with the KRRC to ensure that its operations (i.e., flows) plans account for dam removal. River flows are coordinated by a Flow Account Scheduling Technical Advisory Team and the Flow Management Process. Reclamation would make every attempt to provide two weeks advanced notice to KRRC when requesting flow schedule adjustments.

2.5.4 Forest Management

Forest management around the hydroelectric reach could potentially affect water quality and aquatic resources if vegetation removal allows increased solar radiation to reach waters, wetlands, and the surrounding floodplain surfaces, or causes erosion and increased sediment in stormwater runoff. Ground disturbance, compaction, and vegetation removal during timber harvest can modify drainage patterns and surface runoff resulting in increased peak storm flows which could alter stream channels via sediment aggradation. Temporary or permanent road construction and use for forest management activities like logging could also contribute to sedimentation of wetlands and waters. However, modern-day timber harvest affects aquatic resources at much reduced levels as compared to early-day forestry practices. Adverse effects would also be avoided or minimized because timber harvest plans would undergo review by the California Department of Forestry and Fire Protection (CAL FIRE). The State of Oregon also has a timber harvest review process with similar analysis and effects disclosure. On the other hand, some forest practices would potentially improve long-term water quality and aquatic habitat conditions by revegetating areas, enhancing riparian cover along meadow streams, and decommissioning or downgrading roads to reduce suspended sediment contributions to streams.

2.5.5 Wildfire

The Lower Klamath Project is located in an area at risk of wildfires; the surrounding fuel types and semi-arid climate are conducive to the rapid growth of wildfires (Siskiyou County, 2019; Stephens et al., 2008). Currently, fire risk is elevated in the project area from June 1 to October; summer temperatures often exceed 100°F and are accompanied by low precipitation and drought conditions. Also, thunderstorms are common July to August, but can occur from June through mid-September. Electrical storms are often accompanied by strong winds and little to no precipitation (CAL FIRE, 2021).

An increasing number of large fires and increasing proportion of high-severity burn area within fires is occurring during a period of rapid global climatic change (Mote et al., 2019). Wildfires are generally projected to become larger and more intense with anticipated climate changes, producing changes in the availability of forest habitat required by some species (Dennison et al., 2014; Halofsky et al., 2019). Human actions such as fire suppression and increasing interface between wildland and urban areas, combined with the shift in climate, have further altered historic fire regimes. This trend, combined with a warming climate and longer fire seasons, may serve as a catalyst to permanent shifts in vegetation from forests to shrublands (Lauvaux et al., 2016). To mitigate against potential forest conversion by stand-replacing fires, land managers are expected to increasingly perform fuel treatments that use a combination of fuels reduction via forest thinning and prescribed fire (Moghaddas et al., 2018). Restoration projects to reduce wildfire risk and promote mountain meadows offer an opportunity to improve water storage in topsoils, groundwater recharge, and timing of runoff in the Upper Klamath River Basin (CAL FIRE, 2010). Both wildfire and restoration efforts to reduce large wildfires are expected to continue having direct impacts to both terrestrial and aquatic resources due to high-severity burns, as well as indirect or cumulative impacts from forest management actions designed to reduce fire hazards (e.g., logging, road building). Further details about wildfire risk assessment and anticipated fuels mitigation in and around the project are found in the community wildfire protection plans for Klamath and Siskiyou Counties (Klamath County, 2016; Siskiyou County, 2019).

We discuss the effects of the proposed action on safety issues related to wildfire suppression in section 3.8, *Land Use*. In addition to the project reservoirs, helicopters and ground crews are able to extract water from the Klamath River channel, Lake Ewauna, and Upper Klamath Lake. Retrieving water directly from the Klamath River is consistent with how wildfires are suppressed along the Klamath River downstream of Iron Gate Dam under current conditions.

2.5.6 Agricultural Practices

Expanding agriculture in the region will potentially affect water quality and aquatic resources in the Klamath River. Flow diversions reduce the quantity and alter the timing of water availability, which can result in higher water temperatures. Upland modifications for crop production may negatively affect riparian and wetland habitats via erosion and increased siltation or reductions in water flow in tributary stream channels. Stormwater runoff from cultivated land may also contain nitrogen, ammonia, and other nutrients from fertilizers, as well as pesticides, which can degrade water quality and negatively affect the reproductive success and survival of aquatic organisms.

The cultivation of cannabis, both legally and illegally, in the Klamath River Basin can also affect water quality and aquatic resources, including salmonid habitats. Marijuana farms within the project area can be large-scale operations requiring water diversions for irrigation and can contaminate nearby waters through the discharge of pesticides, rodenticides, and fertilizers. However, regulatory agencies manage the effects from cannabis cultivation, and existing or newly permitted cannabis cultivation projects would be required to adhere to water quality regulations and implement project-specific measures to reduce potential effects on water quality (and thus aquatic resources). As such, these changes in cannabis cultivation practices would have a less than significant effect on aquatic resources, and the combination of the proposed action and these cannabis projects would not result in a significant cumulative effect on aquatic resources.

Grazing activities may affect aquatic resources through an increase in suspended sediment within streams due to soil disturbance and increased erosion of stream channels, trampling and herbivory of riparian vegetation, increased nutrients in streams due to livestock waste, and decreased dissolved oxygen due to the biological oxygen demand from stormwater runoff containing livestock waste. However, grazing projects would incorporate project-specific measures to reduce potential effects on water quality and aquatic resource, including storm water management, streambank setbacks, or exclusionary livestock fencing. Also, grazing and other agricultural projects are required to meet the requirements of Oregon and California's nonpoint source discharge programs and prohibitions against unpermitted discharges, such as the NCRWQB's Agricultural Lands Discharge Program. These require compliance with BMPs designed to meet state water quality requirements.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL ANALYSIS

In this section, we describe the existing condition of environmental resources that are relevant to the environmental effects of the proposed action and analyze the environmental effects of the three alternatives: (1) proposed action; (2) proposed action with staff modifications; and (3) no action. In this draft EIS, we refer to the Klamath River upstream of Iron Gate Dam as the Upper Klamath River and the river downstream of Iron Gate Dam as the Lower Klamath River. We also refer to the reach in which the project facilities are located (the Klamath River from the upstream extent of J.C. Boyle Reservoir to Iron Gate Dam) as the hydroelectric reach. References to the Middle Klamath River[45] refer to the section from Iron Gate Dam to the Trinity River.

We describe the temporal nature of effects as temporary (only occurs during drawdown and deconstruction), short term (less than one year following completion of deconstruction), long term (one year or more following completion of deconstruction, but not permanent), and permanent (likely to continue for the foreseeable future). We also rate the effects as less than significant, significant, or significant and unavoidable. We rate an effect as significant if the intensity of the effect, considering the societal importance of the resources that it affects, contributes in a meaningful way to the overall effect of the proposed action on the human environment. Lastly, we characterize changes to a resource that are considered positive as beneficial and negative as adverse.

Our analyses in the geology and soils, water quantity, and water quality sections focus primarily on expected changes in the physical environment under the alternatives analyzed. Our conclusions regarding how these changes would affect other resources are provided in those sections (e.g., our assessment of the effects of expected changes in water temperature on salmon populations is provided in the aquatic resources section). Due to the societal importance of salmon populations to commercial and recreational fisheries and to the Tribes, we have paid particular attention to factors that would affect their populations, both beneficial and adverse.

3.1 GEOLOGY AND SOILS

3.1.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for geology and soils includes the Klamath River extending from the upstream extent of J.C. Boyle Reservoir downstream into the Pacific Ocean, including the nearshore marine environment extending northwards to and including Crescent City Harbor. The temporal extent of our effects analysis ranges from temporary effects of drawdown during dam removal, including the transport of fine reservoir sediments that is expected to persist for several months after drawdown, to the

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[45] Some documents define the Lower Klamath River as the section downstream from the Trinity River, with the Middle Klamath River defined as the section from Iron Gate Dam to the Trinity River.

permanent restoration of natural sediment transport processes. These processes would result in the restoration of more natural river geomorphology that would better support native fish species and increase the quantity and quality of gravel that is suitable for the spawning of anadromous fish and the support of other native fish and benthic macroinvertebrates.

3.1.2 Affected Environment

3.1.2.1 Regional Geology

The Klamath River watershed spans five physiographic provinces (figure 3.1-1). Much of the drainage area of the Upper Klamath Lake lies within the High Lava Plains. The Modoc province to the south of the High Lava province includes the watershed of the upper part of Lost River tributary, which flows into the Klamath River a few miles downstream of Klamath Falls. Both the High Lava Plains and the Modoc Plateau provinces primarily consist of Tertiary period volcanic rocks. The Cascade Range province extends between about Klamath Falls and Iron Gate Dam; this province is characterized by andesitic volcanic rocks of Cenozoic age.

Between Iron Gate Dam and the confluence with the Trinity River, the Klamath River flows through the Klamath Mountain province; this province is formed mostly by hard metamorphosed marine igneous and sedimentary rocks (of Cretaceous to Paleozoic age), which has resulted in rugged topography with prominent peaks and ridges.

The westernmost province before the river reaches the Pacific Ocean is the Coast Ranges province; this province is underlain by rocks of the Franciscan Complex (tectonically deformed and sheared sedimentary rocks that have experienced low-grade metamorphism). Active movement of tectonic plates in this area results in faulting in the Coast Ranges province and the continued uplifting of the Franciscan rocks. This movement, in conjunction with high precipitation rates and the compositionally weak nature of the rocks, results in high erosion rates, steep hillslopes, and high sediment yields (FERC, 2007).

There has been some concern that a historical lava ledge near the Copco Dam site may have prevented anadromous fish from accessing upstream habitat. Based on our review of available information, including Boyle (1913; 1976), there is no definitive indication that a 31-foot-tall lava dam (or similar barrier) existed around the time of construction of Copco No. 1 Dam. In addition, there are numerous credible accounts of salmon reaching Klamath Lake and its tributaries prior to dam construction (FWS, 2021a; Hamilton et al., 2005; Hamilton et al., 2016; Fortune et al., 1966). Aquatic resources are assessed accordingly in our analyses.

3.1.2.2 Faults and Seismicity

The Lower Klamath Project is located in a region that historically has been seismically active. No faults are beneath Iron Gate, Copco No. 1, and Copco No. 2 Dams or Reservoirs. Faults exist beneath J.C. Boyle Dam and Reservoir; the statewide geohazards viewer shows the faults as active (Oregon Department of Geology and Mineral Industries, 2021a).

Near the J.C. Boyle Dam and Reservoir, the highest level of earthquake shaking (expressed as peak ground velocity) expected to occur with a 2 percent chance in the next 50 years ranges from strong to severe (Oregon Department of Geology and Mineral Industries, 2021b). The earthquake shaking potential in the California stretch of the Klamath River is moderate at the Oregon/California border, but the relative intensity increases toward the coast (Branum et al., 2016).

No earthquake epicenters are mapped beneath J.C. Boyle Reservoir, but one of the largest earthquakes ever recorded in Oregon occurred in 1993, approximately 15 miles north of J.C. Boyle Reservoir. No earthquakes at or greater than magnitude 5 were recorded over 200 years (from 1800 to 1999) in the vicinity of the other three project dams and reservoirs or near the Klamath River between Iron Gate Dam and the coast (Toppozada et al., 2000). The three largest earthquakes that have occurred closest to these three dams occurred on November 11, 1997, approximately 10 miles east of Copco No. 1 Dam with a magnitude of 3.3; on July 17, 1999, approximately 20 miles east of Copco No. 1 Dam with a magnitude of 3.0; and on February 21, 2014, approximately 25 miles south of Iron Gate Dam with a magnitude of 2.5 (California Water Board, 2020a).

3.1.2.3 Volcanic Activity

Volcanism near the Lower Klamath Project includes stratovolcanoes, lava domes, cinder cones, and vents. Quaternary volcanic deposits, including two Pleistocene cinder cones and associated lava flows, occur in the region between the eastern edge of Iron Gate Reservoir and Copco No. 1 Dam. Within the past 10,000 years, Mount Shasta eruptions have occurred on average every 600 to 800 years; the last known eruption occurred approximately 200 years ago (Miller, 1980). Most of the volcanism in the Klamath River Basin consists of single events from a given vent, and most of the smaller explosive cones are formed from the interaction of flow material intersecting groundwater (hydrovolcanic events).

The rocks in the vicinity of the four projects range in age from roughly 45 million years old up to the present. Copco and Iron Gate Dams are in the Western Cascades where the strata are more than 12,000 feet thick. Downcutting has exposed up to half of the Western Cascade strata in the Klamath River Canyon near the Copco No. 1 Reservoir. The strata in this exposure consists of inter-bedded tuffs, ash, and lava flows dipping eastward at approximately 25 degrees. The strata are overlain by the nearly flat-lying High Cascade strata composed of younger Pliocene lava flows with a thickness of up to 500 feet.

3.1.2.4 Geomorphology

The Klamath River from the Oregon-California line to downstream from Iron Gate Dam is a predominantly non-alluvial, sediment supply-limited river flowing through mountainous terrain. Downstream from Iron Gate Dam, and for most of the river's length to the Pacific Ocean, the river maintains a relatively steep, high-energy, coarse-grained channel, much of it confined by bedrock. The course of the river in the Klamath hydroelectric reach is largely bedrock-controlled, interspersed with short alluvial reaches. Therefore, the influence of the four hydropower facilities on river geomorphology within the project area and downstream is limited; floodplain development is minimal; and wider valleys allowing alluvial channel migration processes are rare.

The mouth of the river is characterized by a wave-dominated delta with a large offshore sand bar parallel to the coastline that contains a shallow lagoon about 2,500 feet long by less than 1,000 feet wide. This area of the river is highly dynamic, changing positions during large flood events and transporting most of its fine-grained (silt/clay) suspended sediment load out to sea. Deposits in the lagoon are dominated by medium and silty sand.

3.1.2.5 Sediment Yield and Delivery

The large Upper Klamath Lake essentially traps nearly all sediment from its tributaries. In addition, the province of this region has moderate topography, semi-arid weather conditions, and few streams compared to downstream provinces. Because of these characteristics, sediment yield is low compared to downstream provinces. Therefore, little sediment is supplied to the Klamath River from the watershed upstream of Keno Dam. Bedload transport from the Lost River tributary is expected to have been captured by Copco No. 1 Dam from 1918 (completion year) to 1931 and by Keno Dam after its completion in 1931.

The primary origin of the sediment from tributaries trapped by the four dams is the Cascades Range province. Channel boundaries in the vicinity of the Lower Klamath Project are prominently composed of bedrock, boulders, and cobble, and thus subject to only minor erosion; bank erosion is therefore not a substantial sediment source. Stillwater Sciences (2010) estimated the average annual sediment delivery from Keno Dam to Iron Gate Dam at approximately 151,000 tons per year (tons/yr) (table 3.1-1).

The Klamath Mountain province downstream of Iron Gate Dam has elevations of over 9,000 feet, steep slopes, and deep soils. Sediment yields are higher with significant sediment contributions from tributaries. In the Coast Ranges province, movement of the tectonic plates results in faulting and continued uplifting of the Franciscan rocks. This movement, in conjunction with high precipitation rates and the compositionally weak nature of the rocks, has resulted in high erosion rates that create steep hillslopes and high sediment yields. The total annual delivery of sediment to the ocean from the Klamath River is estimated at 6.2 million tons/yr (table 3.1-1). The largest supplies are contributed by the Scott River (607,000 tons/yr), Salmon River (321,000 tons/yr), Bluff

Creek (338,000 tons/yr), and Trinity River (3.3 million tons/yr). These four tributaries alone contribute 73 percent of the total annual load in the Klamath River.

The average grain size of the sediment load in the Klamath River gradually increases downstream. Approximately 84 percent of the sediment delivered to the river in the Keno Dam to Iron Gate Dam reach consists of silt and clay (with the remaining 16 percent consisting of sand and coarser particles). Sediment delivered to the Pacific Ocean at the mouth of the river consists, on average, of 68 percent silt and clay (4.27 million tons/yr) and of 32 percent sand and coarser particles (1.97 million tons/yr) (table 3.1-1).

The silt and clay fraction in the average sediment supply to the Pacific Ocean is estimated with 4.2 million tons/yr (table 3.1-1). Farnsworth and Warrick (2007) estimated an average annual silt and clay yield to the Pacific Ocean of 1.2 million tons/yr. The discrepancy in estimates of supply and yield is related to channel and floodplain sediment storage, the different approaches to estimation, lack of established relationship between flow and suspended sediment concentrations (SSCs), the lack of a unique relationship between flow and SSCs, the large variation in the measurement of SSCs, and the large annual variation in sediment loads between different water year types (California Water Board, 2020a).

Sediment loads from the watershed vary based on annual hydrologic conditions and other environmental factors (e.g., mass wasting, wildfire, land use) that control sediment supply and transport. The following historical information provides an indication of the range of conditions: The highest annual sediment yield (water year [WY] 1974) in the Klamath River at Orleans was three times greater than the period average (WY 1968–1977). The highest annual sediment yield (WY 1964) in the Trinity River at Hoopa was a factor of 7 greater than the period average (WY 1957–1977) and a factor of 14 greater than the estimated long-term annual average (Janda and Nolan, 1979, as cited in California Water Board, 2020a). The period of record for the Trinity River at Hoopa includes the large flood of 1964, whereas the period of record for the Klamath River at Orleans does not. In dry years, the supply of sediment to the ocean could be less than 1 million tons/yr.

3.1.2.6 Reservoir Substrate Composition

Reclamation (2010a) determined the physical sediment composition and sediment thickness throughout the reservoirs (findings are described in appendix I, *Reservoir Substrate Composition*); other studies investigated the chemical composition of sediments in the reservoirs (see section 3.3, *Water Quality*). In general, the sediment in the larger reservoirs consists primarily of elastic silt and clay (84 percent), with smaller amounts of elastic silt with fine sand (16 percent) (table 3.1-2). Sediments are generally coarser-grained in upper reaches of the reservoirs and become finer toward the dam. The elastic silt in all reservoirs was measured to have a high water content and low cohesion and found to be erodible. In Copco No. 2 Reservoir, its small size and high-flow velocities appear to have limited any fine-grained sediment accumulation.

The total amount of sediment that has accumulated in the project reservoirs is estimated to be approximately 15.5 million cubic yards (or 4.3 million tons) (table 3.1-2). More than half of this volume is accumulated in Copco No. 1 Reservoir.

3.1.2.7 Slope Stability / Landslides

Mass failures and other gravity-driven erosion processes require relatively steep slopes. Such conditions exist along the Klamath River within the canyon area from J.C. Boyle Dam to just downstream of Iron Gate Dam and along the Lower Klamath River in the Coast Ranges province. Slope stability conditions specific to the four project reservoirs are as follows:

- Interior and California DFG (2012) did not identify areas of unstable slopes or existing landslides adjacent to J.C. Boyle or Copco No. 2 Reservoirs. Land surrounding J.C. Boyle Reservoir is generally low gradient and underlain by competent materials (California Water Board, 2020a).
- No large-scale landslides have been identified in either the terrestrial or subaqueous slopes around Copco No. 1 Reservoir, although a large alluvial fan or colluvial deposit on the north side of Copco No. 1 Reservoir may be related to an ancient inactive landslide (PanGEO, 2008). Wave action at the Copco No. 1 Reservoir shoreline has eroded sand and tuff[46] beneath diatomite[47] beds, creating up to 20-feet-high vertical exposures (California Water Board, 2020a).
- Within Iron Gate Reservoir, the adjacent hillside slopes are generally considered stable with no active landslide areas, although geomorphic features suggest old, inactive landslides on the south rim slopes above the reservoir (Interior and California DFG, 2012). In addition, a low level of wave-induced shoreline erosion at the margin of the reservoir was observed by PanGEO (2008). The erosion has not substantially undercut or disturbed the hillside slopes; the exposed material along the shoreline comprises relatively competent volcanic or volcaniclastic rock.

3.1.2.8 Soils

Soils within the Klamath River project watershed span multiple geologies, terrains, and climates. Soils in the vicinity of the Upper Klamath River surrounding J.C.

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[46] Tuff is volcaniclastic rock composed of solid volcanic ash that may contain particles of volcanic glass and/or other fragments of volcanic rock and lava.

[47] Diatomite is a chalk-like, very fine-grained sedimentary rock, used mainly for filtration and other commercial applications.

Boyle Reservoir and downstream along the river to the Oregon-California state line generally consist of lacustrine and alluvial clay, silt, fine-grained sand, and peat (Priest et al., 2008). Soils along the river within the hydroelectric reach in California are less homogenous.

In general, soil types in the project area can be grouped as follows (FERC, 2007):

- **Soils on steeper slopes:** These soils are shallow to moderately deep (typically 17 to 40 inches) and comprise a 7- to 8-inch surface horizon of gravelly loam; an underlying horizon of gravelly, clayey loam; and locally a very gravelly clay.
- **Floodplain or terrace surface soils:** These soils comprise a deep, well-drained combination of alluvium (and in some places colluvium). These soils as found in the project area within the canyon of the J.C. Boyle peaking reach can be divided typically into a 15-inch very gravelly loam upper horizon, a transitional 6-inch gravelly clay loam layer, and a 39-inch horizon of heavy clay loam underlain by weathered bedrock to 60 inches or more below the surface.
- **Soil types directly along the river:** These soils comprise unconsolidated alluvium, colluvium, and fluvial deposits. These geologically recent alluvial, low terrace and landslide deposits consist of unconsolidated sand, silt, and gravels deposited by water or erosion.

Soils along the Klamath River below Iron Gate Dam are generally composed of associations consisting of gravelly clay loam and gravelly sandy loam. Soils on steeper slopes are deeper (22 to 60 inches) than those on less steep slopes and along the floodplain. These soil associations are all classified as well-drained, with low to no flooding frequency or ability for ponding water. Soils directly along the river in floodplain areas are composed of alluvial deposits consisting of sand and gravels (NRCS, 2007; 2008).

3.1.2.9 Mineral Resources

The Klamath River is being mined for construction aggregate (sand, gravel, and rock). Mines are predominantly located within the Klamath Mountain province (between Iron Gate Dam and the mouth of the Trinity River) because of the rock types in the province and the supply from several tributaries.

Other minerals that may be mined along the Klamath River include asbestos, chromium, clay, copper, diatomite, gold, graphite, and mercury. Diatomite deposits surround much of the shoreline of Copco No. 1 Reservoir (PanGEO, 2008, as cited in California Water Board, 2020a). Wave action along the reservoir has undercut and eroded the weak diatomaceous deposits resulting in near-vertical bluffs. These deposits are currently not accessible for extraction.

3.1.2.10 Fate of Sediment from Klamath River in the Pacific Ocean

The fate of the sediment transported into the Pacific Ocean by the Klamath River is governed by complex current patterns. The California Current moves southward along the California coast from July to November. Typically, from November to February, southward winds weaken, reducing upwelling and allowing a nearshore, northward-flowing current (Davidson Current) to prevail (Hickey, 1979; Griggs and Hein, 1980). This period coincides with the months of highest sediment discharge rates. Between March and August, north winds drive surface water offshore and cause upwelling of cooler bottom water. The current systems are similar off the Oregon and Washington margins and also result in a net northward movement of sediment (Wong, 1995, and references therein). The regularly shifting current directions cause the sand spit (and the channel across the spit) at the mouth of the Klamath River to change shape frequently and the channel across the spit to change location, depending on the prevailing current.

3.1.3 Effects of the Proposed Action

3.1.3.1 Effects of Bank Sloughing Caused by Reservoir Drawdown

Drawdown would dewater sedimentary formations along the reservoir slopes, changing their geotechnical characteristics to some extent. This could cause sloughing of steep slopes, potentially affecting properties and infrastructure in these locations. Several commenters expressed concern that drawdown and removal of the dams could damage homes adjacent to the reservoirs; concerns about structural effects also included facilities such as septic systems and groundwater wells.

KRRC proposes to conduct pre-drawdown activities prior to January 1 of the drawdown year (KRRC, 2021e). These activities include regulating project operation flows to keep reservoir levels at or below minimum operating levels. Active drawdown of the four reservoirs would start on January 1 of the drawdown year and extend over approximately six months at a target rate of 5 feet of elevation per day. Aside from direct mobilization of sediment from flowing water and slumping of the sediment along the reservoir sides during drawdown, KRRC would expedite the evacuation and transport of sediments in the historical river channel within Copco No. 1 and Iron Gate Reservoirs using airboat-mounted water jets to jet water onto newly exposed reservoir sediment deposits as the water level drops. Sediment jetting would primarily focus on high-priority tributaries and the mainstem channel margins, with work occurring at low-priority tributaries as conditions and time allow. If sediment jetting becomes infeasible because of hydrological conditions, KRRC would mount a pump and hose apparatus on side-by-side utility terrain vehicles for land-based applications and may use pumps and temporary pipelines to convey water into tributary channels to maximize the evacuation of sediment from the reservoirs. If access allows, KRRC would also grade reservoir sediment using machinery, such as small excavators, to promote evacuation by water flowing in the tributaries and mainstem river.

The Reservoir Drawdown and Diversion Plan identifies reservoir slopes and other project-related areas prone to instability and specifies measures that would be implemented to avoid potential slope instability along the reservoirs from the proposed action (KRRC, 2021e). Measures under the plan include, but are not limited to, the following:

- Monitoring and addressing slope instability, including visual monitoring and inspecting for evidence of potential slumping, cracking, and other signs of slope instability during drawdown and dam removal and after storm events. KRRC would conduct daily, weekly, and monthly monitoring during active drawdown and dam removal. This includes monitoring of daily displacements of the ground surface (reservoir rims and embankments) during the drawdown period using LiDAR data acquisition both airborne (all reservoirs) and ground-based (J.C. Boyle and Copco No. 1).
- Implementing necessary repairs, replacements, and/or additional measures to minimize potential slope instability effects on water quality based on monitoring information.
- Establishing a local impacts mitigation fund that would address potential damage claims involving private properties. The fund would be administered outside of the license surrender order and would provide financial resources to property owners (that select to opt into the fund) to mitigate displacement costs and effects on residential properties that are determined to be caused by the proposed project. Any affected property owners electing not to participate in the local impacts mitigation fund may, instead, pursue any other remedies available to them under applicable state law.

In addition to the Reservoir Drawdown and Diversion Plan, the RAMP and the Erosion and Sediment Control Plan also contain measures designed to stabilize sediments exposed by the drawdown within the reservoir and along slopes.

Our Analysis

For J.C. Boyle Reservoir, drawdown would not substantially affect the stability of the slopes surrounding the reservoir because the area generally has a low gradient, is underlain by competent materials, and has no obvious topographic evidence of past landslides (PanGEO, 2008, as referenced in KRRC, 2018a). Common bedrock in the area consists of volcanic deposits such as basalt and andesite. Sedimentary deposits are present on some of the slopes and terraces around the reservoir margins. KRRC (2018a) concludes that deep-seated large landslides are less likely. Shallower slides could occur in the surficial soil deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface.

Physical characteristics of the strata along the rim of the three reservoirs with steeper slopes (Copco No. 1, Copco No. 2, Iron Gate) suggest that some slope instability could be expected during and following dewatering of these areas from drawdown and dam removal, as described below.

For Copco No. 1 Reservoir, drawdown would have the potential for slope instability in areas containing diatomaceous deposits and associated fluvio-lacustrine terrace deposits because of the geometry and physical properties of these deposits. This potential exists along certain segments of the rim and below the reservoir water level (KRRC, 2018a). Data collection included field investigations and multiple soil borings in and along the rim of Copco No. 1 Reservoir. Slope failure in these segments could affect approximately 1,780 linear feet of existing roads and/or private property outside the reservoir rim, including approximately 430 linear feet of slopes along Copco Road and approximately 1,350 linear feet of slopes adjacent to private property. Potential slope failure could affect 17 parcels and 8 habitable structures. Failing slopes could affect facilities such as septic tanks, groundwater wells, yards, or houses and may require site-specific stabilization measures.

For Copco No. 2 Reservoir, any slope instability is expected to be relatively small because of shallow bedrock and the fact that the colluvium[48] generally comprises coarse sedimentary deposits (Knight Piésold, 2020). Drawdown of the reservoir is not expected to result in large-scale slope instability; therefore, adjacent infrastructure or properties are not anticipated to be affected. Shallower slides may occur in the shallow surficial deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface; shallow slides could present a local, minor hazard to Copco Road where it extends adjacent to the shore.

For Iron Gate Reservoir, the extent and morphology of bedrock outcrops and the general lack of surficial deposits around the reservoir suggest that reservoir slopes would generally remain stable during and following drawdown (KRRC, 2018a). Historical aerial photographs indicate that three possible old landslide-related features on the south rim of the reservoir have been stable and unaffected by historical reservoir drawdowns and therefore would have a low risk of instability during the proposed drawdown (KRRC, 2018a). Shallower slides are likely to occur in the shallow surficial deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface; shallow slides could present a local, minor hazard to Copco Road where it extends immediately adjacent to the shore. Such local slope failures could require minor repairs such as placement of riprap or road surface rehabilitation.

With the implementation of the applicant’s monitoring and mitigation measures (including the local impacts mitigation fund) as part of the Reservoir Drawdown and Diversion Plan (KRRC, 2021e), potential effects on slope instability would be minimized

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[48] Colluvium is a term for loose, unconsolidated sediments that have been deposited at the base of hillslopes.

or mitigated. The plan also allows for revisions if additional risk areas are encountered. Overall, potential adverse effects from drawdown of the reservoirs on slope stability would be less than significant with mitigation, but there could be short-term, significant, adverse effects locally for several private properties along Copco No. 1 Reservoir if slopes became unstable and failed.

3.1.3.2 Effects From Mobilization of Sediments

Drawdown of the reservoirs and sediment evacuation during dam deconstruction and restoration activities would result in the downstream transport of both fine and coarse sediments. Fine sediments could adversely affect all life stages of salmon and steelhead that are present in the river and the quality of spawning habitat, while coarse sediment could fill pools that provide salmon holding habitat and that serve as potential water sources for firefighting efforts. In addition, sediment deposition and bedload movement of coarse sediment may aggrade[49] the streambed and affect downstream flooding, infrastructure, and navigation. Many commenters expressed concern over the large volume of sediment that would be transported down the river, and associated effects on biota, infrastructure, property, and navigation.

KRRC's proposed methodology for drawing down the reservoirs and removing the dams is designed to minimize the duration of high SSCs that could adversely affect salmon and steelhead in the river downstream of Iron Gate Dam. Key elements include work to maximize the discharge capacity of outlet structures to minimize the potential for refilling of the reservoirs during high-flow events, drawing down all four reservoirs within a short period of time (within approximately six months), and measures to expedite the removal of mobilized sediments and stabilize sediments that are not immediately mobilized, as specified in the California Reservoir Drawdown and Diversion Plan (a subplan of the Reservoir Drawdown and Diversion Plan [KRRC, 2021e]) and the RAMP (KRRC, 2021d). Pre-drawdown reservoir releases would bring the reservoirs to or near their minimum allowable operating levels. Then, starting January 1 of the drawdown year, KRRC would draw down the reservoirs and release associated sediment in a controlled manner. Most of the drawdown is expected to take place during the period of naturally high seasonal flows in the mainstem river, maximizing the amount of fine sediment that would remain suspended in the river to facilitate transport to the Pacific Ocean without temporary deposition. Releases from the reservoir would be controlled and vary by reservoir depending on the type of dam, discharge capacity, water year type, and volume of water and sediment within the reservoir. Primary mobilization of sediment from the reservoirs is expected to occur within the six months of drawdown

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[49] Aggrade (verb) and aggradation (noun) are geological terms for an increase in elevation. In riverbeds, aggradation occurs in areas where the supply of sediment is greater than the amount of material that the river is able to transport, causing the riverbed elevation to increase.

(and several months thereafter, depending on flow conditions) (California Water Board, 2020a; KRRC, 2021f,g).

KRRC would assess visibly obvious sediment deposits on lands along the Klamath River from below Iron Gate Dam to the mouth of the Klamath Estuary that may have been deposited during reservoir drawdown activities (KRRC, 2021g). Specifically, KRRC would only assess sediment deposits on parcels with a current or potential residential or agricultural land use, and for which the property owner had notified KRRC of a sediment deposit potentially associated with reservoir drawdown activities. KRRC would assess such deposits within 60 days of property owner notification. If the physical properties of the deposits were consistent with properties associated with reservoir sediments, KRRC would either remediate the property without testing, or test sediment deposits that are consistent with the physical sediment properties of project reservoirs for arsenic. If the arsenic concentration in the deposited sediments exceeds local background levels and human health residential screening levels established by EPA or the California Environmental Protection Agency, KRRC would remediate the deposited sediments to local background levels through removal of the deposited sediments or soil capping.

If a reported sediment deposit does not require remediation, KRRC would notify the property owner and submit a report to the Commission and the California Water Board. If a reported property requires further action, KRRC would submit a California Sediment Deposit Remediation Plan to the California Water Board within 14 days for review and approval. In addition, following remediation, KRRC would provide a report to the property owner, the Commission, and the California Water Board within 30 days of completing remediation activities.

Siltation may affect boat ramps in the Klamath River estuary in Del Norte County (i.e., the Township boat ramp near the town of Klamath and Roy Rook boat ramp near the town of Klamath Glen). In lieu of more expensive quantitative sedimentation monitoring, KRRC proposes to pay $3,500 per boat ramp per year for maintenance and sediment removal during the drawdown year and the following year (total of $14,000), as specified in the Del Norte Sediment Management Plan (another subplan of the Sediment Deposit Remediation Plan).

In addition, KRRC would implement an Erosion and Sediment Control Plan to minimize sediment runoff caused by facilities removal and restoration activities (KRRC, 2021h). This plan would address erosion and sediment runoff at all dam and powerhouse removal sites, spoil disposal areas, recreation site removal areas, J.C. Boyle scour hole, and restoration locations. The plan includes BMPs and annual monitoring of disposal sites.

Our Analysis

Reclamation (2011a) used the model Sedimentation and River Hydraulics – One Dimension (SRH-1D) to analyze the potential transport of reservoir sediment downstream based on different drawdown scenarios. Interior and California DFG (2012) used Reclamation's sediment transport modeling results to evaluate changes in downstream sediment regimes and the effect of the changes on shoreline geology downstream from the reservoirs. The analysis considered the characteristics of the sediments that have accumulated in the reservoirs over the years.

Drawdown would erode and mobilize sediments in the reservoirs primarily during the period of the drawdown. Approximately 84 percent of the accumulated sediment consists of silt and clay (table 3.1-2). Interior and California DFG (2012) estimated that 36 to 57 percent of the accumulated sediment in the reservoirs would be mobilized, depending on hydrological conditions (i.e., flow magnitude and duration) during drawdown and dam removal. Additional erosion and mobilization of fine sediments could occur while the riverbed in the reservoir stabilizes in the following year but would likely be indistinguishable from the background sediment regime. Erosion rates and composition of eroded sediment would vary by reservoir (table 3.1-3). The fine sediments in the reservoirs not eroded during drawdown and dam removal would consolidate on the terraces above the active channel. These areas would be stabilized through revegetation, engineered slope improvements, and other BMPs, as specified in the RAMP.

Drawdown of the four reservoirs would release an estimated total of 1.5 to 2.4 million tons of sediment (table 3.1-3). The sediment mobilized from the reservoirs during drawdown is expected to be transported by the river to the ocean mostly as suspended sediment because most of its predominantly fine-grained composition (silt and clay). Sand and coarser material (approximately 16 percent) would be transported more slowly, depending on the frequency and magnitude of flows and storage in the channel bed. Following are analyses of river channel responses from the released sediment by river reach and of the added sediment load transported to the Pacific Ocean.

Channel Response in Hydroelectric Reach

Within the reservoirs, drawdown would decrease the channel bed elevations and increase the median size of the substrate in the river channel. The proportion of silt and clay in the channel bed of the reservoir reaches would decrease to near zero within two months after drawdown. Over time, the channel in the hydroelectric reach would change from a reservoir with no defined channel to a free-flowing riverine channel. The proportion of sand would initially increase to 30 to 50 percent then decrease to 10 to 25 percent; the proportion of gravel would change (mostly increase) to 20 to 35 percent; and the proportion of cobble would increase to 50 to 70 percent. These estimated changes would vary by reservoir and depend on hydrological conditions but would stabilize within six months as the bed within the historical river channel reaches pre-dam elevations (Interior and California DFG, 2012). On average, drawdown would permanently decrease the bed elevation within the reach of the J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs by 4 feet, 10 feet, and 3 feet, respectively.

The river reaches upstream of J.C. Boyle and Copco No. 1 Reservoirs are expected to experience little change in bed composition or median substrate size during drawdown (Interior and California DFG, 2012). Currently, these reaches consist predominantly of cobble (90 percent) with small fractions of gravel and sand. Modeling of the reach from Copco No. 2 Dam to Iron Gate Reservoir indicates that the substrate would become coarser. Specifically, the combined proportion of sand and fine sediment would decrease, with the dry-year simulations showing decreases to approximately 35 percent of sand and fine sediment two years after drawdown. Overall, effects from the erosion and mobilization of reservoir sediment on the geological resources in the channel in this reach would be permanent, significant, and beneficial because the natural geomorphology would be restored.

Channel Response in the Klamath River Downstream of Iron Gate Dam

The released sediment load would result in aggradation in the river channel and in some sediment deposition along the riverbank and on the floodplain. Riverbed aggradation and sediment deposition on the floodplain would mostly occur within the 8 miles of the Klamath River from Iron Gate Dam to approximately Cottonwood Creek (RM 193.1 to RM 185.1) (Interior and California DFG, 2012); this reach represents four percent of the total mainstem channel length between Iron Gate Dam and the Pacific Ocean (190 miles). Specifically, long-term (50-year) modeling indicates that within the two years following dam removal the channel bed would accumulate up to approximately 1.7 feet of coarse sediment (i.e., sand or larger grain sizes) in the Bogus Creek (RM 192.68) to Willow Creek (RM 187.8) reach and up to 0.9 foot of coarse sediment in the Willow Creek to Cottonwood Creek reach (figure 3.1-2).

Model simulations indicate that the riverbed from Cottonwood Creek downstream would experience less than 0.5 foot of erosion or deposition. Suspended silt and clay particles may temporarily deposit on the channel bed but would be subject to remobilization during future high flows. Temporary deposition during and following drawdown in eddies and pools of the river channel would be higher in a dry year and lower in a wet year (Interior and California DFG, 2012). The smaller load of mobilized sand and coarser sediments would be less transient than the silt and clay fractions and would require higher flows to mobilize. Locally, short-term riverbed aggradation rates would vary, which would in part depend on the local riverbed morphology (such as pools or slack-water areas).

Dam removal would also change the composition of the substrate in the riverbed. In the short term, released sediment from drawdown and dam removal would increase the proportion of sand in the channel bed and decrease median bed substrate size, based on wet, median, and dry-year simulations (Interior and California DFG, 2012). In the Iron Gate to Bogus Creek reach (length of 0.4 miles), sand within the bed was estimated to increase to 30 to 35 percent by March to June of the drawdown year, gradually decreasing to 10 to 20 percent by September two years later. The median substrate size (D50) is expected to fluctuate slightly before stabilizing to approximately existing conditions with a D50 of 100 millimeters (mm). In the Bogus Creek to Willow Creek reach (length of 4.9 miles), the median grain size would decrease from an initial value of approximately 80 mm down to 40 to 65 mm and the proportion of sand would increase up to 40 percent. In the Willow Creek to Cottonwood Creek reach (length of 2.7 miles), the median grain size would decrease from an initial value of approximately 65 mm down to 38 to 45 mm and the proportion of sand would increase up to 35 percent. While these short-term changes in substrate (gravel) size would remain within the range typically used by anadromous salmonids, the elevated contributions of fine sediment (sand and finer) could clog the spaces between the gravels in redds, decreasing spawning gravel permeability and increasing the frequency of egg mortality. These adverse effects would diminish over time as fine-grained sediments are flushed from the gravel during high-flow events.

In the long term (i.e., 50 years), the sediment supply and transport would increase and create a more dynamic and mobile bed downstream of Iron Gate Dam. Sediment would no longer be trapped in the reservoirs, and the streambed would no longer be starved of sediment—particularly of gravel that provides substrate for spawning fish. Riverbed elevations would adjust to a new equilibrium over a length of 8 miles in response to sediment supplied by upstream tributaries within the hydroelectric reach. Long term, the channel bed in the Iron Gate to Cottonwood Creek reach would remain aggraded because of resupplied natural sediment that would no longer be trapped in the reservoirs.

Mobilization of sediment during and following drawdown would elevate the SSCs in the river. Flooding during high-flow events and from aggradation in the 8-mile stretch would therefore lead to higher sediment deposition rates on the floodplain. In addition, peak flood elevations are expected to be higher below Iron Gate Dam (RM 193.1) (i.e., the floodplain would widen) because of aggradation of the riverbed, but this effect would decrease downstream with no significant effect on flood elevations (and hence floodplain width) downstream of Humbug Creek (RM 174) (Interior and California DFG, 2012) (see section *3.2.3.2, Effects of Changes in Water Quantity on Downstream Flooding*). Mitigation measures included in KRRC's proposed Sediment Deposit Remediation Plan (KRRC, 2021g) would help remediate sediment deposition caused by the proposed project on parcels with a current or potential residential or agricultural land use.

The increased sediment deposition on the floodplain during high-flow events during and following the drawdown while sediment is being mobilized from the reservoirs would result in short-term, significant, adverse effects. Effects from the release of reservoir sediment on the channel in this reach would be permanent, significant, and beneficial because natural sediment transport processes would be restored.

Channel Response in the Klamath River Estuary

Most of the fine sediment (silt, clay) released during drawdown and dam removal would be transported to the Pacific Ocean. The existing sediments in the estuary are coarser-grained (except in the backwater and vegetated area), even though the river transports high loads of silt and clay through it to the ocean. High-flow volumes during and following reservoir drawdown would cause most fine sediments to remain suspended, and, as a result, the volume of any sediment deposition in the Klamath River estuary is expected to be small.

Regarding dredging costs at the two boat ramps on the Klamath River in Del Norte County, KRRC provided no rationale for the $14,000 funding cap that KRRC proposes. If actual costs for removing sediment deposited as a result of the proposed action were to exceed $14,000, Del Norte County would be unfairly burdened with the excess cost. Such excess costs could be mitigated if the Del Norte Sediment Management Plan were revised to require that KRRC reimburse Del Norte County for any increase in the cost of maintaining the Klamath River boat ramps in an operable condition that is attributable to sediment deposited as a result of the proposed action. With implementation of these mitigation measures, any adverse effects from the sediment released by the drawdown on the functionality of the boat ramps would be short term and less than significant.

Sediment Transport to the Pacific Ocean

Most of the 1.5 to 2.4 million tons of sediment released from the reservoirs (table 3.1-3) are expected to be transported to the Pacific Ocean over a relatively short period (i.e., within six months of drawdown) because of relatively high-flow rates in the river during this period and the mostly fine-grained nature of the sediment. Temporary sediment deposition in slack-water areas (such as pools, eddies, backwater channel) would be likely, but deposits are expected to be remobilized during higher flows.

The relative contribution of the released sediment load to the total annual sediment load in the Klamath River in the drawdown year would be highest in the reach just downstream of Iron Gate Dam but would gradually decrease farther downstream as large natural sediment loads enter the river from tributaries (see table 3.1-1). The sediment load would be transported by the river mostly as suspended sediment. Specifically, the sediment load released from drawdown would constitute between 7 and 11 times the average annual natural load just before the Scott River confluence, between 1 to 2 times the natural load before the Salmon River confluence, and approximately 2/3 to 1 time the natural load before the Trinity River confluence. At the mouth of the Klamath River, the released sediment load would constitute approximately 25 to 39 percent of the average annual natural sediment load carried by the Klamath River because of the large load contributed by the Trinity River. In addition, because the released sediment is finer grained than the natural sediment, a higher proportion of the released sediment load would be transported in suspension in the water column compared to the natural sediment load.

On a year-to-year basis, the relative contribution of the sediment load from the reservoirs to the total load contributed by the Klamath River to the Pacific Ocean varies. Figure 3.1-3 shows the annual natural sediment load for water years 1961 to 2008 and the modeled sediment contributions released from the reservoirs during the respective water year. In a wet year, the sediment load released from the reservoirs would constitute a smaller portion of the total sediment load discharged to the Pacific Ocean; in a dry year, the released sediment load would constitute a larger portion. However, unless the drawdown is conducted in a very wet water year (such as 1965), the total load released from the Klamath River (including sediment mobilized from the reservoirs) would be well within the range of natural variability, based on the 48-year record in figure 3.1-3. Accordingly, we conclude that any adverse effects of reservoir sediments that are transported to the estuary and the Pacific Ocean would be short term and less than significant.

3.1.3.3 Coastal Sediment Deposition Effects on Navigation

The Klamath River would transport sediment released during drawdown into the Pacific Ocean where it would be dispersed on the continental shelf and along the shore via littoral drift.[50] The sediment would eventually settle in locations with calmer waters, such as in protected locations along the shore and in deeper (calmer) waters. The Del Norte County Board of Supervisors expressed concern about potential increased sediment deposition in Crescent City Harbor because of the sediment loads released during reservoir drawdown; added sediment buildup within the harbor could hamper essential marine operations.

As part of the Del Norte Sediment Management Plan, a subplan of the Sediment Deposit Remediation Plan (KRRC, 2021g), KRRC would monitor the deposition of sediments immediately north and south of the Klamath estuary and at the Crescent City Harbor to determine whether sediment released from the reservoirs moves north from the mouth of the Klamath River to Crescent City Harbor and deposits within the harbor channels, and if so, understand the incremental effect over baseline conditions. The monitoring program would consist of three measures: (1) conduct baseline bathymetric surveys of the Crescent City Harbor prior to drawdown; (2) monitor ocean currents during drawdown by deploying three rows of acoustic doppler current profilers along three transects between the Klamath River mouth and the Crescent City Harbor; and (3) conduct bathymetric surveys of the Crescent City Harbor after drawdown to evaluate the net sediment deposition volumes in the harbor. In addition, KRRC would evaluate the sediment travel time, and monitor water quality and real-time sediment movement from Iron Gate Dam to the mouth of the Klamath River.

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[50] Littoral drift is the term used for longshore transport of sediments (mainly sand) along the upper shoreface because of the action of breaking and longshore currents.

If KRRC determines that the proposed project has adversely affected Crescent City Harbor, KRRC would bear the proportional and incremental costs incurred by the County and/or the Harbor District for dredging and removing such sediment.

Our Analysis

Sediment transport of sediment released from the reservoirs into the Pacific Ocean could create the potential for adding to siltation in the Crescent City Harbor. However, the extent of potential siltation in the harbor is not known because of multiple variables as discussed in the following section.

The sediment released by the drawdown of the reservoirs would be a one-time event. The total volume of released sediment would constitute 25 to 39 percent of the average total volume of sediment discharged naturally by the Klamath River each year to the Pacific Ocean (table 3.1-1). Separated by grain size, the fine sediment (silt and clay) fraction of the load released by the drawdown would constitute 30 to 47 percent of the natural fine sediment load; the sand and coarser fractions would constitute 12 to 19 percent of the average annual natural fine sediment load.

Multiple oceanographic and meteorological variables in the region ultimately affect the fate of the sediment discharged by the Klamath River to the Pacific Ocean. These variables include seasonal and interannual variability of current patterns; frequency, direction, and intensity of storms; and storm-related coastal erosion. However, on balance, the net transport direction for sediment discharged by the Klamath River is northwards (Wong, 1995).

The locations and depth of fine sediment deposition in the Pacific Ocean resulting from the sediment released from the reservoirs cannot be precisely predicted because of the complexities and variability of the transport processes. A considerable amount of fine sediment is anticipated to initially deposit on the seafloor shoreward of the 196-foot depth contour along the coast, decreasing with distance with the mouth of the Klamath River. After fine sediment loading onto the continental shelf during river floods, fluid-mud gravity flows typically transport fine sediment offshore (California Water Board, 2020a). Summer coastal upwelling naturally resuspends some of the river sediments that are transported to the nearshore environment and deposited on the continental shelf (Ryan et al., 2005; Chase et al., 2007). Along with the background river sediments transported annually by the Klamath River and deposited on the continental shelf, a portion of the sediment deposited on the continental shelf following dam removal would also have the potential to be resuspended during the summer coastal upwelling. Any sedimentation of the nearshore seafloor resulting from the proposed project would likely be transported farther offshore to the mid-shelf and into deeper water depths off-shelf.

The estimated shoaling and dredging rate in the recent Crescent City Harbor is approximately 20,000 cubic yards per year (USACE, 2019). Based on past sampling events (1993, 1998, 2003, 2009, 2011, and 2018), the sediment dredged from the harbor entrance channel and marina access channel consisted predominantly of sand (over 80 percent), while the dredged material from the inner harbor basin channel consisted of 34 to 49 percent sand with the remainder being silt and organic matter (figure 3.1-4; table 3.1-4). The estimated shoaling and dredging rate in the navigation channels of the harbor of approximately 20,000 cubic yards per year is small[51] compared to the average annual load (approximately 6.2 million tons) discharged by the Klamath River to the Pacific Ocean, suggesting that most of the sediment is transported to deeper waters on the shelf rather than being transported close to shore (and deposited in calmer waters such as in the harbor).

However, considering the net northward transport of sediment contributed by the Klamath River, it is probable that some of the sediment released by the drawdown of the reservoirs would ultimately be deposited in Crescent City Harbor. The monitoring program under the Del Norte Sediment Management Plan would be appropriate to ascertain if sediment from the drawdown contributed to siltation in the harbor, and mitigation measures under this plan would help protect maritime navigation for the County. In summary, the extent of potential effects on the Crescent City Harbor from sediment released during drawdown is not known, but with implementation of the applicant's proposal, any potential adverse effects would be short term and less than significant.

As an alternative, KRRC might consider a settlement with the Del Norte County and the Harbor District. KRRC's Del Norte Sediment Management Plan includes an extensive monitoring program to determine the net contribution of sediment from the drawdown to the overall sediment accumulation in the harbor. Considering the complexity of coastal processes in the region, the assessment would need to be sufficiently detailed to adequately quantify the multiple variables involved to reliably discern the net contribution for the following reasons:

- According to USACE (2019), most deposited sediments in Crescent City Harbor are sourced from littoral transport of sediments into the harbor from both the north and south. Littoral sediments from both the north and south have fairly similar composition, with approximately equal (30 to 45 percent) proportions of rock fragments and quartz, and mean grain sizes ranging from fine to medium sands. Aside from the Klamath River, there are other rivers that contribute sediment to the continental margin in northern California (e.g., Wong, 1995; Warrick et al., 2013). Coastal currents are complex, and directions vary throughout the year, typically changing from southward (July to November) to northward (November to February), to conditions with north winds that drive water offshore (March and August) (Wong, 1995). These conditions suggest that sediment

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[51] Assuming a bulk density of 1.5 ton/cubic yard, the volume of 20,000 cubic yards would have a mass of 30,000 tons.

involved in longshore transport may be subject to multiple stages of deposition and resuspension.

- The total sediment load to be released during drawdown only represents a fraction of the total average annual sediment load discharged naturally by the Klamath River to the Pacific Ocean, as stated above. Further, the sediment supplied from natural sources contains more sand than the released sediment from the reservoirs on average, although the content would vary depending largely on flow rates. The monitoring program would need to distinguish between the natural and reservoir sediment loads entering the Pacific Ocean as they vary over time throughout the monitoring period.
- Although likely small, other sources of sediment entering the harbor should also be considered such as Elk Creek. Also, the planned bathymetric surveys in the harbor would have to be conducted at a sufficiently high resolution to allow for a detailed comparison between pre- and post-drawdown conditions, as the bathymetry can change during extreme events (such as storms or tsunamis). For example, Wilson et al. (2012) found that the Japanese Tohoku-oki tsunami from March 11, 2011, increased the sediment supply to the harbor and caused "shoaling that made the harbor unusable and creating long-term disposal issues." Widespread erosion and deposition of sediment from this tsunami was also implied through modeling by Malej et al. (2019), with elevation changes throughout the harbor ranging from several inches to several feet).
- There are also experimental risks; the instruments monitoring currents (deployed on the seafloor) would be vulnerable to movement by storms and strong bottom currents, malfunction, or disturbance by bottom fishing gear.
- Finally, the Del Norte Sediment Management Plan for the harbor includes multiple documents (plans, reports, memos) and layers of review needed to advance the proposed plan. Conducting the field surveys, data analyses, reviews, and coordination for plans and work products between all parties would require a considerable investment in funding and time. In addition, considering the wide range of variables, the interpretation of results may vary and lead to litigation costs.

For these reasons, it could be beneficial for KRRC to consider developing a more basic estimate of the potential contribution of sediment from the drawdown to Crescent City Harbor, using best available existing information and reasonable assumptions, and settle with Del Norte County and the Harbor District on an appropriate share of dredging costs to be paid by KRRC, to be administered outside the license surrender order.

3.1.4 Effects of the Proposed Action with Staff Modifications

The effects of the proposed action with staff modifications on geology and soils in the project area would be the same as the proposed action, with the exception described below for the California Slope Stability Monitoring Plan (a subplan under the Reservoir Drawdown and Diversion Plan). The modification would help to further minimize any potential adverse effects.

3.1.4.1 Slope Stability Monitoring

Consistent with KRRC's California Water Board WQC condition 18, modifying the California Slope Stability Monitoring Plan would extend the LiDAR monitoring in Copco No. 1 Reservoir upper rim for six months after completion of drawdown (at a reduced interval of once per month). As geotechnical characteristics of sedimentary slope deposits change from dewatering, stability effects may not be immediate. This monitoring would focus on segments of the Copco No. 1 Reservoir rim identified to be potentially affected by slope failure. These segments consist of approximately 1,780 linear feet of existing roads and/or private property outside the reservoir rim. Effects of the proposed action with staff modifications would be similar to the proposed action but would help identify potentially delayed slumping, cracking, and other signs of slope instability caused by the drawdown.

In addition, the California Slope Stability Monitoring Plan also includes monitoring of the reservoir rims and embankments for slope instability during and after drawdown of the reservoirs. Consistent with California Water Board WQC condition 18 and mitigation measure GEO-1, which were both referenced for proposed measure GRM-1 in the amended surrender application, staff recommends KRRC modify the subplan to include proposed measures for repair and replacement of private property identified to have been affected by slope instability during and after drawdown. These measures would only be provided for landowners who allow KRRC access to their properties for a pre-drawdown baseline assessment and for assessments during and after drawdown, as needed, to determine if any reported structural damage is related to the drawdown. Effects of the proposed action with staff modifications would be similar to effects of the proposed action but would provide more details of steps taken by KRRC to address potential structural damage on private properties.

In summary, potential local effects from the drawdown at the Copco No. 1 Reservoir, described in section 3.1.3.1, *Effects of Bank Sloughing Caused by Reservoir Drawdown*, would still be short term, adverse, and significant, but these staff modifications may help reduce the significance of the effects.

3.1.5 Effects of the No-action Alternative

Under the no-action alternative, there would be no increases in sediment transport in the Klamath River. The project dams would continue to trap sediment, disrupting recruitment of gravel and altering the river's geomorphology within and downstream of the hydroelectric reach. Effects on downstream aquatic habitat would be long term, significant, and adverse.

Table 3.1-1. Estimated cumulative annual sediment delivery by tributaries to the Klamath River (Source: California Water Board, 2018; Stillwater Sciences, 2010; as modified by staff)

Source Area	**River Mile**	**Tributary Supply**	**Cumulative Delivery #**				
			Total	**Sand and larger**		**Clay/Silt**	
		tons/yr	tons/yr	tons/yr	percent	tons/yr	percent
Keno Dam to Iron Gate Dam	193.1		**151,000**	24,160	**16%**	126,840	**84%**
Iron Gate Dam to Cottonwood Creek	185.1		160,961	25,754	16%	135,207	84%
Cottonwood Creek	185.1	*14,599*	175,560	30,426	17%	145,135	83%
Cottonwood Creek to Shasta River	179.5		177,715	31,115	18%	146,600	82%
Shasta River	179.5	*21,544*	199,259	38,009	19%	161,250	81%
Shasta River to Beaver Creek	163.4		231,710	48,393	21%	183,316	79%
Beaver Creek	163.4	*48,159*	279,869	63,804	23%	216,065	77%
Beaver Creek to Scott River	145.1		373,073	93,630	25%	279,443	75%
Scott River	145.1	*607,320*	980,393	287,972	29%	692,421	71%
Scott River to Grider Creek	132.1		1,048,860	309,881	30%	738,978	70%
Grider Creek to Indian Creek	108.3		1,099,934	326,225	30%	773,709	70%
Indian Creek	108.3	*73,312*	1,173,246	349,685	30%	823,561	70%
Elk Creek	107.1	*38,684*	1,211,930	362,064	30%	849,866	70%
Clear Creek	100.1	*42,042*	1,253,972	375,517	30%	878,454	70%
Dillon Creek	85.4	*28,417*	1,282,389	384,611	30%	897,778	70%
Indian Creek to Dillon Creek	85.4		1,354,759	407,769	30%	946,990	70%
Dillon Creek to Salmon River	66.3		1,440,282	435,137	30%	1,005,146	70%
Salmon River	66.3	*320,622*	1,760,904	537,736	31%	1,223,169	69%
Salmon River to Camp Creek	57.3		1,785,769	545,693	31%	1,240,077	69%
Camp Creek	57.3	*137,339*	1,923,108	589,641	31%	1,333,467	69%
Camp Creek to Red Cap Creek	52.9		1,946,606	597,160	31%	1,349,446	69%
Red Cap Creek	52.9	*116,768*	2,063,374	634,526	31%	1,428,848	69%
Red Cap Creek to Bluff Creek	49.7		2,079,504	639,687	31%	1,439,816	69%
Bluff Creek	49.7	*338,470*	2,417,974	747,998	31%	1,669,976	69%
Bluff Creek to Trinity River	43.3		2,439,210	754,793	31%	1,684,416	69%
Trinity River	43.3	*3,317,334*	5,756,544	1,816,340	32%	3,940,204	68%
Blue Creek	16.2	*102,807*	5,859,351	1,849,239	32%	4,010,112	68%
Trinity River to Mouth	0		**6,237,471**	1,970,237	**32%**	4,267,234	**68%**

\# Silt/clay constitutes particles smaller than 0.063 mm in diameter;
sand and larger particles (i.e., gravel and rocks) constitute particles larger than 0.063 mm in diameter.

Notes: Cumulative sediment delivery is reported for the downstream endpoint of the corresponding source area identified in the first column. Mass is reported in US short tons and assumes a density of 1.5 tons/CY. Above Cottonwood Creek, assumes 16 percent of total load is greater than 0.063 mm based on grain size distribution of reservoir sediment. Below Cottonwood Creek, assumes 10 percent of total load is bedload and 24 percent of suspended load is sand greater than 0.063 mm.

Table 3.1-2. Estimated amount of sediment in project reservoirs in 2022 (Source: Interior and California DFG, 2012, modified by staff)

Reservoir[a]	**Accumulated Sediment in 2022**[b]					
	Total Volume	**Total Sediment**	**Fine Sediment (Silt/clay)**	**Sand**	**Fine Sediment (Silt/clay)**	**Sand**
	Cubic Yards	**Tons (Dry Weight)**			**Percent**	
J.C. Boyle	1,229,200	351,200	227,200	124,000	65	35
Copco No. 1	8,412,600	2,131,200	1,835,500	295,700	86	14
Iron Gate	5,890,000	1,790,800	1,511,300	289,800	84	16
Total	15,531,800	4,273,200	3,574,000	709,500	84	16

[a] Copco No. 2 Reservoir does not retain measurable amounts of sediment and therefore is not included in these estimates.

[b] Note: Interior and California DFG (2012) estimated increases of sediment volumes behind the dams of 19,600 cubic yards per year in J.C. Boyle Reservoir, 81,300 cubic yards per year in Copco No. 1 Reservoir, and 100,000 cubic yards per year in Iron Gate Reservoir—a total of 200,900 cubic yards per year.

Table 3.1-3. Mass of sediment estimated to be eroded and mobilized from the project reservoirs (percent and tons dry weight) during drawdown (Source: Interior and California DFG, 2012, modified by staff)[a]

	Sediment Erosion[b]							
					By Size Fraction			
	Total Sediment				**Fine sediment (silt/clay)**		**Sand**	
	Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
Reservoir[a]	**percent**		**tons (dry weight)**		**tons (dry weight)**			
J.C. Boyle (2020)	27	51	90,000	170,000	60,000	110,000	30,000	60,000
Copco No. 1 (2020)	45	76	950,000	1,590,000	820,000	1,370,000	130,000	220,000
Iron Gate (2020)	24	32	420,000	550,000	350,000	460,000	70,000	90,000
Total (2020)	36	57	1,460,000	2,310,000	1,230,000	1,940,000	230,000	370,000
Total[b] (2022)	36	57	1,501,000	2,375,000	1,264,500	1,944,500	236,500	380,400

[a] Copco No. 2 Reservoir does not retain measurable amounts of sediment and therefore is not included in these estimates.

[b] Interior and California DFG (2012) estimated erosion volumes for each reservoir up to year 2020. Between 2020 and 2022, the total sediment volume accumulated behind the dams would increase by approximately 200,900 cubic yards. Applying the same volume to mass conversion rate and erosion rates of 36 to 57 percent, this volume would add a mass of approximately 40,000 to 63,000 tons (dry weight), respectively, to the total 2020 sediment mass projected to be eroded from the reservoirs.

Table 3.1-4. Dredged material grain size and total organic carbon composition in Crescent City Harbor, 1993–2009 (Source: Corps, 2019)

Date	**Entrance Channel**		**Inner Harbor Basin Channel**		**Inner Harbor Basin and Access Channels**		**Marina Access Channel**	
	% Sand	**% TOC[a]**	**% Sand**	**% TOC[a]**	**% Sand**	**% TOC[a]**	**% Sand**	**% TOC[a]**
1993	94	0.1	49	5.6	--	--	--	--
1998	72	1.2	34	8.7	--	--	--	--
1999					88.9	6.04	--	--
2003	--	--	--	--	76	1.81	--	--
2009	87.4	0.8	46.4	10.8	--	--	80.0	6.1

Notes: Samples from the Inner Harbor Basin and Marina Access Channels were composited for analysis.

[a] TOC = Total organic carbon, a measure of organic matter. Organic matter consists of over 50 percent TOC, with the remaining mass consisting of water and other nutrients such as nitrogen and potassium.

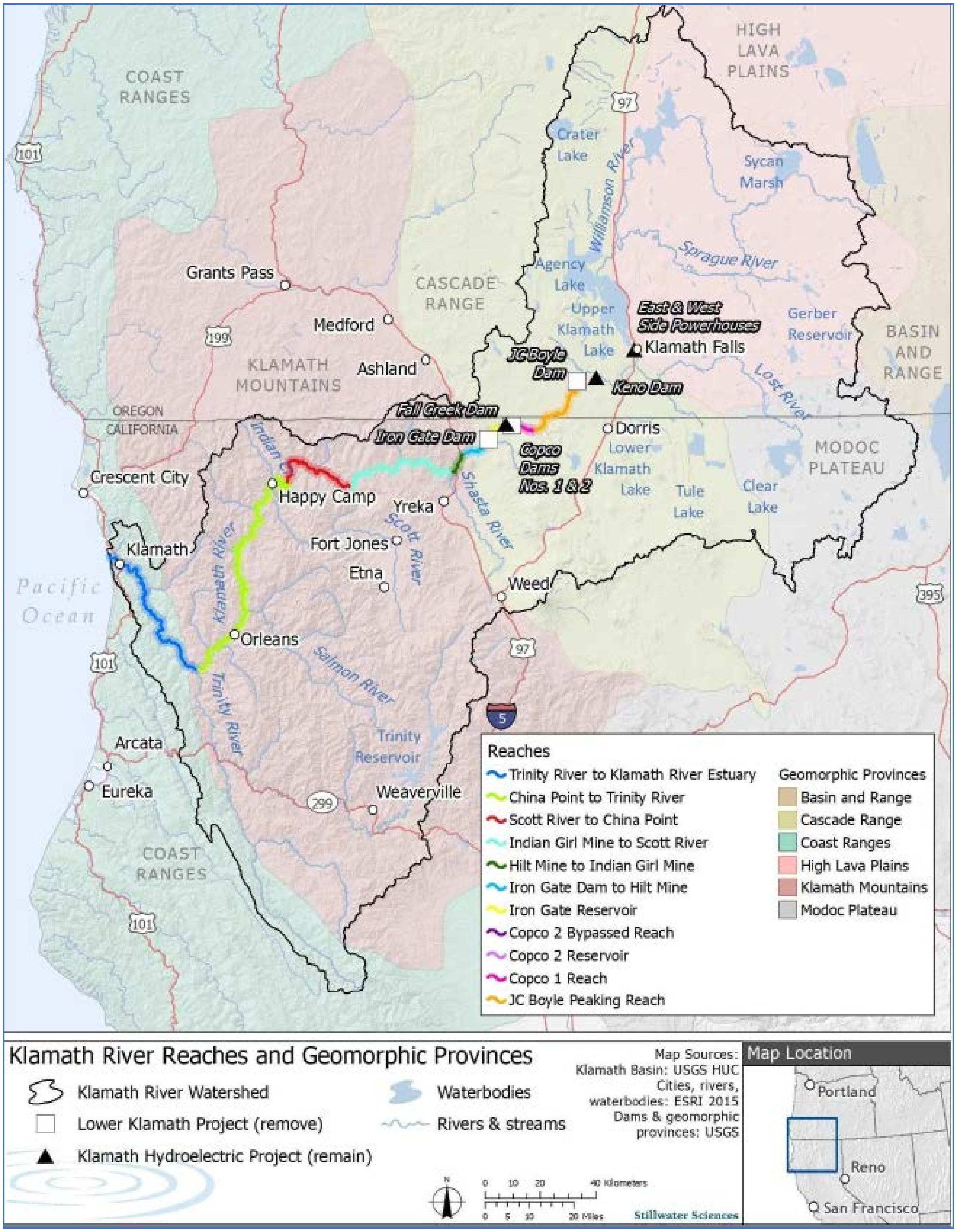


Figure 3.1-1. Geomorphic provinces in the Klamath River Basin and Klamath River reaches within the area of analysis for geology and soils (Source: California Water Board, 2020a)

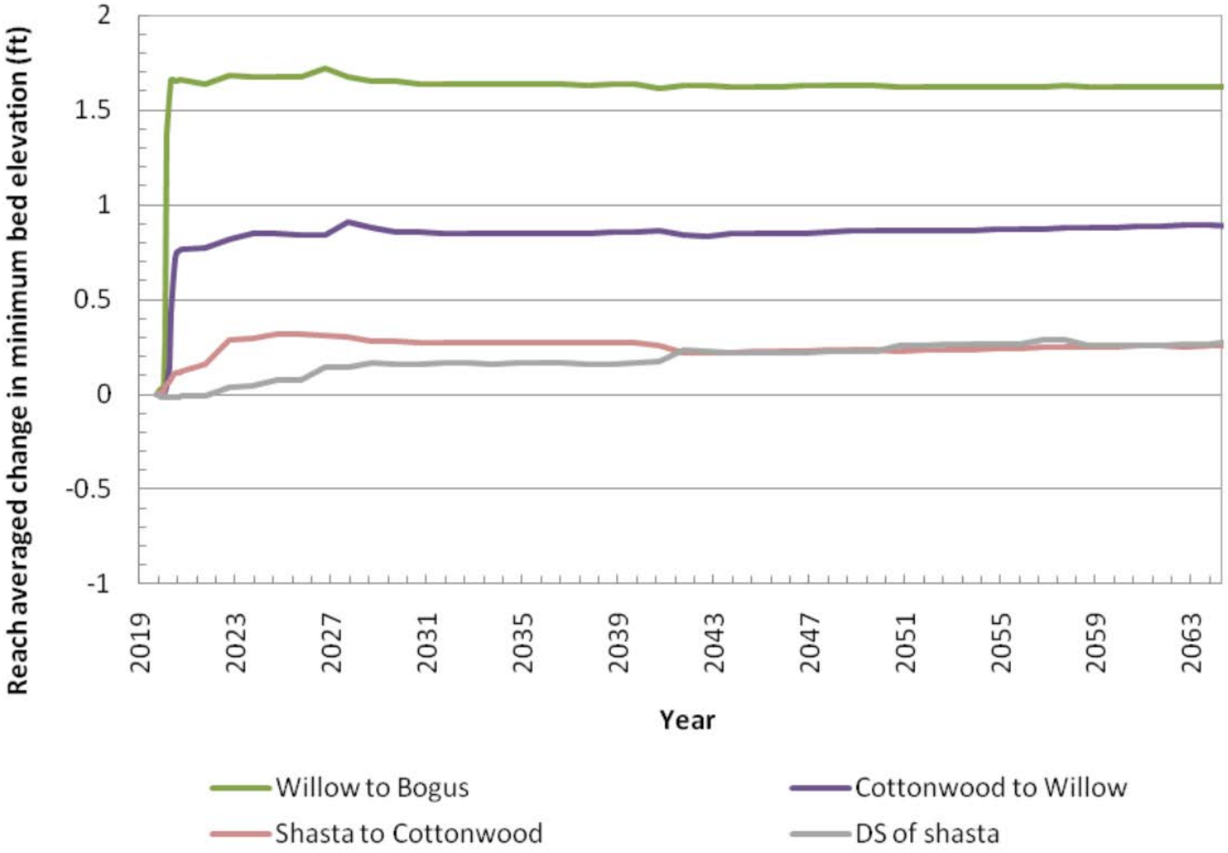


Figure 3.1-2. Reach-averaged change in minimum bed elevation (feet) from Iron Gate Dam to Shasta River post-dam removal, with dam removal occurring in a median water year (based on 50-year model simulations) (Source: Reclamation, 2011a)

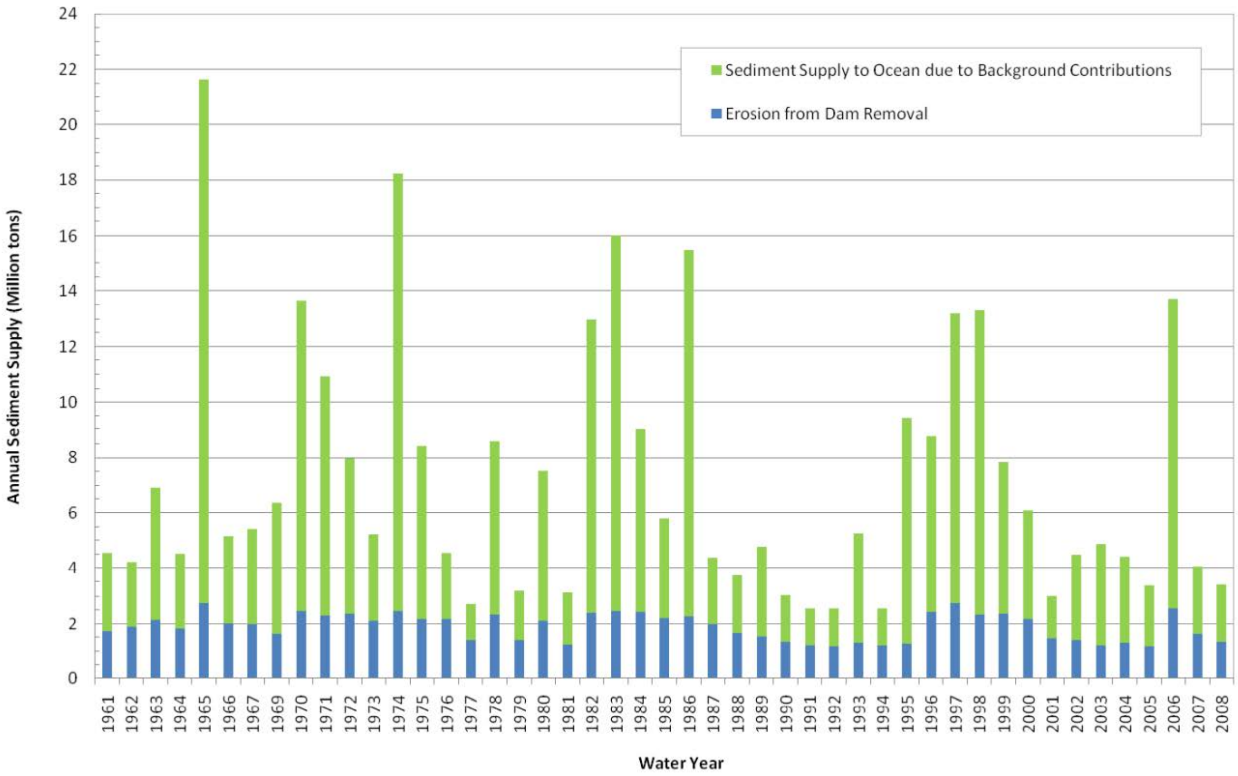
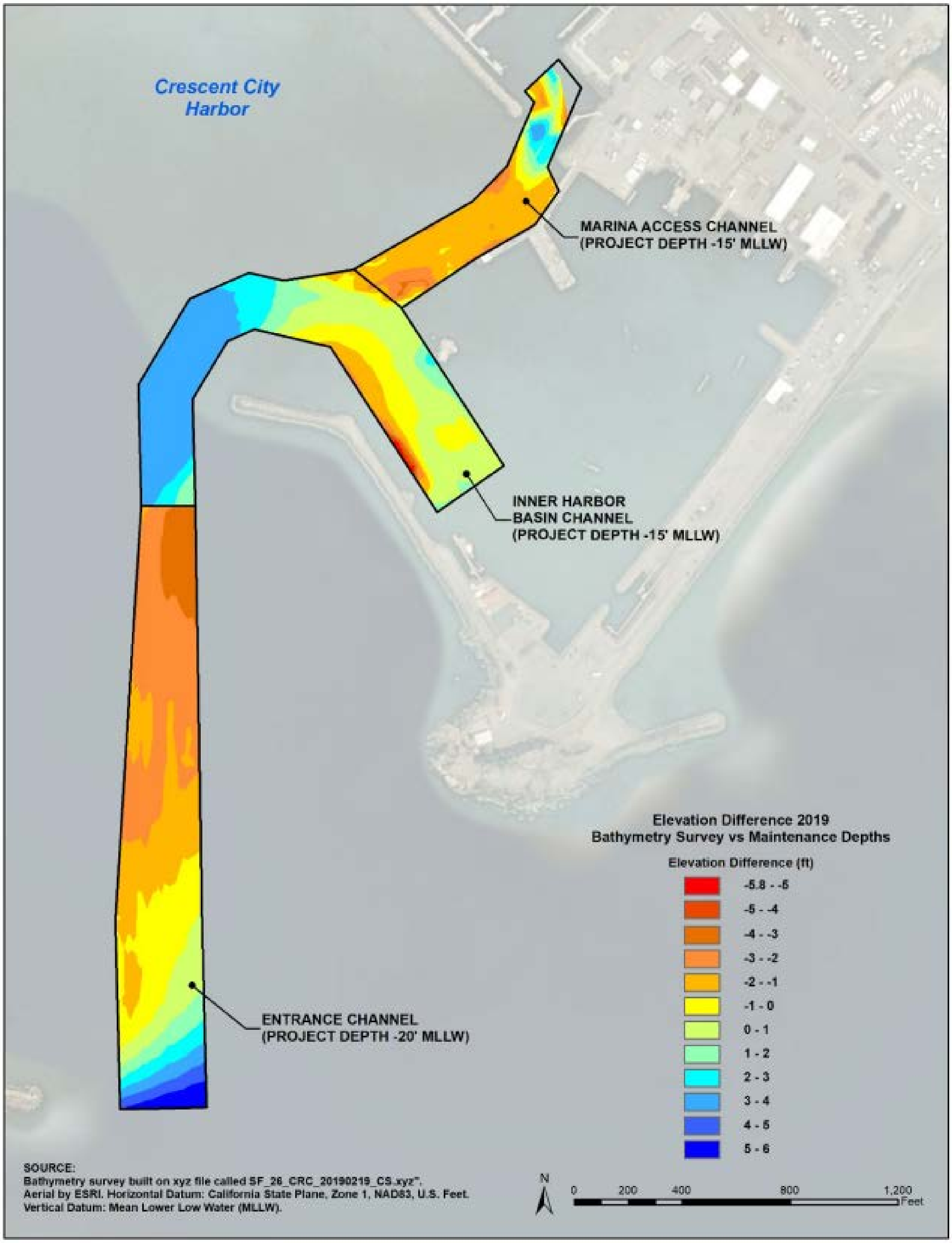


Figure 3.1-3. Annual predicted sediment delivery to the Pacific Ocean under existing natural conditions (background contributions) for water years 1961–2008 (green bars), and modeled additional sediment load if the reservoir release occurred under flow conditions of the respective water year (blue bars) (Source: Reclamation, 2011a)



SOURCE:
Bathymetry survey built on xyz file called SF_26_CRC_20190219_CS.xyz".
Aerial by ESRI. Horizontal Datum: California State Plane, Zone 1, NAD83, U.S. Feet.
Vertical Datum: Mean Lower Low Water (MLLW).

Figure 3.1-4. Crescent City Harbor Federal Channel dredging footprint based on 2019 hydrographic surveys (Source: Corps, 2019)

3.2 WATER QUANTITY

3.2.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for water quantity includes the Klamath River extending from the upstream extent of Upper Klamath Lake to the Pacific Ocean and aquifers within 2.5 miles of the project reservoirs. The temporal extent of our effects analysis includes short-term effects on Klamath River flows during reservoir drawdown extending for approximately one year while any effects of sediment transport on downstream water intakes are addressed, and permanent effects including reinstating a more natural flow regime in the project bypassed reaches between J.C. Boyle Dam and the J.C. Boyle Powerhouse, Copco No. 2 Dam and Powerhouse, and peaking reach between J.C. Boyle Powerhouse and Copco No. 1 Reservoir.

3.2.2 Affected Environment

3.2.2.1 Klamath River Basin Climate, Hydrology, and Flows

Klamath River Basin Climate

The Klamath River Basin upstream of Iron Gate Dam is bordered by the Sacramento River Basin to the south, closed basins within the Great Basin to the east and north, and the Rogue River Basin to the northwest. Precipitation occurs mostly during the late fall, winter, and spring and is mostly in the form of snow above elevations of 5,000 feet mean sea level (msl). Average yearly precipitation varies greatly with elevation and location and ranges from about 10 to more than 50 inches. Streamflow normally peaks during the late spring and/or early summer from snowmelt runoff. Low flows within the watershed typically occur during the late summer or early fall, after snowmelt and before the runoff from the fall storms moving in from the Pacific Ocean.

The U.S. Drought Monitor currently classifies most of the Klamath River Basin and other surrounding areas in southern Oregon and northern California as in an extreme or exceptional drought (NDMC, 2021). Analysis of climatologic and hydrologic information for the Klamath River Basin indicates inflows, particularly baseflows, in the summer and fall have declined over the last several decades (Mayer and Naman, 2011). Reclamation reports that dry-season (April to September) runoff declined by 18 percent between 1950 and 1999 (Reclamation, 2016b). Part of the decline in flow is explained by changing patterns in precipitation; however, other factors likely include increasing temperature, decreasing snow water equivalent, and increasing evapotranspiration (NMFS, 2019a). During the 2030s, Reclamation projects an annual increase in precipitation of about 5 percent, a snow water equivalent decrease of 30 to 40 percent in high plateau areas, and an approximate 10 percent increase in annual flow volume in the Klamath River below Iron Gate Dam, with increases seen primarily in the winter flow period (December through March) accompanied by decreases in the April through September flows (Reclamation, 2021a).

Future Changes in Climate and Hydrology

Climate change is expected to result in a wide variety of effects in the Klamath River Basin (Karl et al., 2009; Barr et al., 2010; Hamilton et al., 2011; Woodson et al., 2011; Dalton et al., 2017; May et al., 2018; Mote et al., 2019; and Reclamation, 2011b, 2016a, 2016b). The Reclamation (2016b) Klamath River Basin Study provides an overview of the climate change impacts on the watershed with respect to historical and projected future water supply and demand. The following summary statements of future effects on water quantity in the Klamath River Basin are consistent with projected changes in temperature and precipitation as presented in the aforementioned reports:

- Climate change models indicate temperatures throughout the Klamath River Basin may increase by approximately 5 to 6°F over the 21st century, with a projected increase of from 2.2 to 2.7 percent in precipitation by 2050.
- Increased warming is expected to reduce snowpack and snowmelt, resulting in less runoff during the late spring through early autumn. Snowpack decreases are projected to be more substantial in the warmer parts of the basin.
- Mean annual runoff is projected to increase by from 2.9 to 9.6 percent by 2050; it may increase by 15 percent by 2070, with a range from a decrease of 6 percent to an increase of 39 percent across all equally likely scenarios.
- Despite a possible increase in annual runoff, projected warming would change runoff timing, with irrigation season runoff (April to September) projected to decrease about 40 percent by the 2070s, with slightly more rainfall-runoff during the winter (December through March) and a more apparent declining trend of less runoff during the late spring and summer (April through July).

Additionally, individual rain events are predicted to become more intense, and thus flooding flows will be more frequent. These hydrologic changes are expected to cause changes in groundwater levels and water quality, which are discussed further in the following sections.

The climate change vulnerability assessment for south-central Oregon (Halofsky et al., 2019) reports that the effects of climate change on hydrology will be significant. Effects include decreased snowpack and earlier snowmelt, which will shift the timing and magnitude of streamflow; peak flows will be higher, and summer low flows will be lower. Projected changes in climate and hydrology affect aquatic and terrestrial ecosystems via predicted increases in frequency of extreme climate events (drought, low snowpack) and ecological disturbances (flooding, wildfire, insect outbreaks).

Klamath River Hydrology

Changes to Klamath River hydrology occurred through the development of water management features related to irrigation, power generation, and environmental requirements over the past century and longer. The available recorded hydrologic time period includes natural hydrology in the Klamath River prior to the development of Reclamation’s Klamath Irrigation Project (also known as the Klamath Project) and private hydroelectric facilities (water years 1905 to 1912), the period in which major irrigation and power peaking facilities were developed (water years 1913 to 1962), and hydrology following construction of Iron Gate Dam (1963 to present), when aquatic habitat flow requirements began to influence water releases downstream from Iron Gate Dam. USGS currently operates six stream gages on the Klamath River (table 3.2-1).

Prior to development, the Upper Klamath River Basin supported a complex of wetlands and open water covering about 80,000 to 94,000 acres in the spring and 30,000 to 40,000 acres in late summer. The elevation of Upper Klamath Lake was originally controlled by a natural rock reef dam at the outlet of the lake. Water then flowed 1.3 miles down the Link River to Lake Ewauna, the headwaters of the Klamath River. During high-flow events out of Upper Klamath Lake, some water was captured and would flow down the Lost River Slough and into Tule Lake, another natural sump and wetland area. Water would also back up from the Keno Reef (near Keno, Oregon) and flow into the Klamath Straits and down to Lower Klamath Lake. The Lower Klamath Lake and Tule Lake areas varied in surface area from 55,000 to more than 100,000 acres (FERC, 2007). Below the Keno Reef, the Klamath River flowed freely to the Pacific Ocean. Figure 3.2-1 presents the average daily flow in the Klamath River at Keno, Oregon, prior to the development of dams and includes three different water years, representing conditions that range from dry to wet.

Prior to construction of Link River Dam in 1921, Upper Klamath Lake was relatively shallow with a mean depth of 9 feet. During construction, the bedrock ledge at the outlet area was removed to allow the lake to be drawn down about 3 feet lower than the natural elevation of 4,140 feet msl, resulting in a maximum range of water level variation of about 6 feet, between elevations 4,136 and 4,143 feet msl. The added available range in water levels increased the storage capacity of Upper Klamath Lake to the present active storage of 579,200 acre-feet and a total storage of 629,780 acre-feet (California Water Board, 2020a).

Upper Klamath Lake provides storage for Reclamation’s Klamath Irrigation Project, which serves 230,000 acres of irrigable lands (Reclamation, 2020a). During the development of the Klamath Irrigation Project, the size of Tule Lake, about 95,000 acres, was lowered to increase the amount of land available for agricultural production, leaving about 9,450 to 13,000 acres of shallow lake and marshland (Reclamation, 2011a). To comply with the ESA, Reclamation operates the Klamath Irrigation Project in accordance with FWS and NMFS BiOps, which include requirements for targeted Klamath River flows (i.e., environmental water account) measured below Iron Gate Dam and water surface elevations in Upper Klamath Lake (FWS, 2019b; NMFS, 2019a). For water years 2019 and 2020, total projected inflow into Upper Klamath Lake from March through September was 670,000 acre-feet and 363,500 acre-feet, respectively (Reclamation, 2019; 2020a).

With the construction of Keno Dam at the Keno Reef in 1967, Lake Ewauna/Keno Reservoir became a long and narrow lake. PacifiCorp operates Keno Dam to maintain the reservoir at an elevation of 4,085.4 feet msl from October 1 to May 15 and at an elevation of 4,085.5 feet msl from May 16 to September 30 to allow for consistent operation of irrigation canals and pumps. Figure 3.2-2 presents the change in the timing and magnitude of average daily flows in the Klamath River at Keno, Oregon, because of development at Upper Klamath Lake and Lake Ewauna.

Downstream of Keno Dam, PacifiCorp operates the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments (table 3.2-2) for hydroelectric operations. PacifiCorp operates J.C. Boyle Reservoir within a range of 5.5 feet between full pond (3,793.5 feet msl) and the minimum operating level (3,788 feet msl) and limits daily fluctuations due to peaking operations at the J.C. Boyle Powerhouse to 1 to 2 feet. At Copco No. 1, the reservoir water level is maintained within a range of 6.5 feet, between elevations 2,601.0 to 2,607.5 feet msl, with daily fluctuations in reservoir water levels of about 0.5 foot due to peaking operations. Copco No. 2 Reservoir has limited storage, and its water level rarely fluctuates more than several inches. The water level in Iron Gate Reservoir is maintained within a range of 4 feet of the full pond elevation (2,328.0 feet msl) and daily water level fluctuations are about 0.5 foot. Evaporation from the surface of the reservoirs is about 11,000 acre-feet of water per year (Interior and California DFG, 2012).

Two perennial tributaries, Jenny and Fall Creeks, enter Iron Gate Reservoir. Flow in Jenny Creek is altered by upstream reservoirs that are part of the Rogue River Irrigation Project. These reservoirs store water during the high runoff season for irrigation and capture about 30 percent of the mean annual runoff (24,000 acre-feet) of the Jenny Creek watershed. PacifiCorp estimates that normally between 30 and 500 cfs enters Iron Gate Reservoir from Jenny Creek. Flow within Fall Creek does not vary much seasonally due to a reliable baseflow from groundwater springs and typically ranges from 30 to 50 cfs. Table 3.2-3 provides monthly discharge statistics for the Klamath River below Keno Dam, J.C. Boyle Powerhouse, and Iron Gate Dam.

Compared to Upper Klamath Lake, J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Reservoirs provide limited to no flood control capacity (California Water Board, 2020a).[52] To support Reclamation's hydrologic and hydraulic modeling of

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[52] Approximately 98 percent of the active surface water storage along the Klamath River is provided by Upper Klamath Lake behind Link River Dam. Keno, J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams provide approximately 2 percent of the active storage on the river.

100-year floodplain inundation, flood frequency analyses for 10-year to 100-year events (table 3.2-4) were performed for the Klamath River downstream of each PacifiCorp facility (Reclamation, 2011a).

3.2.2.2 Surface Water Rights, Water Supply, and Water Demand

Surface Water Rights

The Klamath River Reservation and Hoopa Valley Indian Reservation were established by Executive Orders in 1855 and 1876, respectively. The Reserved Rights Doctrine was first articulated in the 1908 Supreme Court decision *Winters v. United States*, and provides that, when lands are set aside as Indian or other federal reservations, sufficient water to fulfill the purposes of the reservation is reserved as well (Interior and California DFG, 2012).[53] The Klamath River Compact between California and Oregon was ratified by the states and consented to by the United States in 1957, giving domestic and irrigation water supply users in the Klamath River Basin preference for use of water supplies over recreation, industrial, hydropower, and other uses (Reclamation, 2016c). Reclamation's water rights for the Klamath Irrigation Project allow for the storage and delivery of water to irrigable land in southern Oregon and northern California, and deliveries of water to the Lower Klamath and Tule Lake National Wildlife refuges in California and Oregon (California Water Board, 2020a).

PacifiCorp currently operates the J.C. Boyle development under a non-consumptive hydropower water right (i.e., no water right for seasonal water storage or irrigation) issued by the Oregon Water Resources Department (Oregon WRD). In March 2013, the Corrected Findings of Fact and Order of Determination in the Klamath River Basin General Stream Adjudication issued by Oregon WRD set forth the water rights in the Klamath River Basin that are diverted in Oregon (California Water Board, 2020a; Reclamation, 2016c; Oregon WRD, 2014). The highest priority water rights in the adjudication were granted to the Klamath Tribes, who maintain water rights with a priority date of "time immemorial" (i.e., a water right senior to all other users in the basin) to support hunting, gathering, and fishing on their reservation.[54]

California requires water diverters to file annual reports or statements of diversion and use with the California Water Board, which are accessible through the Electronic Water Rights Information Management System. For the Copco No. 1 and Copco No. 2 facilities, PacifiCorp has filed statements of water diversion and use for pre-1914 direct diversion hydropower water rights. For Iron Gate Dam, the California Water Board has

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[53] Unlike state appropriative rights, federal reserved water rights are for present and future uses and may be exercised at any time and are not lost through non-use.

[54] Water is first made available to meet the needs of the ESA listed fishes in Upper Klamath Lake and the Klamath River, then contractual irrigation deliveries, and then to the refuges.

issued a water right license for power generation (1,800 cfs), hatchery operations (50 cfs), and refill of regulatory storage (3,300 cfs). None of the water rights for the Lower Klamath Project facilities are for seasonal water storage or irrigation purposes (California Water Board, 2020a). Four water rights located on Fall Creek include two non-consumptive rights for hydropower generation at PacifiCorp's Fall Creek Powerhouse, one for the City of Yreka's municipal water supply, and one for fish propagation at the Fall Creek Hatchery. An additional 25 water right records list the Klamath River or a California Lower Klamath Project reservoir (i.e., Copco No. 1, Copco No. 2, and Iron Gate) as their water source. Of the 25 records, 22 water right listings are located downstream of Iron Gate Dam, and three are located upstream (Interior and California DFG, 2012; California Water Board, 2020a).[55] In 2011, the California Water Board determined that the mainstem of the Klamath River, from 100 yards downstream from Iron Gate Dam to the Pacific Ocean, is fully appropriated during the entire calendar year (California Water Board, 2020a).

Water Supply and Demand

The supply of water from the Klamath Irrigation Project (i.e., water available for irrigation) and the environmental water account (i.e., water released to the Klamath River to meet Iron Gate Dam target flows) is currently controlled by the criteria in NMFS' 2019 BiOp and varies on a yearly basis. In 2019, project supply was 322,000 acre-feet and the environmental water account was 578,000 acre-feet (Reclamation, 2019). In 2020, project supply was 140,000 acre-feet and the environmental water account was 447,000 acre-feet (Reclamation, 2020a). Historical full irrigation demand during the spring-summer season is 390,000 acre-feet (Reclamation, 2020b).

During severe dry periods, water stored within the Lower Klamath Project (primarily water stored in Copco No. 1 and Iron Gate Reservoirs) is sometimes used to help Reclamation meet NMFS' BiOp requirements below Iron Gate Dam, allowing Reclamation to extend water supply to Klamath Irrigation Project water users above Keno Dam (e.g., provide water to irrigators and the wildlife refuges), and meet BiOp requirements in Upper Klamath Lake. In the fall 2014, PacifiCorp agreed to release 15,400 acre-feet of "borrowed" water to ensure Reclamation did not violate elevation or flow BiOp requirements. In April and May 2018, Reclamation coordinated with NMFS, FWS, PacifiCorp, the Klamath Tribes, and other water users regarding the temporary release of 20,000 acre-feet of water from the Lower Klamath Project reservoirs, to enable charging of the Klamath Irrigation Project's irrigation canals in late April and May (California Water Board, 2020a). Reclamation engaged in a similar agreement with PacifiCorp for the release of 10,000 acre-feet of water in 2021 to support the Tule Lake

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[55] PacifiCorp holds the three water rights upstream of Iron Gate Dam, located on portions of the Klamath River above Copco No. 1 Reservoir, for irrigation and livestock watering. Combined, these water rights allow PacifiCorp to withdraw a total of 5,475 acre-feet from April 1 through October 31.

National Wildlife Refuge. After each release water is repaid to the Lower Klamath Project from storage in Upper Klamath Lake.

The City of Yreka water supply pipeline intake structure originates in Fall Creek. California Water Rights Permit 15379 allocates to the City of Yreka up to 15 cfs, not to exceed 6,300 acre-feet per year from Fall Creek, year-round (California Water Board, 2020a). During the diversion period, the City of Yreka must ensure a minimum flow of 15 cfs, or the natural flow of Fall Creek, whichever is less. At the Fall Creek Hatchery, California Water Board License 11681 authorizes California DFW to divert up to 10 cfs for non-consumptive use (fish propagation) at Fall Creek Hatchery between March 15 and December 15 each year, not to exceed 5,465 acre-feet per year.

The Lower Klamath Project reservoirs also provide water for fire management in the region. Ground-based efforts (e.g., fire trucks) procure water resources in the Lower Klamath Project area from boat launches around the reservoirs and along the river, a gravity-fed hydrant system at Copco No. 1 Reservoir, and a two-hydrant system that services the gated area near the Copco No. 2 Powerhouse (KRRC, 2021i). Aerial efforts with helicopters and fixed-wing aircraft are another component of wildfire suppression, capable of applying large volumes of water to remote areas. Snorkels and buckets represent the two mechanisms for aerial drafting of water. Water tank and bucket capacities of helicopters vary from 100 to 3,000 gallons.

3.2.2.3 Groundwater

Regional groundwater in the Klamath River Basin is primarily fed by the infiltration of surface water and by precipitation (Gannett et al., 2007). Regional groundwater flow patterns along the Klamath River downstream from Keno Dam are generally from the higher elevations (upland areas, mountain ranges, hills) toward the Klamath River and from Keno Dam toward Iron Gate Dam (Reclamation, 2011c). Numerous springs (i.e., where groundwater discharges to the surface) and groundwater-fed drainages occur in the area surrounding J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Reservoirs, indicating a groundwater table that is near the ground surface (Gannett et al., 2007). Gannett et al. (2007) indicates groundwater discharge to the reach between Keno Dam and the J.C. Boyle Powerhouse can vary from less than 200 cfs to greater than 300 cfs and groundwater discharge between the J.C. Boyle Powerhouse to below Iron Gate Dam can vary from 30 cfs to 330 cfs. On average, total groundwater accretion to the hydroelectric reach is over 400 cfs. These springs and drainages occur at elevations from less than 50 feet to more than 800 feet above the reservoir level (Reclamation, 2011a). Local groundwater immediately adjacent, and potentially extending up to a mile from the Lower Klamath Project reservoirs under certain conditions, is more likely influenced by local site-specific variability (i.e., groundwater levels above or below the reservoir stage) and subsurface porosity and permeability (California Water Board, 2020a).

Groundwater pumping for domestic use and irrigation is common in the Klamath River Basin (California Water Board, 2020a). Average well yield in Siskiyou County, California is about 19 gallons per minute (0.04 cfs), and average well yield in Klamath County, Oregon, is about 22 gallons per minute (0.05 cfs). Since 2001, irrigation demand for groundwater increased by 50 percent in response to changes in surface water management practices (e.g., establishment of BiOp requirements). Typical annual drawdown and recovery cycles caused by regional groundwater pumping range from 1 to 10 feet. Overall, the increase in pumping resulted in groundwater levels dropping 10 to 15 feet in the area surrounding the Lower Klamath Project facilities (Reclamation, 2011a).

3.2.3 Effects of the Proposed Action

3.2.3.1 Project Deconstruction Effects on Water Quantity

The process of drawing down the reservoirs and deconstructing the dams would affect downstream river flows during drawdown, and the rate of drawdown and the potential for refilling of the reservoirs during drawdown would be affected by inflows and the effective discharge capacity of outlet structures. Refilling the reservoirs during drawdown would likely extend the duration of high SSCs in the Lower Klamath River, which would adversely affect aquatic resources.

To access the dams for deconstruction, KRRC would perform controlled reservoir drawdowns over a period of four to six months, depending on inflow conditions. KRRC would commence pre-drawdown operations prior to January 1 of the drawdown year, lowering each reservoir water surface level to the normal minimum operating level, and commence full drawdown operations at each facility on January 1. To manage inflows during the deconstruction phase, KRRC would coordinate with Reclamation to establish temporary flow control measures at Upper Klamath Lake. KRRC would lower each reservoir at a target rate of between 2 and 5 feet per day, as inflows allow. Presented below, KRRC’s December 2021 Reservoir Drawdown and Diversion Plan describes the project-specific proposed drawdown methods, procedures, schedules, and monitoring it would implement as part of the proposed action.

At J.C. Boyle Dam, the proposed drawdown would occur in four stages, using the spillway, the power facilities, and a sequenced removal of the diversion culvert stoplogs. KRRC would first lower J.C. Boyle Reservoir to the normal minimum operating level of 3,791.7 feet msl. Then, using the power facilities, it would lower the reservoir water surface level to 3,783.2 feet msl (2 feet below the spillway crest elevation) to initiate both stage three and stage four (sequenced removal of the diversion culvert stoplogs). KRRC would achieve final drawdown when water flowing through the two diversion culverts reaches open channel flow and the reservoir water level is at or below elevation 3,763.1 feet msl.

At Copco No. 1 Dam, prior to drawdown, KRRC proposes to construct a new low-level outlet tunnel under spillway bay 3, to draw down the reservoir. KRRC would commence drawdown operations by keeping the reservoir water level at or below the spillway ogee crest level (2,597.1 feet msl), to as low as the normal minimum operating level of 2,592 feet msl. The drawdown of the reservoir would primarily occur through the proposed low-level outlet tunnel. Upon removal of the plug from the low-level outlet tunnel, KRRC expects the reservoir water level would lower from 2,597.1 to 2,530 feet msl. Once the reservoir water level has been reduced to 2,530 feet msl or less, KRRC would release water through the historic diversion tunnel and achieve final drawdown when the reservoir water level is maintained at or below elevation 2,515 feet msl.

At Copco No. 2 Dam, KRRC would lower and maintain the reservoir water level at the normal minimum operating level of 2,486.1 feet msl. It would initiate drawdown by opening the spillway gates and increasing the flow through the powerhouse and achieve final drawdown when the reservoir water level is at or below 2,459.5 feet msl.

At Iron Gate Dam, prior to drawdown, KRRC would remove accumulated debris from the low-level outlet and rehabilitate its control gate to ensure that outflows can be controlled. During the initial phase of drawdown, KRRC would use the power facilities to lower and maintain the reservoir water level at the normal minimum operating level of 2,327.3 feet msl. It would then use the entire capacity of the existing outlet control gate and achieve final drawdown when the reservoir water level is at or below the historic cofferdam level of 2,212 feet msl. KRRC would initiate the primary drawdown of Iron Gate Reservoir before commencing primary drawdown at the upstream facilities.

Several commenters and local water users, including Siskiyou County, expressed their opposition to the proposed action. These commenters point out that project deconstruction would remove reservoirs that provide water storage for power generation, drought mitigation, and wildfire protection. In addition, they state that removal of the Lower Klamath Project would increase the risk of downstream flooding.

Our Analysis

The proposed action would permanently drain the project reservoirs and have temporary and permanent effects on flows within and downstream of the hydroelectric reach in the Lower Klamath River. KRRC's December 2021 Reservoir Drawdown and Diversion Plan, which is consistent with the California Water Board's final WQC condition 3 and Oregon DEQ's final WQC condition 5, includes the proposed drawdown methods, procedures, schedules, and monitoring activities to reduce potential hazards related to reservoir drawdown (e.g., downstream flooding, water supply delivery interruptions, and embankment failures) in areas surrounding the project. During the drawdown phase, reservoir levels at each facility would continuously drop over the deconstruction period and only increase when inflow rates exceed the discharge capacity of each facility. Release flows would fluctuate throughout the drawdown period due to changes in reservoir inflow rate. Occasional periods of rapid increases in release flows would occur but would quickly attenuate downstream.

If KRRC expects excess flows (i.e., flood conditions) during drawdown, it would continue to use each facility's spillway as a fail-safe for overflow situations. However, if KRRC expects flood conditions, the proposed action would allow KRRC to retain flood flows using the newly available storage capacity resulting from reservoir drawdown. This would have a temporary, beneficial effect on downstream resources. If high flows occur after the removal of the spillway at each facility, KRRC would allow water to spill over the remaining portion of the dam. After completely lowering the reservoir levels at each facility, to maintain safety, KRRC would remove the dam embankment at a rate to prevent potential flood overtopping and embankment failure. Water year type (i.e., inflow conditions) and water surface elevations during removal operations would determine the height of embankment necessary to prevent dam overtopping. After each facility is breached, the 5 percent probable flood event would govern safety requirements.

Temporary flow control measures at the Klamath Irrigation Project, agreed between Reclamation and KRRC, could include lowering Upper Klamath Lake to provide storage to minimize discharge peaks into the hydroelectric reach while the reservoirs are being drawn down. This could help to avoid refill of the project reservoirs during high inflow events that may occur during drawdown, which would extend the duration of high SSCs downstream. The extent to which Reclamation could provide storage space in Upper Klamath Lake for this purpose may be limited by its contractual water supply obligations and the Upper Klamath Lake elevations and outflows outlined in the 2019 BiOp requirements. Reclamation could use additional water stored in the Clear Lake and Gerber Reservoirs to help meet contractual water supply deliveries, but these reservoirs have limited storage capacity.

For the Reservoir Drawdown and Diversion Plan, KRRC developed hydrologic simulations of the reservoir water surface levels for the full record of inflows available for the 2019 BiOp flow data. The 2019 BiOp flows reflect 36 years of river flows, from October 1980 through September 2016. Figures 3.2-3 through 3.2-6 present simulated daily water surface levels for each facility. Effects of these changes in reservoir water levels and river flows on specific resources may be beneficial or adverse and are addressed in following sections. Overall, with implementation of the measures included in the proposed action, the project would have short-term, less than significant effects on downstream flows, and significant, permanent, unavoidable effects on water levels in the existing project reservoirs.

3.2.3.2 Effects of Changes in Water Quantity on Downstream Flooding

Following the removal of the Lower Klamath Project facilities, KRRC expects flooding to occur in the Klamath River above the existing 100-year flood level between Iron Gate Dam (RM 193) and the confluence of Humbug Creek with the Klamath River (RM 174).

Several commenters expressed concern that removal of the dams would cause downstream flooding, and several asked whether KRRC could alternatively modify the dams to improve flood control. The Pacific Coast Federation of Fishermen's Associations noted that analysis presented in Interior and California DFG's 2012 EIR indicates that the reservoirs provide less than 7 percent attenuation of any 100-year flood event, and then only for a few hours' time (i.e., until their reservoirs are full). Conversely, Mr. Gerald Bacigalupi, a self-identified professional engineer, contends that the dams provide substantial (26.7 percent) flood protection and recommends a revised analysis based on historical USGS hydrographs.

Our Analysis

As previously described, during the deconstruction phase of the proposed action, the controlled release of water from each reservoir would occur in stages, and release flows would fluctuate throughout the drawdown period due to changes in reservoir inflow rates. While release flows would occur continuously over a period of four to five months, any periods of rapid increases in flow would only briefly (6 to 10 hours) increase flow conditions in the Klamath River downstream of each facility. Table 3.2-1 presents the estimated maximum drawdown release flow that could occur during the deconstruction phase and the modeled 10-year peak flow event for each facility.

Based on the values presented in table 3.2-1, the additional controlled release flow that would occur for drawing down the project reservoirs would likely result in short-term, less than significant flood risks downstream of the project. While the release rates that would occur during reservoir drawdown are sometimes greater than the flows under existing conditions, and in some months (e.g., months with typical low inflow conditions) above the historical monthly maximum flow (see table 3.2-3 in section 3.2.2.1, *Klamath River Basin Climate, Hydrology, and Flows*), they would be lower than the overall peak flows and within the range of historical flows recorded in each reach. In addition, KRRC's proposal to begin the drawdown of Iron Gate Reservoir at least two weeks before the primary drawdown of the other facilities would create additional storage in Iron Gate Reservoir to help attenuate outflows from J.C. Boyle, Copco No. 1, and Copco No. 2 Reservoirs. Attenuating flows using available storage in Iron Gate Reservoir would have a beneficial effect on downstream resources.

The potential for high runoff conditions in the Klamath River occurs each year from November through April, and the J.C. Boyle and Copco No. 2 facilities have negligible capacity for flood attenuation. Although PacifiCorp does not operate the Lower Klamath Project for flood control, Copco No. 1 and Iron Gate Reservoirs do exhibit minor flood control benefits because of the existing storage between the normal water surface elevation and the top of the spillway at each facility. Reclamation (2011a) estimates a 100-year peak discharge of 31,460 cfs at Iron Gate Dam and that the discharge of the 100-year peak flood immediately downstream of Iron Gate Dam would increase by up to 7 percent (33,800 cfs) following dam removal, and flood peaks would occur about 10 hours earlier.[56] In addition, Reclamation (2011a) estimates that flows during wet conditions would be higher (500 to 2,000 cfs) under the proposed action when compared to existing conditions during January and February and July through September. By analyzing historical USGS peak flow discharge values (see figure 3.2-7), we confirmed that 30,625 cfs is a reasonable estimate of the 100-year peak discharge. This analysis supports Reclamation's conclusion regarding the 100-year peak discharge at Iron Gate Dam and the attenuation potential of the project.

When combined with anticipated downstream streambed aggradation, extending approximately 8 miles downstream from the Iron Gate Dam site, the California Water Board (2020a) estimates peak discharge, based on Reclamation estimates, would result in flood elevations that are 1.65 feet higher on average from Iron Gate Dam (RM 193) to Bogus Creek (RM 192.6) and 1.51 feet higher on average from Bogus Creek to Willow Creek (RM 188). The effect of the proposed action on flood peak elevations would decrease with distance downstream of Iron Gate Dam, and Interior and California DFG (2012) and KRRC expect no significant effect on flood elevations downstream of Humbug Creek (RM 174) because long-term streambed aggradation would not extend this far downstream, and flow attenuation would occur in the mainstem channel. Prior to implementing the proposed action, KRRC would inform the National Weather Service River Forecast Center and the Federal Emergency Management Agency of the expected hydraulic change to the Klamath River and the potential effect of more flooding on the existing 100-year floodplain because the agencies do not currently publish a forecast for river stage at the Iron Gate streamflow gage.

In its June 2018 Definite Plan, KRRC identifies 34 habitable structures within the existing 100-year floodplain between Iron Gate Dam and Humbug Creek and two additional habitable structures within the altered (i.e., no dams) 100-year floodplain. Where feasible, KRRC would work with the owners of these 36 structures to move or elevate them above the altered 100-year floodplain. In the amended surrender application, KRRC indicates homeowners affected by increased flooding would be eligible to participate in a local impact mitigation fund developed to compensate affected parties. KRRC also indicates increased flood depths could affect three existing structures (two pedestrian bridges and one railroad bridge) on the Klamath River. KRRC notes both pedestrian bridges currently lie below the existing 100-year flood elevation. At the railroad bridge, KRRC notes the additional flood depth could increase the scour depth up

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[56] As noted above, Mr. Bacigalupi contends that the project attenuates floods by 26.7 percent based on the same computerized program, data, and time step suggested by Reclamation (2011a). Analysis presented in the comment letter uses a peak inflow of 37,250 cfs to compute flood attenuation, even though, using data from the California Division of Dam Safety Mr. Bacigalupi estimates a 100-year peak discharge of 30,600 cfs at Iron Gate Dam, which is similar to the peak discharge estimated by Reclamation (2011a). Overall, Mr. Bacigalupi does not provide sufficient information to support the inflow value used to calculate the flood attenuation potential of the project.

to 1.2 feet. Under the proposed action, KRRC would potentially remove, with the owner's permission, one of the pedestrian bridges because of its poor condition. At the second pedestrian bridge and the railroad bridge, KRRC proposes to perform additional flood flow analysis to confirm the effects of the proposed action on each structure. Depending on flood conditions, KRRC would replace the remaining pedestrian bridge if needed and mitigate scour effects on the railroad bridge. With implementation of these measures, we conclude that the proposed action would result in a long-term, but less than significant, adverse effect of increased risk of flood damage to infrastructure and habitable structures downstream of the project. This risk would diminish with distance downstream, however, and is not likely to extend farther downstream than Humbug Creek.

3.2.3.3 Effects of Changes in Water Quantity on Water Supply Diversions and Water Rights

Existing water rights, irrigation demands, and environmental flow requirements control water supply in the Klamath River Basin. Removing the Lower Klamath Project facilities would have a direct effect on water supply diversions and water rights in the project area. To protect regional water supply, KRRC proposes to implement the measures identified in its December 2021 Water Supply Management Plan.

KRRC indicates the proposed action could affect 22 active surface water diversions on the mainstem Klamath River downstream of the Lower Klamath Project and 2 active surface water diversions on Fall Creek. To address water supply and diversion concerns in California, KRRC developed the California Water Supply Management Plan.[57]

To protect California public drinking surface water supplies (specifically drinking water sourced from the Klamath River below Iron Gate Dam for the California Department of Transportation's Collier Rest Area and the City of Yreka's water supply diversion located on Fall Creek), KRRC would implement the measures outlined in its California Public Drinking Water Management Plan.[58]

In its August 19, 2021, comment letter, the City of Yreka indicated that KRRC must ensure that the proposed action does not, in any manner, presently or consequently in any future period, adversely affect the City of Yreka's right to divert and consumptively use water for municipal purposes under its water right permit with the California Water Board. With respect to water quantity, the City of Yreka specifically noted that its primary concern is the effect of the proposed action on PacifiCorp's pre-1914 water right to divert water from Spring Creek (16.5 cfs) and from Fall Creek

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[57] Subplan included within KRRC's December 2021 Water Supply Management Plan.

[58] Subplan included within KRRC's December 2021 Water Supply Management Plan.

upon which adequate water flow to the City of Yreka's water diversion is predicated. Siskiyou County provided similar comments, noting the proposed action should implement measures to mitigate all potential community water supply impairments.

Several commenters, including Congressman Doug LaMalfa and the Klamath Water Users Association, indicated the proposed action would have negative effects on other water users in the Klamath River Basin. Specifically, Congressman LaMalfa and the Klamath Water Users Association noted that the proposed action would eliminate the ability of the Lower Klamath Project reservoirs to provide supplemental water during extreme dry periods to the Klamath River downstream of Iron Gate Dam. During low water years, this "water borrowing" practice between PacifiCorp and Reclamation allows Reclamation to meet BiOp requirements and deliver water to the wildlife refuges and other Klamath Irrigation Project water users.

Our Analysis

Pursuant to applicable Oregon and California State water right regulations, PacifiCorp would convert its existing hydroelectric water rights in Oregon to instream water rights and abandon its hydroelectric water rights at the Copco No. 1, Copco No.2, and Iron Gate facilities. Hatchery operations would continue to require water supply for eight years following dam removal but would require changes in water diversions due to the removal of Iron Gate Reservoir and the closure of Iron Gate Hatchery. The California Water Board (2020a) notes that, under the proposed action, PacifiCorp and California DFW would divert up to 8.75 cfs of water from Bogus Creek to operate Iron Gate Hatchery at reduced production levels and up to 9.25 cfs from Fall Creek (downstream of the City of Yreka's intake) to reopen and operate Fall Creek Hatchery. The water diverted from Fall Creek would return to Fall Creek either at a proposed new settling pond location or at the fish ladder on the downstream side of the hatchery. The Fall Creek Hatchery diversion would operate under California DFW's existing appropriative water right for 10 cfs and riparian rights. Because the water diverted for hydropower and hatchery use is non-consumptive, the amount of water available for diversion downstream would not change under the proposed action, and the effect would be less than significant.

Although the proposed action could result in short-term, adverse effects on existing water right holders (e.g., changes to the amount of surface water flow available for diversion), these effects would be addressed by KRRC's proposal to provide the necessary replacement water and implement measures to reduce significant, adverse effects. Implementation of the measures included in the proposed action would allow any affected water right holder to divert water in the same manner (e.g., amounts, suitable quality, and timing) as before project deconstruction. Accordingly, any adverse effects on downstream water right holders' ability to divert water would be short term and less than significant.

Although the proposed action would result in short-term, adverse effects (e.g., periods of delivery outages) on the City of Yreka's existing water supply pipeline and raw infiltration gallery used by the California Department of Transportation's Collier Rest Area, KRRC's proposal to implement the measures outlined in its December 2021 California Public Drinking Water Supply Management Plan would ensure the Collier Rest Area and the City of Yreka maintain an adequate supply of water, and the water supply amount diverted from Fall Creek would not change. As a result, effects on water supply as a result of the proposed action would be less than significant.

As described in section 3.2.2.2, *Water Supply and Demand*, the existing storage within the Lower Klamath Project reservoirs is sometimes used to support Reclamation in meeting minimum instream flows downstream of Iron Gate Dam. The proposed action would permanently remove the storage available for this "water borrowing" agreement and could have a temporary, adverse effect on some Klamath Irrigation Project water users in certain water years. During extreme dry water years, the proposed action would potentially result in reduced supplemental deliveries of 10,000 to 20,000 acre-feet, based on historical borrowing amounts, to Klamath Irrigation Project water users and wildlife refuges in Oregon and California. However, based on reservoir evaporation estimates (11,000 acre-feet of water per year) and the expected evapotranspiration (4,800 acre-feet of water per year) that would occur in the same reaches, the proposed action could result in a net gain of up to 6,200 acre-feet of water per year for the Klamath River (California Water Board, 2020a).

3.2.3.4 Short- and Long-term Effects on Groundwater Supply Wells

Groundwater wells adjacent to the Lower Klamath Project facilities provide domestic and irrigation water supply to local residents. KRRC indicates the proposed action could require groundwater well improvements at wells within 1,000 feet of the project reservoirs. KRRC proposes to implement the measures (e.g., conduct public outreach, conduct monitoring, and provide well restoration to affected wells) outlined in its December 2021 California Water Supply Management Plan and December 2021 Oregon Groundwater Well Management Plan to mitigate any potential effects on groundwater wells in the vicinity of the project.

Several commenters, including Siskiyou County, expressed concerns regarding the proposed action's effect on residential groundwater supply wells. Siskiyou County noted that several communities including Hornbrook, Copco Village, and Beswick rely on groundwater. Siskiyou County stated that KRRC should demonstrate how adequate supply would still be available, given the storage and groundwater recharge that the reservoirs currently provide would be lost with dam removal.

Our Analysis

The location, underlying hydrogeologic conditions, and construction characteristics for a groundwater well influence the potential effect of reservoir removal on well water levels. The water-bearing units from which most of the existing domestic or irrigation wells pump have one of three relationships to the hydroelectric reach: (1) below the elevation of the original river channel; (2) exposed along reservoir walls; or (3) above the reservoir stage (California Water Board, 2020a). Reservoir removal would affect groundwater wells that pump from water-bearing units directly connected to the reservoirs and would not likely affect wells that tap water-bearing units located below the elevation of the original river channel and above the reservoir stage (California Water Board, 2020a; Interior and California DFG, 2012). The potential for effects on groundwater wells is further predicated on the relative elevation differences between the static water level in a well and the water surface elevation of the reservoir. Specifically, if the water-bearing unit being tapped by any given well is in hydraulic connection with a reservoir, then the static water level in the well should be similar or close to the water surface elevation in the reservoir. If the static water level is higher or lower than the reservoir level and the water-bearing unit is not exposed along the reservoir walls, then it is likely that the water-bearing unit is reflecting a regional or local aquifer system influence in addition to, or in place of, the reservoir (Interior and California DFG, 2012).

According to the Oregon WRD online groundwater well database (Find a Well Report) (Oregon WRD, 2021), approximately 54 groundwater wells are located within 2.5 miles of J.C. Boyle Reservoir. Of the 54 wells, 5 groundwater well reports include a specific location and are reported as active. Of the five wells, one active groundwater well, Sportsman’s Park, is located within 1,000 feet of J.C. Boyle Reservoir. Based on a review of existing well log data, KRRC indicates that the shallowness of J.C. Boyle Reservoir and the site topography and location of the well upgradient from J.C. Boyle Reservoir suggest that the groundwater well is not likely hydraulically connected. Analysis presented by Reclamation (2011a) and the California Water Board (2020a) supports this conclusion and suggests the water-bearing units for the wells in the vicinity of J.C. Boyle Reservoir exist deeper than the bottom elevation of the original river channel, and the static water levels in the wells are below the reservoir water surface elevation, suggesting groundwater is flowing downward toward the reservoir and that the water level in the reservoir does not have a significant lateral influence on groundwater levels in the area around J.C. Boyle Dam.

KRRC’s December 2021 Oregon Groundwater Well Management Plan includes (1) measures to reduce potential effects on groundwater wells surrounding J.C. Boyle Reservoir, (2) efforts to restore affected groundwater wells to existing conditions following completion of the proposed action, and (3) mitigation procedures to compensate well owners in case of potential groundwater well disruptions. With implementation of the measures included in the proposed action, the project would likely have a less than significant effect on groundwater wells near J.C. Boyle Reservoir.

At the California reservoirs, KRRC concludes that the proposed action would not affect any groundwater wells within 1,000 feet of Iron Gate or Copco No. 2 Reservoirs but could affect up to 70 wells within 1,000 feet of Copco No. 1 Reservoir. Analysis presented in Reclamation (2011a) and California Water Board (2020a) is consistent with

KRRC findings. In general, the groundwater well static water levels and the water-bearing unit in the vicinity of Iron Gate and Copco No. 2 Reservoirs are above the reservoir water surface elevation at each facility, indicating that the local groundwater gradient is towards the reservoir. In addition, well profiles presented in Reclamation (2011a) suggest that most private wells surrounding Iron Gate Reservoir are located on highlands overlooking the reservoir as opposed to near the shoreline. For wells near the shoreline, Reclamation (2011a) and California Water Board (2020a) indicate the proposed action could a cause a decrease of groundwater levels. At Copco No. 1 Reservoir, analysis presented in Reclamation (2011a) and California Water Board (2020a) indicates the water-bearing units and static water levels are below the reservoir water surface elevation but above the riverbed elevation, suggesting a more pronounced reservoir and groundwater well relationship. Similar to wells along the shoreline at Iron Gate Reservoir, California Water Board (2020a) indicates that groundwater wells immediately adjacent to Copco No. 1 Reservoir exhibit water levels below the reservoir stage, suggesting potential groundwater flow from the reservoir toward the well. However, Reclamation (2011a) and California Water Board (2020a) also indicate that the majority of wells within 1,000 feet of the reservoir appear to be responding to a regional or localized groundwater system that is higher than the reservoir level.

In 2018, KRRC conducted a public outreach effort to identify residents for voluntary participation in pre-drawdown groundwater monitoring. Property owners, within 1,000 feet of Copco No. 1 Reservoir who chose to participate in KRRC’s pre-drawdown groundwater monitoring program would be eligible to participate in the proposed local impact mitigation fund, a program that would provide financial resources to participating property owners if post-drawdown monitoring indicated that the proposed action adversely affected their groundwater. Although KRRC indicates groundwater well owner participation in 2018 was limited, KRRC is committed to conducting a second public outreach effort prior to reservoir drawdown. KRRC notes that any affected property owners who elect not to participate in the groundwater monitoring program may, instead, pursue other remedies available to such property owners under applicable state law.

Removal of the Lower Klamath Project reservoirs could cause a decrease of groundwater levels and a corresponding decrease in production rates in existing wells to a degree that interferes with existing or planned uses. However, if the proposed action does result in adverse groundwater well effects, in either California or Oregon, KRRC would provide temporary water supplies to each affected well user until long-term measures such as motor replacement, well deepening, or full well replacement were implemented. In addition, KRRC would return the production rate of any affected domestic or irrigation groundwater supply well to its condition prior to facility removal.

KRRC notes that 10 of the affected wells near Copco No. 1 Reservoir would require the installation of a new well, 10 wells would require deepening or similar work, and 50 wells would require new pump systems or similar work. KRRC would address the effects on these wells by implementing the measures outlined in its December 2021

California Water Supply Management Plan. Overall, implementation of KRRC's proposal would identify and provide sufficient monitoring to affected groundwater wells in the vicinity of the project. KRRC's proposal to coordinate with the California Water Board and Oregon DEQ and undertake short- and long-term measures to return the production rates of affected groundwater wells to conditions existing prior to the proposed action would mitigate potential effects on private well owners and make the effect of the proposed action less than significant. However, note that any landowner that does not choose to participate in KRRC's well monitoring program runs the risk of not being compensated for any loss in well production.

3.2.4 Effects of the Proposed Action with Staff Modifications

Staff modifications include the adoption of all WQC conditions. WQC conditions not covered by KRRC's current plan are described below. Under the proposed action with staff modifications, effects on groundwater levels, downstream flooding, or existing flows in the Klamath River would be the same as under KRRC's proposed action.

The California Water Board's final WQC condition 15 specifies that to determine the effects of the proposed action on surrounding groundwater wells, KRRC would monitor groundwater levels within a 2.5-mile range of the reservoirs' ordinary high water mark before, during, and after reservoir drawdown. To identify potentially affected groundwater wells, KRRC would contact all residents and landowners within 2.5 miles of the California reservoirs to inquire about their groundwater wells; at least two months prior to commencing drawdown activities, KRRC would monitor groundwater levels at a minimum of 10 locations within 2.5 miles of the California reservoirs. Under KRRC's proposal, only residents within 1,000 feet of Copco No. 1, Copco No. 2, and Iron Gate Reservoirs would be assessed for potential groundwater effects.

Expanding the area of potential effect, as the California Water Board specifies, would expand the number of potentially affected groundwater wells. However, analysis indicates that there would likely be no significant effect on groundwater well levels at wells within 1,000 feet of either Copco No. 2 or Iron Gate Reservoirs. At Copco No. 1 Reservoir, expanding the area of effect could potentially identify additional affected groundwater wells, but it is likely that the effect of the proposed action would further reduce with increased distance from the reservoir. Overall, the effects on groundwater wells would be the same as the proposed action and be less than significant.

3.2.5 Effects of the No-action Alternative

Under the no-action alternative, there would be no effects on existing groundwater levels, downstream flooding, or existing flows in the Klamath River. Expected climatic trends, previously described, would occur regardless.

Table 3.2-1. Location of USGS gages on the Klamath River and period of record (Source: USGS, 2021 a,b,c; California Water Board, 2018)

USGS Gage Station No.	Station Name	Drainage Area (mi^2)	Period of Record (Water Years)
11509500	Klamath River at Keno, OR	3,920	1905–2020
11510700	Klamath River below J.C. Boyle Power Plant near Keno, OR	4,080	1960–2020
11512500	Klamath River below Fall Creek near Copco, CA	4,370	1924–1961
11516530	Klamath River below Iron Gate Dam, CA	4,630	1961–2020
11520500	Klamath River near Seiad Valley, CA	6,940	1913–2020
11523000	Klamath River at Orleans, CA	8,475	1928–2020
11530500	Klamath River near Klamath, CA	12,100	1911–2020

Table 3.2-2. Surface area, inflow, depth and storage capacity of Upper Klamath Lake, Keno Reservoir, and the Lower Klamath Project reservoirs (Source: FERC, 2007)

Reservoir	Surface Area (acres)	Average Yearly Inflow (cfs)	Average Depth (feet)	Active Storage (acre-feet)	Total Storage (acre-feet)
Upper Klamath Lake	67,000	1,450	9	579,200	629,780
Keno	2,475	1,575	7.5	495	18,500
J.C. Boyle	420	1,575	8.3	1,724	3,495
Copco No. 1	1,000	1,585	47	6,235	33,724
Copco No. 2	40	1,585	-	0	73
Iron Gate	944	1,733	62	3,790	58,794

Table 3.2-3. Monthly discharge metrics (cfs) for the Klamath River in the Lower Klamath Project area, 1963–2020 (Source: USGS, 2021a,b,c)

	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**
Klamath River at Keno, OR, USGS Gage No. 11509500. Drainage area 3,290 sq. miles, excluding Lost River												
Mean	1,120	1,400	1,700	1,910	2,010	2,490	2,200	1,540	856	506	654	859
Median	1,040	1,050	1,390	1,370	1,450	2,050	1,930	1,480	790	506	709	840
Max	4,210	5,210	8,160	9,310	9,250	9,780	8,380	6,640	6,640	2,750	1,590	2,240
Min	253	292	215	248	186	200	203	201	147	131	145	145
10 Percent Exceed (Wet)	1,960	2,640	3.430	4,300	4,760	6,010	4,690	3,322	1,659	780	870	1,310
90 Percent Exceed (Dry)	590	620	600	580	450	520	600	450	280	250	330	475
Klamath River below J.C. Boyle Powerhouse, USGS Gage No. 11510700. Drainage area 4,080 sq. miles, excluding Lost River												
Mean	1,350	1,610	1,910	2,130	2,240	2,730	2,460	1,820	1,110	748	893	1,100
Median	1,230	1,240	1,500	1,450	1,480	2,250	1,900	1,510	876	679	940	1,060
Max	4,170	5,100	7,560	9,860	10,200	10,800	8,660	6,790	6,740	3,070	1,660	2,290
Min	320	346	342	318	316	313	306	317	321	309	302	309
10 Percent Exceed (Wet)	2,190	2,810	3,530	3,970	4,500	6,080	4,860	3,590	1,920	1,050	1,140	1,560
90 Percent Exceed (Dry)	810	840	815	800	670	760	860	700	520	410	560	700
Klamath River below Iron Gate Dam, CA, USGS Gage No. 11516530. Drainage area 4,630 sq. miles, excluding Lost River												
Mean	1,470	1,790	2,250	2,560	2,710	3,260	2,910	2,130	1,250	846	975	1,210
Median	1,340	1,360	1,720	1,820	1,800	2,780	2,120	1,810	1,030	743	1,020	1,310
Max	4,510	5,830	25,000	18,500	16,100	16,200	12,500	6,950	7,710	3,570	1,910	2,500
Min	847	848	865	612	508	495	508	484	402	406	389	418
10 Percent Exceed (Wet)	1,900	3,120	4,240	5,050	5,450	7,050	5,690	4,210	2,090	1,060	1,070	1,590
90 Percent Exceed (Dry)	950	940	960	1,020	930	1,000	1,290	1,010	720	690	720	890

Table 3.2-4. Peak flood discharges (cfs) for 10-, 25-, 50-, and 100-year flood events for the Klamath River at Keno Dam, in the hydroelectric reach, and below Iron Gate Dam (Source: Reclamation, 2012)

USGS Gaging Station	Peak Flood Discharge (cfs)			
	10-Year	**25-Year**	**50-Year**	**100-Year**
Klamath River at Keno, OR	9,729	11,071	12,010	12,907
Klamath River below J.C. Boyle Power Plant near Keno, OR	10,362	12,063	13,301	14,518
Klamath River below Fall Creek near Copco, CA	11,910	13,543	14,702	15,821
Klamath River below Iron Gate Dam, CA	14,854	20,867	25,985	31,648

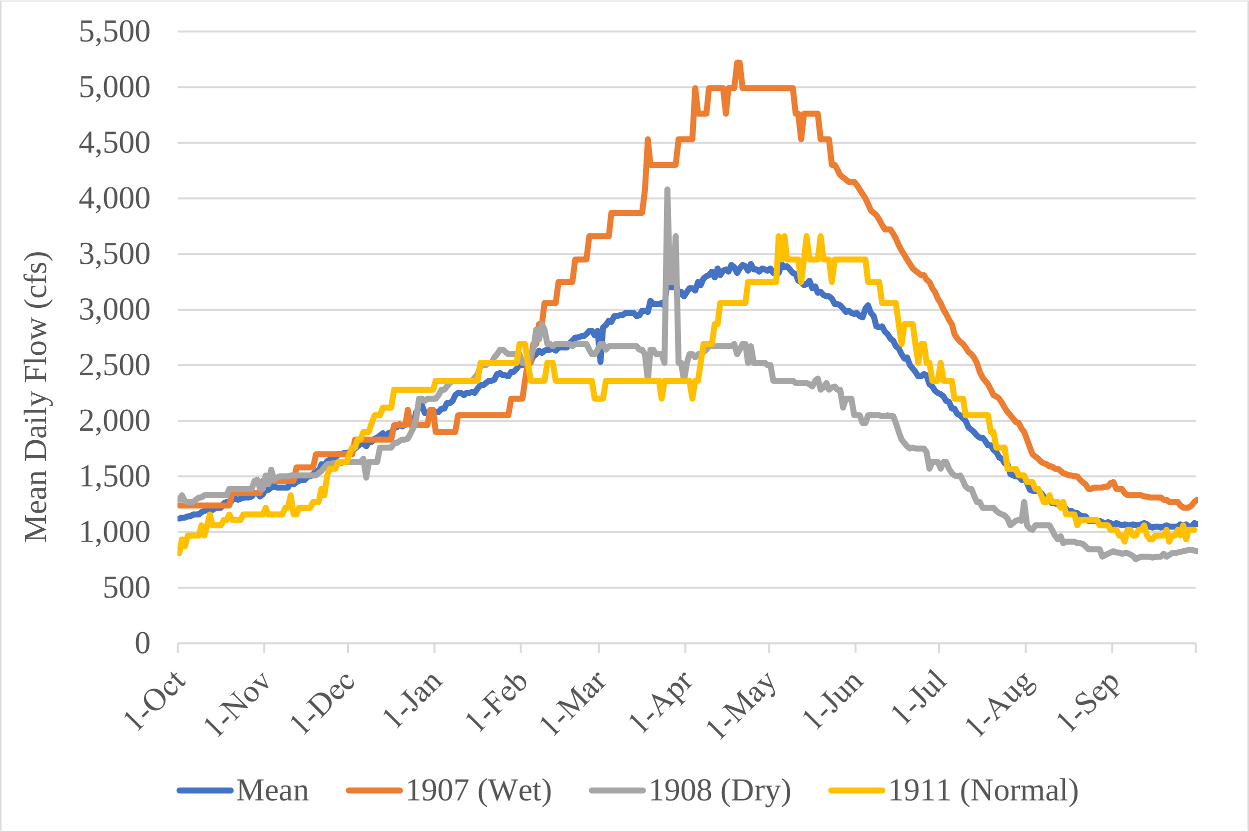

Figure 3.2-1. Average daily flows (cfs) in the Klamath River at USGS gage 11509500 near Keno, Oregon, water years 1905–1912 (Source: USGS, 2021a)

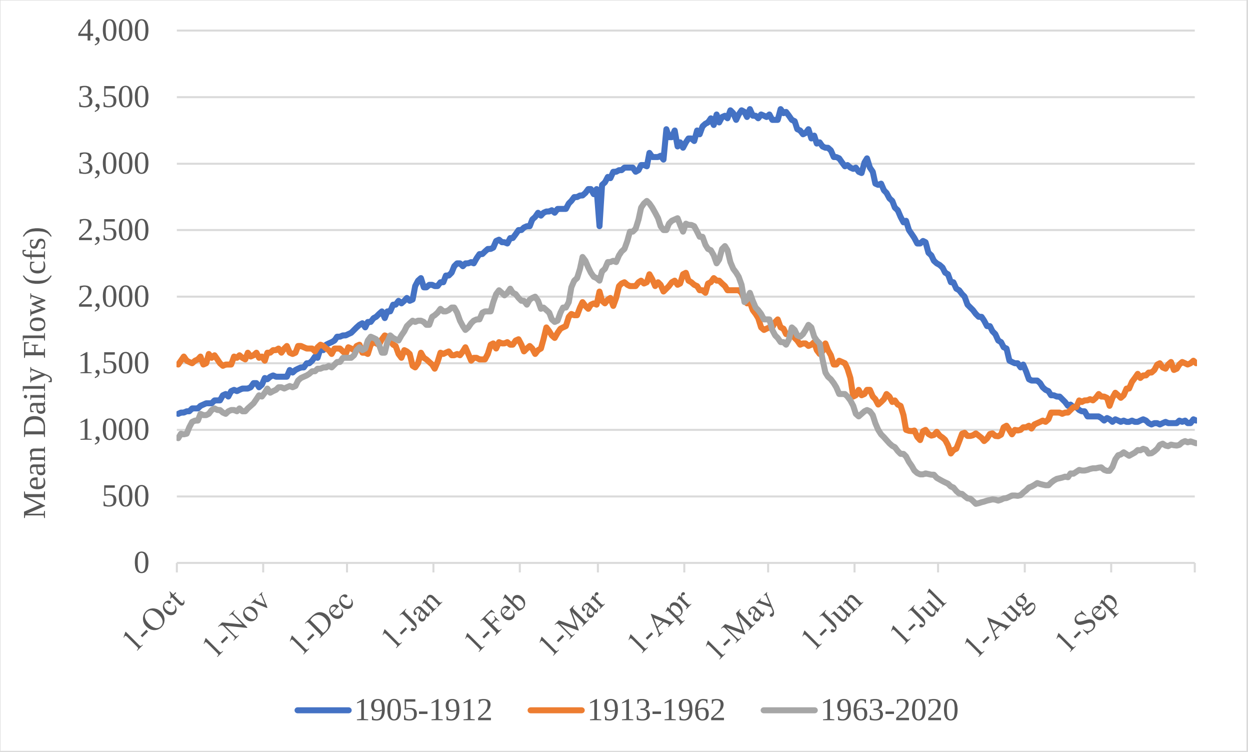

Figure 3.2-2. Average daily flows (cfs) for the Klamath River at USGS gage 11509500 near Keno, Oregon during periods before (1905–1912), during (1913–1962), and after development (post 1963) of the Klamath Irrigation Project (Source: USGS, 2021a)

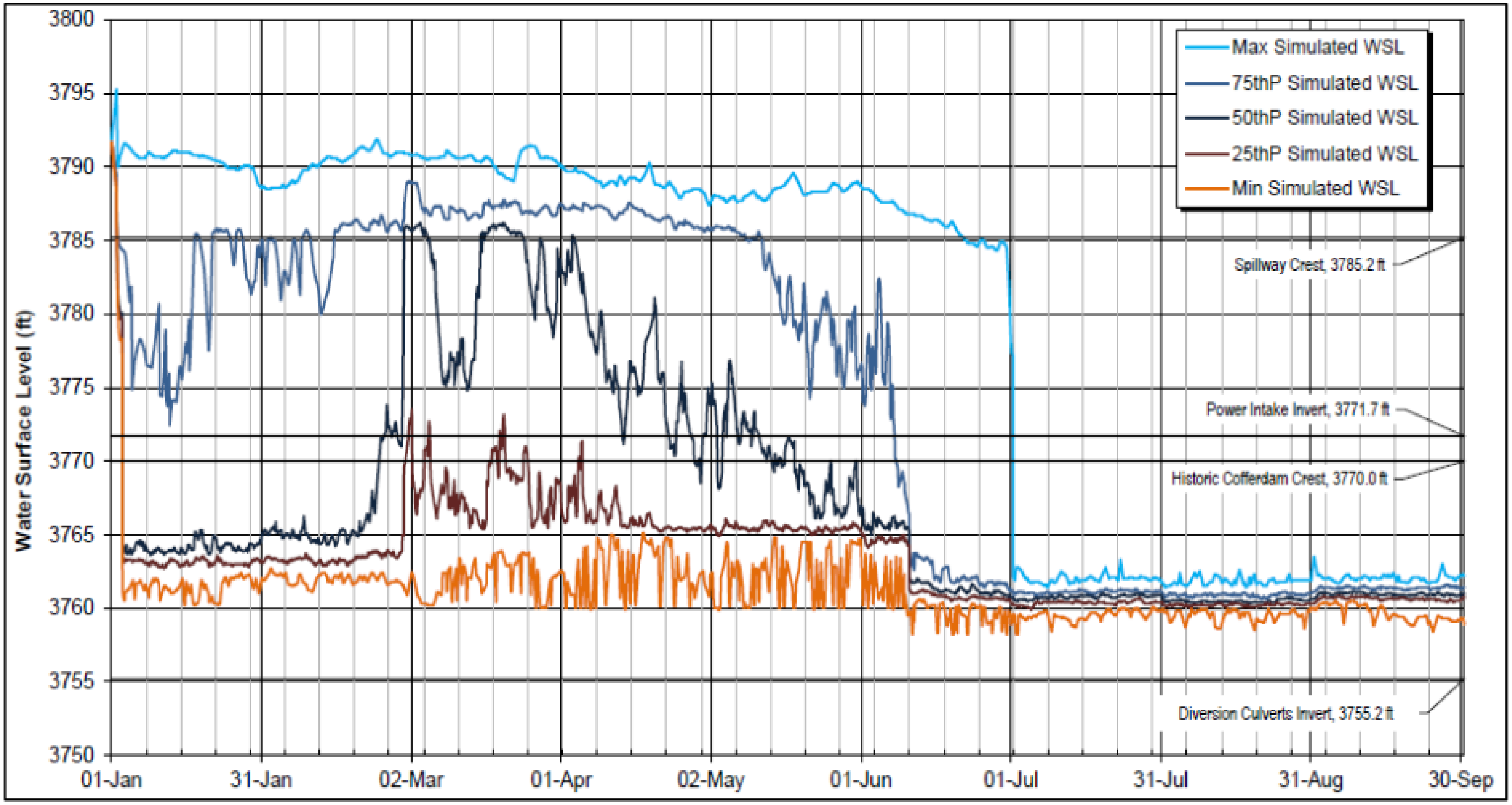

Figure 3.2-3. Simulated minimum, median, and maximum daily water surface level drawdown in J.C. Boyle Reservoir (Source: KRRC, 2021e)

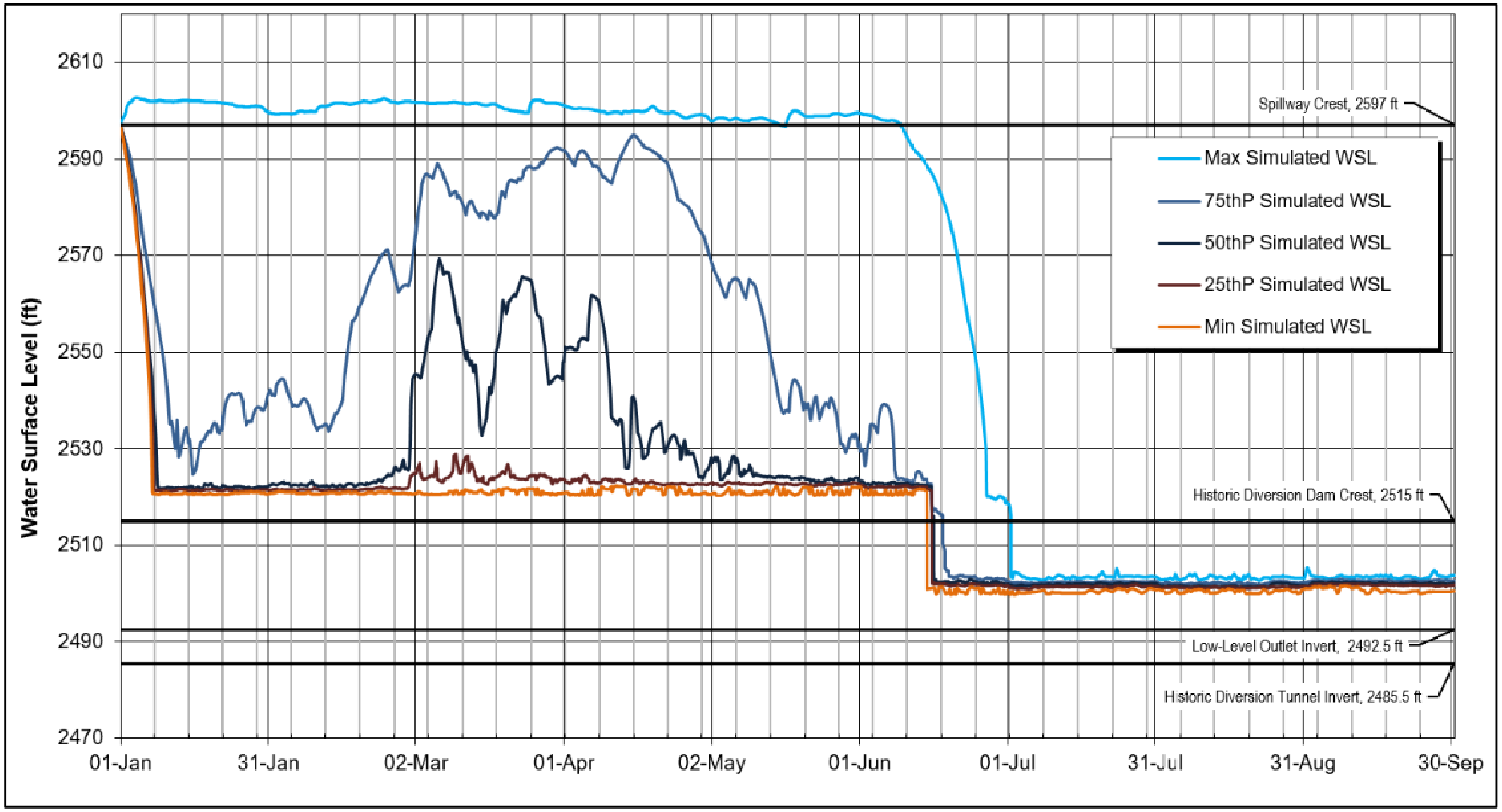

Figure 3.2-4. Simulated minimum, median, and maximum daily water surface level drawdown in Copco No. 1 Reservoir (Source: KRRC, 2021e)

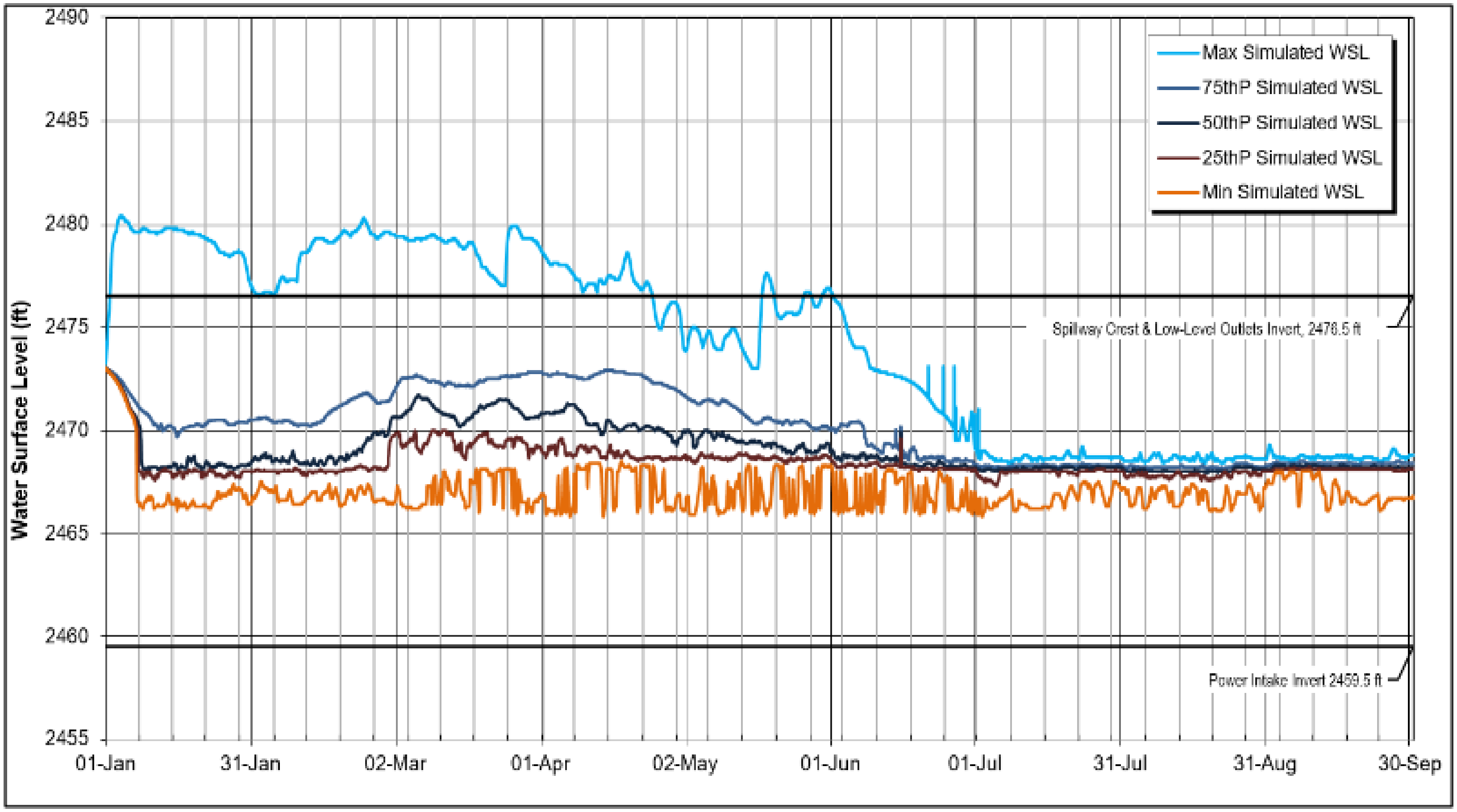

Figure 3.2-5. Simulated minimum, median, and maximum daily water surface level drawdown in Copco No. 2 Reservoir (Source: KRRC, 2021e)

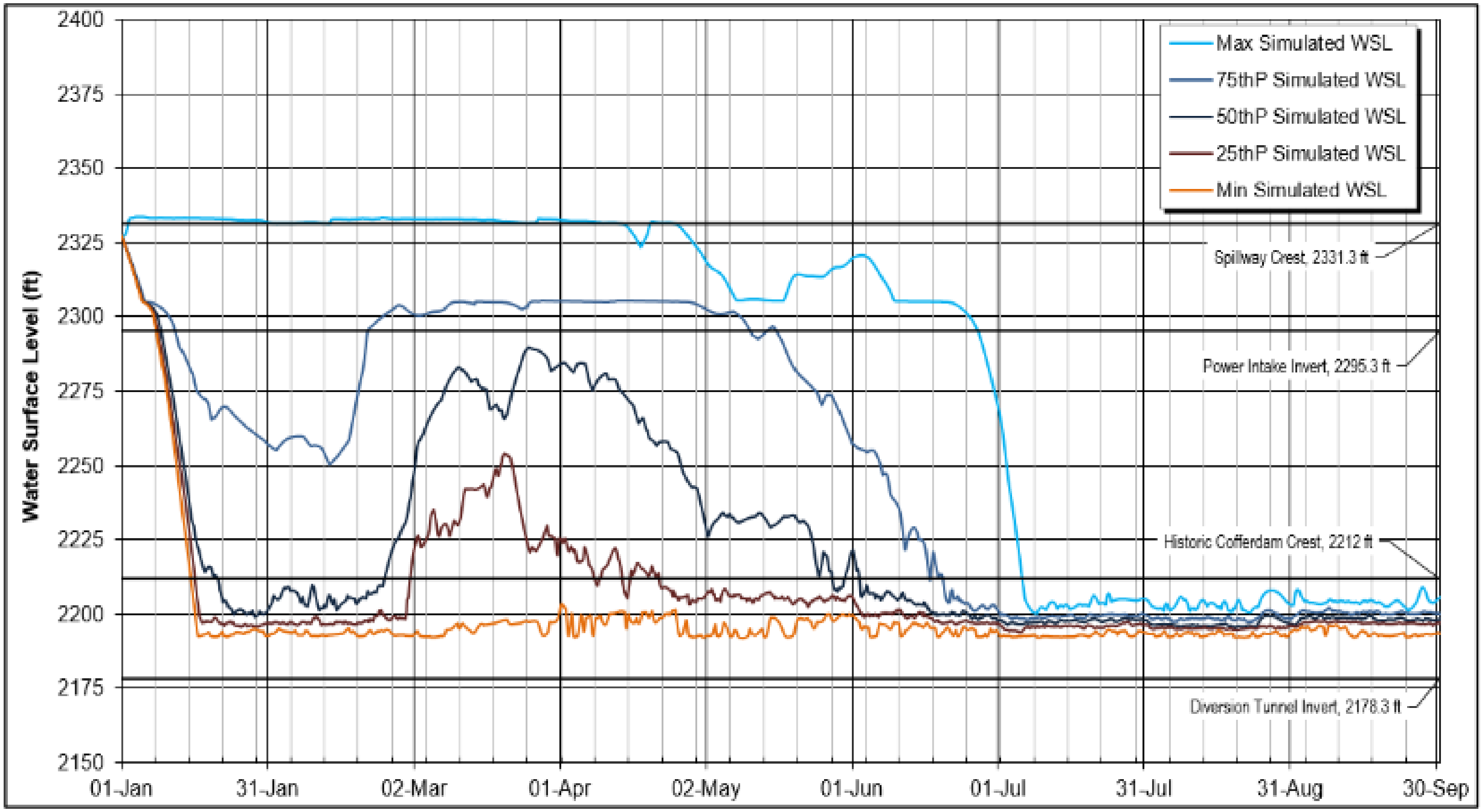

Figure 3.2-6. Simulated minimum, median, and maximum daily water surface level drawdown in Iron Gate Reservoir (Source: KRRC, 2021e)

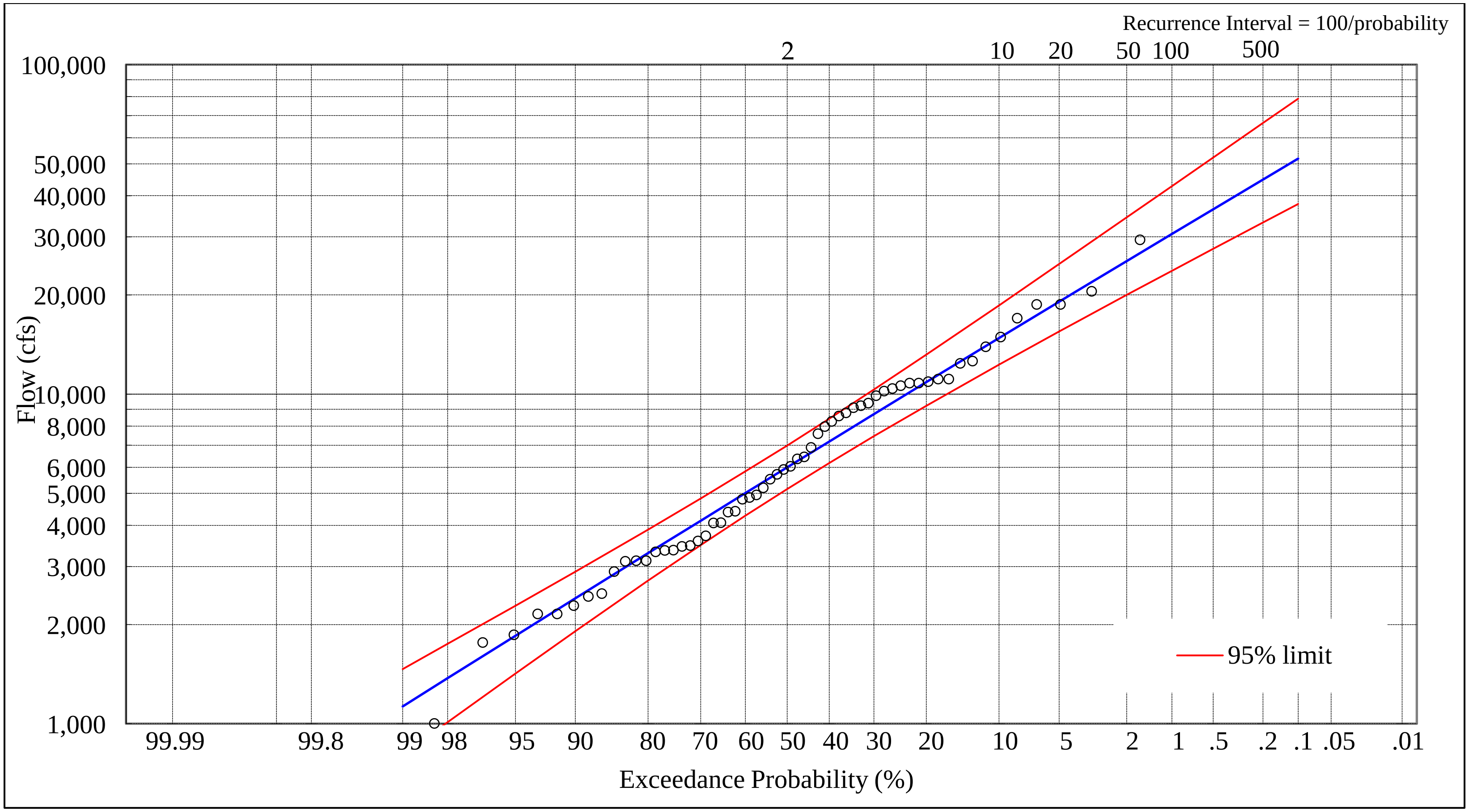

Figure 3.2-7. Flood frequency curve (peak annual flood ± 95% confidence limits) for USGS gage 11516530 Klamath River below Iron Gate Dam, 1960–2020 (Source: USGS, 2021c)

3.3 WATER QUALITY

3.3.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for water quality includes the Klamath River extending from below Keno Dam to the Pacific Ocean. The temporal extent of our effects analysis ranges from the short-term effects of drawdown and dam removal, including high SSCs that are expected to persist for several months after drawdown, to permanent improvements in water quality including a more natural temperature regime, increased dissolved oxygen (DO) concentrations, and a reduction in the incidence of blue-green algae (cyanobacteria) blooms and associated high levels of *Microcystis* and microcystin, which would benefit aquatic biota and reduce potential adverse effects on humans and terrestrial wildlife that use the Klamath River.

3.3.2 Affected Environment

3.3.2.1 Water Quality Standards and Impairments

The CWA regulates the quality of waters of the United States, including the Klamath River, by setting and applying water quality standards. EPA is the federal agency that manages CWA implementation, which includes determination for whether a Native American Tribe should be treated like a state under the act. The water quality standards consist of designated uses, water quality criteria, antidegradation requirements, and general policies affecting the application and implementation of the water quality standards (EPA, 2014). Individual states and Native American Tribes with authority to be treated like a state (table 3.3-1) develop water quality standards and submit them to EPA for approval; once approved by EPA, the standards are applicable to federal actions, including the proposed action evaluated in this EIS. The CWA requires that each state report on the health of its waters (known as a section 305(b) report), including the section 303(d) lists of impaired waters, every two years and develop TMDLs for 303(d) listed impairments.[59] Tribes that have treatment as a state status have essentially the same rights and responsibilities under the CWA as states.

Table 3.3-2 presents the designated beneficial uses set in the water quality standards for the Klamath River and marine waters near the mouth of the river. State and Tribal water quality objectives/criteria for selected constituents are provided in tables 3.3-3, 3.3-4, and 3.3-5. Since the Hoopa Valley Tribe is the only entity with criteria for harmful algal blooms, its criteria are provided with guideline values from various other entities in section 3.3.2.6, *Phytoplankton and Microcystin*. Table 3.3-6 provides a

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[59] TMDLs must allocate the total pollutant load among contributing point sources (i.e., waste load allocations) and nonpoint sources (i.e., load allocations).

summary of the most recent section 305(b) integrated reports and status of total maximum daily loads (TMDLs)[60] to address them.

The following description of existing water quality is primarily based on information provided in the *Lower Klamath Project Biological Assessment* (BA) (KRRC, 2021f), previous environmental impact documents and reports (FERC, 2007; Oregon DEQ, 2018b; Interior and California DFG, 2012; California Water Board, 2020a), water quality data collected under the KHSA interim measure 15[61] (Watercourse Engineering, Inc., 2017a-f, 2018a, 2019a,b, 2020a,b, 2021a,b), and continuous *in situ* monitoring below Iron Gate Dam (PacifiCorp, 2012, 2013, 2014, 2015, 2016a, 2017c, 2018, 2019a, 2020a, 2021a). The KHSA water quality monitoring sites are described in table 3.3-7.

3.3.2.2 Suspended Sediments

For this EIS, suspended sediment refers to settleable suspended material in the water column. Coarse materials (e.g., sand, gravel, and larger substrates) are considered bedload and discussed in section 3.1.2.5, *Sediment Yield and Delivery*. Suspended sediment consists of organic and inorganic materials, and the sources for each type of suspended material differ and vary spatially and temporally.

Suspended sediments supplied to Upper Klamath Lake via its tributaries are generally from mineral (inorganic) materials, with peak values associated with winter and spring high flows. In contrast, outflows from Upper Klamath Lake to the Link River have primarily algal-derived (organic) material during the summer and fall. These algal-derived suspended materials decrease with distance downstream, as algae settle out of the water column in Keno Reservoir (Sullivan et al., 2011).

Suspended sediments in the reach from J.C. Boyle Reservoir to Iron Gate Dam are primarily algal-derived in the summer and fall and mineral-derived during high-flow events in the winter. SSCs generally decrease through this reach, although summertime algal blooms in Copco No. 1 and Iron Gate Reservoirs sometimes increase them. Inflow from the springs in the J.C. Boyle bypassed reach dilutes the suspended sediments in this reach.

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[60] A TMDL characterizes pollutant sources and allocates load reductions (point sources receive a wasteload allocation and/or nonpoint sources receive a load allocation) necessary to meet the water quality standards.

[61] KHSA interim measure 15 states that PacifiCorp shall fund long-term baseline water quality monitoring to support dam removal, nutrient removal, and permitting studies, and will fund blue-green algae and blue-green algae toxin monitoring as necessary to protect public health. Each year, the monitoring plan is developed in consultation with PacifiCorp, NCRWQCB, Oregon DEQ, Karuk Tribe, Yurok Tribe, Reclamation, and EPA.

KRRC (2021f) reports that Iron Gate Reservoir traps most suspended sediment. However, releases of in-reservoir algal blooms sometimes occur. Winter/spring high flows can cause riverbed scour and resuspension of materials previously deposited and thereby increase SSCs between Iron Gate Dam and Seiad Valley. SSCs tend to decrease with distance downstream as suspended materials gradually settle out of the water column farther downstream or are diluted by tributary inputs.

Downstream of Iron Gate Dam, suspended sediments are primarily mineral-derived, and major tributaries to the Klamath River contribute large amounts of mineral suspended sediments in winter and spring. KRRC (2021f) states that the Klamath River SSCs between Iron Gate Dam and the estuary generally range from less than 5 milligrams per liter (mg/l) during summer low flows to greater than 500 mg/l during winter high flows. During large winter storms or following landslides in the Klamath River Basin, extremely high SSCs have been observed in the Klamath River and its tributaries. Klamath River SSCs generally increase in a downstream direction from the contribution of tributaries. The three tributaries that contribute the largest amount of sediment to the Klamath River are the Scott, Salmon, and Trinity Rivers. Suspended sediment loads are substantially affected by factors other than the project, including timber harvest, road construction, and wildfires.

Table 3.3-8 summarizes total SSCs and organic (volatile) SSCs sampled in the Klamath River and its primary tributaries in 2011 to 2020. This table also summarizes turbidity reported in nephelometric turbidity units. These data also show high organic SSCs in releases from Upper Klamath Lake (Site ID KR25444) and near the surface of Keno Reservoir (Site ID KR24600) and Copco Reservoir (Site ID KR19874) and high total SSC and turbidity in the Trinity River (Site ID TR00000). Continuous measurements of turbidity just below Iron Gate Dam, in formazin nephelometric units,[62] were generally low but with high instantaneous (hourly) peaks of 15 to 37 units in late September to mid-November in 2019 and 2020.[63]

3.3.2.3 Inorganic and Organic Contaminants

Contaminants from many sources, including naturally occurring sources, land use, and wildfires, can adversely affect water quality. Depending on the contaminant and

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[62] The continuous turbidity values are not directly comparable to values in table 3.3-6, because they are determined by the intensity of scattered light for different wavelengths of light. Nephelometric turbidity units are based on white light in the 400 to 680 nanometer range, whereas formazin nephelometric units are based on infrared light in the 780 to 900 nanometer range (Instrument Choice, 2020).

[63] We omitted the continuous turbidity values for 2018 from our analysis, because their much higher level (27–41 in 2018 compared to 0.6–16 in 2019 and 0.0–37 in 2020) and very little hourly variation compared to 2019 and 2020 strongly suggest they are not representative.

other conditions, the contaminants can be flushed through the system or retained in sediments, particularly organic materials that settle to the bottom of reservoirs. These contaminants can subsequently re-enter the water column through resuspension, release from the sediments, or both, especially during low to zero DO (anoxic) conditions near the bottom of reservoirs. Fish and other aquatic organisms can also consume contaminants that are in their food sources, and contaminant concentrations can bioaccumulate in the food chain.

The following evaluation of existing contaminant conditions in the project's reservoirs is based on studies conducted to inform decisions on removal of the project's dams and EPA's evaluation of the suitability determinations based on this information. EPA Region 9 was directly involved in development of a 2009–2010 sampling and testing plan and in the screening-level evaluation of contaminants in the project's reservoirs, which was based on the sediment evaluation framework (SEF) process (RSET, 2009) to inform the Secretarial Decision on removal of the project's dams (CDM, 2011). KRRC subsequently conducted an evaluation (AECOM and River Design Group, 2020) with an assessment that used the updated SEF (RSET, 2018). KRRC addressed EPA's requests for an evaluation of the extent and pattern of new sediment deposition in the reservoirs in the 10 years since sediment testing and whether any spills or land use changes occurred that could have substantially changed potential contaminants contained in newly deposited sediments.

The evaluation of potential contaminants, which was conducted using information from several regulatory agency databases,[64] indicates the absence of significant spills and the lack of changes in major land use or developments within the vicinity of the reservoirs since sediment collection in 2010. On August 25, 2020, EPA (2020b) indicated that the existing information remains representative of the sediments in the project's reservoirs that may be released when the dams are removed, and that additional sediment testing is not necessary to support the permitting process. Following review of a subsequent reevaluation of sediment accumulation in the project's reservoirs (CAMAS, 2021), EPA (2021a) reconfirmed its earlier determinations that the extensive physical, chemical, and biological evaluations conducted in 2009–2010 remain valid. Extensive evaluation of reservoir sediments shows that these are relatively homogeneous, have generally low concentrations of contaminants, and are not acutely toxic (CDM, 2011; AECOM and River Design Group, 2020; EPA, 2021a). Thus, accumulated sediments in reservoirs behind the four project dams would likely have no effects on the health of humans or fish and wildlife when released during dam removal.

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[64] These databases include the NPDES, Comprehensive Environmental Response, Compensation and Liability Act, Oregon DEQ, California Environmental Protection Agency, leaking underground storage tanks and brownfields (AECOM and River Design Group, 2020).

Past (CDM, 2011) and most recent (AECOM and River Design Group, 2020) evaluations of potential contaminants used the SEF with data collected from J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs between 2006 and 2010. The SEF uses a tiered process developed by regional state and federal agencies for the Pacific Northwest (RSET, 2018) to evaluate potential contaminant effects by comparing sediment chemistry results to relevant contaminant screening levels. As shown in figure 3.3-1, this evaluation includes two levels, with two parts to Level 2 (i.e., 2A and 2B). A Level 1 analysis of sediment data collected in 2006 from J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs (Shannon and Wilson, Inc., 2006; Dillon, 2008) did not indicate a risk of sediment toxicity but led to additional sediment sampling and analysis. The CDM (2011) study included a Level 2 analysis and special evaluations for bioaccumulation and associated potential human health concerns from consuming contaminated fish using regionally derived maximum levels and screening levels from the SEF.[65] In addition to the SEF process, secondary regional and national chemical screening values were used to evaluate the potential for adverse levels of contaminants. In cases where no relevant screening level existed or relevant screening values were exceeded, biological tests were conducted.

Level 2A included 75 sediment cores collected by Reclamation from the project reservoirs (26 cores in J.C. Boyle, 25 cores in Copco No. 1, and 24 cores in Iron Gate) and 2 sediment cores in the Klamath River estuary.[66] Analyses were conducted for 501 constituents, including metals, polycyclic aromatic hydrocarbons, polychlorinated biphenyls (PCBs), pesticides/herbicides, phthalates, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), dioxins, furans, and polybrominated diphenyl ethers (i.e., flame retardants) (CDM, 2011). Level 2B bioassay, bioaccumulation, and elutriate[67] tests were conducted on reservoir sediments where no relevant screening level existed or where relevant screening values were exceeded from Level 2A assessments.

Special evaluations included comparing sediment chemistry values to risk-based screening levels of residents potentially exposed to sediments, analyzing resident fish collected from the reservoirs for bioaccumulative chemicals of concern and results, and comparing to fish tissue advisory levels protective of human health.

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[65] Levels, in both cases, signify chemical concentrations. Maximum levels represent potentially significant, adverse effects, and screening levels represent no adverse effects.

[66] Details on specific coring locations, core depths, and other details are available in section 3.2.2.8, Inorganic and Organic Contaminants of the California Water Board EIR (2020a).

[67] Elutriate chemicals are chemicals that are suspended and separated from the riverbed.

The CDM (2011) process identified the chemicals of potential concern (COPC) listed with the rationale for these decisions for project reservoirs (tables 3.3-9 through 3.3-11) and in for the Klamath estuary (table 3.3-12). CDM (2011) concludes that:

- Sediment in the project reservoirs and the estuary do not have significant levels of contaminants compared to screening levels within the SEF and human health criteria and relatively few chemicals identified as COPCs (CDM, 2011; AECOM and River Design Group, 2020; EPA, 2021a).
- No consistent spatial pattern of elevated chemical composition is evident across discrete sampling locations within a reservoir (CDM, 2011; AECOM and River Design Group, 2020).
- Sediments in J.C. Boyle Reservoir have marginally higher chemical concentrations and more detected COPCs than the other two reservoirs and the estuary (CDM, 2011).
- All metals identified by CDM (2011) as COPCs in sediment of the project reservoirs, estuary or both had concentrations similar to local background, were lower than 2018 screening levels, or could not be detected with methods employed.

To evaluate the overall effects of dioxin-like compounds, including dioxins, furans, and PCB congeners, CDM (2011) estimated the total toxic equivalency (TEQs)[68] for fish, birds, and mammals (including humans) based on the sum of measured or estimated concentrations of each compound multiplied by the compound-specific toxic equivalency factor and then compared these values to the Oregon DEQ bioaccumulation screening-level values (SLVs) for 2,3,7,8-TCDD. Based on this analysis, CDM (2011) concludes that:

- While J.C. Boyle does have marginally higher chemical concentrations and more detected COPCs in sediment than the other project reservoirs and the estuary, this is not necessarily the case with dioxins, furans, and PCBs.
- TEQs with the dioxins, furans, and PCBs range from approximately 4 to 9 parts per thousand (ppt) for J.C. Boyle; 6 to 10 ppt for Copco No. 1, and 2 to 4 ppt for Iron Gate; and were all below 0.2 ppt for the Klamath estuary.
- In some cases, values for dioxins, furans, and PCBs are slightly higher than background values reported by EPA for Region 9 (i.e., 2 to 5 ppt), Region 10 (i.e., 4 ppt), and for non-impacted lakes of the United States (i.e., 5.3 ppt) (EPA, 2010).

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[68] The resulting TEQs are based on concentrations of the most highly toxic form, 2,3,7,8-TCDD.

- TEQ values indicate the dioxins, furans, and PCBs present in the reservoir sediments have limited potential for adverse effects for either ecological or human receptors exposed to sediment.

Water quality information reported by the California Water Board (2020a) concludes that:

- Water quality data collected under the California Surface Water Ambient Monitoring Program at eight monitoring locations between the Oregon-California Stateline and Turwar for the period 2001−2005 meet the water quality objectives for the majority of inorganic contaminants tested.[69] Aluminum concentrations meet the 1,000-micrograms per liter (µg/l) California primary drinking water standards, but are slightly elevated compared to EPA freshwater aquatic life standards (87 µg/l) and EPA and California secondary drinking water standards (50 µg/l). Analyses reveal no detectable concentrations for 50 PCB congeners and only occasional detections of pesticides (NCRB, 2008).
- Based on water quality studies conducted at four USGS gage stations with increasing distance downstream of Iron Gate Dam in 2002 and 2003, concentrations of trace elements (except for calcium, nickel, and magnesium) generally decrease from upstream to downstream, likely because these trace metals adhere to particles and settle out of the water column (Flint et al., 2005). However, we note that an evaluation of trace metals at 15 locations in the Klamath River from just below Copco No. 2 Dam to about RM 6 (Norgaard et al., 2013) determined that although neither state- nor federally mandated metal consumption intake levels for humans were exceeded, the concentration of some metals increased in a downstream direction from likely point sources (e.g., Celtor Chemical Works,[70] a formerly EPA-listed Superfund site located on the Hoopa Indian Reservation just above the confluence of the Klamath and Trinity Rivers, and EPA-listed Superfund site Grey Eagle Mine,[71] which drains into Indian Creek).

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[69] Including arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

[70] Celtor Chemical Works was an ore processing plant (for copper, zinc, and precious metals) from 1958 to 1962 (EPA, 1985) and was removed from the EPA National Priorities List in 2003 (EPA, 2021b).

[71] Grey Eagle Mine was a copper mine located on the banks of Indian Creek about 5.5 miles north of Happy Camp that operated last in World War II before becoming a lumber mill that was operated into the 1980s (EPA, 1988).

- Analysis of fish tissue samples from sport fish indicates that fish in Iron Gate and Copco No. 1 Reservoirs have methylmercury concentrations above the 300-nanogram/gram wet weight EPA criterion for noncommercial freshwater fish consumption.[72] Selenium and PCB concentrations are lower than the Office of Environmental Health and Hazard Assessment thresholds (Davis et al., 2010, as cited in California Water Board, 2020a). Mercury concentrations in perch collected from Iron Gate Reservoir and bullhead from J.C. Boyle, Copco No. 1 and Iron Gate Reservoirs exceed toxicity reference values (CDM, 2011). Copco No. 1 and Iron Gate Reservoirs are on the 303(d) list of impaired waterbodies for mercury, due to elevated concentrations in fish tissue; however, a TMDL has not been completed.

3.3.2.4 Water Temperature

Water temperatures in the Klamath River Basin vary seasonally and by location. Except for J.C. Boyle Reservoir, the Klamath River is listed as impaired for temperature from Keno Dam to the river's mouth (see table 3.3-6). As a result, temperature TMDLs were developed to address these impairments within Oregon (Oregon DEQ, 2019a) and California (NCRWQCB, 2010). The Oregon DEQ TMDL allocates 0.0 degrees Celsius (°C) warming from J.C. Boyle Reservoir. The NCRWQCB TMDL allocates an allowable increase in daily average and daily maximum late summer/fall water temperatures of 0.5°C for Copco No. 1 and Copco No. 2 Reservoir tailraces and 0.1°C for the Iron Gate Reservoir tailrace. This TMDL also specifies that a portion of Copco No. 1 and Iron Gate Reservoirs must provide suitable water temperature and DO conditions for cold-water fish during the critical summer period. In addition, properly functioning thermal refugia[73] are necessary to meet the Basin Plan water temperature objectives.

J.C. Boyle Reservoir, which is shallow and has short hydraulic retention times, does not exhibit long-term thermal stratification in the summer as documented by the typical difference between surface and bottom water temperatures of less than 2°C (FERC, 2007). Temperature in the bypassed reach is determined by the ratio of water released from J.C. Boyle Dam and about 250 to 300 cfs cool groundwater spring inflow to the reach. The associated cool-water input from the bypassed reach during the summer, combined with the fluctuation in discharge from the J.C. Boyle Powerhouse

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[72] EPA recommends methylmercury concentrations in fish to be no more than 300 nanogram/gram wet weight for the most vulnerable population—women in child-bearing years (18 to 45 years) and children 1 to 17 years old.

[73] Juvenile Chinook salmon can feed and grow at continuous temperatures up to 24°C when food is abundant and other conditions are not stressful (Myrick and Cech, 2001). National Oceanic and Atmospheric Administration describes thermal refugia as ≥2° C cooler than surrounding waters (NOAA, 2021).

during normal operations, results in an increase in the daily range of water temperatures in the peaking reach, which is located between the J.C. Boyle Powerhouse and Copco No. 1 Reservoir. The range of daily water temperature variation below the powerhouse is greatly reduced, relative to unaffected sites, under conditions of constant daily discharge (FERC, 2007). Natural hot springs that contribute flow to the peaking reach near the confluence with Shovel Creek were not found to result in consistent substantial warming of the Klamath River based on two sets of measurements made in November and December 2017 (KRRC, 2018c). Figure 3.3-2 displays simulated 7-day average daily maximum (7DADM) temperatures between J.C. Boyle Reservoir and the Oregon-California border under current conditions (Oregon DEQ, 2019a). Under existing conditions, the combination of J.C. Boyle and Keno Dams cause the 7DADM temperatures at the Oregon-California border to increase by up to about 2.5°C in July and November (Oregon DEQ, 2019a).

Copco No. 1 and Iron Gate Reservoirs exhibit seasonal (spring through fall) thermal stratification with three layers: (1) the warm, upper layer referred to as the epilimnion; (2) the metalimnion, which has a steep thermal gradient; and (3) the cold, deep hypolimnion (figures 3.3-3 and 3.3-4, respectively). The epilimnion begins to form in early spring, reaching maximum temperatures approaching 25°C during late July, and then gradually cools to winter minimum temperatures typically around 5°C. Year-round temperatures in the deeper portions (the hypolimnion when the reservoir stratifies) of Iron Gate Reservoir typically remain below 10°C. The depth of the metalimnion varies by season, expanding as surface temperatures rise. By mid-summer, the depth of the metalimnion is around 50 feet in both reservoirs. Thermal stratification begins to break down by October and relatively uniform temperatures of about 6 to 8°C exist in November throughout the water column in both reservoirs. As is common in thermally stratified reservoirs, their surface waters experience diurnal temperature changes as a result of solar heating and temperature variations over several days in response to changing weather patterns, and diurnal variations are not evident in the deeper waters. Modeling conducted for the TMDL (NCRWQCB, 2010) indicates the presence of Copco Nos. 1 and 2 developments can increase Klamath River daily maximum temperatures by as much as 3.5°C during the late summer and fall months and can decrease daily maximum temperatures by as much as 7°C in late spring.[74] Similarly, the Iron Gate development can increase Klamath River daily maximum temperatures by as much as 3°C during the late summer and fall months and can decrease daily maximum temperatures by as much as 4°C in early summer (NCRWQCB, 2010).[75]

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[74] Immediately downstream of Copco No. 2 Dam.

[75] Immediately downstream of Iron Gate Dam.

The elevation of the Copco No. 1 and Iron Gate Powerhouse intake structures[76] results in water typically being drafted from the epilimnion during periods when the reservoirs are stratified. The combination of thermal stratification and drafting water from the epilimnion delays the natural warming and cooling of downstream temperatures on a seasonal basis, generally resulting in cooler than natural conditions in late winter and early spring and warmer late summer and fall temperatures (figures 3.3-5).

In 2015, PacifiCorp installed a powerhouse intake barrier/thermal curtain in Iron Gate Reservoir, under KHSA interim measure 11, to isolate near-surface waters and withdraw cooler, denser deeper waters from the reservoir.[77] Results from the intake barrier/thermal curtain indicate that modest (up to 2°C) water temperature improvement is possible (PacifiCorp, 2017c), although the California Water Board (2020a) concludes that the data collected indicate that this measure could not achieve compliance with California's TMDL temperature requirement in the Middle Klamath River (North Coast Regional Board, 2010).

Figure 3.3-6 displays continuous water temperatures measured by PacifiCorp in 2011–2020 immediately downstream of the Iron Gate Dam, and the monthly frequencies at which these values exceed 20°C are provided in table 3.3-13. Table 3.3-14 summarizes discrete in situ water temperature and other water quality measurements collected under KHSA interim measure 15 in the Klamath River and major tributaries. In addition, figure 3.3-7 shows the annual frequency that six sites in the Lower Klamath River exceeded 18°C in June–October of 2009 to 2017.

Figure 3.3-8, which compares Klamath River 7DADM temperatures to EPA (2003) life stage-specific salmonid guidelines,78 shows that these targets are frequently exceeded between Iron Gate Dam and the river's mouth. As discussed in section 3.4.2.7, *Diseases Affecting Salmon and Steelhead*, high temperatures can increase the risk for fish diseases. To reduce the risk of a disease outbreak and adult fish kill, supplemental releases of cold water from Trinity Reservoir were provided during the late summer and early fall in 2003, 2004, and 2012–2016. An analysis of water temperatures during these years suggests that the releases are generally effective at achieving their water temperature objectives in late summer to early fall (David and Goodman, 2017). This conclusion is supported by: (1) once the Trinity Reservoir releases reached the Klamath River, Lower Klamath River mean daily temperatures were nearly always reduced to

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[76] The bottom of the Copco No. 1 and Iron Gate intake structures are about 32 and 35 feet below the full pool elevation of their respective reservoirs.

[77] The purpose of the curtain was to isolate near-surface waters that are warmer and have high concentrations of cyanobacteria (commonly referred to as blue-green algae) such that extensive summer and fall blooms were not readily released downstream.

[78] This figure applies 7DADMs of 20°C for adult migration and 16°C juvenile rearing year-round, and 13°C for spawning, incubation, and emergence to October 1–April 30.

below the 23°C objective, and (2) statistical models indicate that an increase of 1,000 cfs in Trinity River flows reduced Klamath River mean temperature by about 0.9°C just downstream of the confluence with the Trinity River and about 0.4°C just above the river's mouth.

The California Water Board 2020 EIR (2020a) concludes that:

- Water temperature data collected as part of KHSA interim measure 15 indicate that water temperature trends under the 2013 BiOp flows are consistent with those under the pre-2013 BiOp flows.
- Maximum temperatures in the Klamath River from Iron Gate Dam downstream to the estuary regularly exceed the range of chronic (sublethal) temperature thresholds (13.0–20°C) for full salmonid support in California.
- The temperature of water released from Iron Gate Dam is about 1.0−2.5°C cooler in the spring and approximately 2−10°C warmer in the summer and fall compared to modeled conditions without the project's dams and tends to exhibit relatively low variability due to the influence of Iron Gate Reservoir's water releases.
- Meteorological influences increase river temperature with distance downstream from Iron Gate Dam in the summer and fall months.
- Effects of the Lower Klamath Project on river temperature are significantly diminished at the Salmon River confluence with the Klamath River (RM 66.3).
- Downstream from the Salmon River, summer river temperatures begin to decrease slightly with distance as coastal weather influences (i.e., fog and lower air temperatures) decrease longitudinal warming and cool-water tributary inputs increase the overall flow volume in the Klamath River. However, temperatures in this reach still regularly exceed salmonid thermal preferences (less than 20°C) during the summer.
- Water temperatures in the estuary are linked to inflowing water temperatures and flows, the timing and duration of sand berm formation across the estuary mouth, and salinity and resulting density stratification in the estuary. During low-flow summertime conditions when the mouth closes, estuary surface temperatures have been observed at 18.0−24.7°C.
- Input of cool ocean water and fog along the coast minimizes extreme water temperatures much of the time.
- Klamath River estuary temperatures are affected by a salt wedge of cool dense saltwater flowing under the less dense warm freshwater (figure 3.3-9). The upstream extent of the salt wedge is determined by the river

flows and the elevation of tides. In 2005, the salt wedge resulted in daily fluctuations of about 5°C about 2 river miles up the estuary (Strange, 2007).

3.3.2.5 Nutrients, Dissolved Oxygen, and pH

Nutrients

Primary nutrients, including nitrogen and phosphorus, are influenced by the geology of the watershed, upland productivity and land uses, and several physical processes that affect aquatic productivity in reservoir and riverine reaches. Upper Klamath Lake is categorized as extremely productive (hypereutrophic) and is a major source of nitrogen and phosphorus loading to the Klamath River. On an annual average basis, the majority of Upper Klamath Lake's phosphorus load is provided by internal loading (i.e., 61 percent from lake sediments and algal blooms) and external sources (inflows from tributaries and springs) provide the remaining 39 percent (Oregon DEQ, 2002). The lake is a significant source of nitrogen[79] as a result of internal loading from nitrogen fixation[80] of the blue-green alga *Aphanizomenon flos-aquae* and anaerobic bacterial decomposition mobilizing inorganic nitrogen from lake sediments (Oregon DEQ, 2002).

In the project reach from J.C. Boyle Reservoir to Iron Gate Dam, nutrient concentrations generally decrease with distance from Upper Klamath Lake because the reservoirs trap particulate sediments, in addition to downstream dilution and uptake along the river channel. In summer and fall when there can be an absence of DO at the bottom of the reservoirs (i.e., hypolimnetic anoxia), the reservoir sediments release dissolved forms of phosphorus (orthophosphate) and nitrogen (ammonium), to a lesser degree.[81] These seasonal nutrient releases from reservoir sediments can be released from Iron Gate Dam and transported down the Klamath River and may stimulate periphyton growth. Figure 3.3-7 indicates that the Lower Klamath River frequently has high concentrations of total phosphorus and total nitrogen in June–October.

In the reach from Iron Gate Dam to the Seiad Valley, May–December, total phosphorus concentrations generally range from 0.1 to 0.25 mg/l, and total nitrogen concentrations range from <0.1 to 2.0 mg/l (Asarian et al., 2010). The concentrations are typically highest below Iron Gate Dam and decrease with distance downstream because of dilution from tributary inflows, deposition of sediments on riverbanks following high-flow events in spring and early summer, and in-river nitrogen removal processes (e.g.,

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[79] The average total nitrogen load in 1992–1999 was 3.5 times higher in Upper Klamath Lake's outflow than its inflow.

[80] Nitrogen fixation is the chemical process by which molecular nitrogen from the air is converted into ammonia or related nitrogenous compounds in the aquatic environment.

[81] This process is referred to as internal loading.

denitrification[82] and biomass uptake) (Asarian et al., 2010, as cited in KRRC, 2021f). Although ratios of nitrogen to phosphorus suggest nitrogen may limit primary productivity, high enough concentrations of both nutrients indicate that primary productivity may be limited by other factors (e.g., light, water velocity, or available substrate), particularly near Iron Gate Dam.

Downstream of the confluence with the Salmon River, nutrient concentrations continue to decrease because of dilution from tributary inflows. This reach generally has total phosphorus concentrations of 0.01 to 0.2 mg/l and total nitrogen concentrations of 0.1 to 0.7 mg/l. In the estuary, the concentration of total phosphorus is typically 0.2 mg/l or less, and total nitrogen is 0.1 to 0.7 mg/l.

Dissolved Oxygen

DO levels are influenced by numerous factors, including water temperature, atmospheric pressure, salinity,[83] the extent of mixing of the water,[84] solar radiation, evaporation, production of oxygen through photosynthesis, and consumption of oxygen through bacterial decomposition of organic matter and respiration of organisms.

Upper Klamath Lake DO concentrations respond to the primary production that produces molecular oxygen and respiration, which consumes molecular oxygen needs of algal blooms and biological oxygen demand (BOD) from aerobic decomposition of organic material in the water, and to a lesser extent, the bottom substrate. Low DO levels in Upper Klamath Lake have been associated with declining algal blooms, typically in later summer and early fall (Perkins et al., 2000). DO also varies daily in response to photosynthesis and respiration of aquatic macrophytes and algae.

Upper Klamath Lake's high nutrient loads result in eutrophic conditions and substantial seasonal and spatial variation in the lake's DO levels, which range from near 0 mg/l to supersaturation. Low DO concentrations (0 to 4 mg/l) are most common in August coinciding with lake warming and declining algal blooms (Kann, 2017; Oregon DEQ, 2002; Walker, 2001).

Downstream in Keno Reservoir, DO concentrations reach very low levels (<1 to 2 mg/l) during July through October (KRRC, 2021f). Although the reservoir receives

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[82] Denitrification is the conversion of nitrates and nitrites to molecular nitrogen, which is typically released to the air.

[83] Water can hold less DO as temperature increases, salinity increases, and pressure decreases (e.g., altitude increases).

[84] The wind and water velocities can promote mixing within the water column; however, differences in water temperatures and salinity can result in different water densities within the water column and reduce mixing throughout it (e.g., stratification within reservoirs, deep pools in the river, and the estuary; and slow mixing of inflows from tributaries and groundwater/springs).

treated wastewater from four water treatment facilities, these inflows contribute very little (<1.5 percent) to the reservoir's organic material load and oxygen demand. Decomposition of algae transported from Upper Klamath Lake appears to be the primary driver of low oxygen in Keno Reservoir (Sullivan et al., 2011; Oregon DEQ, 2019b).

Even though J.C. Boyle Reservoir does not thermally stratify for prolonged periods, it has DO concentrations near the surface that range from 5.3 to 13.4 mg/l,[85] and DO near the bottom is as low as 3.9 mg/l (see table 3.3-14).

Copco No. 1 and Iron Gate Reservoirs, which are much bigger and deeper, establish prolonged thermal stratification. These reservoirs also experience a wide range of DO levels, primarily due to high rates of photosynthesis by algae near the surface and decomposition and respiration in deep waters (figure 3.3-10). Discrete measurements made in 2011–2020 indicate that Copco No. 1 and Iron Gate Reservoirs are moderately affected by photosynthesis and decomposition at depths of less than 1 meter (see table 3.3-14). However, DO concentrations in deeper waters ranged from 0.0 to 19.6 mg/l in Copco No. 1 Reservoir and 0.0 to 18.6 mg/l in Iron Gate Reservoir, indicating substantial effects of these processes on DO levels in deeper waters.

Downstream from Iron Gate Dam, DO levels are much more stable than in the reservoirs but still vary substantially from mid-July through October. Daily minimum DO concentrations measured in the Lower Klamath River generally occur at night and early morning (YTEP, 2005), coinciding with the lack of photosynthesis but continued nighttime bacterial respiration. Continuous measurements immediately downstream of Iron Gate Dam in 2011–2020 indicate that DO percent of saturation is below the Basin Plan's minimum objective[86] more than 10 percent of the time in August–January (see table 3.3-13). The DO concentrations ranged from 3.8 to 14.0 mg/l (PacifiCorp, 2012, 2013, 2014, 2015, 2016a, 2017b, 2018, 2019a, 2020a, 2021a) and fell below 8 mg/l more than 10 percent of the time in July–November (see table 3.3-13). In June–October, the Lower Klamath River generally experiences DO of less than 90 percent of saturation most frequently near Iron Gate Dam (figure 3.3-7).

In August and October 2008, PacifiCorp conducted a pilot test of the potential for turbine venting at the Iron Gate Powerhouse to increase DO in its discharges, which indicates that it could increase DO concentration by about 0.5 to 2 mg/l (Carlson and Foster, 2008). PacifiCorp installed a blower system at the Iron Gate Powerhouse and found that it can increase DO levels below Iron Gate Dam by approximately 1 to 2.5 mg/l (PacifiCorp, 2011b). PacifiCorp developed a turbine venting standard operation procedure consistent with the terms of PacifiCorp's incidental take permit for coho

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[85] We omitted a 0.4-mg/l value reported for July 20, 2015, at 9:40 a.m., which appears to be an error.

[86] The Basin Plan's minimum DO objective is 85 percent in April–September and 90 percent in October–March.

salmon[87] in 2013 and has been implementing turbine venting at the Iron Gate Dam Powerhouse (PacifiCorp, 2020b) whenever DO levels fall to or below 87 percent of saturation in the Klamath River downstream of the dam.

Point measurements indicate that DO concentrations in the mainstem below Iron Gate Dam generally increase to at least 7 mg/l by RM 156.26, are generally between 7 and 13 mg/l down to the estuary and are between 5 and 13 mg/l in the estuary (table 3.3-14). Based on an evaluation of DO conditions in the first 6 miles downstream of Iron Gate Dam, mechanical reaeration plays a key role in increasing DO concentrations with increasing distance from Iron Gate Dam, while photosynthesis augments mechanical reaeration, especially later in the day (Mejica and Deas, 2020). In the estuary, low DO concentrations (2.5 to 5.5 mg/l) have been observed at the bottom of deep pools or within heavily vegetated side channels and sloughs within 1.5 river miles of the ocean (Wallace, 1998).

pH

The hydrogen ion activity, pH, is measured on a logarithmic scale of 0 to 14 standard units in which values below 7 are acidic and values above 7 are basic (EPA, 2021c). In surface waters, pH is controlled by atmospheric carbon dioxide and the photosynthetic and respiratory processes of aquatic organisms. Even small changes in pH can alter the chemical state of many pollutants (e.g., metals and ammonia) and change their solubility, transport, and bioavailability. This can increase exposure to and toxicity of metals and nutrients to aquatic plants and animals.

The ability of a system to buffer changes in pH is measured by the total alkalinity of the water. Typical alkalinity of freshwater ranges from 20 to 200 mg/l; levels below 100 mg/l indicate limited buffering capacity and increased susceptibility to changes in pH. Data collected in 2011–2020 indicate that total alkalinity throughout the Klamath River is generally less than 100 and therefore is susceptible to changes in pH.

The high concentration of algae in Upper Klamath Lake and Keno Reservoir influences pH levels because photosynthesis and associated uptake of carbon dioxide results in high pH (basic conditions) during the day, and respiration by algae and other organisms at night decreases the pH to more neutral conditions (FERC, 2007). Generally, pH at Link Dam increases from spring to early summer and decreases in the fall and is lower in Keno Reservoir than at Link Dam (Watercourse Engineering, Inc., 2019b, 2020b, 2021b). Discrete measurements of pH in 2011–2020 indicate that pH tends to become closer to neutral between the Link River Dam and J.C. Boyle Reservoir (see table 3.3-14, stations KR25444 to KR22478).

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[87] The incidental take permit requires that DO not fall below 85 percent of saturation downstream of Iron Gate Dam for longer than seven consecutive days in the 6 miles of river downstream of Iron Gate Dam during the period of June 15–September 30 when over-summer rearing juvenile Coho salmon are present.

From J.C. Boyle Reservoir to Iron Gate Dam, pH is seasonally variable, with levels near neutral during the winter, increasing in the spring and summer. In addition, pH varies with depth in the project's reservoirs, especially in Copco No. 1 and Iron Gate Reservoirs (see figure 3.3-10), likely due to photosynthesis of floating phytoplankton in surface waters increasing pH and respiration decreasing pH. In 2011–2020, the lowest discrete pH value recorded was 4.0 at RM 219.5, and the highest values were 10.0 at RM 206.42 and at the surface of Iron Gate Reservoir and 9.9 at the surface of Copco No. 1 Reservoir (see table 3.3-14). High pH levels typically coincide with high algal photosynthesis rates at or near the water surface during periods of thermal stratification and high nutrient concentrations in the reservoirs (Raymond, 2008, as cited in KRRC, 2021f).

PacifiCorp's continuous pH measurements collected below Iron Gate Dam in 2011–2020 ranged from 7.1 to 9.7, were generally stable from mid-October to mid-March and varied substantially for the remainder of the year. These data exceeded the Basin Plan's upper pH objective of 8.5 more than 10 percent of the time in July through September (see table 3.3-13). Lower Klamath River pH values in June–October fall outside the 7.0–8.5 range most frequently near Seiad Valley and Weitchpec (figure 3.3-7).

The pH reaches a level higher than 8.5 at each of the KHSA interim measure 15 monitoring sites in the Lower Klamath River (see table 3.3-14). The highest pH reported for this reach was 10.1 at RM 59.1, which is the first site downstream of the Salmon River confluence. At RM 0.5 in the estuary, pH generally ranges from about 7.5 to 8.5 (YTEP, 2012, 2013, 2014, 2017). Daily variations in pH are typically on the order of 0.5 pH units, and fluctuations tended to be somewhat larger in the late summer and early fall.

3.3.2.6 Phytoplankton and Microcystin

Phytoplankton and periphyton are primary producers that use energy from the sun to convert nutrients into biomass, which serves as the base of the food chain. Their population, biomass, and community structure are determined primarily by temperature, sunlight, and the availability of nutrients, and generally follow the same trends in a waterbody from year to year (Wetzel, 1983). They are an important component to the overall water quality and water chemistry processes affecting water quality. High biomass levels elevate the concentration of chlorophyll-*a* and can create extreme diel fluctuations in DO and pH due to photosynthesis (the consumption of carbon dioxide and waste production of oxygen in daylight) and cellular respiration (the consumption of oxygen and waste production of carbon dioxide) (California Water Board, 2020a). Decomposition of dead phytoplankton can further reduce DO and release free ammonia into the water column, especially following a bloom (California Water Board, 2020a). In addition, some blue-green algae species (e.g., *Anabaena flos-aquae* and *Microcystis aeruginosa*) produce algal toxins (e.g., microcystin) that can reach levels that are harmful to humans, fish, and mammals. Table 3.3-15 summarizes the Hoopa Valley Tribe's water quality criteria for potentially harmful algal blooms, EPA-recommended criteria, and guideline values from various other entities.

Upper Klamath Lake, which is considered eutrophic to hypereutrophic, frequently has summer chlorophyll-*a* concentrations, a surrogate measure of planktonic algae abundance, above 200 (µg/l) (Oregon DEQ, 2019b). The lake's phytoplankton biomass increases from relatively low concentrations in winter and spring to peak concentrations in summer to fall and then decreases to relatively low concentrations again in late fall/early winter (Kann, 1997). The phytoplankton community is dominated by diatoms in spring (Eilers et al., 2004; Kann, 1997; Sullivan et al., 2009) and blue-green algae, which consists primarily of *Aphanizomenon flos-aquae* in the summer (Eilers et al., 2004; FERC, 2007; Eldridge et al., 2012) that can obtain nitrogen from air. Upon the die-off of the *Aphanizomenon flos-aquae* bloom, their decaying cells release nitrogen and phosphorus that fuels growth of *Microcystis aeruginosa* (Stillwater Sciences et al., 2013), which is dependent on the availability of nitrogen in the water column. *Microcystis aeruginosa* is believed to be responsible for the production of microcystin in Upper Klamath Lake (Eldridge et al., 2012), which has exceeded the World Health Organization guidelines for drinking water (1 µg/l) and the Oregon DEQ guideline for safe recreational water contact (8 µg/l) (VanderKooi et al., 2010).

Between Upper Klamath Lake and Copco No. 1 Reservoir, phytoplankton patterns are primarily driven by conditions in Upper Klamath Lake and its releases. The phytoplankton biovolume is typically dominated by diatoms in the spring and blue-green algae in the summer and fall (figures 3.3-11 and 3.3-12) (Sullivan et al., 2009). Phytoplankton biovolume and chlorophyll-*a* concentrations generally decrease in the Klamath River with distance downstream of Upper Klamath Lake (figures 3.3-13 and 3.3-14) (Raymond, 2005; Kann and Asarian, 2006; Sullivan et al., 2009). Between J.C. Boyle Dam and the upper end of Copco No. 1 Reservoir, numerous factors, including turbulent mixing, higher water velocities, and cool-water inflow from springs in the J.C. Boyle bypassed reach, provide less favorable conditions for phytoplankton and are presumed to be the cause for the lower phytoplankton abundance (Kann and Asarian, 2006; Kann and Corum, 2009; Asarian and Kann, 2011). The community in this reach has a larger proportion of diatoms and less blue-green algae than J.C. Boyle Reservoir (see figures 3.3-11 and 3.3-12). Samples collected in 2015–2020 indicate that *Microcystis aeruginosa* cell density was typically less than 1,000 cells/ml between Keno and Copco No. 1 Reservoirs (Watercourse Engineering, Inc., 2017e,f, 2018a, 2019a, 2020a, 2021a). However, monthly average *Microcystis aeruginosa* cell density in 2015 reached more than 150,000 cells/ml in J.C. Boyle Reservoir in July, and more than 18,000 cells/ml in the J.C. Boyle bypassed reach in August.

Copco No. 1 and Iron Gate Reservoirs, which have much slower velocities, have much higher summertime chlorophyll-*a* concentrations and larger phytoplankton blooms than inflow, especially in July–September and in Copco No. 1 Reservoir in October (see figures 3.3-13 and 3.3-14). Based on data collected in 2015–2020, these blooms are usually dominated by blue-green algae (see figures 3.3-11 and 3.3-12). *Aphanizomenon* *flos-aquae* dominates these reservoir communities in spring and early summer, and *Microcystis aeruginosa* tends to dominate them in late summer or early fall bloom. From upstream to downstream, the highest *Microcystis aeruginosa* monthly average densities were about 63,300 cells/ml in Copco No. 1 Reservoir in September 2017 (figure 3.3-15), nearly 45,600 cells/ml between Copco No 1 and Iron Gate Reservoirs in August 2019, and about 19,600 cells/ml in Iron Gate Reservoir in September 2018 (figure 3.3-16). The frequency in which *Microcystis aeruginosa* monthly average densities in July through September of this six-year dataset exceeded 1,000 cells/ml was more than 40 percent at each of these three sites, and they had corresponding frequencies for exceeding 5,000 cells/ml of 20 to 29 percent.

Under KHSA interim measure 11 (Interim Water Quality Improvements), PacifiCorp has been evaluating methods to reduce the release of blue-green algae from Iron Gate Dam through the use of an intake barrier curtain to segregate the epilimnetic waters near the Iron Gate penstock intake[88] from the main body of the reservoir. The curtain is designed to extend from the surface to a maximum depth of about 35 feet. However, PacifiCorp manages the curtain's deployment depth to maximize the benefits of the curtain and achieve the desired DO concentration in releases to the Lower Klamath River. Evaluation of data collected between 2015 and 2018 indicates the curtain is effective at significantly reducing the release of blue-green algae downstream of Iron Gate Dam, when it is deployed to its design depth, and is less effective at controlling transport of blue-green algae past the dam when it is not fully extended (PacifiCorp, 2021d).

In the Lower Klamath River, the highest *Microcystis aeruginosa* monthly average density was about 2,800 cells/ml at the first site below Iron Gate Reservoir in September 2017. This site's *Microcystis aeruginosa* monthly densities in July–September of this six-year dataset exceeded 1,000 cells/ml 33 percent of the time. All eight sites downstream of this site had lower peak monthly average *Microcystis aeruginosa* densities and a lower frequency of exceeding 1,000 cells/ml. Continuous monitoring of blue-green algae phycocyanin concentration in the Lower Klamath River indicates that blue-green algae densities tend to be highest in August to mid-October (figure 3.3-17). The density of blue-green algae and *Microcystis aeruginosa* generally diminishes with distance downstream of Iron Gate Dam (figures 3.3-17 and 3.3-18, respectively). A genetics study of *Microcystis aeruginosa* in the Klamath River Basin (Otten et al., 2015) that used rapid changes in the prevalence of the two dominant subpopulations to fingerprint *Microcystis* assemblages over time and space, determined that the population at the Hatchery Bridge site immediately below Iron Gate Dam, closely resembles that within Iron Gate Reservoir. The subpopulations at the other Lower Klamath River sites

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[88] The penstock intake drafts water from the full depth (i.e., drafts near surface waters). PacifiCorp (2021d) reports that corresponding to deploying the curtain to about 25 feet in late July 2017, the temperature downstream of Iron Gate Dam dropped about 1°C.

also follow this pattern, which indicates that Iron Gate Reservoir is the primary source for *Microcystis* cells to the Lower Klamath River and that these cells are actively transported as far as the Pacific Ocean.

Sampling results from 2011–2020 indicate that summer microcystin concentrations reached levels that exceed 4 µg/l in the river between Link Dam and just below Keno Dam; in J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs; between Copco No. 1 and Iron Gate Reservoirs; and between Iron Gate Dam and the estuary. However, these data also suggest that microcystin concentrations likely remained below 4 µg/l just above J.C. Boyle Reservoir and between J. C Boyle Dam and Copco No. 1 Reservoir. These results also indicate that the highest microcystin concentrations occurred in the near surface of Copco No. 1 (2,100 µg/l), Iron Gate (840 µg/l), and J.C. Boyle Reservoirs (470 µg/l). As expected, deep water in the reservoirs have much lower microcystin concentrations.

Microcystin concentrations in depth-integrated samples from the top 8 meters reached more than 4 µg/l in Copco No. 1 and Iron Gate Reservoirs during July–October (tables 3.3-16 and 3.3-17). The peak depth-integrated microcystin concentration was 56 µg/l in Copco No. 1 Reservoir on August 21, 2013, and 30 µg/l in Iron Gate Reservoir on September 17, 2018.

Blue-green algae blooms and toxins produced by them, including microcystin, pose a risk to the health and survival of aquatic biota (e.g., fish and zooplankton), birds, and mammals including humans (Butler et al., 2009; Liu et al., 2006; Miller et al., 2010; OEHHA, 2012; Paerl et al., 2001). The Lower Klamath River frequently exceeds public safety thresholds for *Microcystis* (figure 3.3-18) and microcystin (figures 3.3-7 and 3.3-18). Based on samples collected in July–October of 2005–2016, *Microcystis aeruginosa* and microcystin concentrations exceed the public health thresholds most frequently in September (Genzoli and Kann, 2017). Figures 3.3-7 and 3.3-18 indicate that, as expected, the microcystin concentration exceeds the 0.8-µg/l threshold more frequently near the upper end of the reach. Genzoli and Kann (2017) report higher concentrations of *Microcystis aeruginosa* and microcystin at shoreline sites than in open water that reflect the buildup of cells and toxins, which can get trapped in the channel margins (Kann et al., 2012). The concentration of total microcystin correlates strongly with the number of *Microcystis* cells (Otten et al., 2015).[89]

The California Water Board evaluated the potential for bioaccumulation of microcystin with objectives to: (1) perform a screening-level analysis of microcystin accumulation in a range of aquatic species, (2) provide microcystin levels in yellow perch to the Office of Environmental Health Hazard Assessment that could be used to develop a public fish tissue consumption advisory, and (3) provide support for other studies by

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[89] Otten et al. (2015) report a high positive associations between microcystin concentrations and *Microcystis* cell counts ($R^2 = 0.81$) and between microcystin concentrations with estimates of microcystin synthetase E genes ($R^2 = 0.76$).

analyzing water samples for microcystin (Kanz, 2008). A subsequent study was conducted on samples collected in 2009, and results were compared to the earlier analysis of samples collected in 2007 and 2008 (Kann et al., 2010). The Karuk Tribe evaluated microcystin bioaccumulation in salmonids collected from the Iron Gate Hatchery, Happy Camp, Ishi Pishi Falls, Orleans, and Weitchpec in September–November 2010 (Kann et al., 2012).[90] Findings of these reports include:

- Bioaccumulation of microcystin occurs in freshwater mussels in the Lower Klamath River as evidenced by a greater frequency of detection and higher concentrations in mussel tissue than in water.
- Microcystin concentrations in freshwater mussels in the Lower Klamath River exceed all guideline levels set to protect 10-kilogram (22-pound) children defined by Ibelings and Chorus (2007).[91]
- Microcystin concentrations in yellow perch tend to be higher in Copco No. 1 Reservoir than Iron Gate Reservoir and correlate with microcystin concentrations in nearby reservoir water (Kanz, 2008).
- Microcystin concentrations in a single composite sample from six yearling Chinook salmon from the Iron Gate Hatchery were 301 nanogram per gram (i.e., parts per billion) in a liver sample and non-detectable in fillet and stomach samples (Kanz, 2008).
- The results for 2007 and 2008 samples warrant an Office of Environmental Health Hazard Assessment recommendation against consuming shellfish from the affected sections of the Klamath River and yellow perch from Iron Gate and Copco No. 1 Reservoirs (Kanz, 2008).
- Microcystin may affect the level of stress and/or disease in salmonids in the Lower Klamath River and Iron Gate Hatchery (Kann et al., 2013).

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[90] This study includes evaluation of liver and fillet samples from 25 steelhead, 14 Chinook salmon, and three coho. Fish from the hatchery were collected after being spawned.

[91] These guideline levels are 250 micrograms per kilogram, parts per billion, for acute single-exposure tolerable intake, 40 parts per billion seasonal tolerable daily intake for several weeks during the blue-green algae season, and 4 parts per billion lifetime tolerable daily intake for many months in settings where microcystin-producing blue-green algae proliferate perennially.

3.3.3 Effects of the Proposed Action

3.3.3.1 Suspended Sediment and Contaminants

Drawdown of the reservoirs and deconstruction activities would result in the suspension and mobilization of fine sediments from the reservoirs, which would cause elevated SSCs in the hydroelectric reach and the Lower Klamath River, and some deposition of fine sediment in the river channel and Klamath estuary. Numerous commenters expressed concern about the effects that the movement of these sediments and any contaminants that they contain would have on biota in the Lower Klamath River, especially salmon.

KRRC's proposed approach for reservoir drawdown is detailed in its Reservoir Drawdown and Diversion Plan. This approach is designed to flush fine sediments from the historical river channel in the reservoirs as rapidly as possible so that the duration of adverse effects on downstream biota (especially salmon) is as limited as possible and to time the drawdown and mobilization of sediments to occur during seasonal high flows so that nearly all fine sediment would remain suspended as it passes through the Lower Klamath River and Klamath estuary to the Pacific Ocean. KRRC proposes to use a process called sediment jetting and other methods to expedite the mobilization of sediment from the historical river channel in Copco No. 1 and Iron Gate Reservoirs.

KRRC also proposes measures to stabilize reservoir sediments that are not in the historical river channel by implementing revegetation efforts detailed in its RAMP and to limit erosion from areas disturbed during deconstruction activities using measures described in its proposed Erosion and Sediment Control Plan (KRRC, 2021h).

Our Analysis

Suspended Sediments

Our analysis of the effects of the proposed action on suspended sediments is primarily based on the Sedimentation and River Hydraulics-One Dimensional Model (SRH-1D) sediment transport modeling developed for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration (Reclamation, 2011a) and as updated in 2020 (KRRC, 2021f, appendix I)[92] to reflect the following:

- 2019 BiOp flows
- 2018 updates to bathymetry and LiDAR (GMA, 2018)
- Revised estimate of the maximum dam outlet discharge capacity at Iron Gate from 8,500 cfs to 4,000 cfs

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[92] Both modeling studies use Reclamation's SRH-1D.

- Revised estimate of the maximum dam outlet discharge capacity at Copco No. 1 from 5,000 cfs to 4,000 cfs (via a new low-level outlet)
- Revised estimate of the maximum combined discharge capacity at two J.C. Boyle culverts from 5,500 cfs to 4,000 cfs
- Change in Iron Gate Reservoir drawdown rate from 1 to 3 feet per day to about 3 feet per day[93]
- Subsequent revisions to the drawdown schedule

The California Water Board (2020a) evaluated the effects of the proposed action before the 2020 update was available. However, its overall conclusions are still expected to be valid for the reaches upstream of Iron Gate Reservoir because revisions that would affect conditions in this reach are minimal. Based on model simulations for a wet, median, and dry year (1999, 1968, and 2004, respectively), SSCs immediately downstream of J.C. Boyle Dam would have peak values of 2,000–3,000 mg/l in January or February following initiation of reservoir drawdown, and concentrations would decrease to below 100 mg/l within six to ten months following drawdown (California Water Board, 2020a). The California Water Board estimates that the proposed drawdown rate, which is higher than the rate used in the simulations, would result in these peak concentrations increasing to 4,000–6,000 mg/l and shorten the period of elevated concentrations by one to two weeks. SSCs downstream of Copco No. 1 Dam are expected to peak at about 14,000–16,000 mg/l in January or February following initiation of initiation of reservoir drawdown and decrease to less than 1,000 mg/l within two months after initiation of the drawdown (California Water Board, 2020a). After drawdown, SSCs downstream of Copco No. 1 Dam would decrease through time to less than 10 mg/l. Because Copco No. 2 Reservoir is small and impounds very little sediment, its removal is not expected to result in measurable effects when combined with removal of J.C. Boyle and Copco No. 1 Dams.

Simulated Iron Gate Reservoir water surface elevations during drawdown and SSCs 0.5 miles downstream of Iron Gate Dam in dry, average, and wet water years are shown in figures 3.3-19 and 3.3-20, 3.3-21 and 3.3-22, and 3.3-23 and 3.3-24, respectively. Inflows to the project would influence when and at what rate Iron Gate Reservoir is drawn down.[94] The simulations indicate that the target drawdown elevation would be attained by mid-February in a dry year (figure 3.3-19) but would occur about

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[93] Note that the KRRC's current proposal includes drawdown of the four reservoirs at a target rate of 5 feet per day and acknowledges that the actual drawdown rate would be based on the existing hydrologic conditions (KRRC, 2021e).

[94] For example, initiation of drawdown could be delayed until February in a wet water year (figure 3.3-23), and the initial drawdown rate could be larger in a dry water year than in other water year types (compare figure 3.3-19 to figures 3.3-21 and 3.3-23).

3.5 to 4 months later in average and wet years (figures 3.3-21 and 3.3-23, respectively).[95] Because river flows would exceed the dam outlet discharge capacities in average and wet water years, the spring freshet (i.e., period of high flows due to peak snowmelt) would result in partial to complete refilling of the reservoirs. For example, simulations indicate the spring freshet in a wet water year could completely refill Iron Gate Reservoir until early April, and the target drawdown elevation would not be reached until mid-July (figure 3.3-23). Simulations indicate SSCs after March of the drawdown year would likely be above 1,000 mg/l for about half a month in a dry year, about one month in an average year, and more than one and a half months in a wet year (figures 3.3-20, 3.3-22, and 3.3-24, respectively).

Under the proposed action, SSCs 0.5 miles downstream of Iron Gate Dam are estimated to peak at about 15,000 mg/l in all water year types, with the peak occurring in June in dry and average water years and in August in wet water years (figures 3.3-20, 3.3-22, and 3.3-24). One or more peaks of lower magnitude are expected when the reservoir is initially drawn down in January to mid-March, the low-level outlet at Copco No. 1 is opened in early July, and the downstream portion of the J.C. Boyle Dam embankment is removed down to bedrock in early August.[96] SSCs 0.5 miles downstream of Iron Gate Dam under the proposed action (figures 3.3-20, 3.3-22, 3.3-24, and 3.3-25) would generally be less than 1,000 mg/l by September of the drawdown year, and less than 15 mg/l above background levels by July of the year following drawdown. As water flows downstream, inflows from tributaries, and to a lesser degree, springs would dilute SSCs (see figures 3.3-26 for RM 129.4, 3.3-27 for RM 59, and 3.3-28 for RM 5), especially during high runoff periods, which would have relatively small increases compared to existing conditions. In the Lower Klamath River from Orleans to the ocean, the proposed action's largest adverse effects on SSCs would generally occur in June and July (figures 3.3-27 and 3.3-28).

An evaluation of the effects of different project reservoir drawdown rates on sediment transport using DREAM-1, one of the two dam removal express assessment models developed for simulation of sediment transport following dam removal (et al., 2006a,b), indicates that increasing the drawdown rate from 3 feet per day to 6 feet per day would increase the peak SSCs below Iron Gate Dam from about 10,000 to 20,000 mg/l, but the SSCs would decrease at a much faster rate and shorten the duration of elevated SSCs by several weeks (Stillwater Sciences, 2008). We expect the current proposal to increase the drawdown rate from 1 to 3 feet per day to 5 feet per day may

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[95] This prolonged drawdown compared to Reclamation's earlier simulations is primarily a result of updating the hydraulic capacity for the low-level release points at Iron Gate and Copco No. 1 Dams and subsequent revisions to the drawdown schedule.

[96] Implementation timeline provided in the Reservoir Drawdown and Diversion Plan (KRRC, 2021e).

increase the peak SSCs from about 15,000 mg/l to about 20,000 mg/l but would reduce the duration of SSCs above 100 mg/l.

KRRC proposes to use sediment jetting during reservoir drawdown to maximize mobilization of sediment from the historical river channel within Copco No. 1 and Iron Gate Reservoirs to minimize the potential for sediment mobilization after the drawdown period. Based on the approximate areas for restoration actions and the assumption that all sediment in the areas are mobilized, the California Water Board (2020a) estimates the sediment volume potentially mobilized by sediment jetting would be from 970,000 to 1,278,000 cubic yards from Copco No. 1 Reservoir and from 237,000 to 554,000 cubic yards from Iron Gate Reservoir, and that suspended sediment concentrations during reservoir drawdown would increase relative to prior model results.[97]

SSCs resulting from sediment jetting would depend on the pressure and angle of the water jet and the cohesiveness of the reservoir sediments. Assuming a sediment jetting flow of about 10 to 30 cfs, which was used on the Mill Pond Dam removal project located on Sullivan Creek near Seattle City Light's Boundary Hydroelectric Project (Washington Department of Ecology, 2016, as cited by California Water Board, 2020a), SSCs in sediment jetting flows would likely range from less than 1,000 mg/l to approximately 100,000 mg/l (California Water Board, 2020a). The California Water Board (2020a) conservatively estimates the effects of sediment jetting on SSCs based on the volume of sediment estimated to be mobilized by sediment jetting over a three-month period, the modeled flow and SSCs for the Klamath River, and the estimated flow and SSCs for sediment jetting.[98] The typical increase over SRH-1D simulated SSCs under the range of typical drawdown flows for all water year types is estimated to be about 350 to 1,400 mg/l from Copco No. 1 Reservoir, by about 270 to 1,200 mg/l from Iron Gate Reservoir, and by about 620 to 2,600 mg/l for both reservoirs. The California Water Board (2020a) concludes that sediment jetting would result in a maximum increase in SSCs under the low flows of a dry water year and that increases in SRH-1D simulations are expected to be increased by less than 2,200 mg/l for Copco No. 1, 1,700 mg/l for Iron Gate, and 3,900 mg/l if the maximum increase from the two reservoirs coincide. The California Water Board (2020a) concludes that these increases in the magnitude of SSC would not alter the overall effect of suspended sediments because the increases would primarily occur during peak SSCs and are not expected to increase the duration that SSCs are above 100 mg/l. Furthermore, sediment jetting would reduce the potential for

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[97] Since the 2020 updated SRH-1D simulations do not appear to include the effects of sediment jetting, we conclude that the California Water Board's estimates also generally apply to the updated simulated suspended sediment concentrations.

[98] The estimated increases in SSCs are conservative (i.e., higher than expected) because the SRH-1D simulations include sediments mobilized from the areas where sediment jetting would occur.

mobilization of sediments remaining in the Copco No. 1 and Iron Gate Reservoir footprints after the drawdown period.

In summary, the proposed action is expected to result in short-term, significant, unavoidable, adverse effects on SSCs in the hydroelectric reach and Lower Klamath River.

Contaminants

Several studies were conducted to evaluate the potential for chemical contamination in the project reservoir sediments to adversely affect biota or human health as a result of removal of the dams. As discussed in section 3.3.2.3, *Inorganic and Organic Contaminants*, these studies included:

- Direct involvement of EPA Region 9 staff in development of a 2009–2010 sampling and testing plan.
- Evaluation of the extent and pattern of new (i.e., since sediment testing in 2009–2010) sediment deposition in the reservoirs (AECOM and River Design Group, 2020; CAMAS, 2021; EPA, 2021a).
- Evaluation of whether any spills or land use changes occurred that could have substantially changed potential contaminants contained in newly deposited sediments in the reservoirs (AECOM and River Design Group, 2020; EPA, 2021a).
- Evaluation of sediments collected from J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs between 2006 and 2010 using the SEF for the Secretarial Determination on removal of the project's dams (CDM, 2011).[99]
- Evaluation of the J.C. Boyle Reservoir sediments using the updated, 2018 SEF (AECOM and River Design Group, 2020).

On March 29, 2021, EPA (2021a) reconfirmed its determinations that the extensive physical, chemical and biological evaluations conducted in 2009–2010 remain valid, and the accumulated sediments in reservoirs behind the four project dams proposed to be removed by KRRC are suitable for release.

The CDM (2011) evaluation examined existing contaminant levels in the project's reservoirs and the Klamath estuary and the potential expected effects of disturbance and redistribution of these sediments through the stepwise procedure shown in figure 3.3-29. This procedure considers five potential exposure pathways for freshwater biota, marine

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[99] The CDM (2011) report serves as the primary source for evaluation of potential contamination risks associated with the release of sediments currently in the project's reservoirs in the Klamath Dam Removal Overview Report (Interior and NMFS, 2013), and for evaluations for section 401 certification for surrender of the project (Oregon DEQ, 2018b; California Water Board, 2020a).

biota, terrestrial biota, and humans, using freshwater and marine sediment screening levels, water quality evaluations for elutriate, various bioassays, and effects of bioaccumulation on aquatic organisms and human health from fish consumption, to evaluate potential ecological or human health related effects (table 3.3-18). Pathways 1-4 were used to evaluate conditions under the proposed action and pathway 5 was used to evaluate conditions for leaving the project unchanged with the dams in place.[100]

The AECOM and River Design Group (2020) conducted a similar evaluation for the J.C. Boyle Reservoir sediments using the updated, 2018 SEF (RSET, 2018). The 2020 evaluation includes, but is not limited to, the following:

- Environmental, historical, and physiographical project area background information
- Results for each exposure pathway identified by CDM (2011), and a focus on potential effects on ESA-listed fish species[101]
- Geologic background metal concentrations for the project area
- Data validation for the past study (CDM, 2011)
- Evaluation of 2018 SEF freshwater screening levels against J.C. Boyle reservoir sediment chemical concentrations[102]

Table 3.3-19 summarizes the results for the level of significance on benthic invertebrates, fish, ESA species, birds and mammals, and humans.

Below, we present CDM's (2011) conclusions for each of the five exposure pathways supplemented with findings of AECOM and River Design Group (2020).

Existing sediments in the project's reservoirs and the estuary contain the following chemicals of particular concern: three metals (arsenic, iron, and nickel), four pesticides (4,4-DDD, 4,4-DDE, 4,4-DDT, Dieldrin), a number of dioxin and furan congeners, and pentachlorophenol (wood preservative).[103] CDM's evaluation of yellow perch and bullhead fish tissue collected in 2010 from J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs suggests that current fish tissue concentrations of arsenic, mercury, total PCBs, and dioxins and furans (based on 2,3,7,8-TCDD) exceed human health screening

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[100] Pathway 5 (i.e., long-term exposures to reservoir sediments under Dams-In Scenario) considers how aquatic biota and humans are affected by eating fish that have been exposed to reservoir sediments.

[101] That is: DPS green sturgeon, SONCC coho salmon, and Southern DPS eulachon.

[102] The SEF is focused on evaluating potential risks in freshwater, not the marine environment.

[103] See tables 3.3-9 through 3.3-12.

levels for fish consumption, for one or more of the reservoirs.[104] Total toxic equivalencies (i.e., screening levels for a mixture of chemicals) derived from bullhead and perch samples from all reservoirs exceed the human health regional screening levels (RSLs) and acceptable tissue levels corresponding to subsistence fish consumption rates for one-in-a-million cancer risk. CDM (2011) suggests the degrees in which sediment contaminants exceed screening levels are generally small (e.g., the dioxin 2,3,7,8-TCDD was not detected in fish tissue, but its detection limit was higher than human health screening levels) and potentially reflect regional background conditions in some cases. Because of this, concentrations of chemicals of concern in reservoir sediments are considered to be low.

Pathway 1 (i.e., effects from potential short-term water column exposure for freshwater and marine biota from sediments flushed downstream under the proposed action) results suggest that four elutriate chemicals (total phosphorus, aluminum, arsenic, and total PCBs) could have potential short-term, adverse effects on freshwater and marine biota (i.e., less than two years), and periodically minor adverse effects on freshwater receptors. However, rapid mixing, dilution, and dispersion of the sediment as it moves downstream is expected to limit this adverse effect to right below the dams initially post-dam removal. It is unlikely that marine ecological receptors would experience adverse effects from short-term exposure to chemicals in the sediments transported to the estuary and nearshore areas because the reservoirs' fine sediments (silt and clay) would likely remain suspended through the Lower Klamath River and estuary, and their chemical concentrations would be diluted as the sediments mix with sediment loads from the rest of the watershed. AECOM and River Design Group (2020) report that dilution of contaminant concentrations would result in less than significant, adverse effects on benthic invertebrates and fish, including coho salmon, sturgeon, and eulachon.

Pathway 2 includes two lines of evidence to evaluate effects from potential long-term sediment exposure on terrestrial biota and humans from newly exposed reservoir terraces and riverbank deposits (terrestrial exposures). This exposure pathway could result from exposure to the reservoir sediments that become dewatered soil in the reservoir footprints and deposits along the new riverbanks after dam removal. Since sediments mobilized out of the reservoir would no longer be submerged, CDM treated them as soils, instead of sediments. Results suggest the sediments are not highly toxic but indicate arsenic and nickel levels exceed EPA RSLs for residential use, or California Human Health Screening Levels.[105] However, reservoir sediments are not expected to increase nickel concentrations in or along the Lower Klamath River because nickel concentrations are lower in the sediments of the reservoirs than in the estuary (California

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[104] Yellow perch are water column foragers, and bullhead are bottom-dwelling fish, both common in each reservoir and important to the local fishery (CDM, 2011).

[105] The reporting limits for several pesticides and SVOCs are above at least one of the human health SLs while concentrations were non-detectable.

Water Board, 2020a). Some total toxic equivalencies calculated for dioxin, furan, and dioxin-like PCBs are slightly above regional background concentrations and thus have limited potential for adverse effects for terrestrial biota and humans exposed to sediments.

AECOM and River Design Group (2020) also considered pre-dam sediment exposure after reservoir sediment evacuation (aquatic exposures) from drawdown during dam removal and note there would be insignificant contaminant exposures to benthic (bottom-dwelling) invertebrates and fish species through this pathway in J.C. Boyle Reservoir because of coarse substrate and bedrock that would be exposed after fines are evacuated.[106] They report that there could be some long-term dietary exposure to invertebrates that colonize the new soils and enter the food web; limited long-term dietary exposure to terrestrial biota; and short-duration, intermittent exposure to humans who recreate in the reservoir footprints, which would result in less than significant, adverse effects on invertebrates, terrestrial biota, and humans. Considering the relatively small amount of sediment expected to be deposited as soil,[107] the low toxicity of current reservoir sediments, and expectation that human exposures would be infrequent and of short duration, we conclude that further evaluation of arsenic concentrations in sediment deposited along the Lower Klamath River, as proposed by KRRC in its Sediment Deposit Remediation Plan, would adequately address the proposed action's potential for adverse effects on human health and the need for mitigation. We discuss KRRC's Sediment Deposit Remediation Plan in detail in section 3.1, *Geology and Soils.*

Pathway 3 includes 16 lines of evidence to evaluate effects from potential long term sediment exposure on aquatic biota and humans from the new river channel in the reservoir footprints and riverbed deposits downstream of the project dams (aquatic exposures) under the proposed action. CDM (2011) states that the evaluation is based on sediment transport modeling performed as part of the Klamath River dam removal study (Reclamation, 2011a; Stillwater Sciences, 2008). Multiple simulations using DREAM-1 indicate that dam removal would result in little to no discernable deposition of fine-grained sediment (i.e., silts and clays), but possible deposition of coarser sediment (i.e., sand), not typically associated with appreciable contaminant levels. Deeper sediments would be exposed under the proposed action when reservoir footprints become eroded by new stream channels, versus baseline conditions where deeper sediments would remain buried by surficial sediment deposits.

CDM (2011) reports that under the proposed action, accumulation of chemicals in fish is unlikely to pose a risk to humans because it is expected to occur at a slower rate and at lower concentrations than currently occurs for fish living in the reservoirs. CDM (2011) states that exposure to chemicals in sediment deposited in the aquatic environment downstream is unlikely to have long-term, adverse effects on freshwater and human

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[106] Contaminants generally do not adhere well to coarse substrates or bedrock.

[107] Soil is not submerged under water. Sediment is submerged under water.

receptors, because chemical concentrations are generally low, and most sediments would be carried to the ocean and dispersed once the dams are removed. The multiple lines of evidence also suggest that exposure to chemicals in the newly formed river channel have a low potential to cause long-term, adverse effects on freshwater and human receptors, because chemical concentrations are generally low, and the new riverine environment would provide less time and fewer opportunities for freshwater and human receptors to be exposed to contaminants. For example, fish using the new riverine habitat within the reservoir footprints and existing downstream habitat would have less exposure to contaminants than fish currently residing in the reservoirs because sediments would be dispersed, meaning intermittent exposure in the river, instead of continuous exposure in the reservoir. AECOM and River Design Group (2020) note that in the first year or two after initiation of J.C. Boyle Reservoir drawdown, the bed of the new riverine channel in the reservoir footprint is expected to be primarily sand, which generally poses relatively low toxicity risk and is expected to disperse rapidly, especially through the steep channel reach below J.C. Boyle.[108] They also note there is some potential for dry upland reservoir sediments to become airborne on warm, windy days following drawdown if revegetation efforts are less successful, but exposure would be less than significant because of spatial and temporal limitations (AECOM and River Design Group, 2020).[109]

Pathway 4 includes 12 lines of evidence to evaluate the effects from potential long-term exposure on marine- and nearshore sediment that would be deposited under the proposed action. J.C. Boyle Reservoir sediments contain Dieldrin at a concentration that exceeds the marine SEF screening level 1, and 2,3,4,7,8-PECDF that exceeds the Oregon DEQ bioaccumulation screening-level value in 1 of 14 samples (CDM, 2011).[110] Evaluation of elutriate chemistry indicates exceedances of marine water quality criteria at potentially harmful or toxic concentrations. Copper and other chemicals with the greatest potential to cause adverse effects in elutriate are primarily expected to bind to particulate matter, resulting in minimal increases of the dissolved form, which is more toxic. Although phosphorus may reach levels that exceed marine water quality criteria during drawdown of the reservoirs, these levels are expected to decrease over the long term. Chemical concentrations are expected to be reduced to non-concerning levels prior to settling in widespread, long-term depositional areas offshore (CDM, 2011). Under the proposed action, they are expected to mix with sediments from the rest of the watershed, become diluted by water flow from tributaries, and be dispersed by water currents and

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[108] Coho salmon are the only ESA-listed species that could be exposed to sandy deposits, specifically when they migrate to the Klamath River in the spring.

[109] It is anticipated that restoration efforts at J.C. Boyle Reservoir are more certain to be effective compared to the other reservoirs because J.C. Boyle reservoir has a smaller surface area and cooler climate.

[110] Although the Oregon DEQ bioaccumulation screening level is exceeded, it is not a regulatory requirement in the estuary, which is in California.

wind (CDM, 2011). AECOM and River Design Group (2020) also state that the deposition of reservoir sediments under the proposed action would occur in a much larger area than the reservoirs and would have less than significant, adverse effects on aquatic biota, terrestrial biota, and humans.

Pathway 5 includes 16 lines of evidence to evaluate long-term exposure to reservoir sediment under continued operation of the project. Existing sediments in the project's reservoirs and the estuary contain the following chemicals of particular concern: three metals (arsenic, iron, and nickel), four pesticides (4,4-DDD, 4,4-DDE, 4,4-DDT, Dieldrin), several dioxin and furan congeners, and pentachlorophenol (wood preservative).[111] CDM's evaluation suggests that current fish tissue concentrations of arsenic, mercury, total PCBs, and dioxins and furans (based on 2,3,7,8-TCDD[112]) exceed human health screening levels for fish consumption for one or more of the reservoirs. All total toxicity equivalencies for humans exceed the human health RSLs and acceptable tissue level for subsistence fish consumption rates (derived for bullhead and perch samples from all reservoirs) based on one-in-a-million cancer risk.[113] AECOM and River Design Group (2020) note coho salmon are not exposed to reservoir sediments under pathway 5 due to the lack of fish passage at the Iron Gate, Copco and J.C. Boyle Dams. They also state that current conditions expose aquatic receptors to maximum levels of sediment toxicity and bioaccumulation in the reservoirs due to the undiluted sediment.

In summary, the screening-level evaluation of contaminants in sediments collected in 2009–2010 (CDM, 2011; AECOM and River Design Group, 2020; CAMAS, 2021; EPA, 2021a) provides a reliable evaluation of sediment toxicity and determination of short- and long-term effects likely to be caused by the presence of contaminants in the sediment under the baseline and proposed action. Potential adverse effects on freshwater, oceanic, and terrestrial biota in both the short- and long-term would be less than significant because the proposed single-year drawdown of the project's reservoirs is expected to rapidly transport most of the mobilized reservoir fine sediments through the river system to the ocean and likely shorten the period for contaminant loading to the Lower Klamath River and estuary.

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[111] See tables 3.3-9 through 3.3-12.

[112] The laboratory detection limit for dioxin 2,3,7,8-TCDD exceeded human health screening levels for fish tissue, so it was conservatively estimated to be present in fish tissue, even though it was not detected. CDM (2011) also notes atmospheric deposition has been linked to high concentrations of several of the chemicals exceeding human health screening levels for fish tissue.

[113] AECOM and River Design Group (2020) state the evaluation of long-term exposure pathways for baseline conditions (i.e., no action/dams in) were not required by the 2018 SEF; therefore, they provided no additional evaluations for Pathway 5.

3.3.3.2 Water Temperature

Drawdown and removal of the four project reservoirs would influence water temperature within and downstream of the hydroelectric reach, which could affect aquatic biota. Several commenters expressed concern that removing the reservoirs could cause water temperatures to become less suitable for salmon.

Our Analysis

Currently, the Copco No. 1 and Iron Gate Reservoirs undergo seasonal thermal stratification (figures 3.3-3 and 3.3-4, respectively), and releases from Iron Gate Dam cause a seasonal delay in the temperature regime in the Lower Klamath River (figure 3.3-5). The temperature throughout the Lower Klamath River frequently exceeds the EPA 7DADM temperature guidelines of 20°C for the protection of salmonid adult migration; 16°C for juvenile rearing; and 13°C for spawning, incubation, and emergence (figure 3.3-8).

The proposed action would permanently convert the reservoirs to riverine reaches within their footprints and create a more natural hydrologic regime through the hydroelectric reach and Lower Klamath River. The geomorphology and hydraulics in the vicinity of several tributaries that currently flow into the reservoirs would be altered by drawdown of the reservoirs and sediment jetting near their confluences with the mainstem during the drawdown, and alterations would continue while the new riverine reaches become established within the reservoir footprints. The new riverine reaches would be subject to considerable solar radiation, which could substantially warm these waters until riparian vegetation become established within the previously impounded areas as proposed by KRRC in its RAMP.

Our analysis of the proposed action's effects on water temperature is based on simulations performed using the three numeric water temperature models described below. The scenarios evaluated and boundary conditions used in these simulations are shown in (table 3.3-20).

1) The PacifiCorp (2004c, 2005) model developed on a 1-dimensional Resource Management Associates-2 hydrodynamic platform and a Resource Management Associates-11 water quality processes platform linked to a 2-dimensional CE QUAL W2 platform to simulate conditions from the Link Dam to Turwar (RM 6) for relicensing the Klamath Hydroelectric Project.[114]

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[114] The PacifiCorp model simulates hourly temperature through the application of 2 dimensions (i.e., length and depth) for each impoundment and assumes complete mixing throughout the water column for all riverine reaches.

2) The NCRWQCB (2010) TMDL model, which extends the downstream end of the PacifiCorp model from Turwar to the Pacific Ocean using the 3-dimensional environmental fluid dynamics code platform.[115]
3) The RBM10 model used by Perry et al. (2011), a 1-dimensional model for the Link Dam to the Pacific Ocean developed on the River Basin Model 10 platform to evaluate climate change.[116]

The primary limitations for these models are:

- None of the models can predict the temperature regime in local areas where cool water enters the river from groundwater or tributary sources.
- The PacifiCorp model cannot predict conditions downstream of Turwar.
- The TMDL model simulations assume that measures have been taken to meet temperature load allocations.[117]
- The RBM10 model simulations for Iron Gate Dam are likely less reliable than other locations due to the assumption that the entire water column of each reservoir is fully mixed.
- Assumptions associated with growth of vegetation that would provide riparian shading in the reservoir footprints are not evident for any of these models.

Simulations performed using all three models indicate that removal of the four Lower Klamath Project dams would cause water temperatures downstream of the Iron Gate Dam site to be higher from February to July and lower from August to November compared to existing conditions (figures 3.3-5 and 3.3-30). The reason for this shift is that under current conditions the large thermal mass of the reservoirs (especially Copco No. 1 and Iron Gate) delay warming in the spring and cooling in the fall, and this delay would no longer occur if the dams are removed. All three models indicate that with the

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[115] The TMDL model simulates hourly temperature between Link Dam and Turwar like the PacifiCorp model and applies a 3-dimensional approach between Turwar and the ocean.

[116] The climate change model simulates daily average temperature assuming complete mixing throughout the water column for all reaches, including the impoundments and estuary.

[117] Although the TMDL's baseline scenario (T1BSR) and Oregon and California allocation scenarios (TOD2RN/TCD2RN) assume Keno Dam is removed, the Keno reach would still be partially impounded by the natural reef, which is 2 feet lower than the current full pool elevation for the Keno impoundment, Lake Ewauna. Therefore, this assumption is not expected to materially influence the model results.

dams removed, water temperatures below Iron Gate Dam would increase by about 1 to 2.5°C in the spring and decrease by about 2 to 10°C in the late summer and early fall.

Model simulations also indicate that the difference between water temperatures under existing conditions and with the dams removed would decrease with distance downstream from Iron Gate Dam as outflows are diluted by inflows from tributaries and as water temperatures equilibrate with air temperatures (see figures 3.3-30 and 3.3-31 for the RBM10 model). Figure 3.3-32 indicates that removal of the dams would increase the mean water temperature in the Klamath River in May by about 2°C below Iron Gate Dam but only by about 1°C below the confluence with the Scott River. The mean temperature in October would decrease by about 4°C below Iron Gate Dam but that decrease would be reduced to less than 1.5°C downstream of the Scott River confluence and by less than 0.5°C below the Trinity River confluence. Perry et al. (2011) report that removal of the dams would cause the annual temperature cycle (warming in the spring and cooling in the fall) to occur about 18 days earlier below the Iron Gate Dam site, 6 days earlier at the confluence with the Scott River, and 2 days earlier at the confluence with the Trinity River.

TMDL model simulations of hourly water temperatures indicate that removal of the dams would result in much larger daily fluctuations, which are characteristic of natural conditions, just below the Iron Gate Dam site (NCRWQ, 2010). The increase in daily fluctuations would diminish with distance downstream and would be negligible downstream of the Shasta River confluence.

The 1-dimensional RBM10 model simulations for RM 2.7 indicate that removal of the dams would have little effect on the estuary’s daily average temperature (Perry et al., 2011). The California Water Board (2020a) concludes that any resulting changes to the estuary’s morphology would not be likely to increase short-term estuary water temperatures in a manner that would cause or substantially exacerbate an exceedance of water quality standards or result in a failure to maintain the beneficial uses that are currently supported.

Air temperatures in the Klamath River Basin are expected to be higher than the 1961–1990 conditions by 1.1 to 2.0°C in 2035–2045 and 2.6 to 4.0°C later in this century, with greater increases in the summer and lesser increases in the winter (Barr et al., 2010). Bartholow (2005) reports that HEC-5Q[118] model simulations indicate that water temperatures in the Lower Klamath River have increased by about 0.5°C per decade since the early 1960s.[119] Bartholow states that this trend seems unrelated to any

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[118] HEC-5Q is a 1-dimensional water quality model developed by the Corps’ Hydrologic Engineering Center.

[119] This estimate is based on historical gauge data from 13 stations with more than 10 years of data collected between 1962 and 2001. The model was used to fill in gaps in the data record to eliminate some of the uncertainty associated with the handling of missing data in the statistical analysis.

change in hydrology below Iron Gate Dam but is consistent with measured basin-wide increases in air temperature.

Perry et al. (2011) used the RBM10 model to evaluate the potential effects of climate change on water temperature by comparing simulation results for historical conditions with air temperatures predicted by five global circulation models. Simulations for 1961–2009 historical conditions indicate that with the removal of the dams,[120] future water temperature increases would be less than if the dams remain in place with the current flow regime as required by the 2010 BiOp (figure 3.3-33). Water temperatures predicted using all five of the global circulation models increase compared to historical conditions for nearly all decades from 2012 to 2061 (figure 3.3-33), increasing by about 1 to 2.3°C over 50 years.

Localized water patches that are cooler than the river's main flow can provide important thermal refugia for aquatic organisms. Cooler water patches above Iron Gate Dam are generally created by cold-water springs and seeps; whereas, downstream from Iron Gate Dam cold-water refugia are generally created by cool-water tributaries (Strange, 2010). Studies in the Lower Klamath River documented the following characteristics for cool-water areas:

- Relatively cool water (10.0-21.5°C) compared to 21.3-26.2°C in the Klamath River mainstem in July and August of 1996 (Belchik, 1997).
- Twenty-eight of the 35 confluences for flowing tributaries from Iron Gate Dam to Seiad Creek had cool-water areas; 4 sites >1,000 square feet; 14 sites between 50 and 1,000 square feet; 9 sites <50 square feet; and Bogus Creek had a cool area for a short period (Belchik, 1997).[121]
- Twenty-two of 26 Lower Klamath River tributaries from Cottonwood Creek (RM 184.5) to Seiad (RM 134.8) were cooler than the Klamath River at the confluence on July 27, 1998 (figure 3.3-34) (McIntosh and Li, 1998).[122]

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[120] Although the RBM10 simulations assumed implementation of flow measures identified in the KBRA and the KBRA has not been implemented, their simulations indicate little change in water temperatures at Keno Dam, indicating that the changes in simulated temperatures downstream of Keno Dam are primarily attributable to removal of the dams.

[121] Tributaries that did not provide cool-water areas are the Shasta River; Cottonwood and Dogget Creeks, and Brushy and Sambo Gulches; the Ash and Dutch Creek confluences with the Klamath River were not evaluated because their entry points are in rapids.

[122] Tributaries that did not provide cool-water areas are the Shasta River, Cottonwood and Little Humbug Creeks.

- Springs/seeps accounted for four cool-water areas ranging in size from 4 to 225 square feet (Belchik, 1997).
- None of the 46 mainstem pools were thermally stratified by more than 0.1°C (McIntosh and Li, 1998).

The proposed action's potential to alter or eliminate the cooler water patches depends primarily on any effect on sediment deposition in and around these areas in the Lower Klamath River and the altered flow regime in the reach between J.C. Boyle Dam and the Copco No. 1 Reservoir footprint. As discussed in section 3.1.3.2, *Effects from Mobilization of Sediments*, most of the reservoir sediment mobilized during drawdown and future high flows would be flushed through the Lower Klamath River and estuary, but deposits of coarse-grained sediments (i.e., sand and larger) would occur between Iron Gate Dam and Cottonwood Creek (RM 193.1 to RM 185.1) following drawdown and continue over the long term. Although this deposition could reduce the size of cool-water patches in this 8-mile-long reach of the Lower Klamath River, we do not anticipate a significant reduction in the size of other cool-water patches or alteration of pools in a way that would result in thermal stratification within the remainder of the Lower Klamath River.

After dam removal, tributaries and groundwater that currently flow into the reservoirs would flow directly into the mainstem Klamath River and have more influence on local water temperatures. Based on historical maximum temperatures, we anticipate that Fall, Shovel, and Spencer Creeks would likely create patches of cool water that could be used as thermal refugia.[123]

The proposed action would alter the size and temperature differential of the patches of cool water in the J.C. Boyle bypassed reach that is created by about 220 to 250 cfs of groundwater inflows (FERC, 2007). Current operations divert most of the flow around the J.C. Boyle bypassed reach, causing the cool groundwater inflows to account for about two-thirds of the flow and reducing water temperature. The proposed action would permanently cease diversion around the bypassed reach, significantly reducing the proportion and influence of groundwater flow on water temperatures in this reach. PacifiCorp (2004c)[124] indicates that summertime temperatures would generally increase in the bypassed reach, and daily temperature fluctuations between the J.C. Boyle Powerhouse and Copco No. 1 Reservoir would shift from an artificial pattern caused by J.C. Boyle peaking operations to a natural daily pattern. Although the effects of

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[123] Fall, Shovel, and Spencer Creeks have historical (1950–2008) maximum daily temperatures of 14.6, 17.1, and 22.2°C, respectively (Flint and Flint, 2012). TMDL modeling indicates water temperatures as high as 25°C occur immediately downstream of Keno Dam (NCRWQCB, 2010, appendix 7).

[124] Based on comparison of scenario WIGCJCB to EC (refer to table 3.3-20).

groundwater inflows on average water temperatures in the bypassed reach would be reduced, the groundwater inflows would still create cool-water patches in the reach.

We conclude that the effects of the proposed action would be permanent, significant, and beneficial by shifting to a more natural temperature regime with earlier warming in the spring and cooling in the late summer and early fall in the hydroelectric reach and the Lower Klamath River down to the Trinity River confluence. Although the size of cool-water patches in the J.C. Boyle bypassed reach would be permanently reduced, patches of cool water would be created at the mouth of tributaries to the new riverine reach in the reservoir footprints. In the Lower Klamath River, patches of cool water are expected to continue to occur near inflow from cool-water tributaries and springs.

3.3.3.3 Nutrients, Dissolved Oxygen, and pH

Currently, much of the hydroelectric reach and the Lower Klamath River have been listed as impaired by high concentrations of nutrients and low DO (table 3.3-6). The nutrient-rich conditions cause seasonal algal blooms in Copco No. 1 and Iron Gate Reservoirs that contribute to low DO in the hypolimnion and high pH near the surface (figure 3.3-10). As a result, the river downstream of Iron Gate Dam receives water with low DO and high pH. Although the project implements turbine venting at Iron Gate Powerhouse whenever DO levels fall to or below 87 percent of saturation in the Klamath River downstream of the dam, DO still occasionally falls below 90 percent of saturation immediately below Iron Gate Dam (figure 3.3-7). Mechanical reaeration and, to a lesser extent, photosynthesis generally increase daily average DO to greater than 90 percent of saturation within 6 miles of the dam (Mejica and Deas, 2020).

Drawdown and removal of the four project reservoirs would alter nutrient dynamics in the hydroelectric reach and downstream of the hydroelectric reach in the Lower Klamath River. Concentrations would change for different forms of nutrients and DO, as well as pH, and these changes would affect aquatic biota and compliance with applicable water quality standards. Several commenters expressed concern that removing the reservoirs could adversely affect water quality in the Lower Klamath River.

Our Analysis

The proposed action would have short-term effects from the release of nutrients stored in the reservoirs' sediments and alteration in the reservoir's seasonal nutrient uptake and release during and following drawdown. Long-term effects would result from conversion of the reservoirs to riverine reaches.

Short-term Effects

Drawdown of the reservoirs would release sediments and associated nutrients that have accumulated in the reservoirs. The drawdown is scheduled to occur during seasonal high flows in the late winter and spring to quickly flush sediments and associated organic matter through the hydroelectric reach and Lower Klamath River with little deposition along the way. In addition to eliminating the reservoirs, the proposed action would stop diverting water from the J.C. Boyle bypassed reach and cease peaking operations at the J.C. Boyle Powerhouse. Oregon DEQ (2018b) concludes that drawdown of J.C. Boyle Reservoir would have minimal effects on water quality, including phytoplankton production and pH fluctuations, because nutrients would be exported quickly through the system during a cool period with limited sunlight that maintains low levels of primary production, nutrient cycling, and bioavailability. We note that the short retention times of J.C. Boyle and Copco No. 2 Reservoirs[125] has limited sediment accumulation in them; therefore, much less sediment would be released from them than from Copco No. 1 and Iron Gate Reservoirs. Nutrient concentrations are expected to decrease as the remaining volume of sediment in the reservoirs decreases and as inflow from downstream tributaries dilutes the concentration of suspended material (Oregon DEQ, 2018b). Reduction and the ultimate elimination of the reservoirs is also expected to virtually eliminate the seasonal release of nutrients (e.g., ortho-phosphorus, nitrate, and ammonium), which currently occurs under low DO conditions in late summer to early winter.

PacifiCorp (2017b) states that the proposed action would increase DO demand and reduce DO concentrations in the hydroelectric reach and in the Lower Klamath River from Iron Gate downstream to RM 100 (Clear Creek). To evaluate the short-term effects on DO in the Lower Klamath River for the Secretarial Determination, Stillwater Sciences (2011) developed a simplified spreadsheet model based on a modification of Streeter and Phelps (1925) formula that incorporates an initial DO concentration, initial oxygen demand, and BOD rates that deplete as a function of SSCs; reach-specific sediment oxygen demand rates; Klamath River channel geometry, hydrology, and water temperature; and hydrology for 17 tributaries downstream of Iron Gate Dam.[126] The initial oxygen demand and BOD rates were developed based on laboratory analyses of sediments collected from Copco No. 1 and Iron Gate Reservoirs.[127] This model also incorporates depletion rates for initial oxygen demand and BOD that are dependent on

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[125] At average flows, retention times are 1.2 days in J.C. Boyle Reservoir and about 30 minutes in the Copco No. 2 impoundment compared to 12 and 16 days in Copco No. 1 and Iron Gate Reservoirs, respectively.

[126] The Water Quality Sub Team and the Engineering/Geomorphology/ Construction Sub Team for the Klamath Dam Removal Secretarial Determination process deemed this model appropriate to assess a range of potential downstream DO impacts on aquatic resources caused by removal of the dams.

[127] Initial oxygen demand is the amount of oxygen needed by reduced metals and chemicals in anoxic sediments that would be released or resuspended, and BOD is the amount of oxygen needed by aquatic microbes to metabolize organic matter, and oxidize ammonia reduced nitrogen species and reduced mineral species (e.g., ferrous iron).

SSCs and Klamath River channel geometry, and water temperature.[128] KRRC (2021f) updated this model with the revised drawdown schedule to simulate its short-term effects on DO.

KRRC simulated a range of potential short-term effects of reservoir drawdown on DO in the Lower Klamath River by simulating conditions under high suspended sediment concentrations with water passing Iron Gate Dam at 80 percent of saturation as a high level and 0 percent of saturation to represent worst-case conditions.[129] These simulations were conducted for WY 1991 and 1970, which KRRC (2021f) categorized as median and severe impact years, respectively, for coho salmon using the boundary condition input values shown in tables 3.3-21 and 3.3-22.[130] These tables also show the simulated minimum DO and its distance downstream of the Iron Gate Dam site. Figures 3.3-35 to 3.3-38 show when and where simulated DO is less than 5 mg/l, 5–7 mg/l, and greater than 7 mg/l.

Simulated DO concentrations are less than 5 mg/l during high SSC events that would occur in mid-January and mid-June under the median impact year (1991) and mid-June under the severe impact year (1970). The mid-January event would result from sediment mobilization associated with reservoir drawdown. Both mid-June events are associated with sediment mobilization due to the removal of the Copco No. 1 cofferdam (see tables 3.3-21 and 3.3-22).

As shown in figures 3.3-35 to 3.3-38, DO is expected to increase with distance downstream from the Iron Gate Dam site as it becomes reaerated from turbulence and mixes with inflow from tributaries. The distance and length of time that low DO conditions persist would vary based on SSCs, water temperature, DO saturation, and inflow from tributaries.

We conclude that the proposed action would result in a short-term, significant and unavoidable reduction in DO levels in the Lower Klamath River, which would adversely affect aquatic resources. This adverse effect would likely extend the farthest downstream during the pulse of suspended sediment caused by the initial drawdown of the reservoirs (figures 3.3-35 to 3.3-38).

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[128] Stillwater Sciences (2011) discuss specific sampling and analysis procedures used to derive the rates for initial oxygen demand, biological oxygen demand, sediment oxygen demand and other factors incorporated into the model and the model verification process.

[129] KRRC (2021f) indicates that flow passing through Iron Gate tunnel may result in 100 percent of saturation, but it uses 80 percent of saturation as a conservative estimate for the high initial DO.

[130] Based on simulated suspended sediment concentrations and an analysis of severity of adverse impacts on coho salmon, the KRRC (2021f) categorizes WY 1991 and 1970 as median and severe impact years, respectively.

Long-Term Effects

The proposed action would convert the project reservoirs into riverine reaches, which would become more stable through time especially with implementation of measures proposed in the RAMP (KRRC, 2021d).[131] These new riverine reaches are expected to consist of about 17 miles of mainstem habitat, 1.2 miles of side channels, and 4.2 miles of tributaries within the reservoir footprints (KRRC, 2021d). KRRC estimated the post-drawdown topography in the reservoir footprints (figures 3.3-39 to 3.3-41) based on bathymetric data collected in 2018, estimates of sediment thicknesses from past coring studies in the reservoirs, and assumptions for the response of the sediment to dewatering based on previous sediment analyses of each reservoir. The primary assumptions used in this process were:

- All sediment within active river and tributary channels and steep narrow valleys would be naturally mobilized and transported beyond the reservoir footprint.
- The Klamath River and its tributaries would occupy about the same alignment as they did historically.
- The sediment would initially dry and shrink by 40 percent.
- Sheer cliffs would fall to an angle of repose of 10:1 vertical to horizontal (i.e., about 84 degrees).

Conversion of the reservoirs to riverine habitat would provide the opportunity for periphyton to become established in the new river channels in the reservoir footprints. However, the flow regime under the proposed action is expected to limit most periphyton growth in the mainstem to the margins of low-gradient portions of the Copco No. 1 and Iron Gate Reservoir footprints (California Water Board, 2020a). The proposed action would not completely prevent the potential for growth of nuisance periphyton species (i.e., *Cladophora* sp., which indirectly contributes to fish disease) in these areas.

Asarian et al. (2010) evaluated the long-term effects from removal of the dams through a mass-balance analysis of seasonal total phosphorus and total nitrogen loads. They computed historical flow-weighted average concentrations and retention rates for the Copco–Iron Gate Reservoir complex and then estimated the conditions with the dams removed assuming the new riverine habitat through the reservoir footprints would retain total phosphorus and total nitrogen at the same rate as nearby Klamath riverine reaches. This analysis suggests that the largest effects of removing the dams would be a significant reduction in retention of total nitrogen in July through September, which would increase from about 1.1 mg/l to about 1.6 mg/l based on 2007–2008 conditions

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[131] Proposed measures that would encourage stabilization of the riverine reaches over the long term include, but are not limited to, sediment jetting, grading, and flushing sediments using portable pumps from tributaries that extend in the former reservoirs.

(figure 3.3-42). With less retention of nutrients in the reservoir footprints, more of the inflowing nutrients would be passed through the hydroelectric reach to the Lower Klamath River and would increase the average concentration of total nitrogen and total phosphorus farther downstream, but these effects would be diminished to insignificant from Orleans (near RM 60) to the ocean (Asarian et al., 2010). Stream restoration and implementation of the TMDLs in the Upper Klamath River Basin (Oregon DEQ, 2002, 2019b) are expected to reduce nutrient concentrations of inflows to the hydroelectric reach through time. These reductions in nutrient loads would also reduce total nitrogen and total phosphorus concentrations within and downstream of the hydroelectric reach. In addition, non-project habitat restoration and enhancement projects in tributaries and implementation of TMDLs in the Lower Klamath River (NCRWQCB, 2010) are expected to further reduce total nitrogen and total phosphorus concentrations in the mainstem downstream of the confluences of the associated tributaries.

In the Lower Klamath River, the algal and macrophyte community dynamics are complex and determined by numerous factors, including the availability of nitrogen and phosphorus, nitrogen-to-phosphorus ratios, light penetration, and stream roughness and velocities. Under current operations, trends in the abundance of nitrogen-fixing periphyton suggest that algal growth becomes nitrogen-limited downstream of Seiad Valley (California Water Board, 2020a). If this is true, the expected increase in nitrogen concentrations would likely shift nitrogen-fixing algae farther downstream than their current upstream limit near the Seiad Valley, and the upstream algae community could benefit by replacement with non-nitrogen-fixers (Asarian et al., 2010).

The TMDL (NCRWQCB, 2010) model results also provide insight into the long-term effects that would likely occur after removal of the project's dams, although it is important to keep in mind that the "dams-out" scenario for this model assumed removal of Keno Dam and reduction of temperature and nutrient loads to meet TMDL allocations. Although the dams-out scenario indicates a slight increase in the concentration of total phosphorus and total nitrogen immediately downstream of the J.C. Boyle Dam site, the California Water Board (2020a) concludes that concentrations in the hydroelectric reach would likely remain unchanged, because the proposed action does not include removal of Keno Dam. The proposed action would eliminate the project's slow-moving reservoir habitat and reduce nutrient availability in the summer and fall, which would likely eliminate phytoplankton blooms (including blue-green algae blooms) and increase periphyton colonization in the Copco No. 1 and Iron Gate Reservoir footprints.

The Klamath River TMDL model supports the conclusions of Asarian et al. (2010) that dam removal would result in very small annual increases in total phosphorus and larger annual increases in total nitrogen immediately downstream from the Iron Gate Dam site due to dam removal, and these increases in nutrients would diminish with distance downstream from the Iron Gate Dam site (California Water Board, 2020a). The proposed action would eliminate seasonal releases of dissolved forms of nutrients from deep anoxic reservoir waters, which are currently available for phytoplankton growth during the growing season. In the Lower Klamath River, long-term effects of the proposed action would not support the growth of nuisance and/or noxious phytoplankton or nuisance periphyton and would not result in a failure to maintain a beneficial use or cause an exceedance or exacerbate an existing exceedance of a water quality objective. Elimination of seasonal releases of dissolved nutrients from the reservoir bottom waters to downstream reaches of the Klamath River would be beneficial (California Water Board, 2020a). The California Water Board (2020a) also concludes that the proposed action would result in a small increase in total nutrient concentrations on an annual basis in the Pacific Ocean nearshore environment but is not expected to exacerbate exceedances of water quality objectives for biostimulatory substances.

Comparison of simulated hourly DO concentrations and pH under the TMDL dams-out to existing scenarios (Tetra Tech, Inc., 2009) suggest long-term effects from the proposed action include:

- DO and pH would likely remain nearly unchanged immediately downstream of the J.C. Boyle Dam site.
- Elimination of peaking operations at the J.C. Boyle development would likely reduce the spring-fall fluctuations in DO concentrations and in pH at the Oregon-California state line.
- DO concentrations would be higher below the Iron Gate Dam site throughout most of the summer and fall, partially due to the coinciding reduction in water temperature. The long-term effects on DO concentrations would generally diminish with distance downstream of the Iron Gate Dam site and would be very small upstream of the Indian River confluence.
- pH could be slightly higher in summer to early fall below the Iron Gate Dam site and result in exceedances of the 9.0 standard unit upper objective downstream of the Iron Gate Dam site in June and July and upstream of the Shasta River in June through August. However, pH would generally have less than significant adverse effects in the Klamath River from the Shasta River confluence to the ocean.

We conclude that the proposed action would result in:

- Permanent, significant, seasonal, beneficial effects from conversion of the reservoirs to riverine reaches that would increase DO via aeration and eliminate internal loading of ammonia and orthophosphate; and
- Permanent, significant, beneficial effects from eliminating seasonal algae blooms in Copco No. 1 and Iron Gate Reservoirs would reduce large fluctuations in DO and pH.

3.3.3.4 Microcystin

Since 2005, the Klamath River and Lower Klamath Project reservoirs have experienced large blue-green algae blooms of *Microcystis aeruginosa*, which produces a liver toxin, hepatotoxin (microcystin) that can affect the health of both humans and animals (California Water Quality Monitoring Council, 2021; OEHHA 2012). While overall microcystin concentrations are anticipated to decline significantly with the removal of the reservoirs, the California Water Board, in its 401 certification, states that the proposed action could continue to contribute nutrient inputs into the Klamath River that could support algal blooms either from: (1) additional inputs of dormant blue-green algae and sediment-associated nutrients from sediments that would remain in former project reservoirs areas that may continue to erode; and/or (2) reservoir sediments that would be deposited in backwater areas of the Klamath River following reservoir drawdown. Some commenters noted that most of the microcystin is produced in Upper Klamath Lake, and that Copco No. 1 and Iron Gate Reservoirs actually reduce the amount of microcystin that is transported downstream. Several commenters also stated that no adverse health effects on humans or animals due to microcystin exposure have been reported at either reservoir.

Our Analysis

Summer and fall blooms of *Microcystis aeruginosa* currently occur annually, resulting in microcystin exceeding levels set to protect human health in Copco No. 1 and Iron Gate Reservoirs and the Lower Klamath River (table 3.3-16 and table 3.3-17 and figure 3.3-7, respectively). The proposed action would have effects over the short- and long-term due to drawdown and elimination of the project's reservoirs.

The proposed drawdown schedule would virtually eliminate the project reservoirs by July in the drawdown year (figures 3.2-3 to 3.2-6). Although drawdown would release nutrients with the suspension and downstream transport of reservoir sediments, conversion of the reservoirs from their current slow-moving thermally stratified characteristics, which are preferred by *Microcystis* (Paerl et al., 2001), into much faster well-mixed riverine habitat would generally not support blooms of *Microcystis* and other blue-green algae. However, we expect the drawdown process to result in some areas of standing water within the reservoir footprints that would be only marginally connected to the river's main flow during the drawdown. These areas could support development of localized blue-green algal blooms in the latter part of the drawdown in a wet year. Any such bloom would be localized and short-lived as the reservoirs are drawn down and these areas become isolated from the main river channel.

Although we recognize that microcystin can be produced by numerous blue-green algae, including *Microcystis*, *Anabaena*, *Aphanocapsa*, *Gloeotrichia*, *Hapalosiphon*, *Nostoc*, *Oscillatoria*, and *Pseudanabaena* (Smith et al., 2021) and not all *Microcystis* in the Klamath River Basin create microcystin (Otten et al., 2015; Eldridge et al., 2012), *Microcystis aeruginosa* dominates the blue-green algae blooms in Copco No. 1 and Iron

Gate Reservoirs and its density has a strong correlation with microcystin concentration in the Klamath River Basin (Otten et al., 2015). Therefore, we conclude that the lower *Microcystis aeruginosa* densities would result in lower microcystin concentrations in the reservoir footprints. Since Iron Gate Reservoir is the primary source of the Lower Klamath River's *Microcystis aeruginosa* (Otten et al., 2015), the lower levels of *Microcystis* and microcystin are expected to continue through the Lower Klamath River.

We concur with the California Water Board's statement that dormant blue-green algae would be released from the reservoir sediments during the drawdown and that *Microcystis* cells that overwinter in the sediments could inoculate subsequent blooms (Cai et al., 2021). However, the trend of lower *Microcystis aeruginosa* densities and microcystin concentrations with distance downstream of Iron Gate Dam in both open-channel and slow-moving shoreline habitat suggests that growth of *Microcystis aeruginosa* is limited to slow-moving habitat along the shoreline (Genzoli and Kann, 2017). Therefore, we conclude that *Microcystis* could develop localized blooms and elevated microcystin concentrations in these slow-water areas of the Lower Klamath River and estuary, but they would have minimal effect on microcystin in the river's main flow.

We have not located any documentation of microcystin-related adverse health effects in humans or animals that are specifically associated with the project reservoirs. However, the lack of such information does not diminish the risks that are associated with consumption of water and/or aquatic organisms (e.g., fish and mussels) with high microcystin concentrations.

We conclude that the proposed action would permanently and significantly reduce the summer and fall density of *Microcystis* from the Copco No. 1 Reservoir footprint to the Pacific Ocean, which would permanently and significantly reduce the frequency of high microcystin concentrations in these periods, but may not eliminate toxigenic stress on aquatic organisms and potential health risks to recreationists and animals that drink Klamath River water or prey on aquatic organisms from it.

3.3.3.5 Monitoring and Adaptive Management

The proposed action has the potential to cause short-term and permanent adverse effects on water quality within the hydroelectric reach and Lower Klamath River including the estuary. Contact with water during recreation has the potential to expose recreation users to conditions that could adversely affect their health. Although we have evaluated the potential for effects based on the best available information, there is some uncertainty in the magnitude and longevity of adverse effects that would result from the proposed action, especially under extreme climatic and hydrological conditions.

KRRC's proposed Water Quality Monitoring and Management Plan includes separate subplans for Oregon and California to confirm when exceedances of water quality standards caused by the proposed action cease within each state (KRRC, 2021b). The plan is nearly consistent with the Oregon DEQ WQC conditions 2 and 3 and

California Water Board WQC conditions 1 and 2. However, the Water Quality Monitoring and Management Plan does not include continuous monitoring in the Klamath River at a station between Shovel Creek and Copco No. 1 Reservoir, which is specified in Oregon DEQ condition 2. We assume this inconsistency would be resolved in the Oregon DEQ approval process.

In addition, KRRC (2021a) proposes to monitor water contact water quality constituents (fecal coliform, *Escherichia coli*, and microcystin) following the requirements of the WQCs for Oregon and California at recreation sites where future public water contact could occur, and during construction activities that remove or modify recreation sites.[132] This would include:

- Turbidity monitoring at recreation sites where construction activity would remove or modify the facilities adjacent to existing waterbodies.[133]
- Prior to drawdown of the reservoirs, continuation of monitoring at the existing recreation sites with river access on Parcel B lands, as described in the Operations and Maintenance Agreement (2017) between the KRRC and PacifiCorp.
- KRRC would determine, in consultation with the California Water Board, whether monitoring is warranted at fire access ramps that would be constructed at the Fall Creek Day Use Area and Iron Gate Hatchery Day Use Area.[134]
- Microcystin would be monitored for at least two years following completion of construction or enhancements at new facilities that may be developed by the States of Oregon and California.

Our Analysis

Numerous studies have been conducted to evaluate potential effects on water quality from the proposed action, although there is some uncertainty about the magnitude and time in which it would cause exceedance of state water quality standards. KRRC's Water Quality Monitoring and Management Plan proposes to compare water quality conditions under the proposed action with baseline conditions collected prior to dam

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[132] Refer to Oregon DEQ WQC condition 2 and California Water Board WQC condition 19.

[133] Turbidity monitoring would be conducted approximately 100 feet upstream and 300 feet downstream of construction activity with the potential to cause turbidity consistent with Oregon DEQ WQC condition 2.f.

[134] Although these ramps would be intended for fire access only, their use for boating access would not be limited; therefore, KRRC expects they would be used by the public for boat launching and recreation use.

removal to assess spatial-temporal exceedances of water quality standards (KRRC, 2021b). KRRC would transmit and store the continuous water quality monitoring data in an online database for the six monitored USGS gage sites (tables 2.1-2 and 2.1-3). KRRC would submit monthly reports that include continuous data from all other water quality monitoring stations, results from water quality grab samples, and sediment samples.[135] These monthly reports would include any adaptive management measures taken and proposals of any additional measures to address water quality exceedances caused by the proposed action. This would enable the California Water Board, NCRWQB, and Oregon DEQ to conduct timely evaluations of the data, identify needs for corrective actions to minimize unanticipated adverse effects on water quality, and consider alternatives for further mitigation measures.

Recreational use of surface waters introduces the potential for transmission of disease and cyanotoxins that could adversely affect the health of recreationists. Monitoring fecal coliform, *Escherichia coli*, and microcystin would provide a means of evaluating the water contact health risks at recreation sites. Under the mandated WQC conditions, KRRC would notify the Commission and the California Water Board and post notices at recreation sites to warn the public about the health risks of water contact, if adverse water quality effects that are hazardous to the public were identified during monitoring. We assume that the California Water Board's decision on whether monitoring is warranted at the two new fire access ramps would adequately protect the health of recreational use of these facilities. The effect on the public health of recreation users would be less than significant at the fire access ramps with the monitoring and public notification procedures established in the Recreation Facilities Plan (KRRC, 2021a) and the Water Quality Monitoring and Management Plan (KRRC, 2021b).

KRRC's sediment surveys conducted 12 months and 24 months after completion of drawdown would provide estimates of the amount of sediment in each reservoir footprint, total amount of sediment vacated from the project reservoirs, and amount of sediment that has settled in the Klamath River between Iron Gate Dam and Cottonwood Creek (RM 185). This information would enable resource managers to compare the proposed action's actual sediment balance to calculated values for two time periods that would serve as baselines for any future evaluations. In addition, combining spatial-temporal sediment survey data and sediment grab sampling would provide insight into concentration levels and movement of potential contaminants contained in reservoir sediments. This information could be used to guide restoration efforts and adaptive measures to mitigate for potential adverse effects from the proposed action in the former reservoir footprints and downstream of Iron Gate Dam.

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[135] Results from laboratory analyses would not be immediately available; therefore, they may not be included in the report for the month in which sampling occurred but would be included in the report for the month they are reported.

3.3.4 Effects of the Proposed Action with Staff Modifications

The effects on water quality would be the same as the proposed action with the following exception.

Including Native American Tribes that have obtained CWA treatment as a state status in all reports and correspondence under the Water Quality Monitoring and Management Plan as stipulated by California Water Board WQC condition 22 and staff-recommended modification would facilitate the Tribe's timely evaluation of reports and identification of potential corrective actions to address unanticipated adverse effects of the proposed action on water quality.[136] This could significantly benefit the management of water quality in the Klamath River Basin and result in faster attainment in meeting California state and Tribal water quality standards.

3.3.5 Effects of the No-action Alternative

Under the no-action alternative, there would be no changes in the mobilization of suspended sediments within and below the project area compared to current conditions. Any contaminated sediments held behind the project dams would remain in place and continue to exceed human health screening levels for fish consumption in the reservoirs. In addition, the reservoirs would continue to adversely affect water temperature, and seasonal algae blooms in the reservoirs would continue to cause large fluctuations in DO and pH, and high concentrations of microcystin, both within and downstream of the hydroelectric reach.

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[136] Note that the Native American Tribes have contributed significantly to the current understanding of water quality in the Lower Klamath River, including the estuary.

Table 3.3-1. Native American Tribes that are approved for treatment as a state under the Clean Water Act with associated water quality standards (Source: EPA, 2022a,b; Hoopa Valley Tribe, 2020; Yurok Tribal Code Chapter 21.25)

Native American Tribe[a]	**Eligible for Treatment as a State**[b]	**Water Quality Standards**
Karuk Tribe	June 26, 2020	---
Quartz Valley Indian Community	February 13, 2020	---
Hoopa Valley Tribe	May 17, 1996	Water Quality Control Plan Hoopa Valley Indian Reservation became effective for federal actions on May 29, 2020
Yurok Tribe[c]	---	Yurok Tribal Code Chapter 21.25 Water Quality Control Plan
Resighini Rancheria	August 31, 2021	---

Notes: --- indicates not applicable.

[a] The Klamath Tribes is omitted because their land is located upstream of the project and would not be directly affected by the proposed action.

[b] Date that EPA determined entity is qualified under section 518(e) of the CWA for treatment as a state, enabling it to administer a water quality standards program without an enforcement component under CWA section 401.

[c] In August 2004 the Yurok Tribal Council passed the Water Quality Control Plan for the Yurok Reservation. This plan set water quality standards for the Klamath River and its tributaries and established a process for obtaining a Tribal water quality certification for federally and state-funded projects subject to NEPA or CEQA compliance that have the potential to impact water quality of surface waters within the Yurok Reservation. However as of January 28, 2022, these standards have yet to be approved by the EPA for federal actions under the CWA.

Table 3.3-2. Surface water beneficial uses for the Klamath River designated by the States of Oregon and California, and Tribes along the Lower Klamath River (Source: Oregon DEQ, 2021a; NCRWQCB, 2011; Hoopa Valley Tribe, 2020; Yurok Tribal Code Chapter 21.25)

Oregon	California[a]	Hoopa Valley Tribe[b]	Yurok Tribe[b]
Domestic Water Supply			
Public domestic water supply, Private domestic water supply[c]	Municipal and Domestic Supply	Municipal and Domestic Supply	Municipal and Domestic Supply
Industrial Water Supply			
Industrial water supply	Industrial service supply[d]	Industrial service supply	---
---	Industrial process supply	Industrial process supply)	---
---	Hydropower generation	---	Hydropower generation
Agricultural Water Supply			
Irrigation	Agricultural supply	Agricultural supply	Agricultural supply
Livestock Watering	---	---	---
---	Aquaculture	---	---
---	Mariculture[e]	---	---
Fish and Wildlife			
---	Warm freshwater habitat	---	Warm freshwater habitat
Redband trout or Lahontan cutthroat trout	Cold freshwater habitat	Cold freshwater habitat	Cold freshwater habitat
---	Migration of aquatic organisms[f]	Fish migration	Migration of aquatic organisms

Oregon	California[a]	Hoopa Valley Tribe[b]	Yurok Tribe[b]
---	Spawning, reproduction, and/or early development[g]	Fish spawning	Spawning, reproduction, and/or early development
---	Shellfish harvesting[h]	---	---
---	Estuarine habitat[i]	---	Estuarine habitat
---	Marine habitat[j]	---	---
Wildlife & hunting	Wildlife habitat	Wildlife habitat	Wildlife habitat
---	Rare, threatened, or endangered species	Preservation of threatened and endangered species	Rare, threatened, or endangered species
Recreation and Aesthetic			
Water contact recreation	Water contact recreation[k]	Water contact recreation	Water contact recreation
Boating	Non-contact water recreation[k]	Non-contact water recreation	Non-contact water recreation
Aesthetic quality	--- [k]	---	---
Fishing	---	---	---
Water Replacement			
---	Groundwater recharge[l]	Groundwater recharge	Groundwater recharge
---	Freshwater replenishment	---	Freshwater replenishment
Cultural and Subsistence			
---	---	Wild and Scenic	---
---	Native American culture[m]	Ceremonial and cultural water use	Cultural

Oregon	**California**[a]	**Hoopa Valley Tribe**[b]	**Yurok Tribe**[b]
Commercial			
---	Commercial and sport fishing[d]	---	Commercial and sport fishing
Navigation			
---	Navigation[d]	---	Navigation

Notes: --- indicates not applicable.

[a] Applies to inland surface waters unless stated otherwise.

[b] Applies to the sections within the Tribal boundaries.

[c] With adequate pretreatment (filtration & disinfection) and natural quality to meet drinking water standards.

[d] Also applies to marine waters.

[e] Only applies to marine waters.

[f] In marine waters, fish migration.

[g] In marine waters, fish spawning.

[h] Only applicable in Iron Gate and lowermost subareas.

[i] Only applicable in lowermost subarea.

[j] In marine waters, rare and endangered species.

[k] In marine waters, also including aesthetic enjoyment.

[l] Not applicable in Copco Lake or Iron Gate subareas.

[m] Only applicable to Seiad Valley to the mouth.

Table 3.3-3. Water quality objectives and criteria for the Klamath River designated by the States of Oregon and California and Native American Tribes (Source: Oregon DEQ, 2021a; NCRWQCB, 2011; Hoopa Valley Tribe, 2020; Yurok Tribal Code Chapter 21.25)

	Oregon	**California**	**Hoopa Valley Tribe**	**Yurok Tribe**
Sediment	---	Suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.	Suspended sediment load and suspended sediment discharge rate of waters shall not be altered in such a manner as to cause impairment or adversely affect beneficial uses.	Same as California objective plus soil and silt from any operation shall not be placed or disposed where such material could cause a nuisance or adversely affect specified beneficial uses the waters support.
Settleable Material	---	Shall not result in deposition of material that causes nuisance or adversely affects beneficial uses.	Same as California objective.	Same as California objective, but restricted to settleable material caused by human activities.
Suspended Materials	---	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.	Same as California objective.	Same as California objective, but restricted to suspended material caused by human activities.

	Oregon	**California**	**Hoopa Valley Tribe**	**Yurok Tribe**
Turbidity (Nephelometric turbidity units, NTU)	No more than a 10% cumulative increase in natural stream turbidities may be allowed.	Shall not be >20% above naturally occurring background levels.	---[a]	● Human-caused changes in turbidity shall not cause a nuisance, or adversely affect support for specified beneficial uses. ● Shall not increase: > 5 NTU over background levels when background is ≤ 50 NTU, or > more than 10% when background is ≥ 50 NTU.
Temperature	From June – September in cold water class: ● No NPDES point source may increase the water temperature > 0.3°C above the natural background (i.e., the temperature of the Klamath River at the outflow from Upper Klamath Lake plus any natural warming or cooling that occurs downstream) after mixing with 25% of the stream.	● Natural receiving water temperature of intrastate waters shall not be altered[c] ● COLD and WARM waters must be ≤5°F (<2.78°C) above natural receiving water temperature.	● Salmonid life stage time-period dependent temperature requirements are provided in table 3.3-4.	The natural receiving water temperature shall not be altered unless it is shown to Yurok Tribal Environmental Program (YTEP), and YTEP concurs, that it does not affect beneficial uses. ● Salmonid life stage time-period dependent temperature requirements are provided in table 3.3-5.
Biostimulatory Substances	---	Concentrations shall not promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.	Same as California objective.	Same as California objective.

	Oregon	**California**	**Hoopa Valley Tribe**	**Yurok Tribe**
Dissolved Oxygen	Cold water class: ● 6.0 mg/l absolute minimum ● ≥ 6.5 mg/l 7-day minimum mean, and ● ≥ 8.0 mg/l 30-day mean. If conditions of barometric pressure, altitude, and temperature preclude achievement of 8.0 mg/l, then 90 % saturation applies.	DO % saturation shall conform to the following: **DO (%) Time Period** OR-CA border to Scott River 85% Apr - Sep 90% Oct - Mar Scott River to Hoopa boundary 90% year-round Hoopa boundary to Turwar 85% Jun - Aug 90% Sep - May Upper and middle estuary 80% Aug 85% Sep - Oct & Jun - Jul 90% Nov - May Lower estuary Levels shall not be depressed to adversely affect beneficial uses as a result of controllable water quality factors.	● COLD (year-round) designated use for water column: ≥ 8.0 mg/l 7-day moving average of daily minimum ● SPWN (whenever spawning occurs, occurred, or has potential to occur): ≥ 11.0 mg/l 7-day moving average of daily minimum ● If DO standards are not achievable due to natural conditions, then the COLD and SPWN standard shall instead be DO concentrations equivalent to 90% saturation under natural receiving water temperatures. ● Inter-gravel DO: Any human related activity shall not decrease to < 8.0 mg/l.	● Shall not be altered by human-caused activities that could cause a barrier to salmonid fish migration or adversely affect the water to support specified beneficial uses. ● Water column objectives year-round: ≥ 8 mg/l, 7-day moving average daily minimum; ● Incubation and emergence life stage period: A) Inter-gravel: ≥ 8 mg/l, 7-day moving average daily minimum B) Water column: ≥ 11 mg/l, 7-day moving average daily minimum

	Oregon	**California**	**Hoopa Valley Tribe**	**Yurok Tribe**
pH	May not fall outside the range of 6.5–9.0.	Shall be between 7.0 and 8.5. Changes in normal ambient pH levels shall not be > 0.5 within specified range in fresh waters with designated COLD or WARM beneficial uses.	Shall always be maintained within 7.0–8.5.	Changes related to human-caused activities in normal pH levels shall: ● not exceed 0.5 units. ● not be below 6.5 and not exceed 8.5 due to human-caused activities.
Toxic Substances and Toxicity	May not be above natural background levels in the water in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife or other designated beneficial uses.[d]	May not be in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.[d]	Same as California objective plus: Toxic substances shall not be introduced into waters within the boundaries of the Reservation.[e,f]	Same as California objective.[g]

[a] Turbidity criteria for all Hoopa Valley Reservation waters have been withdrawn as they are still being evaluated and will be revised for inclusion in the next triennial review.

[b] OAR 340-041-0185 Basin-Specific Criteria (Klamath): Water Quality Standards and Policies for this Basin for pH, temperature, TDS, & Time schedule for J.C. Boyle Dam removal.

[c] Unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.

[d] Specific criteria for toxic substances are provided for aquatic life and human health in Oregon (2021) Attachment 2: OAR 340-041-8033.

[e] Numeric criteria for freshwater aquatic life and human health are provided in the California Toxics Rule (a).

[f] Compliance with this objective will be determined by analysis of indicator organisms, species diversity, population density, growth anomalies, biotoxicity tests of appropriate duration, or other methods as specified by the Riparian Review Committee.

[g] Compliance with this objective will be determined by use of indicator organisms, analysis of species diversity, population density, growth anomalies, bioassays of appropriate duration and/or other appropriate methods as specified by EPA’s toxicity test guidance.

Table 3.3-4. Hoopa Valley Tribe reservation tributary temperature criteria for the Klamath River (Source: Hoopa Valley Tribe, 2020)

Life Stage	**Time Period**	**Maximum Weekly Average Temperature (˚C)**
Dry and Critically Dry Years		
Adult Holding/Coho Incubation and Emergence/Spawning/Smoltification	May 23–June 4	14.0
Adult Holding/Peak Temperatures Timeframe According to Hoopa Tribal Data	June 5–July 9	17.0
Adult Holding	July 10–Sept. 14	20.0
Adult Holding/Spawning	Sept. 15–Oct. 31	16.0
Adult Incubation and Emergence (Including Coho)/Smoltification/Spawning	Nov. 1–May 22	12.0
Extremely Wet, Wet and Normal Years		
Adult Holding/Coho Incubation and Emergence/Spawning/Incubation	May 23–June 4	13.0
Adult Holding/Peak Temperatures Timeframe According to Hoopa Tribal Data	June 5–July 9	16.0
Adult Holding	July 10–Sept. 14	18.0
Adult Holding/Spawning	Sept. 15–Oct. 31	14.0
Adult Incubation and Emergence (Including Coho)/Smoltification/Spawning	Nov. 1–May 22	10.0

Table 3.3-5. Yurok Tribe numerical water temperature objectives for the Klamath River (Source: Yurok Tribal Code Chapter 21.25)

Life Stage	Time Period (Estimated)	Maximum Weekly Average Temperature (˚C)	Maximum Weekly Mean Temperature (˚C)	Instantaneous Maximum Temperature (˚C)
Adult migration	Year-round	15	17	21
Adult Holding	May–Dec	14	16	22
Spawning	Sept–Apr.	11	13	22
Incubation/Emergence (Non-Coho Salmonids)	Jan–May	11	13	22
Incubation/Emergence (Coho salmon)	Nov–June	10	12	22
Juvenile Rearing	Year-round	15	17	22
Smoltification	Jan–June	12	14	22

Table 3.3-6. Clean Water Act section 303(d) listings, impairments, and TMDL status (Source: California Water Board, 2021; EPA, 2021d; NCRWQCB, 2010a; Oregon DEQ, 2019a, 2019b, 2020a, 2021b)

Waterbody/Reach	303(d) List [a]	Temperature	Dissolved Oxygen [b]	Nutrients	Chlorophyll-a	Microcystin	Metals [c]	Sediment [d]
Klamath River, Keno Dam to J.C. Boyle Reservoir	N	Oregon DEQ, 2019a	Oregon DEQ, 2019b	---	Oregon DEQ, 2019b	---	---	---
J.C. Boyle Reservoir	N	---	Oregon DEQ, 2019b	---	---	---	---	---
Klamath River, J.C. Boyle Dam to Oregon state border	Y	Oregon DEQ, 2019a	Oregon DEQ, 2019b	---	Oregon DEQ, 2019b	---	Arsenic, low priority	---
Klamath River Oregon state border to Iron Gate	N	NCRWQCB, 2010a	NCRWQCB, 2010a	NCRWQCB, 2010a	---	NCRWQCB, 2010a	---	---
Copco No. 1 Reservoir	Y	---	---	---	---	NCRWQCB, 2010a	Mercury, 2025	---
Iron Gate Reservoir	Y	---	---	---	---	NCRWQCB, 2010a	Mercury, 2025	---
Klamath River, Iron Gate Dam to Scott River	Y	NCRWQCB, 2010a	NCRWQCB, 2010a	NCRWQCB, 2010a	---	NCRWQCB, 2010a	Aluminum, 2031	2025
Klamath River, Scott River to Trinity River	Y	NCRWQCB, 2010a	NCRWQCB, 2010a	NCRWQCB, 2010a	---	NCRWQCB, 2010a	---	2025
Klamath River, Muddy Creek to mouth	Y	NCRWQCB, 2010a	NCRWQCB, 2010a	NCRWQCB, 2010a	---	---	Aluminum 2031	2025

Notes: Impaired parameters are indicated by a citation to the existing TMDL addressing the impairment or the year that a TMDL is expected to be completed.

[a] Y indicates reach is on 303(d) list and N indicates it is not on the 303(d) list.

[b] All impairments in California are for organic enrichment/low dissolved oxygen.

[c] Specific metals causing impairment are identified. Low priority indicates TMDL development will be scheduled at a future date as TMDLs for high and medium priority listings are completed.

[d] Impairment for lowermost reach (i.e., Muddy Creek to mouth) is for sedimentation/siltation.

Table 3.3-7. KHSA baseline monitoring sites and entities responsible for sampling (Source: Watercourse Engineering, Inc., 2018a)

Site ID	RM	Site Description	Sampling Entity
KR25444	254.44	Link Dam	Reclamation
KR24600	246.00	Keno Reservoir at Miller Island	Reclamation
KR23340	233.40	Klamath River below Keno Dam near a USGS gage	Reclamation
KR22822	228.22	Klamath River above J.C. Boyle Reservoir	PacifiCorp
*KR22478	224.78	J.C. Boyle Reservoir	PacifiCorp
KR22460	224.60	Klamath River below J.C. Boyle Dam	PacifiCorp
KR22000	220.00	Klamath River at Spring Island	PacifiCorp
KR21950	219.50	Klamath River below USGS Gage	PacifiCorp
KR20642	206.42	Klamath River above Shovel Creek	PacifiCorp
*KR19874	198.74	Copco Reservoir	PacifiCorp
KR19645	196.45	Klamath River below Copco Dam	PacifiCorp
*KR19019	190.19	Iron Gate Reservoir	PacifiCorp
KR18973	189.73	Klamath River below Iron Gate Dam	PacifiCorp
SH00000	---	Shasta River near mouth	Karuk Tribe
KR15626	156.26	Klamath River at Walker Bridge	Karuk Tribe
SC00000		Scott River near mouth	Karuk Tribe
KR12850	128.50	Klamath River below Seiad	Karuk Tribe
KR10130	101.30	Klamath River below Happy Camp	Karuk Tribe
SA00000	---	Salmon River near mouth	Karuk Tribe
KR05910	59.10	Klamath River at Orleans (USGS)	Karuk Tribe
KR04350	43.50	Klamath River at Weitchpec	Yurok Tribe
TR00000	---	Trinity River near mouth	Yurok Tribe
KR03850	38.50	Klamath River below Trinity River	Yurok Tribe
KR00600	6.00	Klamath River near Klamath	Yurok Tribe
KR00050	0.50	Klamath River estuary	Yurok Tribe

Notes: Listed from upstream to downstream; site IDs starting with * are impoundments.
--- indicates river mile on tributaries not reported.

Table 3.3-8. Summary of suspended solid concentrations and turbidity in the Klamath River and major tributaries, 2011–2020 (Source: Watercourse Engineering, Inc., 2017, 2018b-g, 2019, 2020, 2021)

Site ID [a]	Depth (m)	Total suspended solids (mg/l)	Volatile suspended solids (mg/l)	Turbidity (NTU)
KR25444	<1	<5-105 (168)	<2-49 (100)	4.8-59 (168)
KR24600	<1	<5-101 (108)	<2-69 (64)	4.1-68 (108)
KR23340	<1	<4-85 (107)	<2-12 (64)	3.5-87 (150)
KR22822	<1	<5-111 (57)	<2-20 (57)	2.6-32 (12)
*KR22478	<1	<2-24 (12)	<2-7.6 (12)	4.6-19 (4)
*KR22478	8	1.6-22 (9)	<2-6 (9)	---
KR22460	<1	<2-53 (105)	<2-10 (65)	3.1-27 (10)
KR22000	<1	<2-24 (10)	<2-6.8 (10)	---
KR21950	<1	<2-50 (92)	<2-7.6 (53)	1.4-37 (82)
KR20642	<1	<2-269 (109)	<2-18 (69)	1.6-86 (96)
*KR19874	<1	<2-270 (100)	<2-250 (62)	1.1-12 (11)
*KR19874	1 to 20	2-26 (50)	2-7 (5)	2.2-11 (10)
*KR19874	>20	<2-107 (98)	<2-30.8 (60)	2.9-12 (3)
KR19645	<1	<2-312 (103)	<2-16 (63)	1.8-12 (11)
*KR19019	<1	<2-117 (99)	<2-33 (63)	1-13 (12)
*KR19019	1 to 25	2-16 (32)	2-5 (3)	0.7-14 (8)
*KR19019	>25	<2-15 (98)	<2-3.2 (61)	3.4-17 (5)
KR18973	<1	<2-97 (165)	<2-12 (100)	0-17 (145)
SH00000 (Shasta)	<1	<0.5-59 (109)	<0.5-11 (80)	0.0-11 (99)
KR15626	<1	1.5-140 (110)	<0.5-28 (81)	0-13 (20)
SC00000 (Scott)	<1	<0.5-47 (109)	<0.5-4.5 (80)	0.1-13 (99)
KR12850	<1	1.3-155 (110)	<0.5-9.5 (81)	0.4-31 (101)
KR10130	<1	1.2-79 (105)	<0.5-9 (76)	0.6-5.9 (12)

Site ID [a]	Depth (m)	Total suspended solids (mg/l)	Volatile suspended solids (mg/l)	Turbidity (NTU)
SA00000 (Salmon)	<1	<0.5-87 (110)	<0.5-25 (81)	<0.1-3.6 (100)
KR05910	<1	0.9-87 (110)	<0.5-17 (82)	0.2-18 (103)
KR04350	<1	<2.0-160 (116)	<0.5-15 (116)	0.2-70 (77)
TR00000 (Trinity)	<1	<0.5-394 (116)	<0.5-24 (116)	0.2-160 (107)
KR03850	<1	<0.5-191 (116)	<0.5-16 (116)	0.3-73 (68)
KR00600	<1	<2.0-126 (116)	<0.5-10.5 (116)	0.3-58 (121)
KR00050	<1	<0.5-178 (116)	<0.5-13 (116)	0.2-60 (74)

Notes: Values reported as minimum-maximum (number of values); --- indicates no data reported

[a] Site IDs starting with * are impoundments and are abbreviated as two letters for stream name followed by approximate RM x 100 (e.g., *KR22478 is the Klamath River at RM 224.78, which is in J.C. Boyle Reservoir); additional insight into sampling locations is provided in table 3.3-7.

Table 3.3-9. J.C. Boyle Reservoir determination for chemicals of potential concern, based on samples collected in 2009–2010 (Source: CDM, 2011)

Attribute[a]	**Ecological**[b]	**Human Health**[b]
Chemicals of potential concern (COPC)	Two metals, four pesticides, a single dioxin congener, and a single furan congener[c]	Two metals, four pesticides, a number of dioxin and furan congeners, and pentachlorophenol (wood preservative)
Exceeds the SEF SL-1 and SL-2 (step 2b)	Nickel	---
Does not exceed SEF SL, but exceeded secondary SL (steps 2c and 2d)	Iron, legacy pesticides and dioxin-like compounds (4,4-DDD, 4,4-DDE, 4,4-DDT, Dieldrin, 2,3,4,7,8-PECDF, and 2,3,7,8-TCDD)[d]	---
Exceeds the EPA non-carcinogenic RSL for residential soils	---	None
Exceeds the EPA total carcinogenic RSL for residential soils	---	Arsenic and nickel
Exceeds the Oregon DEQ bioaccumulation SLV for human-subsistence and human-general	---	legacy pesticides (4,4-DDD, 4,4-DDE, 4,4-DDT, Dieldrin), dioxin-like compounds, and pentachlorophenol
Not detected, but reporting limit is above the screening level[e]	Single metal (cadmium), several pesticides, PCB Aroclors, and SVOCs, including PAHs	Several pesticides and PCB Aroclors, PAHs, and a single VOC

Notes: --- indicates not applicable

[a] SEF = sediment evaluation framework; SL = screening level; RSL = regional screening levels; SLV = screening level value

[b] PAHs = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyl; SVOCs = semi-volatile organic compounds; VOC = volatile organic compounds

[c] On the basis of public concern, the full World Health Organization suite of 17 dioxin and furan congeners was retained as a COPC.

[d] Dieldrin was detected in only one of 14 samples.

[e] Although this does not directly indicate a COPC, it suggests the possibility that it could be one.

Table 3.3-10. Copco No. 1 Reservoir determination for chemicals of potential concern, based on samples collected in 2009–2010 (Source: CDM, 2011)

Attribute[a]	**Ecological**[b]	**Human Health**[b]
Chemicals of potential concern (COPC)	Two metals (nickel and iron) and a single furan congener	Two metals (arsenic and nickel) and multiple dioxin and furan congeners
Exceeds the SEF SL-1 and SL-2 (step 2b)	Nickel	---
Does not exceed SEF SLs, but exceeded secondary SLs (steps 2c and 2d)	Iron and 2,3,4,7,8-PECDF	---
Exceeds the EPA non-carcinogenic RSL for residential soils	---	None
Exceeds the EPA total carcinogenic RSL for residential soils	---	Arsenic and nickel
Exceeds the Oregon DEQ bioaccumulation SLV for human-subsistence and human-general	---	Multiple dioxin and furan congeners
Not detected, but reporting limit is above the screening level	Single metal (silver), multiple pesticides, two PCB Aroclors, four phthalates, and four SVOCs, including PAHs	Two PCB Aroclors, a single pesticide, and multiple SVOCs, including PAHs

Notes: --- indicates not applicable

[a] SEF = sediment evaluation framework, SL = screening level, RSL = regional screening levels, SLV = screening level value

[b] PAHs = polycyclic aromatic hydrocarbons, PCB = polychlorinated biphenyl, SVOCs = semi-volatile organic compounds

Table 3.3-11. Iron Gate Reservoir determination for chemicals of potential concern, based on samples collected in 2009–2010 (Source: CDM, 2011)

Attribute[a]	**Ecological**[b]	**Human Health**[b]
Chemicals of potential concern (COPC)	Two metals (nickel and iron) and a single furan congener	Two metals (arsenic and nickel) and multiple dioxin and furan congeners
Exceeds the SEF SL-1 and SL-2 (step 2b)	Nickel	---
Does not exceed SEF SLs, but exceeded secondary SLs (steps 2c and 2d)	Iron and 2,3,4,7,8-PECDF	---
Exceed the EPA non-carcinogenic RSL for residential soils	---	None
Exceed the EPA total carcinogenic RSL for residential soils	---	Arsenic and nickel
Exceeded the Oregon DEQ bioaccumulation SLV for human-subsistence and human-general	---	Multiple dioxin and furan congeners
Not detected, but reporting limit is above the screening level	Single metal (silver), multiple pesticides and PCB Aroclors, phthalates, and SVOCs, including PAHs	Two PCB Aroclors and multiple SVOCs, including PAHs

Notes: --- indicates not applicable

[a] SEF = sediment evaluation framework, SL = screening level, RSL = regional screening levels, SLV = screening level value

[b] PAHs = polycyclic aromatic hydrocarbons, PCB = polychlorinated biphenyl, SVOCs = semi-volatile organic compounds

Table 3.3-12. Klamath estuary determination for chemicals of potential concern, based on samples collected in 2009–2010 (Source: CDM, 2011).

Attribute[a]	**Ecological**[b]	**Human Health**[b]
Chemicals of potential concern (COPC)	None	Two metals (arsenic and nickel)
Exceed the EPA non-carcinogenic RSL for residential soils	---	None
Exceed the EPA total carcinogenic RSL for residential soils	---	Arsenic and nickel
Not detected, but reporting limit is above the screening level	Pesticides and SVOCs, including PAHs	Single pesticide and multiple SVOCs, including PAHs

Notes: --- indicates not applicable

[a] RSL = regional screening levels

[b] PAHs = polycyclic aromatic hydrocarbons, SVOCs = semi-volatile organic compounds

Table 3.3-13. Threshold values for various water quality constituents and the respective percentages at which these thresholds were not met based on continuous water quality data collected below Iron Gate Dam, 2011–2020 (Source: PacifiCorp, 2012–2021)

Constituent	Rationale	Threshold	Average Monthly Percentages Thresholds were not Met Below Iron Gate Dam (2011–2020)											
			Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Temperature (°C)	Protection of cold-water species	≤20.0	0%	0%	0%	0%	0%	17%	89%	100%	40%	0%	0%	0%
DO (mg/l)	Previous objective	≥8.0	0%	0%	0%	0%	1%	4%	48%	65%	71%	45%	16%	1%
DO (% of saturation)	Oct–Mar objective	≥90	27%	0%	2%	---	---	---	---	---	---	74%	74%	46%
DO (% of saturation)	Apr-Sep objective	≥85	---	---	---	1%	2%	0%	6%	38%	46%	---	---	---
pH (standard units)	Min objective	≥6.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
pH (standard units)	Max objective	≤8.5	0%	0%	2%	4%	8%	4%	20%	53%	38%	4%	0%	0%

Table 3.3-14. Range of discrete temperature, dissolved oxygen, pH, and specific conductivity measurements in the Klamath River and major tributaries, 2011–2020 (Source: Watercourse Engineering, Inc., 2017, 2018b-g, 2019, 2020, 2021)

Site ID [a]	Depth (m)	Water Temperature (°C)	Dissolved Oxygen (mg/l)	pH (standard units)	Specific Conductivity (µS/cm)
KR25444	<1	0.6-24.4 (169)	3.9-13.5 (169)	5.5-10.4 (168)	94-135 (169)
KR24600	<1	0.5-25.2 (109)	0.1-13.4 (109)	6.3-9.9 (108)	101-277 (109)
KR23340	<1	0.7-24.6 (150)	5.9-13.3 (150)	6.3-9.4 (149)	102-327 (150)
KR22822	<1	0.1-25.5 (53)	6.5-12.5 (54)	6.2-8.9 (52)	113-319 (51)
*KR22478	<1	3.0-26.9 (36)	5.3-13.4 (35)	7.1-8.9 (36)	118-283 (35)
*KR22478	8	4.9-20.2 (6)	3.9-12.3 (6)	7.2-8.7 (6)	130-282 (6)
KR22460	<1	0.0-24.4 (100)	7.2-13.2 (100)	6.2-9.3 (94)	45-504 (97)
KR22000	<1	0.6-20.5 (8)	6.5-11.8 (8)	6.8-7.9 (8)	118-288 (8)
KR21950	<1	0.0-23.7 (88)	5.7-12.7 (89)	4-9.4 (86)	92-298 (88)
KR20642	<1	2.4-25.2 (121)	7.5-13.8 (119)	5.7-10.0 (114)	93-303 (116)
*KR19874	<1	0.8-25.7 (94)	7.0-19.2 (94)	5.9-9.9 (90)	100-303 (93)
*KR19874	1 to 20	1.4-22.3 (66)	0.0-19.6 (64)	5.3-9.5 (64)	100-311 (66)
*KR19874	>20	1.6-16.7 (62)	0.0-11.6 (61)	5.4-8.6 (62)	121-359 (62)
KR19645	<1	1.3-24.3 (97)	5.8-18.7 (96)	5.4-9.5 (93)	100-700 (93)
*KR19019	<1	3.3-26.8 (93)	5.0-18.5 (93)	6.1-10.0 (88)	105-256 (90)
*KR19019	1 to 25	2.8-22.3 (67)	0.0-18.6 (65)	5.4-9.3 (65)	112-252 (65)
*KR19019	>25	2.6-11.0 (67)	0.0-12.4 (65)	6.4-8.1 (66)	132-259 (66)
KR18973	<1	2.9-26.2 (140)	6-11.9 (140)	6.6-9.5 (135)	101-253 (138)
SH00000 (Shasta)	<1	2.5-24.9 (114)	8.6-14.6 (113)	8.1-9.0 (113)	51-624 (114)
KR15626	<1	3.4-24.3 (112)	6.9-12.9 (111)	6.2-9.4 (111)	147-457 (111)
SC00000 (Scott)	<1	0.1-24.7 (114)	8.3-13.6 (112)	7.6-9.0 (113)	90-594 (114)
KR12850	<1	2.4-23.9 (114)	7.7-13.3 (114)	7.8-8.9 (113)	91-236 (114)
KR10130	<1	2.4-24.4 (104)	7.1-13.6 (103)	7.6-8.8 (103)	70-226 (104)
SA00000 (Salmon)	<1	1.6-22.3 (113)	8.2-13.5 (112)	7.3-8.7 (111)	48-160 (113)
KR05910	<1	2.9-24.8 (111)	7.5-13.4 (111)	6.9-10.1 (109)	85-452 (111)
KR04350	<1	3.1-24.1 (114)	8.8-16.8 (112)	6.9-9.4 (114)	91-340 (114)

Site ID [a]	**Depth (m)**	**Water Temperature (°C)**	**Dissolved Oxygen (mg/l)**	**pH (standard units)**	**Specific Conductivity (µS/cm)**
TR00000 (Trinity)	<1	3.7-24.5 (114)	8.5-13.3 (112)	6.9-8.8 (114)	83-342 (114)
KR03850	<1	3.4-24.2 (115)	7.6-13.3 (114)	6.4-8.8 (115)	97-332 (115)
KR00600	<1	4.4-23.2 (145)	6.5-13.3 (144)	4.2-8.9 (145)	14-1520 (145)
KR00050	<1	4.7-22.6 (144)	5.1-12.9 (141)	4.6-9.0 (144)	102-80501 (143)

Notes: Values reported as minimum-maximum (number of values).

[a] Site IDs starting with * are impoundments and are abbreviated as two letters for stream name followed by approximate RM x 100 (e.g., *KR22478 is the Klamath River at RM 224.78, which is in J.C. Boyle Reservoir); additional insight into sampling locations is provided in table 3.3 7.

Table 3.3-15. Selected blue-green algal bloom and *Microcystis aeruginosa* criteria and guidance levels issued by various entities to protect human and animal health (Source: WHO, 2020; EPA, 2019; Oregon Health Authority, 2021; CCHAB, 2021; Hoopa Valley Tribe, 2020; YTEP, 2016)

Entity	**Blue-Green Algae**	***Microcystis aeruginosa***	**Total Microcystin**
World Health Organization Provisional Guidelines	20,000 cells/ml for irritative or allergenic effects 100,000 cells/ml for moderate probability of adverse health effects scums for severe health hazards	---	Provisional guidelines are: ≤1 µg/l for lifetime drinking water ≤12 µg/l for short-term drinking water ≤24 µg/l for recreational water
EPA-Recommended Criteria	---	---	Recreation: 8 µg/l not to be exceeded in more than three 10-day assessment periods over a recreational season Swimming advisory: 8 µg/L not be exceeded on a single day
Oregon Guidelines	---	---	≤0.2 µg/l for dogs ≤0.3 µg/l for ages 5 years and younger short-term drinking water; ≤1.6 µg/l adult short-term drinking water >8 µg/l triggers recreational health advisory
California Cyanobacteria and Harmful Algal Bloom	Total potentially toxicogenic triggers for human and animal health:	---	Triggers for human and animal health: <0.8 µg/l no advisory 0.8 µg/l caution

Entity	Blue-Green Algae	*Microcystis aeruginosa*	Total Microcystin
Network Thresholds[a]	< 4,000 cells/ml no advisory 4,000 cells/ml caution		6 µg/l warning 20 µg/l danger
Hoopa Valley Tribe Criteria	<100,000 total potentially toxicogenic cells/ml for recreational water[b]	<5,000 cells/ml for drinking water <40,000 cells/ml for recreational water	<1 µg/l for drinking water <8 µg/l for recreational water
Yurok Tribe Guidelines	Triggers for public health advisories: Detection for caution 100,000 cells/ml for warning 500,000 cells/ml for danger	Triggers for public health advisories: detection caution 1,000 cells/ml warning 5,000 cells/ml danger	Triggers for public health advisories: detection caution 0.8 µg/l warning 4.0 µg/l danger

[a] California Cyanobacteria and Harmful Algal Bloom Network comprises various entities, including the California Water Board, the California Department of Public Health, the California Environmental Protection Agency Office of Environmental Health and Hazard Assessment, Native American Tribes, and reservoir managers.

[b] Specifically includes Anabaena, Microcystis, Planktothrix, Nostoc, Coelosphaerium, Anabaenopsis, Aphanizomenon, Gloeotrichia, and Oscillatoria.

Table 3.3-16. Monthly ranges of Copco Reservoir (RM 198.74) depth-integrated water quality measurements, 2011–2020 (Source: Watercourse Engineering, Inc., 2017, 2018b-g, 2019, 2020, 2021)

Month	Chlorophyll-a (µg/l)	Pheophytin (µg/l)	Carbon, Particulate (mg/l)	Nitrogen, Particulate (mg/l)	Turbidity (NTU)	Microcystin (µg/l)
Jan	---	---	---	---	---	---
Feb	2.0-3.5 (4) [a]	1.5-2.7 (4)	0.5-0.6 (4)	0.07-0.08 (4)	---	---
Mar	0.6-19.7 (8)	0.9-6.1 (8)	0.5-1.2 (4)	0.05-0.21 (4)	---	---
Apr	1.0-27.4 (10)	0.8-8.0 (10)	0.3-1.4 (6)	0.04-0.23 (6)	---	---
May	0.9-7.2 (9)	0.8-4.3 (9)	0.4-0.7 (5)	0.05-0.08 (5)	5.7 (1)	<0.15-<0.18 (7)
Jun	0.7-10.5 (10)	0.8-3.6 (10)	0.3-0.7 (6)	0.04-0.08 (6)	2.3 (1)	<0.15-1.4 (9)
Jul	0.5-48.5 (9)	0.5-6.2 (9)	0.3-2.1 (5)	0.04-0.42 (5)	4.0 (1)	<0.15-28 (10)
Aug	1.3-642 (9)	0.5-87.9 (9)	0.3-1.3 (5)	0.07-0.22 (5)	4.4 (1)	0.2-56 (8)
Sep	<0.68-125.1 (10)	<0.68-8.8 (10)	0.3-2.9 (6)	0.03-0.57 (6)	2.6 (1)	<0.18-52 (10)
Oct	0.8-49.1 (9)	0.8-3.7 (9)	0.3-2.3 (5)	0.04-0.48 (5)	7.4 (1)	<0.15-20 (9)
Nov	<0.68-1.6 (8)	0.6-2.0 (8)	0.2-0.7 (5)	0.02-0.07 (5)	5.3 (1)	---
Dec	1.1-3.6 (6)	0.9-2.5 (6)	0.5-0.9 (4)	0.07-0.10 (4)	9.5 (1)	---

Notes: --- not sampled; turbidity only sampled in 2015; number in parentheses indicates number of samples

Table 3.3-17. Monthly ranges of Iron Gate Reservoir (RM 190.19) depth-integrated water quality measurements, 2011–2020 (Source: Watercourse Engineering, Inc., 2017, 2018b-g, 2019, 2020, 2021)

Month	**Chlorophyll-a (µg/l)**	**Pheophytin (µg/l)**	**Carbon, Particulate (mg/l)**	**Nitrogen, Particulate (mg/l)**	**Turbidity (NTU)**	**Microcystin (µg/l)**
Jan	---	---	---	---	---	---
Feb	1.3-5.2 (4)	1.0-2.1 (4)	0.5-0.7 (4)	0.07-0.12 (4)	---	---
Mar	0.6-11.6 (9)	0.8-5.4 (9)	0.4-0.9 (5)	0.06-0.15 (5)	---	---
Apr	0.7-14.7 (10)	0.8-3.3 (10)	0.4-0.7 (6)	0.04-0.1 (6)	---	---
May	2.2-8.1 (9)	0.8-5.1 (9)	0.3-0.8 (5)	0.05-0.1 (5)	4.8 (1)	<0.15-<0.18 (7)
Jun	0.6-25.4 (9)	0.6-3.9 (9)	0.3-0.8 (6)	0.05-0.14 (6)	3.0 (1)	<0.15-0.8 (9)
Jul	0.4-14.3 (10)	0.5-3.3 (10)	0.2-0.9 (6)	0.02-0.16 (6)	1.6 (1)	<0.15-7 (10)
Aug	<0.68-58.5 (10)	<0.68-22.1 (10)	0.3-2.6 (6)	0.04-0.38 (6)	3.0 (1)	0.42-4.3 (9)
Sep	<0.68-82.3 (10)	<0.68-1.7 (10)	0.3-2.4 (6)	0.04-0.38 (6)	2.2 (1)	0.21-30 (10)
Oct	0.7-32.0 (8)	<0.68-2 (8)	0.2-0.9 (5)	0.03-0.17 (5)	---	0.18-9.6 (7)
Nov	0.4-13.5 (7)	0.4-1.5 (7)	0.3-0.4 (5)	0.03-0.08 (5)	1.7 (1)	---
Dec	<0.68-2.7 (7)	0.6-1.4 (7)	0.3-0.6 (5)	0.04-0.08 (5)	3.7 (1)	---

Notes: --- not sampled; turbidity only sampled in 2015; number in parentheses indicates number of samples

Table 3.3-18. Lines of evidence included to evaluate the potential sediment-contaminant exposure pathways for the Klamath Secretarial Determination (Source: CDM, 2011, as modified)

Line of Evidence [a,b]	Pathway 1	Pathway 2	Pathway 3	Pathway 4	Pathway 5
Sediment Evaluation Framework Level 2A Step 1 – Sediment Screening Levels					
1. DMMP Marine MLs				+	
Sediment Evaluation Framework Level 2A Steps 2a, 2b, 2c, 2d – Sediment Screening Levels					
2. Ecological SLs (freshwater and marine)			+	+	+
3. Ecological TEQ SLVs (sediment)			+	+	+
Sediment Evaluation Framework Level 2B – Results of Water Quality Criteria Evaluations and Bioassays					
4. Elutriate WQC (ecological)	+			+	
5. Chironomus Bioassay			+	+	+
6. Hyalella Bioassay			+	+	+
7. Trout Bioassay	+			+	
8. Corbicula Bioaccumulation Study/BSAF			+		+
9. Lumbriculus Bioaccumulation Study/BSAF			+		+
10. Corbicula Tissue TRV [b]			+	+	+
11. Lumbriculus Tissue TRV [c]			+	+	+
Special Evaluations –Human Health in Sediment and Fish Tissue					
12. Perch Tissue TRV (ecological)			+	+	+
13. Bullhead Tissue TRV (ecological)			+	+	+
14. Fish Tissue TEQ (ecological)			+	+	+
15. HHSLs		+	+		+
16. HH TEQ SLVs (sediment)		+	+		+
17. Elutriate WQC (human health)	+				
18. Perch Tissue TRV (human health)			+		+
19. Bullhead Tissue TRV (human health)			+		+

Notes:

[a] BSAF = Biota-Sediment Accumulation Factor; DMMP = Dredged Material Management Program; HHSL = Human Health Screening Level; ML = maximum level; SL = screening level; SLV = Screening-Level Value, TEQ = Toxic Equivalency; TRV = Toxicity Reference Value; WQC = Water Quality Criteria

[b] Organisms include: *Chironomus* = nonbiting midges; *Hyalella* = an amphipod crustacean; *Corbicula fluminea* = Asian clam (representative bivalve); *Lumbriculus variegatus* = blackworm (representative oligochaete)

Table 3.3-19. Level of significance effects on benthic invertebrates, fish, ESA species, birds and mammals, and humans (Source: AECOM and River Design Group, 2020, table 4-1, as modified)

<u>Contaminant Media</u> Generated by sediment and/or associated chemicals **Release Mechanisms** Processes that liberate contaminant media during and after mobilization of reservoir sediments		**Exposure Route** The point of contact or entry of a contaminant into a receptor		**Receptors and Habitat**				
				Benthic Invertebrates (bottom-dwelling)	**Fish**	**Endangered Species Act Species**	**Birds/Mammals**	**Humans**
Dredge Area Pathways (between the sediment and receptors in the dredge area)								
<u>Suspended Sediment</u> Resuspension of sediment into the water column	→	Direct contact		I	I	I	X	X
		Dietary	Tissue	I	I	I	I	I
<u>Generated Residuals</u> Deposition of sediments mobilized from the reservoirs	→	Direct Contact		I	I	I	I	I
		Dietary	Tissue	I	I	I	I	I
<u>Undisturbed Residuals</u> Exposure of buried sediments	→	Direct Contact		I	I	I	I	I
		Dietary	Tissue	I	I	I	I	I
Unconfined, Aquatic Disposal Pathways *(between disposed sediment and disposal site receptors)*								
<u>Suspended Sediment</u> Suspension of sediment into the water column	→	Direct Contact		I	I	I	X	X
		Dietary	Tissue	I	I	I	I	I
<u>Disposal Material</u> Deposition of dredged sediment	→	Direct Contact		I	I	I	X	X
		Dietary	Tissue	I	I	I	I	I

Note: Pathway completeness abbreviations: I = Complete but insignificant, X = Incomplete (i.e., receptor group is unlikely to come in contact with sediment-associated contaminants under the given pathway)

Table 3.3-20. Water temperature model scenarios used in this EIS (Source: staff)

Scenario(s)	Model	Dams Removed	Boundary Conditions
EC	Relicensing	None	Existing conditions
WIGCJCB	Relicensing	J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate	Existing conditions
WOP	Relicensing	Keno,[a] J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate	Existing conditions
T1BSR	TMDL	Keno, J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate	TMDLs for the Klamath River Basin implemented and removal of all point sources[b]
TOD2RN/TCD2RN	TMDL	Keno, J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate	TMDLs for the Klamath River Basin implemented [c]
T4BSRN	TMDL	None	Oregon and California TMDLs implemented
Historic	Climate Change	None	Historic conditions for January 1, 1961, to September 30, 2009
BO with Index Sequential method[d]	Climate Change	None	2010 biological opinion (National Marine Fisheries Service, 2010) flows; TMDLs not included
KBRA dams-in	Climate Change	None	KBRA flows; TMDLs not included
KBRA dams-out	Climate Change	J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate	KBRA flows; TMDLs not included

Scenario(s)	Model	Dams Removed	Boundary Conditions
BO with five global circulation models[e]	Climate Change	None	Meteorology and hydrology based on five global circulation models; 2010 biological opinion flows; TMDLs not included
KBRA with five global circulation models[e]	Climate Change	J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate	Meteorology and hydrology based on five global circulation models; KBRA flows; TMDLs not included

Notes:

[a] In the Lake Ewauna-Keno Dam reach, the channel widths were reduced to represent riverine versus impounded conditions and the bedrock sill near Keno was included in the geometry.

[b] Boundary conditions at Upper Klamath Lake based on the existing Upper Klamath Lake drainage TMDLs, removal of point source inputs, keeps flows for Lost River and Klamath Straits Drain but sets their water quality and temperature the same as at Upper Klamath Lake, and assigns natural or TMDL conditions for tributaries (which vary by tributary). Upper Klamath Lake flow set to same as the calibrated Klamath River Model (as cited by NCRWQCB, 2010), but the water quality and temperature are based on 1995 Upper Klamath Lake TMDL model conditions.

[c] Boundary conditions at Upper Klamath Lake based on the existing Upper Klamath Lake TMDL, including point source inputs, keeping Lost River and Klamath Straits Drain flows but with higher nutrient concentrations and the same DO and temperature as Upper Klamath Lake, and natural or TMDL conditions for tributaries (which vary by tributary). Upper Klamath Lake flow was set to be the natural baseline scenario T1BSR.

[d] The Index Sequential method simulates a 50-year period through the use of historic data for 1961–2009 followed by data from water year 1961.

[e] The five simulated global circulation models are the Canadian Centre for Climate Modeling Analysis 75th quantile for temperature and precipitation, Geophysical Fluid Dynamics Laboratory 50th quantile for temperature and precipitation, Meteorological Institute of the University of Bonn 75th quantile for temperature with 25th quantile precipitation, Meteorological Research Institute 25th quantile temperature with 75th quantile precipitation, National Center for Atmospheric Research 25th quantile temperature and precipitation. Each global circulation model incorporates both the effects of climate change and management alternatives as simulated over a 50-year period to represent each decade and applies the RBM10 calibration factors for historic data.

Table 3.3-21. Spreadsheet model boundary condition input values and simulated minimum dissolved oxygen concentration and distance downstream of Iron Gate Dam for high short-term suspended sediment concentrations and high initial dissolved oxygen conditions under the proposed action, based on WY 1991 and 1970 (Source: KRRC, 2021f)

	Boundary Conditions at Iron Gate Dam						**Spreadsheet Model DO Output**	
Period[a]	**Avg. Monthly WT (°C)[b]**	**Flow (cfs)[c]**	**SSC (mg/l)[d]**	**IOD (mg/l)**	**BOD (mg/l)**	**Initial DO, 80% (mg/l)[e]**	**Minimum (mg/l)**	**Location (miles)[f]**
Coho Median Impact Year (WY 1991 Conditions)								
10/27/2022	11.8	1,021	1	0.0	0.0	8.0	8.0	0.0
11/24/2022	7.0	964	64	0.0	0.2	8.9	8.9	0.0
12/31/2022	3.1	997	66	0.0	0.2	9.9	9.9	0.0
1/13/2023	1.7	3,166	16,226	10.2	57.1	10.3	0.2	1.2
2/1/2023	2.6	1,356	3,840	2.4	13.5	10.0	7.7	0.6
3/1/2023	5.0	921	478	0.3	1.7	9.4	9.2	0.6
4/2/2023	8.5	1,122	147	0.1	0.5	8.6	8.6	0.6
5/15/2023	12.2	943	625	0.4	2.2	7.9	7.6	0.6
6/17/2023	17.2	810	12,423	7.8	43.7	7.1	0.0	0.6
7/1/2023	20.1	701	1,334	0.8	4.7	6.7	5.9	0.6
8/2/2023	19.1	956	475	0.3	1.7	6.8	6.6	0.6
9/17/2023	16.3	966	263	0.2	0.9	7.2	7.1	0.6
Coho Severe Impact Year (WY 1970 Conditions)								
10/23/2022	11.8	1,255	2	0.0	0.0	8.0	8.0	0.0
11/14/2022	7.0	1,461	86	0.1	0.3	8.9	8.9	0.0
12/31/2022	3.1	1,105	68	0.0	0.2	9.9	9.9	0.0
1/7/2023	1.7	14,250	556	0.4	2.0	10.3	10.0	1.9
2/7/2023	2.6	5,796	620	0.4	2.2	10.0	9.7	1.2
3/16/2023	5.0	4,212	1,694	1.1	6.0	9.4	8.4	1.2
4/15/2023	8.5	3,569	4,968	3.1	17.5	8.6	5.6	1.2
5/5/2023	12.2	2,729	1,544	1.0	5.4	7.9	7.0	1.2
6/16/2023	17.2	1,636	13,205	8.3	46.5	7.1	0.0	0.6
7/4/2023	20.1	828	2,001	1.3	7.0	6.7	5.5	0.6

	Boundary Conditions at Iron Gate Dam						**Spreadsheet Model DO Output**	
Period[a]	**Avg. Monthly WT (°C)[b]**	**Flow (cfs)[c]**	**SSC (mg/l)[d]**	**IOD (mg/l)**	**BOD (mg/l)**	**Initial DO, 80% (mg/l)[e]**	**Minimum (mg/l)**	**Location (miles)[f]**
8/2/2023	19.1	879	314	0.2	1.1	6.8	6.7	0.6
9/1/2023	16.3	911	167	0.1	0.6	7.2	7.2	0.6

Notes: WY = water year, WT = water temperature, SSC = suspended sediment concentration, IOD = initial oxygen demand, BOD = biological oxygen demand

[a] Date for maximum simulated suspended sediment concentration in the month; years assume reservoir drawdown in 2023.

[b] Simulated daily water temperature from HEC5Q water temperature model.

[c] Daily flow values simulated with updated Reclamation hydraulic model for the revised KRRC drawdown scenario (KRRC, 2021f, appendix I) that correspond with the simulated peak suspended sediment concentration for each month.

[d] Simulated peak suspended sediment concentration for each month from updated Reclamation SRH-1D suspended sediment concentration model for revised KRRC drawdown scenario (KRRC, 2021f, appendix I).

[e] Calculated with the average monthly water temperature, salinity = 0 parts per thousand, and elevation = 2,320 feet.

[f] Miles downstream of Iron Gate Dam site.

Table 3.3-22. Spreadsheet model boundary condition input values and simulated minimum dissolved oxygen concentration and distance downstream of Iron Gate Dam for high short-term suspended sediment concentrations and low initial dissolved oxygen conditions under the proposed action, based on WY 1991 and 1970 (Source: KRRC, 2021f)

	Boundary Conditions at Iron Gate Dam						**Spreadsheet Model DO Output**	
Period[a]	**Avg. Monthly WT (°C)**[b]	**Flow (cfs)**[c]	**SSC (mg/l)**[d]	**IOD (mg/l)**	**BOD (mg/l)**	**Initial DO, 0% (mg/l)**[e]	**Minimum (mg/l)**	**Location (miles)**[f]
Coho Median Impact Year (WY 1991 Conditions)								
10/27/2022	11.8	1,021	1	0.0	0.0	0.0	0.0	0.0
11/24/2022	7.0	964	64	0.0	0.2	0.0	0.0	0.0
12/31/2022	3.1	997	66	0.0	0.2	0.0	0.0	0.0
1/13/2023	1.7	3,166	16,226	10.2	57.1	0.0	0.0	0.0
2/1/2023	2.6	1,356	3,840	2.4	13.5	0.0	0.0	0.0
3/1/2023	5.0	921	478	0.3	1.7	0.0	0.0	0.0
4/2/2023	8.5	1,122	147	0.1	0.5	0.0	0.0	0.0
5/15/2023	12.2	943	625	0.4	2.2	0.0	0.0	0.0
6/17/2023	17.2	810	12,423	7.8	43.7	0.0	0.0	0.0
7/1/2023	20.1	701	1,334	0.8	4.7	0.0	0.0	0.0
8/2/2023	19.1	956	475	0.3	1.7	0.0	0.0	0.0
9/17/2023	16.3	966	263	0.2	0.9	0.0	0.0	0.0
Coho Severe Impact Year (WY 1970 Conditions)								
10/23/2022	11.8	1,255	2	0.0	0.0	0.0	0.0	0.0
11/14/2022	7.0	1,461	86	0.1	0.3	0.0	0.0	0.0
12/31/2022	3.1	1,105	68	0.0	0.2	0.0	0.0	0.0
1/7/2023	1.7	14,250	556	0.4	2.0	0.0	0.0	0.0
2/7/2023	2.6	5,796	620	0.4	2.2	0.0	0.0	0.0
3/16/2023	5.0	4,212	1,694	1.1	6.0	0.0	0.0	0.0
4/15/2023	8.5	3,569	4,968	3.1	17.5	0.0	0.0	0.0
5/5/2023	12.2	2,729	1,544	1.0	5.4	0.0	0.0	0.0
6/16/2023	17.2	1,636	13,205	8.3	46.5	0.0	0.0	0.0
7/4/2023	20.1	828	2,001	1.3	7.0	0.0	0.0	0.0
8/2/2023	19.1	879	314	0.2	1.1	0.0	0.0	0.0

	Boundary Conditions at Iron Gate Dam						Spreadsheet Model DO Output	
Period[a]	Avg. Monthly WT (°C)[b]	Flow (cfs)[c]	SSC (mg/l)[d]	IOD (mg/l)	BOD (mg/l)	Initial DO, 0% (mg/l)[e]	Minimum (mg/l)	Location (miles)[f]
9/1/2023	16.3	911	167	0.1	0.6	0.0	0.0	0.0

Notes: WY = water year, WT = water temperature, SSC = suspended sediment contamination, IOD = initial oxygen demand, BOD = biological oxygen demand

[a] Date for maximum simulated suspended sediment concentration in the month; years assume reservoir drawdown in 2023.

[b] Simulated daily water temperature from HEC5Q water temperature model.

[c] Daily flow values simulated with updated Reclamation hydraulic model for the revised KRRC drawdown scenario (KRRC, 2021f, appendix I) that correspond with the simulated peak suspended sediment concentration for each month.

[d] Simulated peak suspended sediment concentration for each month from updated Reclamation SRH-1D suspended sediment concentration model for revised KRRC drawdown scenario (KRRC, 2021f, appendix I).

[e] Calculated with the average monthly water temperature, salinity = 0 parts per thousand, and elevation = 2,320 feet.

[f] Miles downstream of Iron Gate Dam site.

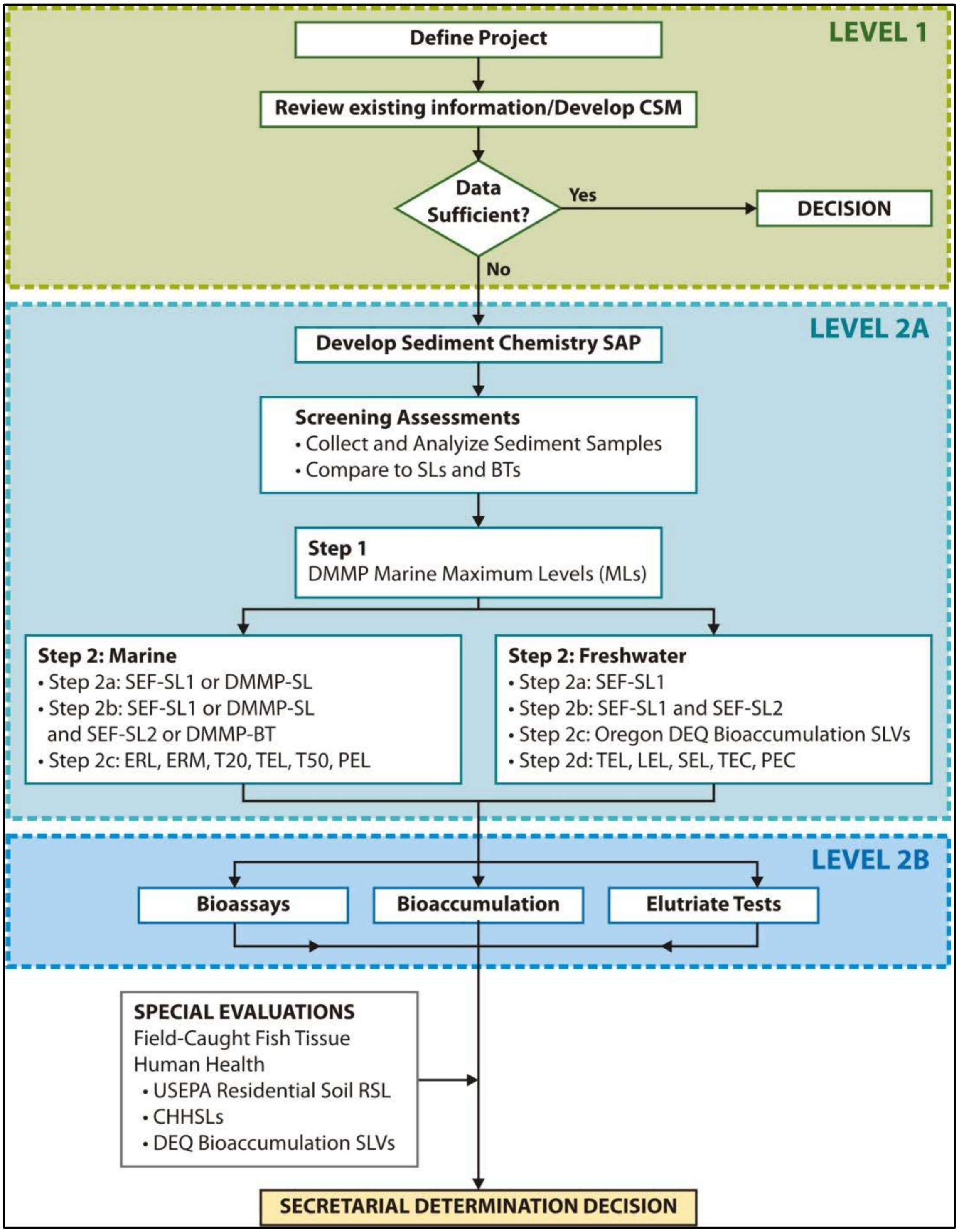


Figure 3.3-1. Flow diagram of the sediment evaluation framework and application to the Klamath Reservoir contaminant investigation under the Secretarial Determination (Source: CDM, 2011)

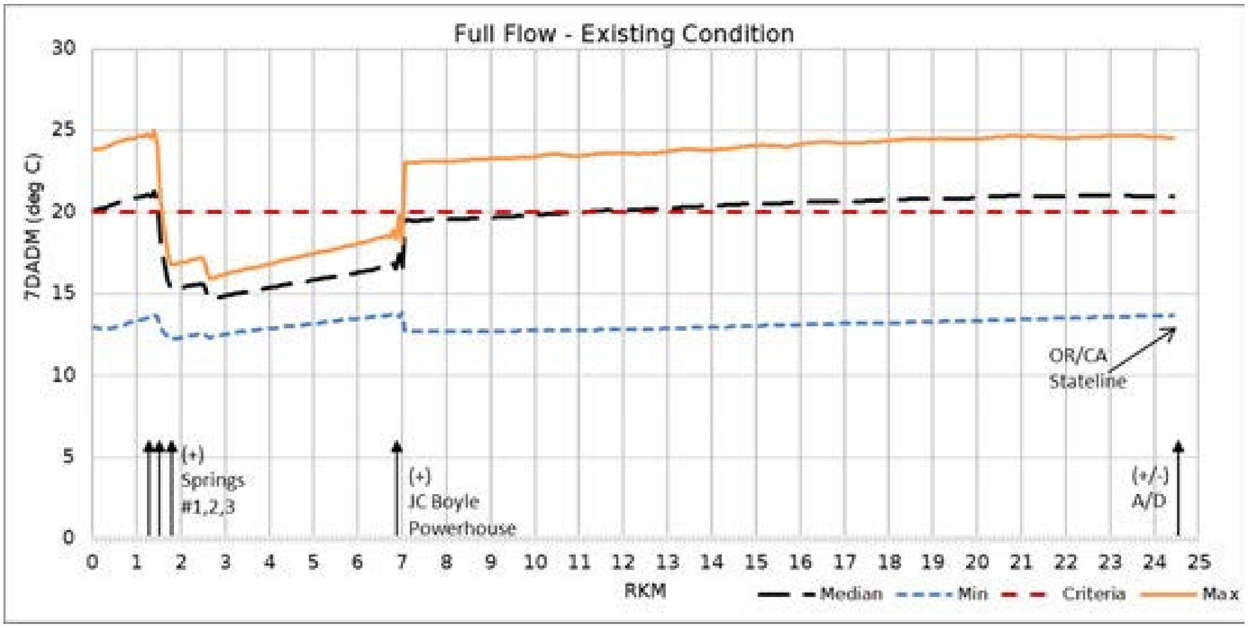


Figure 3.3-2. Simulated minimum, median, and maximum 7-day average daily maximum (7DADM) water temperatures downstream of J.C. Boyle Reservoir by river kilometer to the Oregon-California state border, 2001 (Source: Oregon DEQ, 2019a)

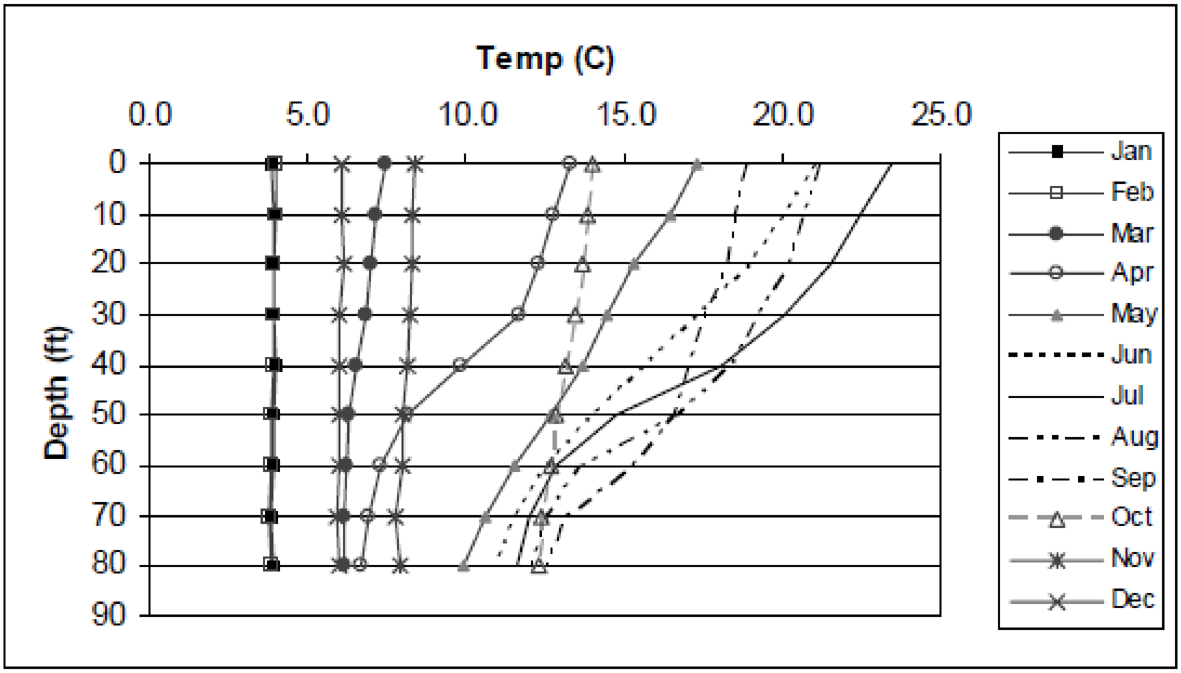


Figure 3.3-3. Average monthly water temperature vertical profiles in Copco No. 1 Reservoir, 2002 (Source: PacifiCorp, 2004a, as modified by staff)

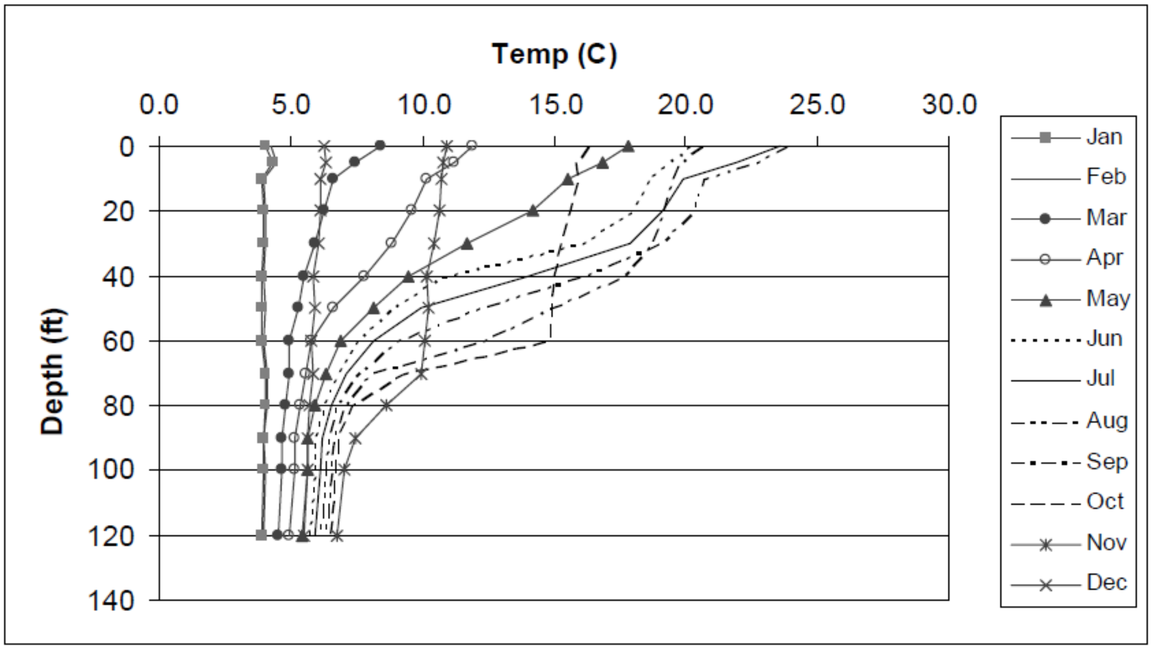


Figure 3.3-4. Average monthly water temperature vertical profiles in Iron Gate Reservoir, 2001 (Source: PacifiCorp, 2004a, as modified by staff)

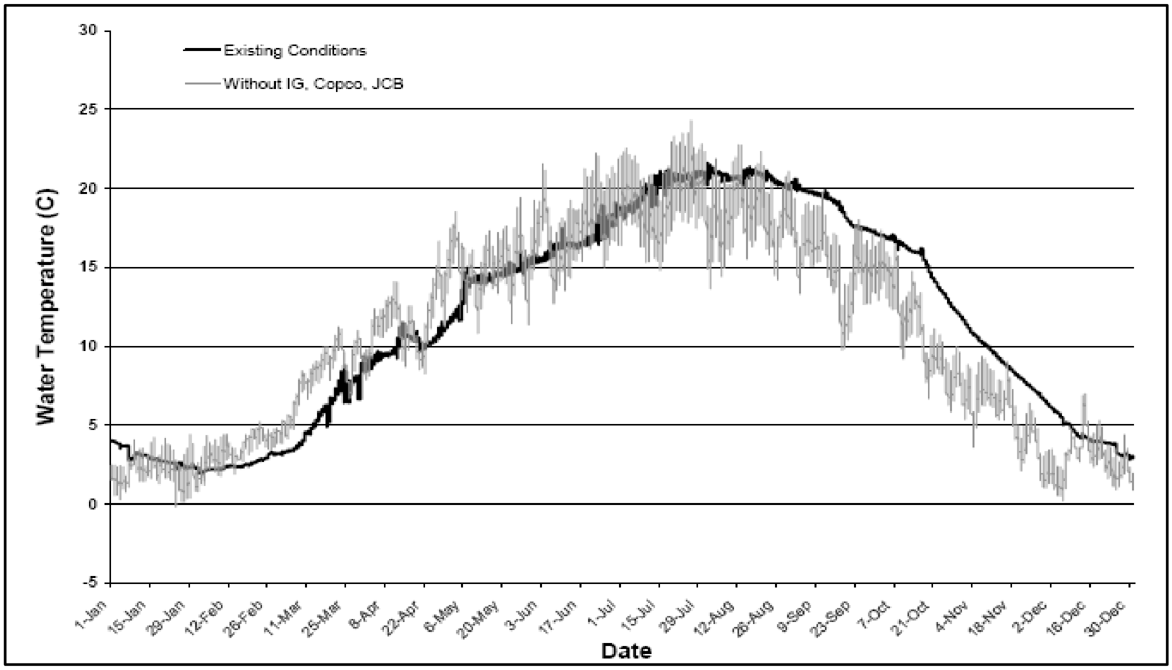
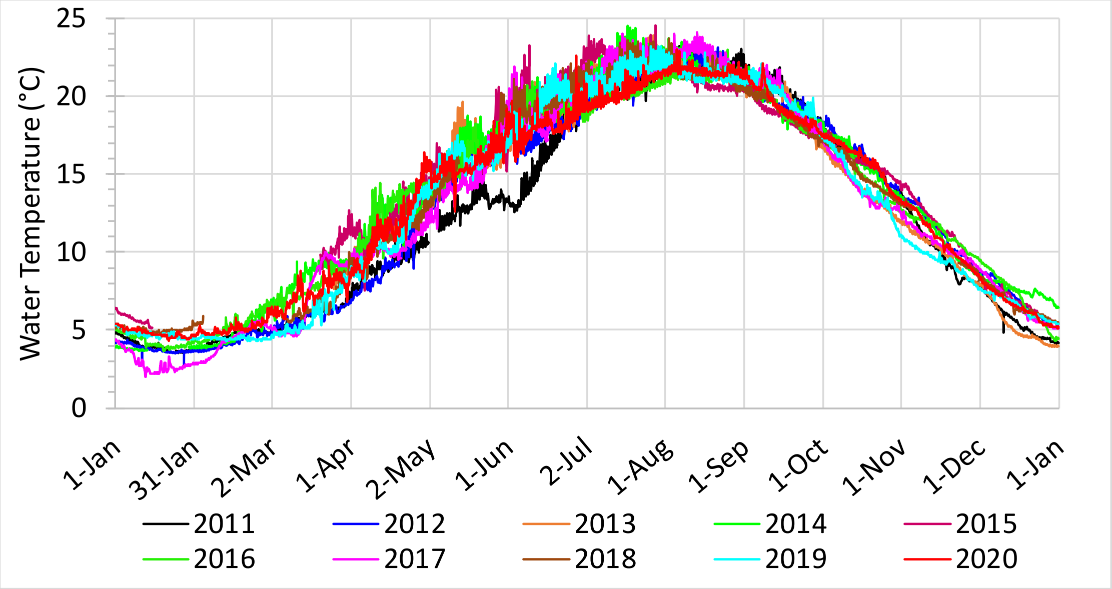
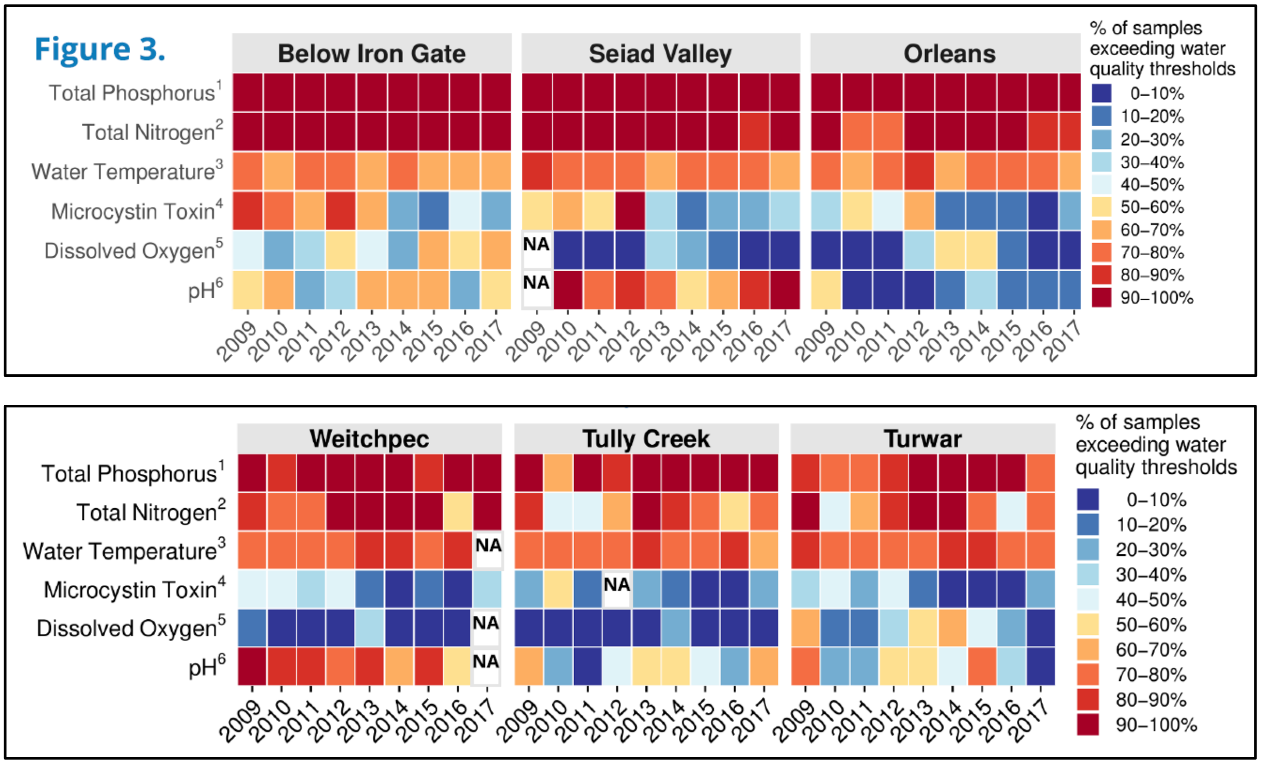


Figure 3.3-5. Simulated hourly water temperature downstream from Iron Gate Dam for existing conditions compared to hypothetical conditions with Lower Klamath Project dams removed, based on the 2004 water year (Source: PacifiCorp, 2005)



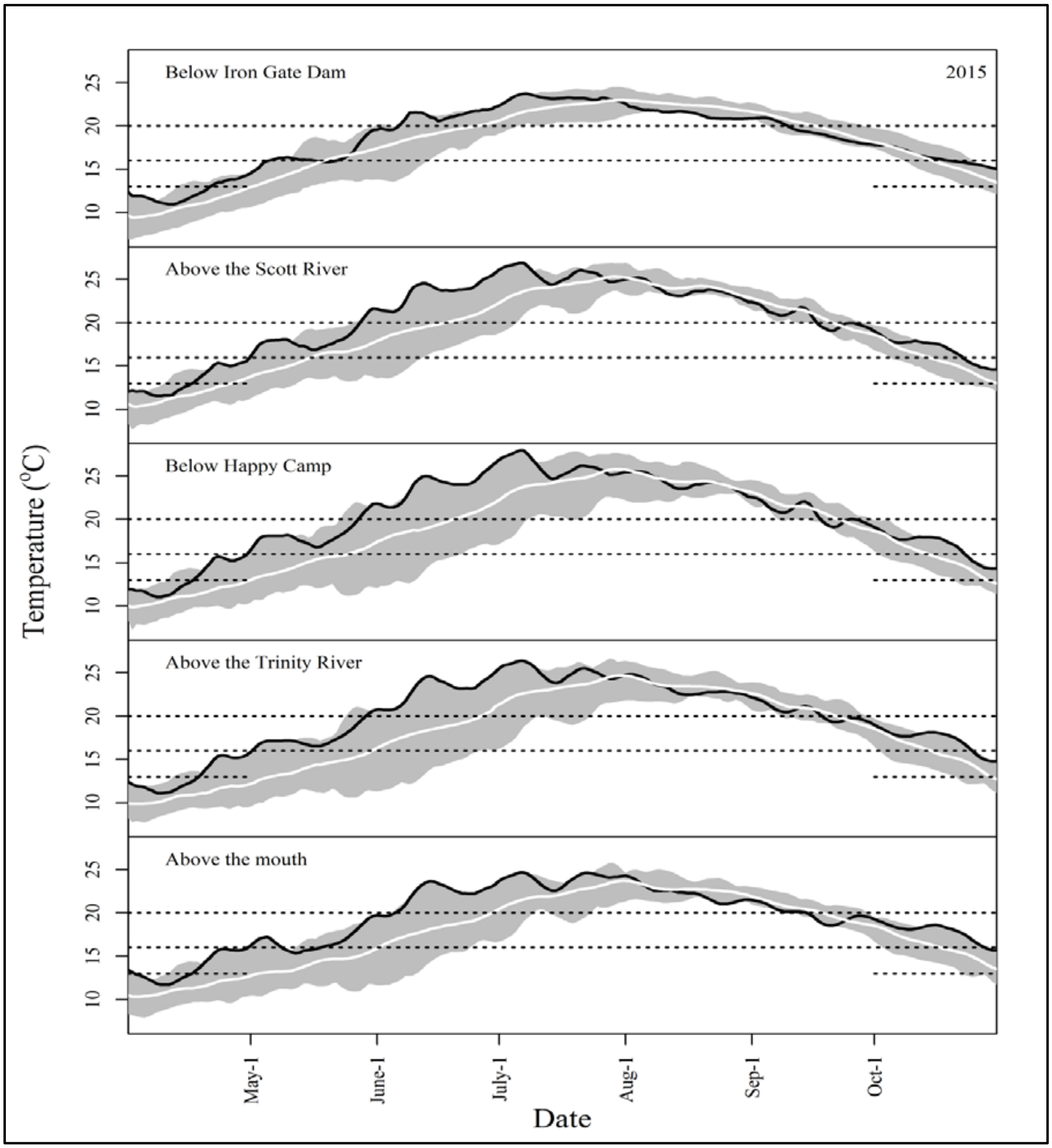
Note: Measurements recorded at 1-hour or less increments.

Figure 3.3-6. Hourly water temperatures measured below Iron Gate Dam, 2011–2020 (Source: PacifiCorp, 2012, 2013, 2014, 2015, 2016a, 2017b, 2018, 2019a, 2020a, 2021a)



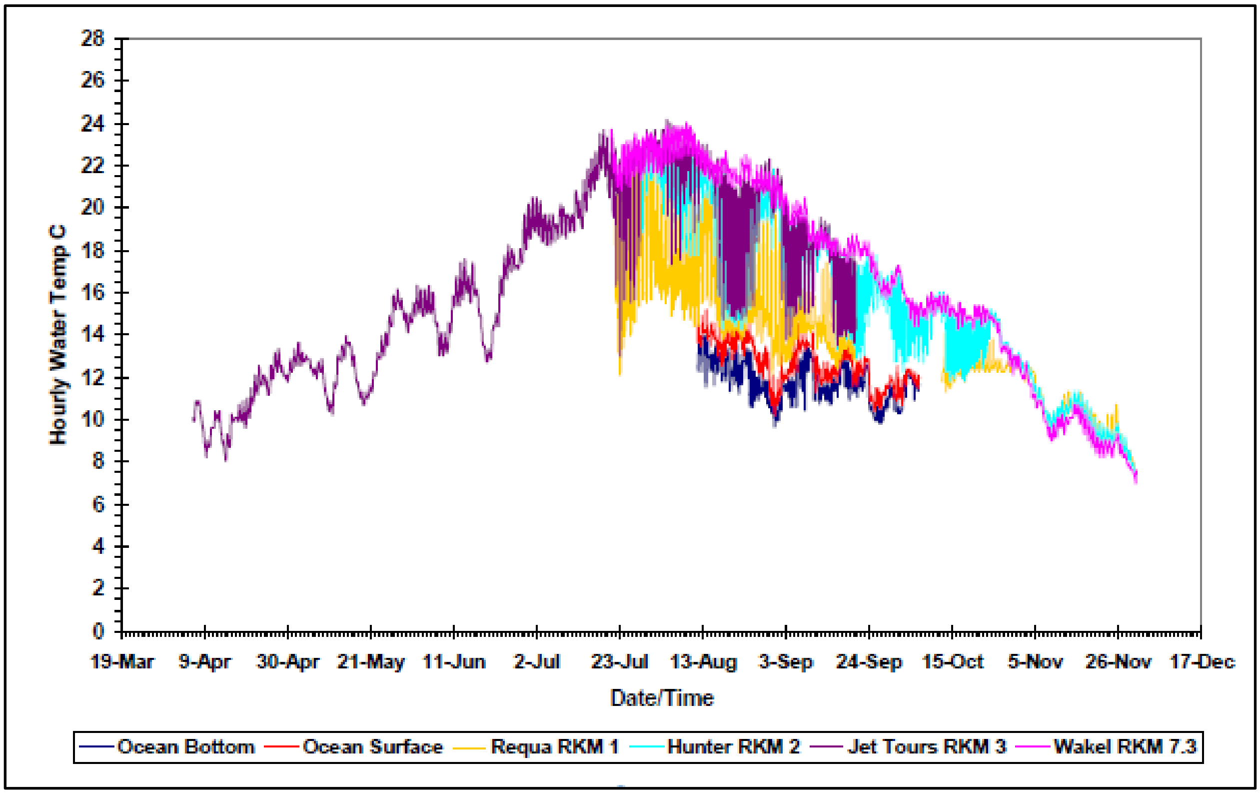
Notes: Water quality thresholds are based on Tribal and State water quality objectives. For seasonal and site-specific thresholds, this analysis uses a single threshold. 1. total phosphorus 0.022 mg/l (upper limit), 2. total nitrogen 0.182 mg/l (upper limit), 3. water temperature 18°C (upper limit), 4. Microcystin 0.8 µg/L (caution level, upper limit), 5. dissolved oxygen 90 percent of saturation (lower limit), and 6. pH range of 7.0–8.5.

Figure 3.3-7. Summertime water quality threshold exceedance frequencies at six Lower Klamath River monitoring sites, June–October 2009–2017 (Source: Genzoli et al., 2018)



Legend: Black lines are 7DADM temperatures in 2015, white lines are long term (2000–2016) mean 7DADM, gray polygons are long-term range of 7DADM; and dotted lines are EPA (2003) Pacific Northwest water temperature guidelines.

Figure 3.3-8. Comparison of 7-day average daily maximum water temperatures measured at five locations in the Klamath River (between Iron Gate Dam and the mouth of the Klamath River at the ocean) (April 1–October 31, 2015) versus EPA water temperature guidelines (Source: David and Goodman, 2017)



Note: The saltwater wedge, which became established at river kilometer 3 on July 21 coinciding with a river flow of <5,000 cfs, was not detected above river kilometer 4 and did not influence river temperatures at Wakel river kilometer 7.3.

Figure 3.3-9. Hourly water temperatures in the nearshore ocean and at the bottom in the Klamath River estuary, 2005 (Source: Strange, 2007)

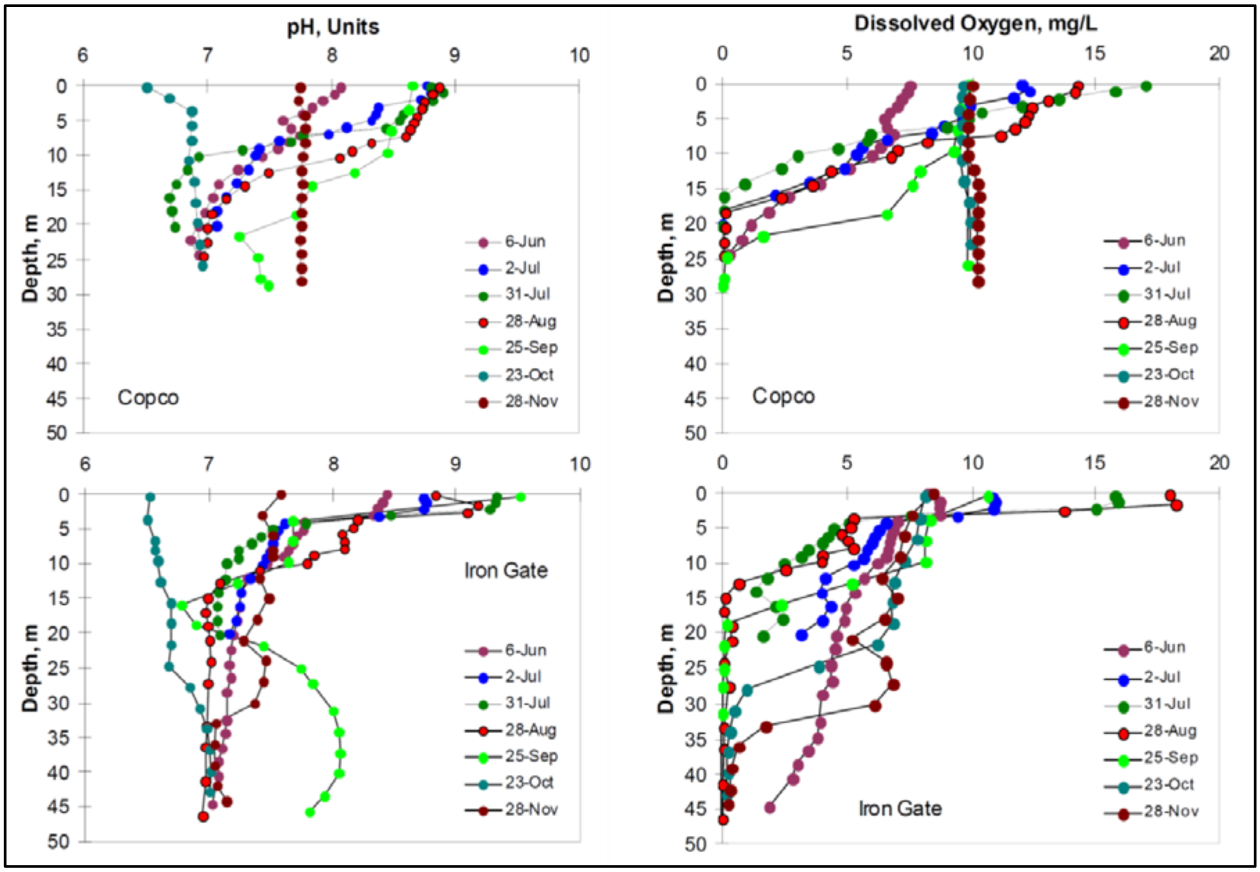
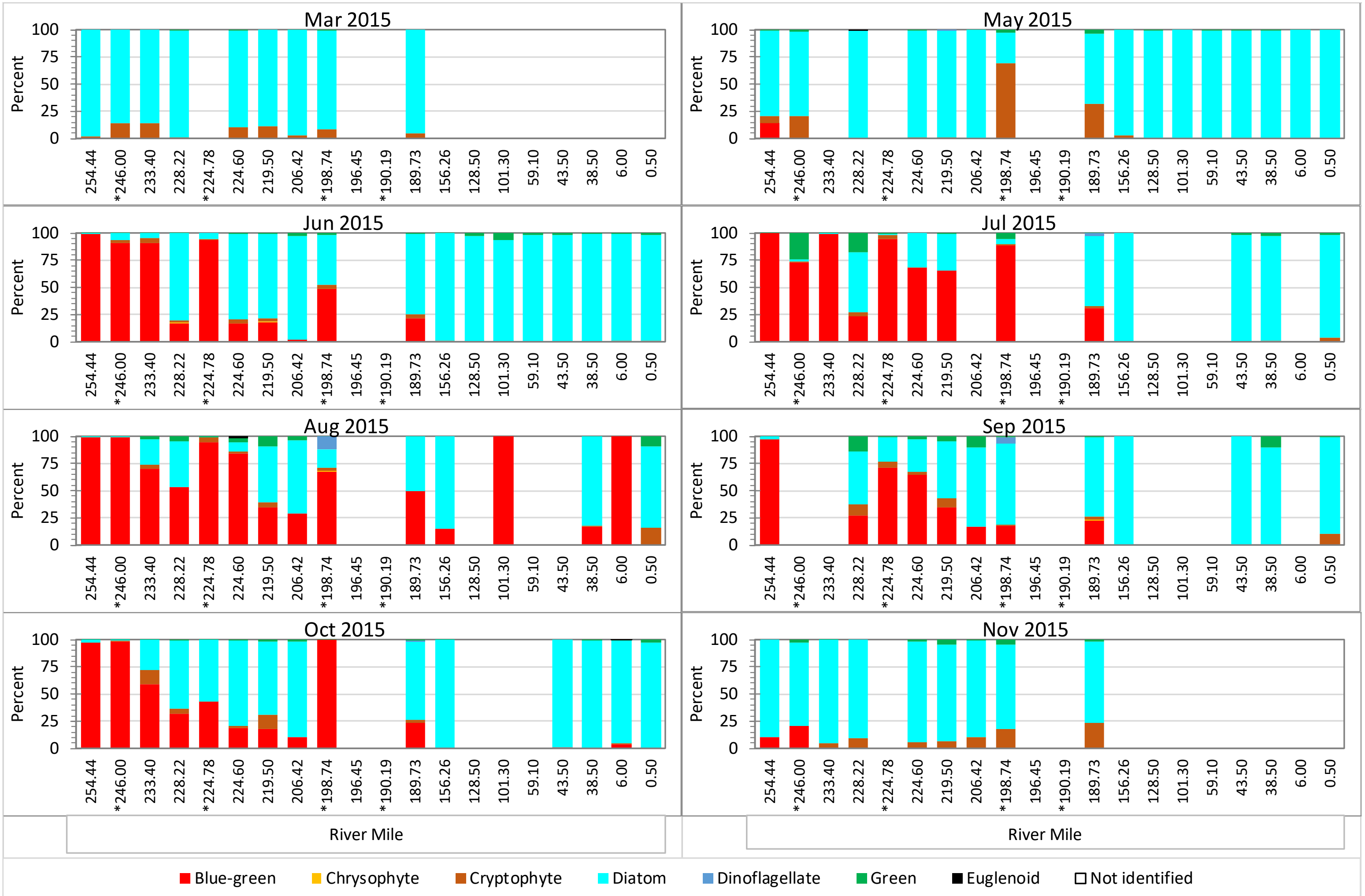
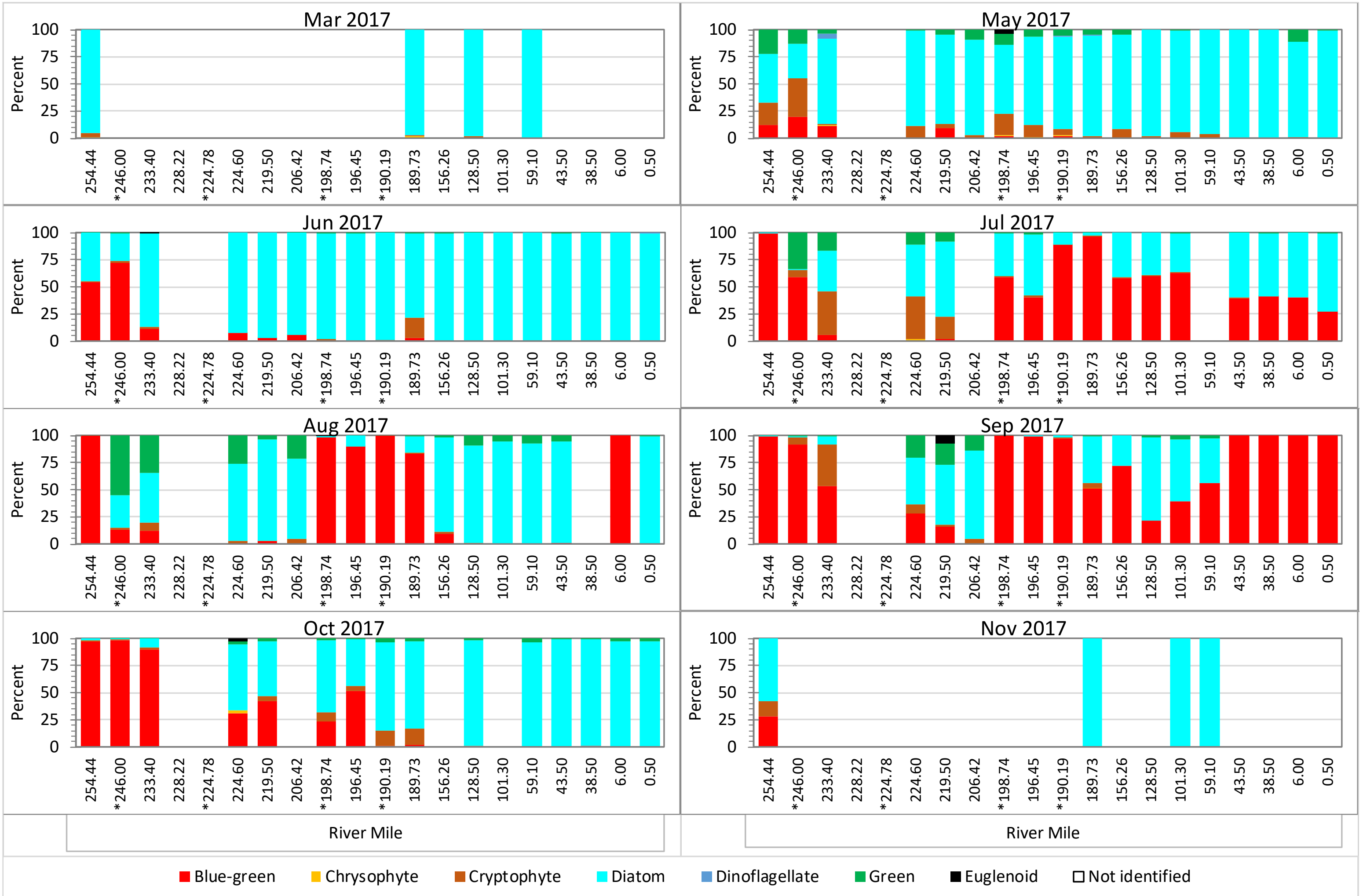


Figure 3.3-10. Vertical profiles of pH and dissolved oxygen in Copco No. 1 and Iron Gate Reservoirs at their log booms, 2007 (Source: California Water Board, 2020a, adapted from Raymond, 2008)



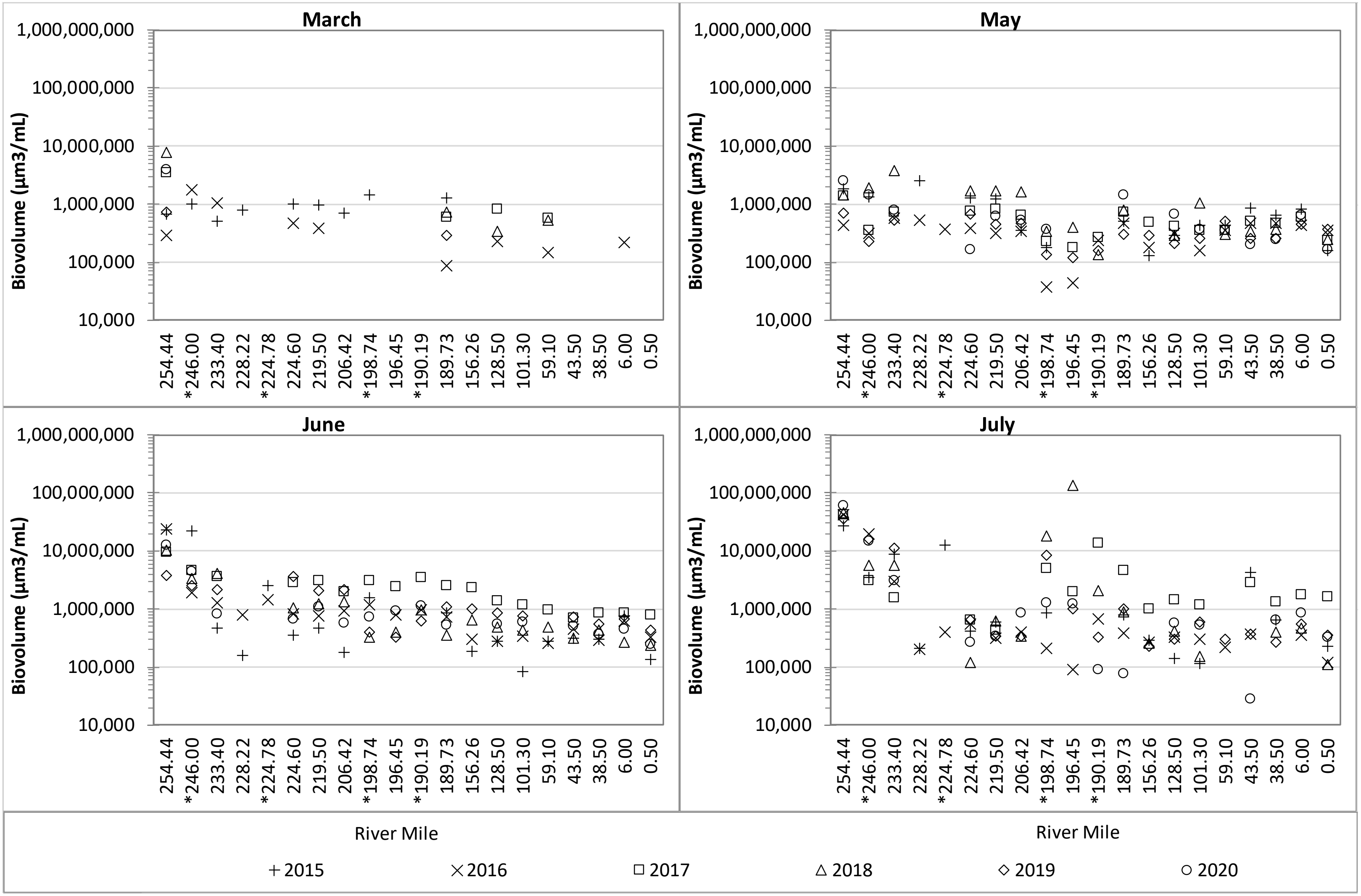
Note: * preceding RM indicates reservoir: RM 224.78 J.C. Boyle, RM 198.74 Copco No. 1, RM 190.19 Iron Gate.

Figure 3.3-11. Average monthly composition of the phytoplankton community sampled along a longitudinal profile within and downstream of the Klamath River hydroelectric reach, under the dry conditions of 2015 (Source: Watercourse Engineering, Inc., 2017e)



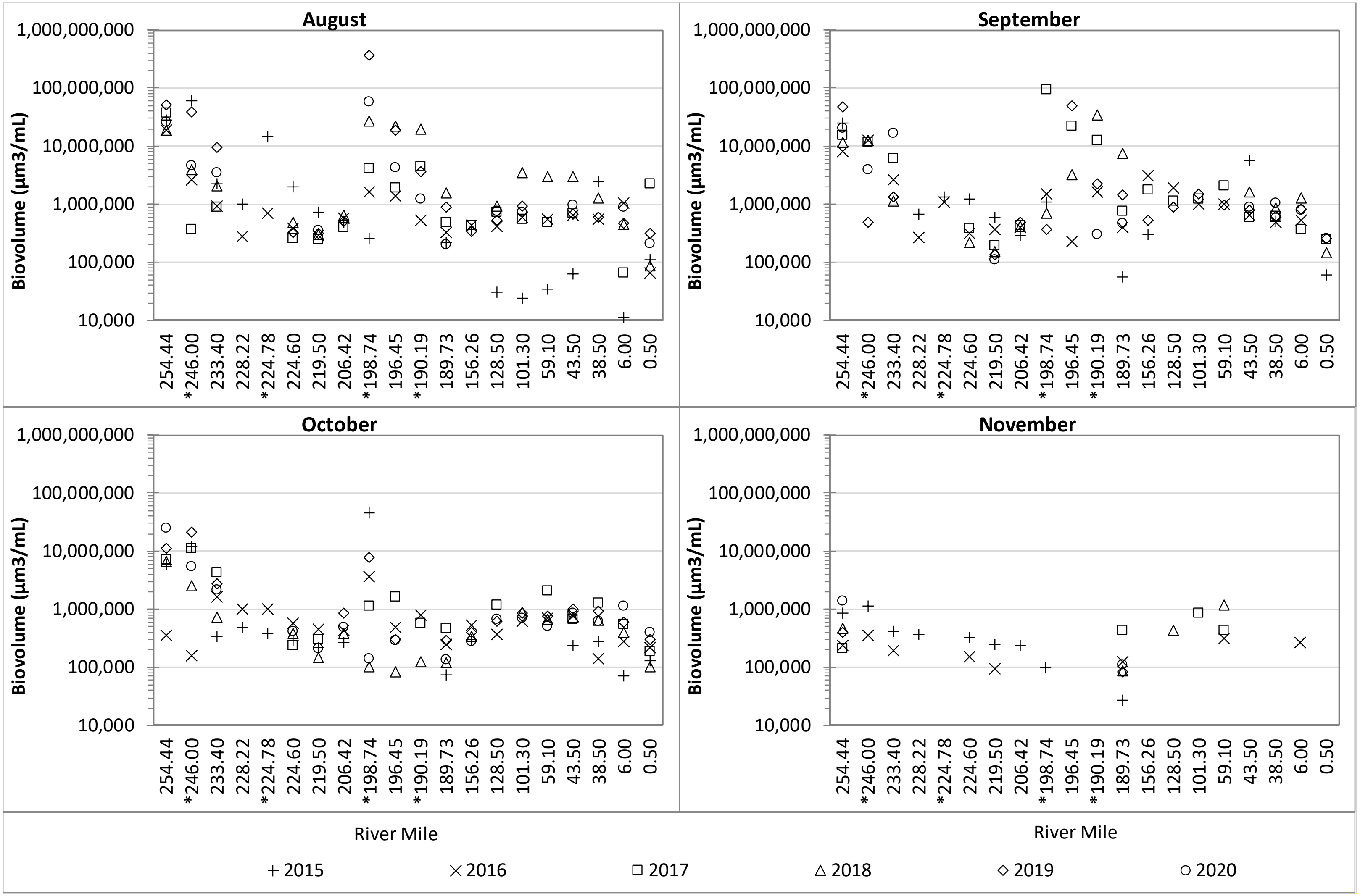
Note: preceding RM indicates reservoir: RM 224.78 J.C. Boyle, RM 198.74 Copco No. 1, RM 190.19 Iron Gate.

Figure 3.3-12. Average monthly composition of the phytoplankton community sampled along a longitudinal profile within and downstream of the Klamath River hydroelectric reach, under the wet conditions of 2017 (Source: Watercourse Engineering, Inc., 2018a)



Note: * preceding RM indicates reservoir: RM 224.78 J.C. Boyle, RM 198.74 Copco No. 1, RM 190.19 Iron Gate.

Figure 3.3-13. Monthly average phytoplankton total biovolume (µm^3/ml) in the Klamath River, March–July 2015–2020 (Source: Watercourse Engineering, Inc., 2017e-f, 2018a, 2019a, 2020a, 2021a)



Note: * preceding RM indicates reservoir: RM 224.78 J.C. Boyle, RM 198.74 Copco No. 1, RM 190.19 Iron Gate.

Figure 3.3-14. Monthly average phytoplankton total biovolume (µm3/ml) in the Klamath River, August–November 2015–2020 (Source: Watercourse Engineering, Inc., 2017e-f, 2018a, 2019a, 2020a, 2021a)

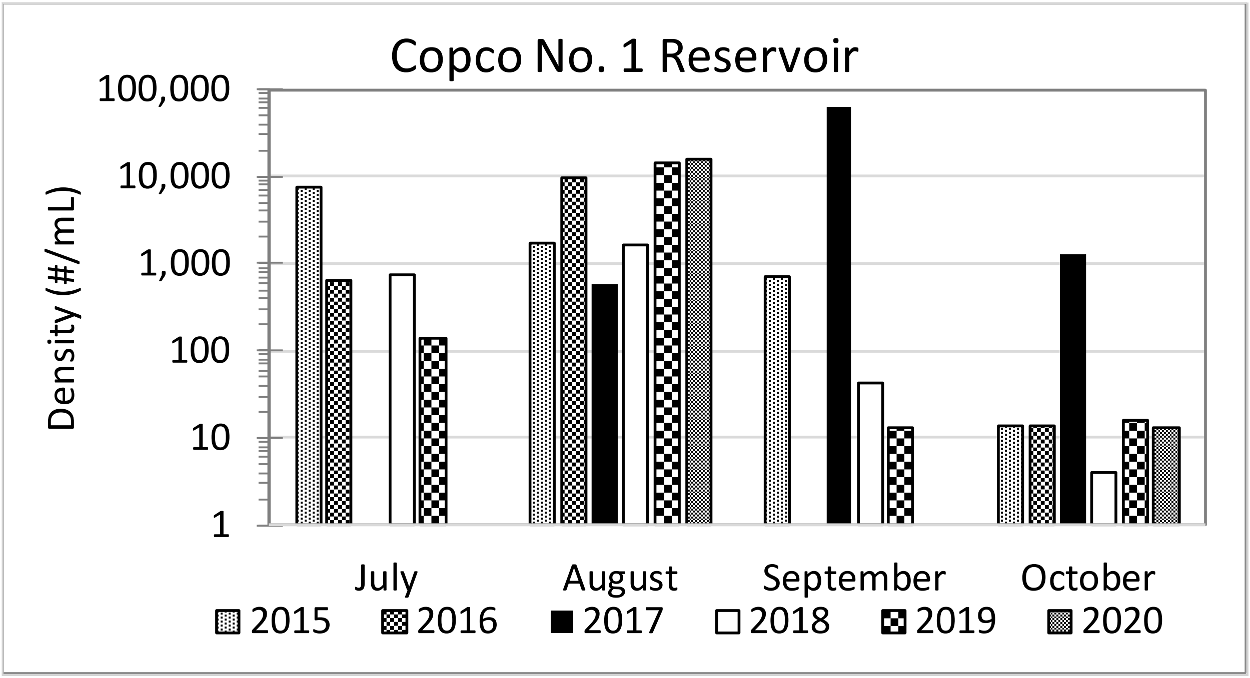


Figure 3.3-15. Monthly average *Microcystis aeruginosa* density (n/ml) in Copco No. 1 Reservoir, July–October 2015–2020 (Source: Watercourse Engineering, Inc., 2017e-f, 2018a, 2019a, 2020a, 2021a)

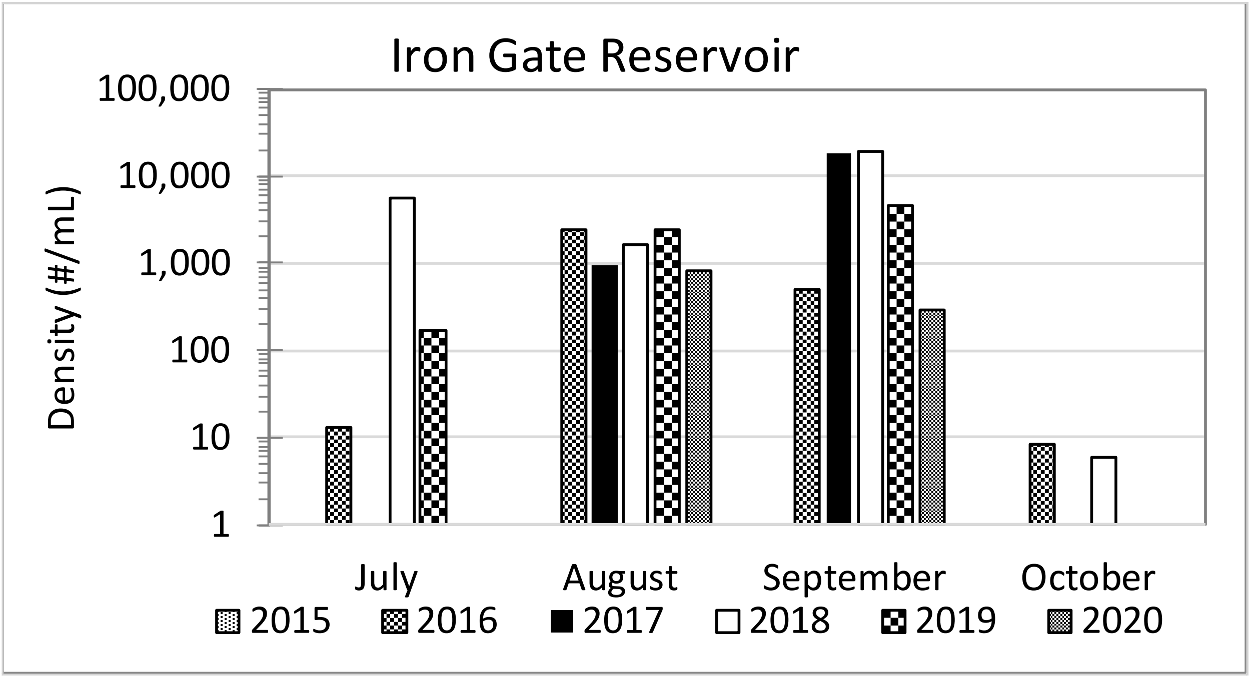
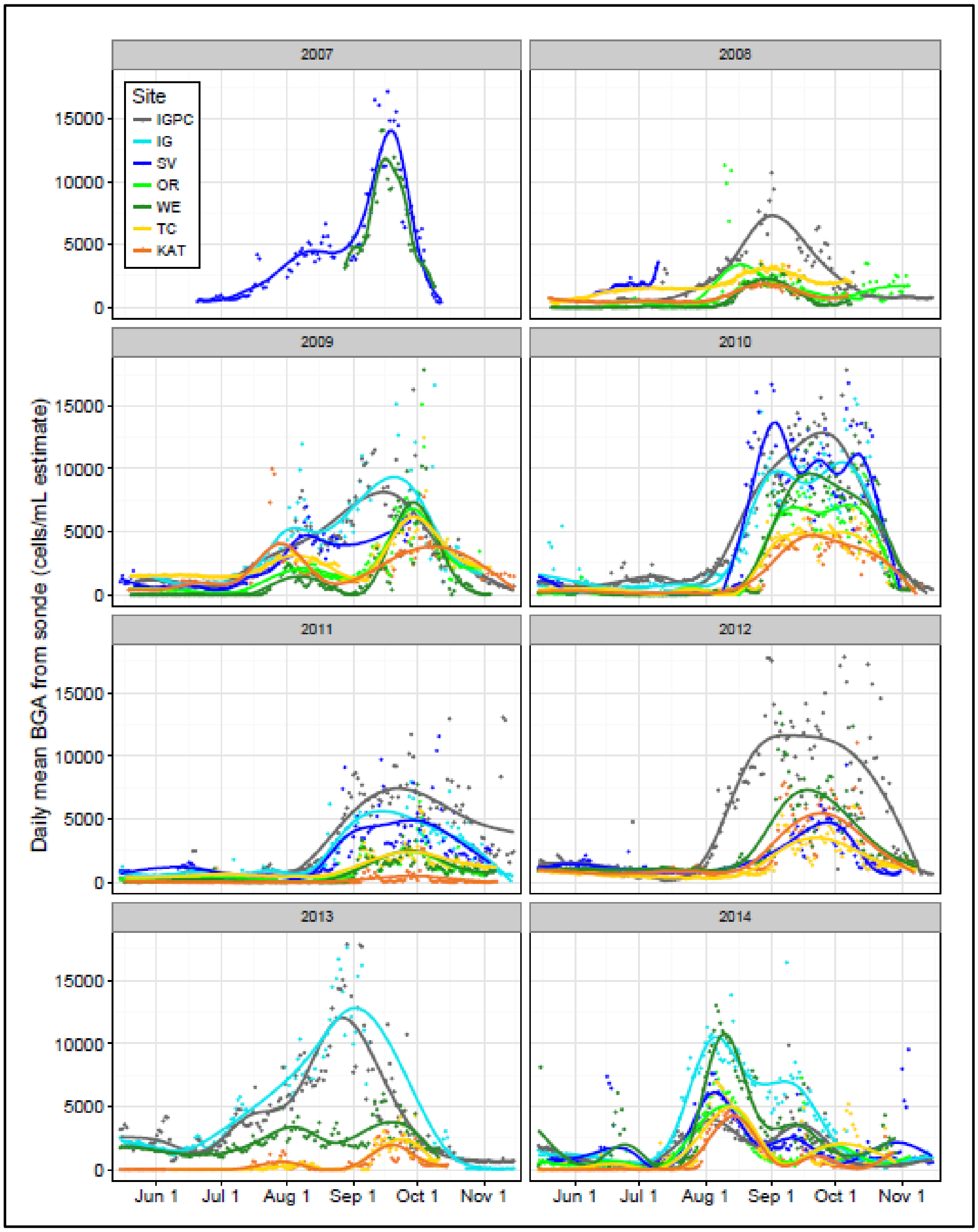
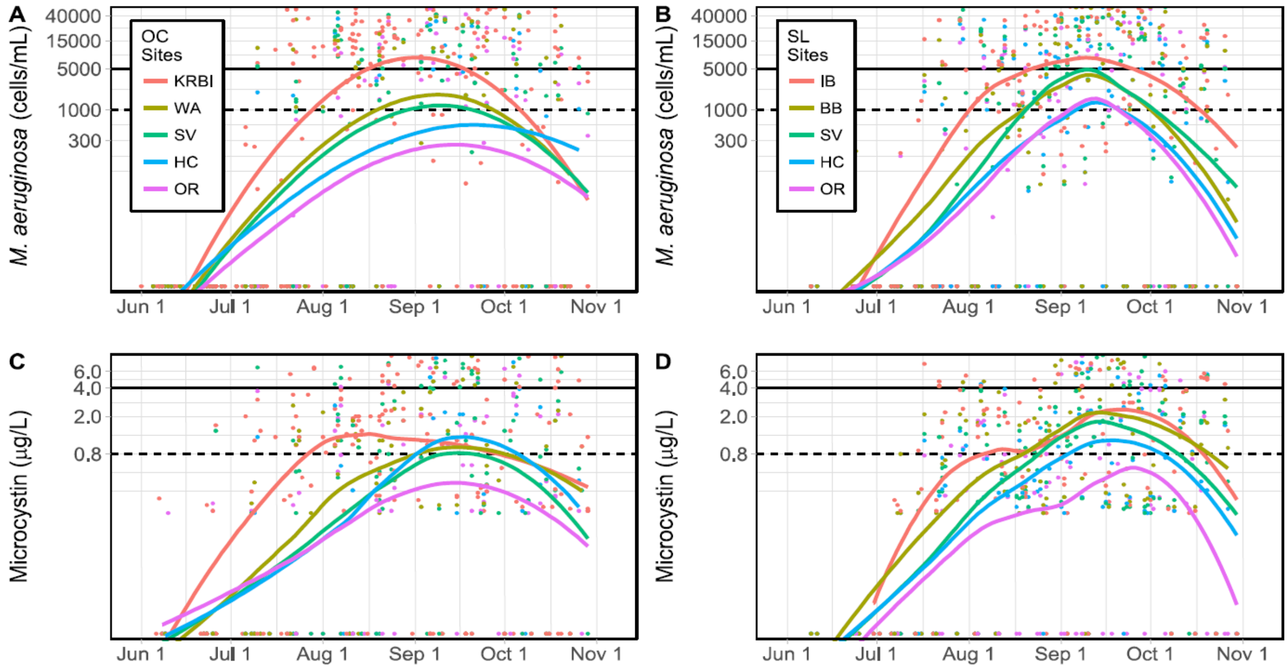


Figure 3.3-16. Monthly average *Microcystis aeruginosa* density (n/ml) in Iron Gate Reservoir, July–October 2015–2020 (Source: Watercourse Engineering, Inc., 2017e-f, 2018a, 2019a, 2020a, 2021a)



Note: Klamath River sites are IGPC = RM 189.5 below Iron Gate Dam, IG = RM 189.1 below Iron Gate Dam, SV = RM 128.6 at Seiad Valley, OR = RM 59.1 at Orleans, WE = RM 43.5 at Weitchpec, TC = RM 38.5 above Tully Creek, KAT = RM 5.8 at Turwar. EPA (undated) provides a brief discussion of the locally weighted scatterplot smoothing process.

Figure 3.3-17. Daily mean blue-green algae concentrations by site and year in Lower Klamath River (non-parametric locally weighted scatterplot smoothing curves through the 90% quantile), May–November 2007–2014 (Source: Genzoli and Kann, 2016)



Notes: Some high data points are not shown because y-axes are truncated to show detail in the LOESS curves. EPA (undated) provides a brief discussion of the LOESS process.

Panels A and C show open-channel samples and panels B and D show shoreline samples

Solid and dashed black lines are the lower thresholds for the Yurok Tribe Level II Danger Advisory and Level I Advisory Warning, respectively.

Klamath River sites are KRBI = RM 189.7 below Iron Gate Dam, IB = RM 176 at I5 Bridge, WA = RM 157 at Walker Bridge, BB = RM 150 at Brown Bear river access, SV = RM 128.5 at Seiad Valley sluice box, HC = RM 108.4 at Happy Camp, and OR = RM 59.1 at Orleans.

Figure 3.3-18. Lower Klamath River seasonal Microcystis aeruginosa cell density (panels A and B) and microcystin toxin concentration (panels C and D) for each site with all years combined (non-parametric locally weighted scatterplot smoothing curves through the 90% quantile), June–October 2008–2016 (Source: Genzoli and Kann, 2017)

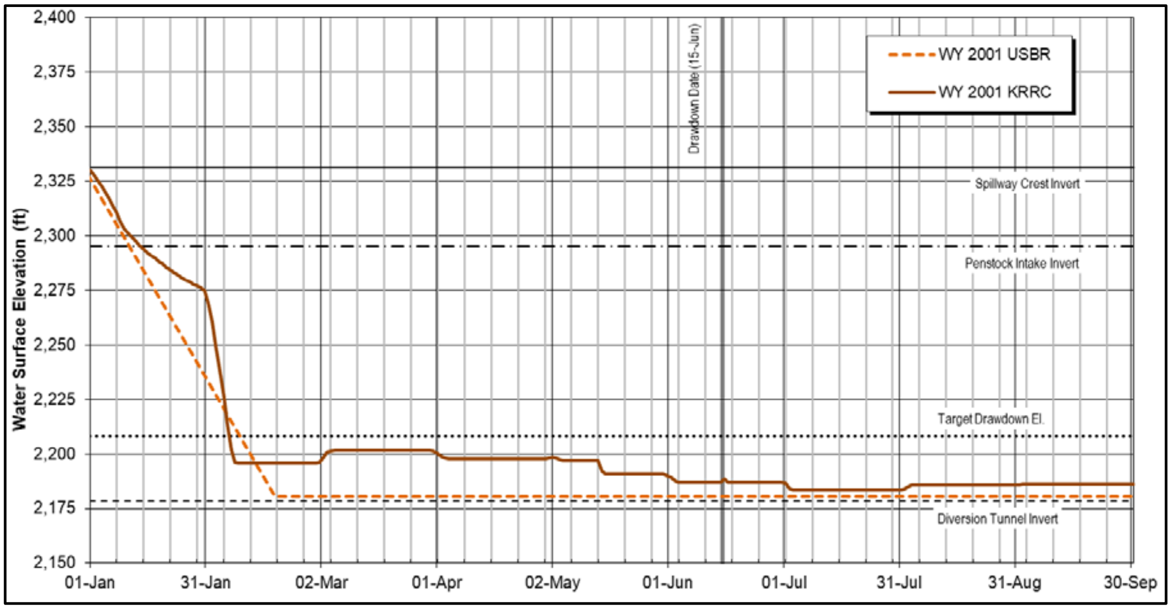
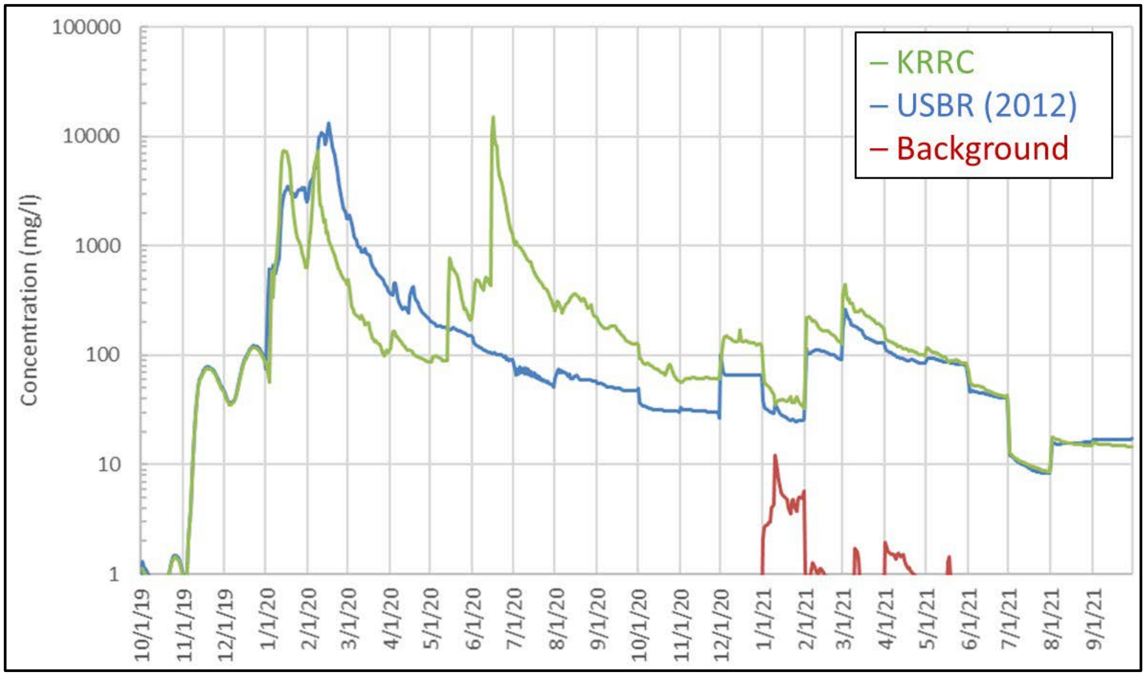


Figure 3.3-19. Simulated drawdown schedule using KBRA hydrologic flows at Iron Gate Dam (Reclamation) and updated KRRC schedule, for a dry water year (Source: KRRC, 2021f, appendix I)



Note: Years on horizontal axis are relative.

Figure 3.3-20. Simulated SSCs at the Iron Gate USGS gage under baseline (background) KBRA hydrologic flows (Reclamation), and updated KRRC flow schedule for a dry water year (Source: KRRC, 2021f, appendix I)

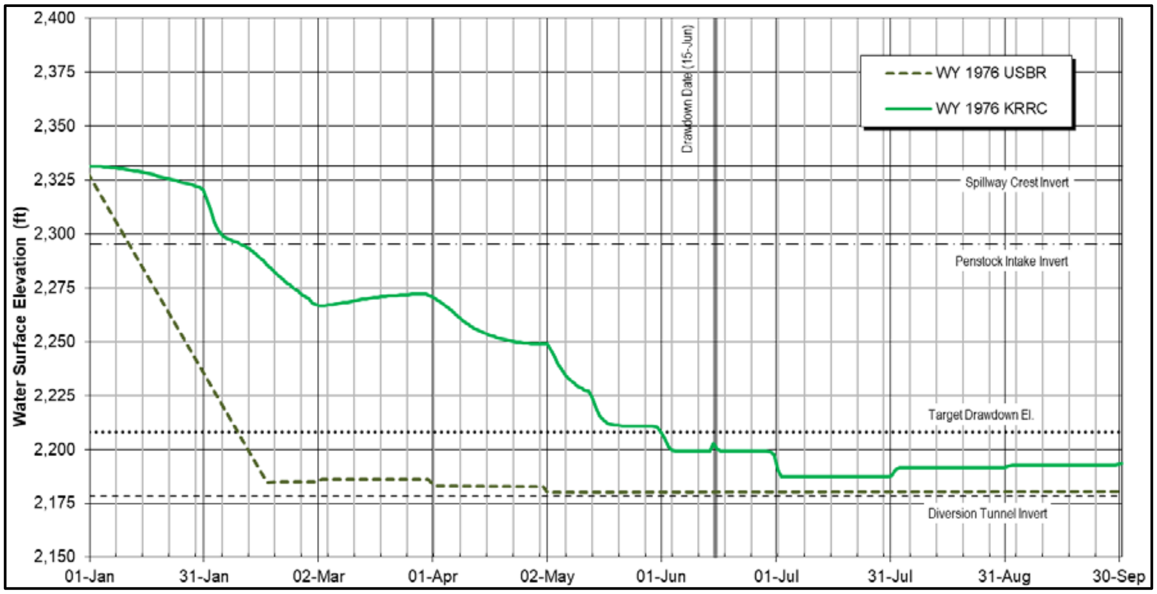
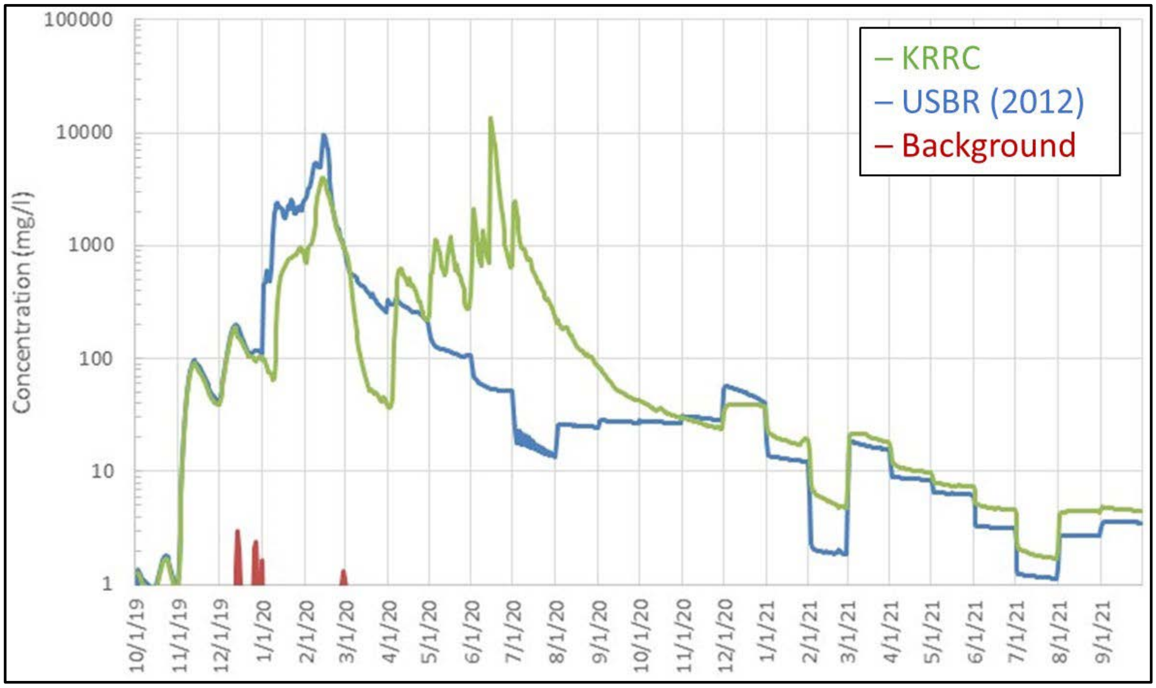


Figure 3.3-21. Simulated drawdown schedule using KBRA hydrologic flows at Iron Gate Dam (Reclamation) and updated KRRC schedule for an average water year (Source: KRRC, 2021f, appendix I)



Note: Years on horizontal axis are relative.

Figure 3.3-22. Simulated SSCs (mg/l) at the Iron Gate USGS gage under baseline (background), KBRA hydrologic flows (Reclamation), and updated KRRC schedule for an average water year (Source: KRRC, 2021f, appendix I)

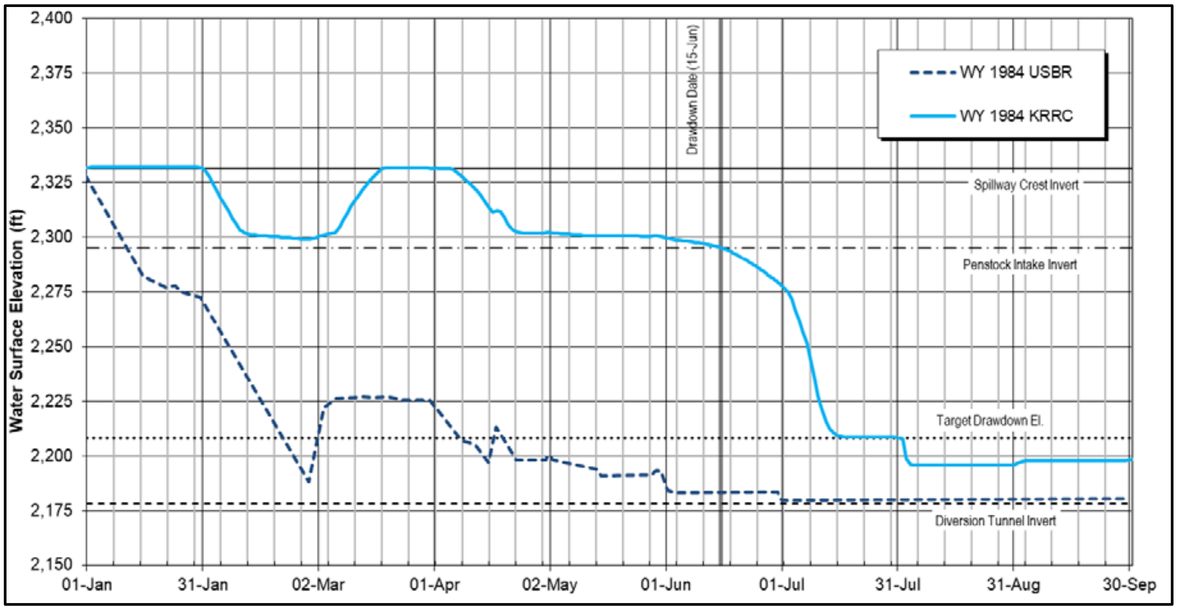
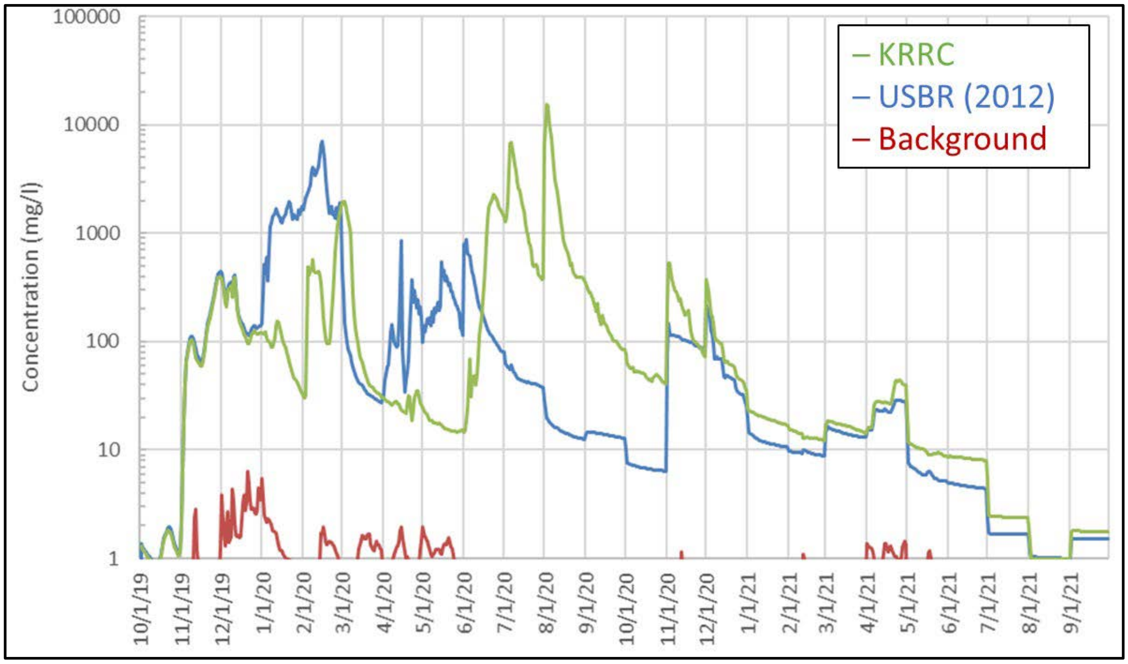
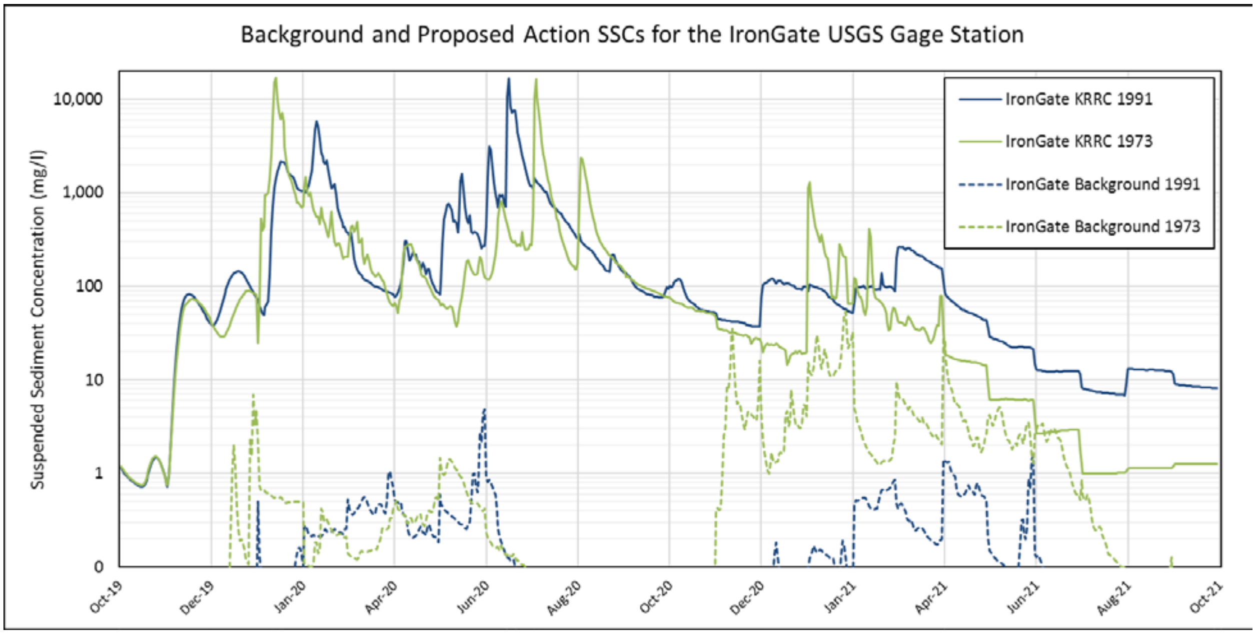


Figure 3.3-23. Simulated drawdown schedule using KBRA hydrologic flows at Iron Gate Dam (Reclamation) and updated KRRC schedule for a wet water year (Source: KRRC, 2021f, appendix I)



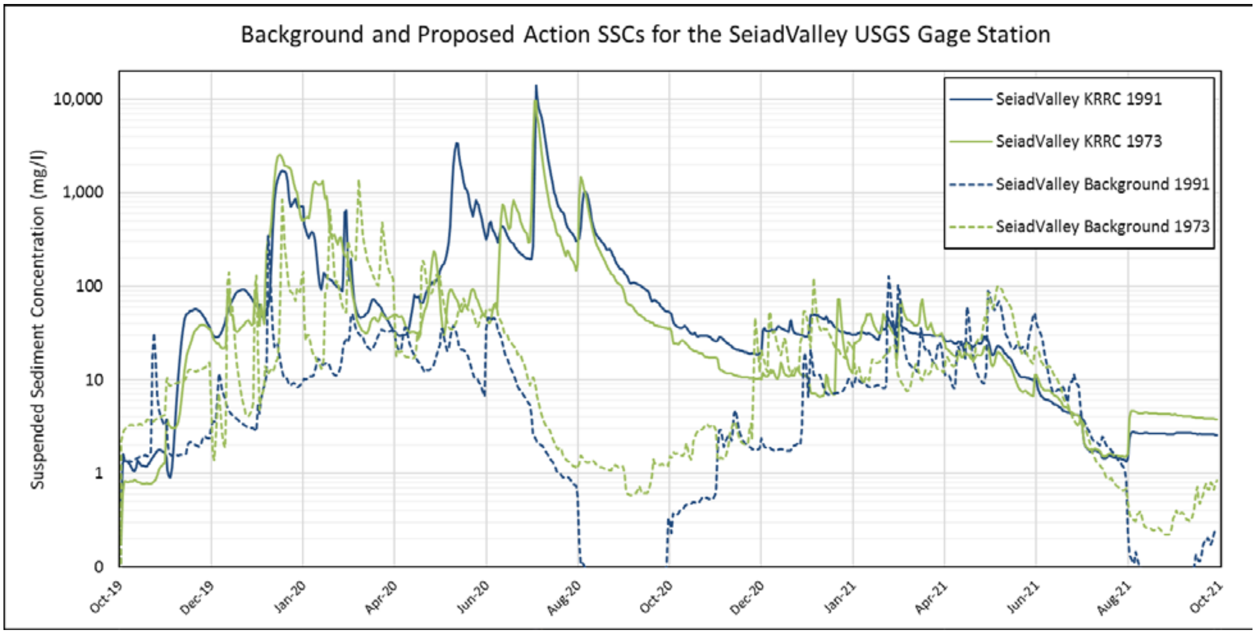
Note: Years on horizontal axis are relative.

Figure 3.3-24. Simulated SSCs (mg/l) at Iron Gate USGS gage under baseline (background), KBRA hydrologic flows (Reclamation), and updated KRRC schedule for wet water year (Source: KRRC, 2021f, appendix I)



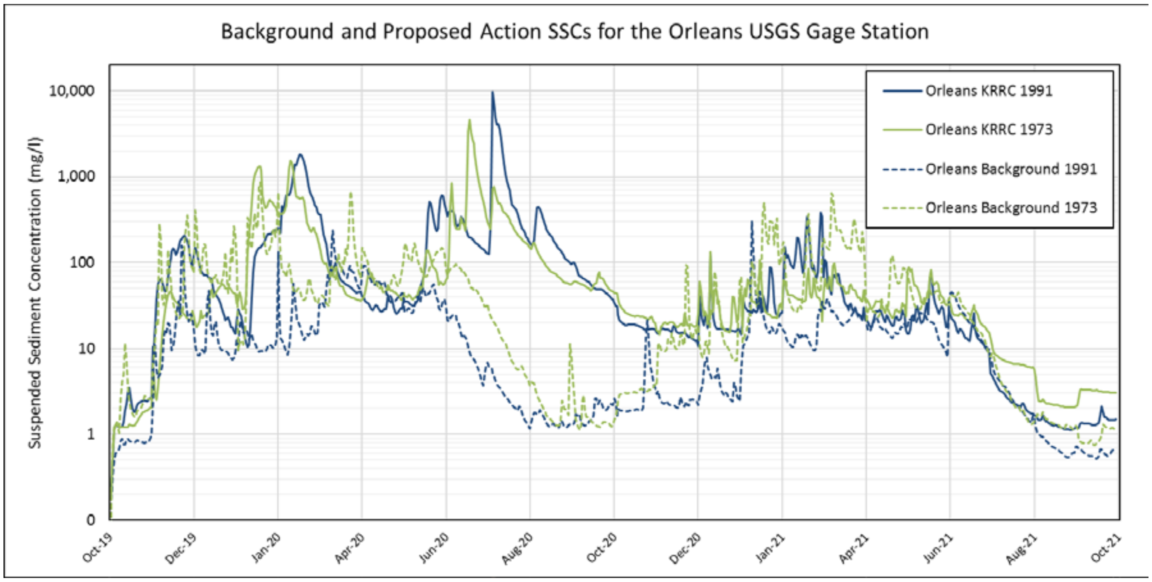
Note: Impact years were ranked based on the magnitude and duration of high SSC effects on adult and juvenile salmon.

Figure 3.3-25. Comparison of simulated daily SSCs (mg/l) at Iron Gate station (RM 193.1) for Chinook salmon median impact year (1991) and severe impact year (1973) under background conditions and proposed action (Source: KRRC, 2021f, appendix J)



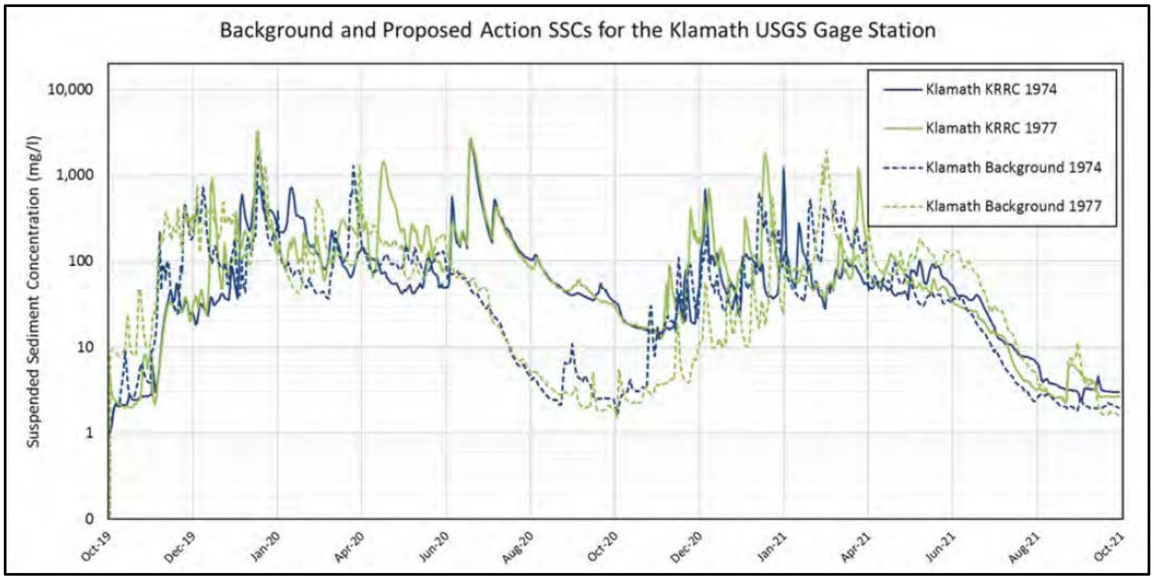
Note: Impact years were ranked based on the magnitude and duration of high SSC effects on adult and juvenile salmon.

Figure 3.3-26. Comparison of simulated daily SSCs at Seiad Valley station (RM 129.4) for Chinook salmon median impact year (1991) and severe impact year (1973) under background conditions and proposed action (Source: KRRC, 2021f, appendix J)



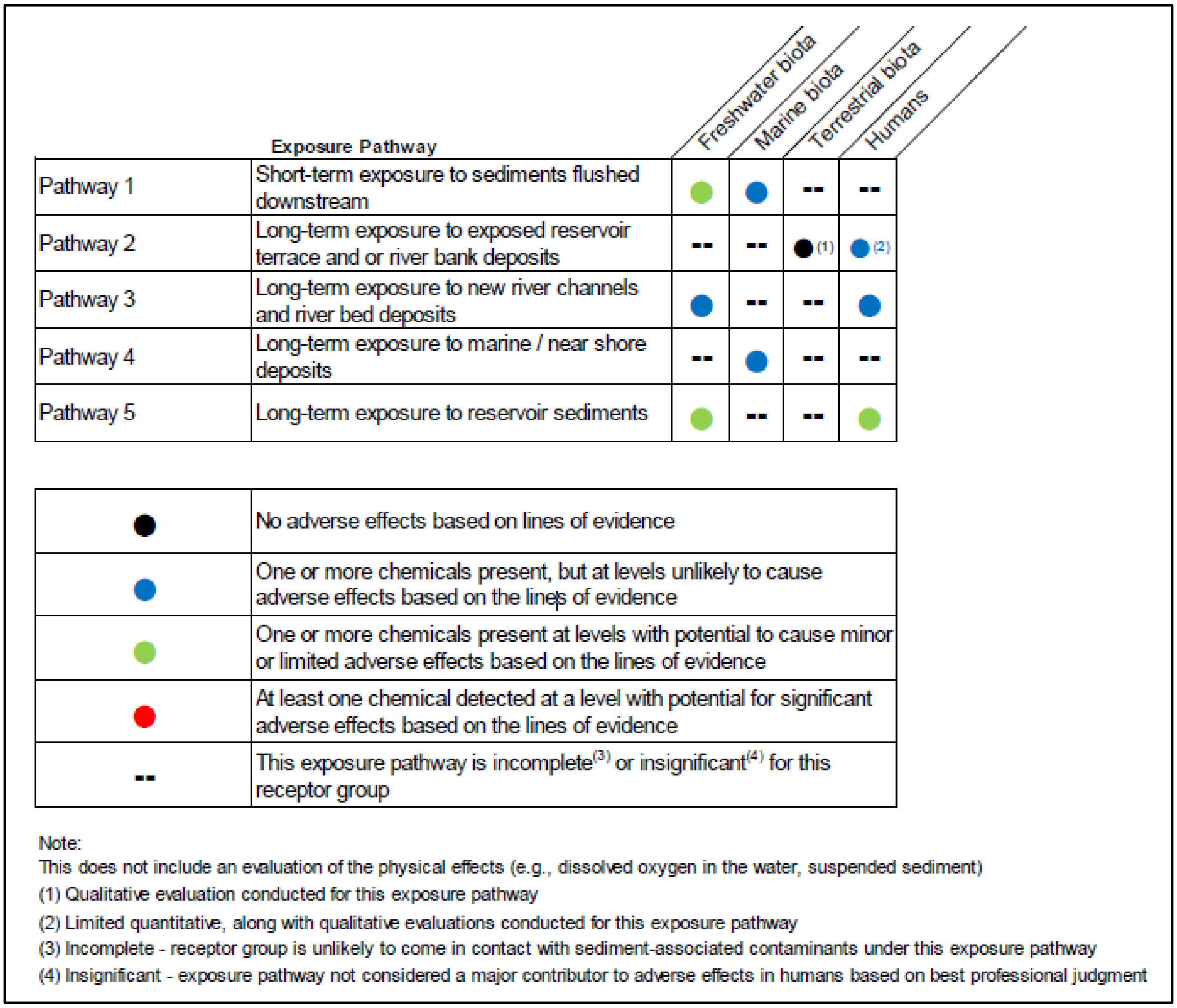
Note: Impact years were ranked based on the magnitude and duration of high SSC effects on adult and juvenile salmon.

Figure 3.3-27. Comparison of simulated daily SSCs at Orleans station (RM 59) for Chinook salmon median impact year (1991) and severe impact year (1973) under background conditions and proposed action (Source: KRRC, 2021f, appendix J)



Note: Impact years were ranked based on the magnitude and duration of high SSC effects on adult and juvenile salmon.

Figure 3.3-28. Comparison of simulated daily SSCs at Klamath Station (RM 5) for the DPS Eulachon median impact year (1974) and severe impact year (1977) under background conditions and proposed action (Source: KRRC, 2021f, appendix A)

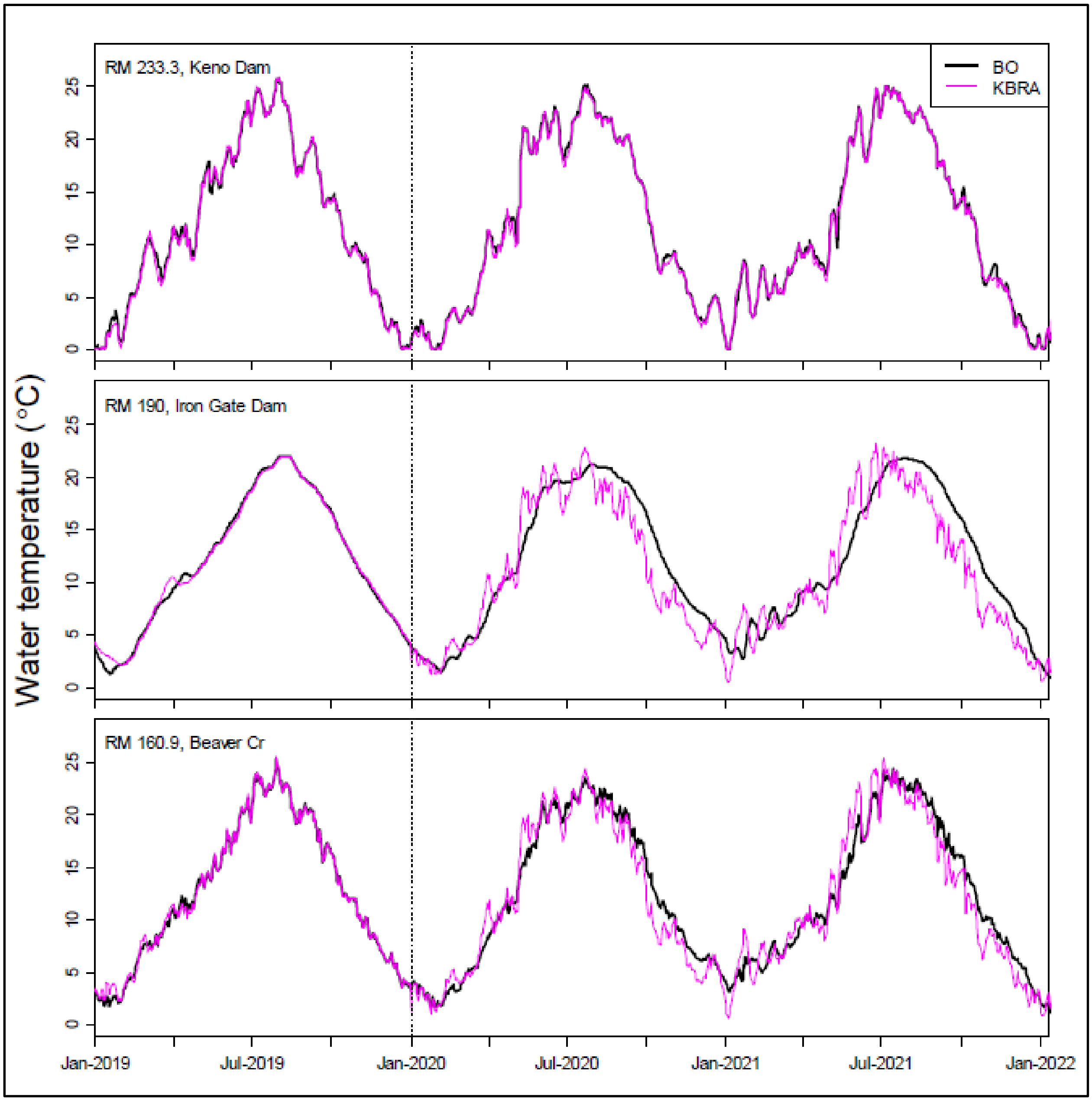


	Exposure Pathway	Freshwater biota	Marine biota	Terrestrial biota	Humans
Pathway 1	Short-term exposure to sediments flushed downstream	🟢	🔵	--	--
Pathway 2	Long-term exposure to exposed reservoir terrace and or river bank deposits	--	--	⚫ (1)	🔵 (2)
Pathway 3	Long-term exposure to new river channels and river bed deposits	🔵	--	--	🔵
Pathway 4	Long-term exposure to marine / near shore deposits	--	🔵	--	--
Pathway 5	Long-term exposure to reservoir sediments	🟢	--	--	🟢

⚫	No adverse effects based on lines of evidence
🔵	One or more chemicals present, but at levels unlikely to cause adverse effects based on the lines of evidence
🟢	One or more chemicals present at levels with potential to cause minor or limited adverse effects based on the lines of evidence
🔴	At least one chemical detected at a level with potential for significant adverse effects based on the lines of evidence
--	This exposure pathway is incomplete(3) or insignificant(4) for this receptor group

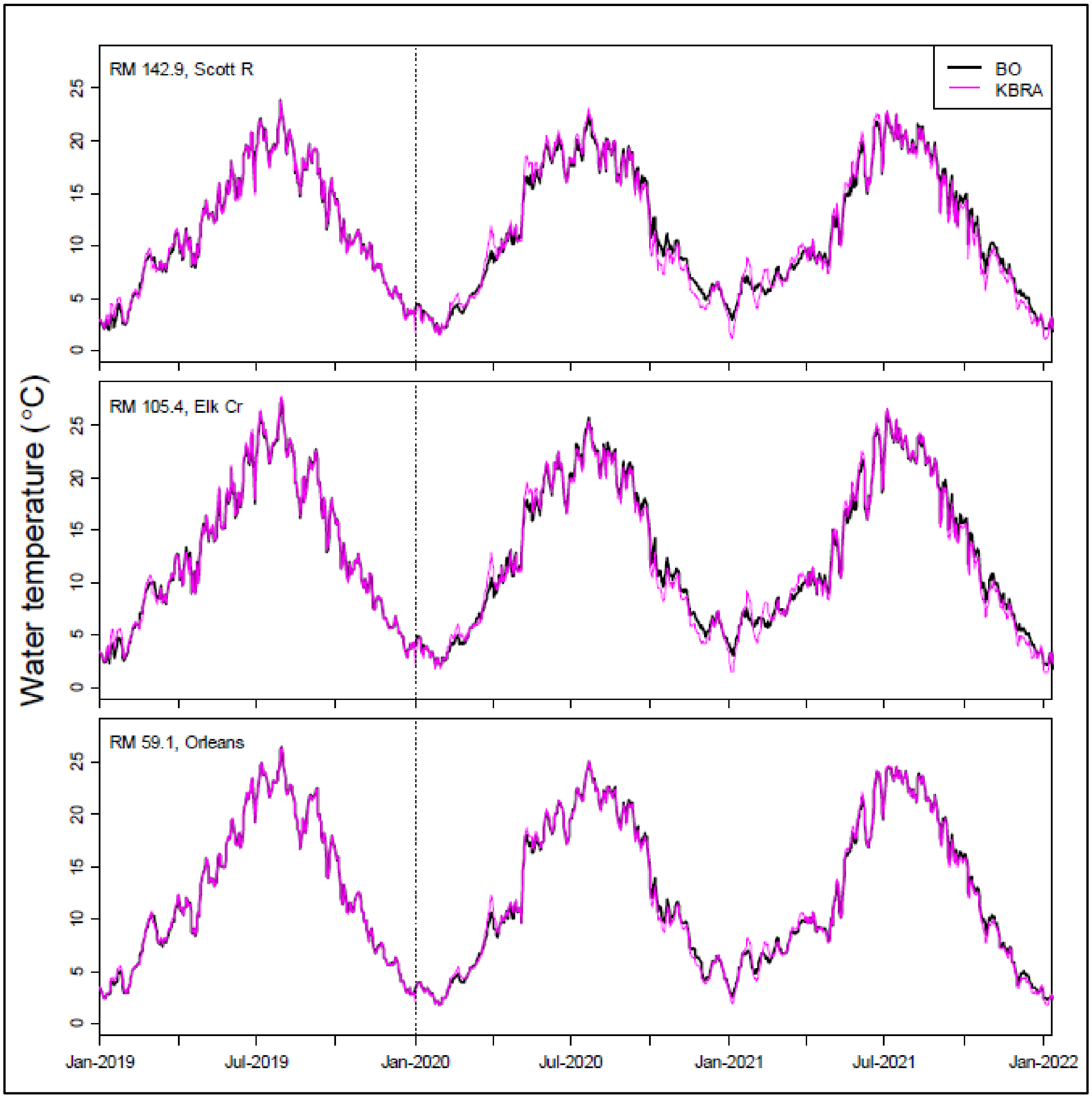
Note:
This does not include an evaluation of the physical effects (e.g., dissolved oxygen in the water, suspended sediment)
(1) Qualitative evaluation conducted for this exposure pathway
(2) Limited quantitative, along with qualitative evaluations conducted for this exposure pathway
(3) Incomplete - receptor group is unlikely to come in contact with sediment-associated contaminants under this exposure pathway
(4) Insignificant - exposure pathway not considered a major contributor to adverse effects in humans based on best professional judgment

Figure 3.3-29. Summary of conclusions for potential adverse ecological or human health effects from exposure to chemical contamination in Klamath Reservoir sediments through five exposure pathways (CDM, 2011).



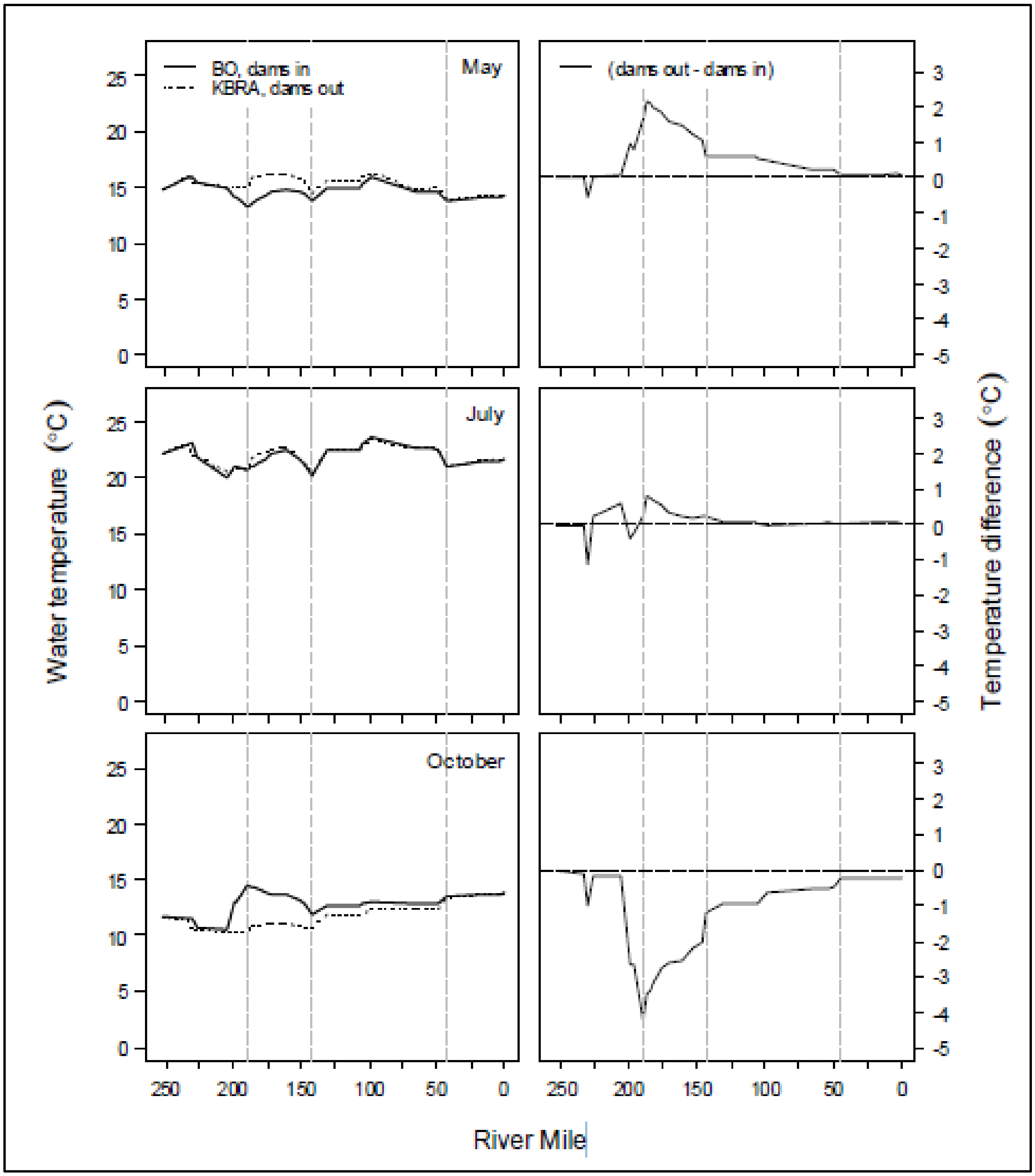
Note: The three years shown include one year prior and two years following dam removal. The dashed vertical line indicates removal of the dams.

Figure 3.3-30. Klamath River simulated daily mean temperature at RM 233.3, 190.0, and 160.9 under the Index Sequential climate with KBRA (Lower Klamath Project dams removed) and BiOp (dams in) flow regimes, based on historical hydrology and meteorology, 1968–1970 (Source: Perry et al., 2011)



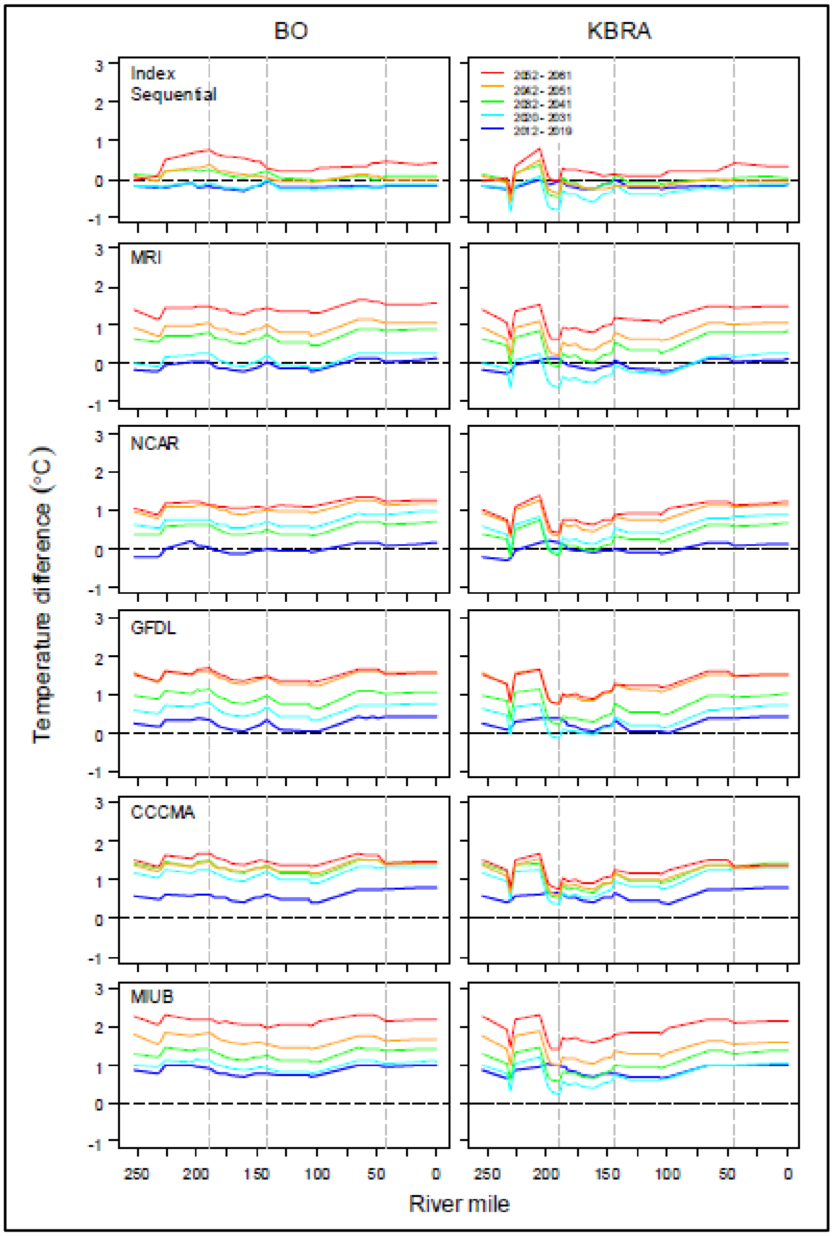
Note: The three years shown include one year prior and two years following dam removal. The dashed vertical line indicates removal of the dams.

Figure 3.3-31. Klamath River simulated daily mean temperature at RM 142.9, 105.4, and 59.1 under the Index Sequential climate with KBRA (Lower Klamath Project dams removed) and BiOp (dams in) flow regimes, based on historical hydrology and meteorology, 1968–1970 (Source: Perry et al., 2011)



Note: Vertical lines indicate the location of Iron Gate Dam (RM 190), the Scott River (RM 142.9), and the Trinity River (RM 43.3).

Figure 3.3-32. Simulated mean monthly temperature (left panels) and temperature difference (right panels) by river mile at Klamath River for KBRA (Lower Klamath Project dams removed) and BiOp (dams in) flow regimes, based on 2020–2061 Index Sequential period (Source: Perry et al., 2011)



Notes: Vertical lines indicate the location of Iron Gate Dam (RM 190), the Scott River (RM 142.9), and the Trinity River (RM 43.3); Index Sequential represents simulation of future operational conditions using historical hydrology and meteorology from 1961–2009.

CCCMA = Canadian Centre for Climate Modeling Analysis, GFDL = Geophysical Fluid Dynamics Laboratory, MIUB = Meteorological Institute of the University of Bonn, MRI = Meteorological Research Institute, and NCAR = National Center for Atmospheric Research.

Figure 3.3-33. Predicted difference between the 49-year historical mean water temperature and water temperatures simulated using five global circulation models under the BiOp (dams-in) and KBRA flow regimes (dams removed on January 1, 2020), by decade and river mile (Source: Perry et al., 2011)

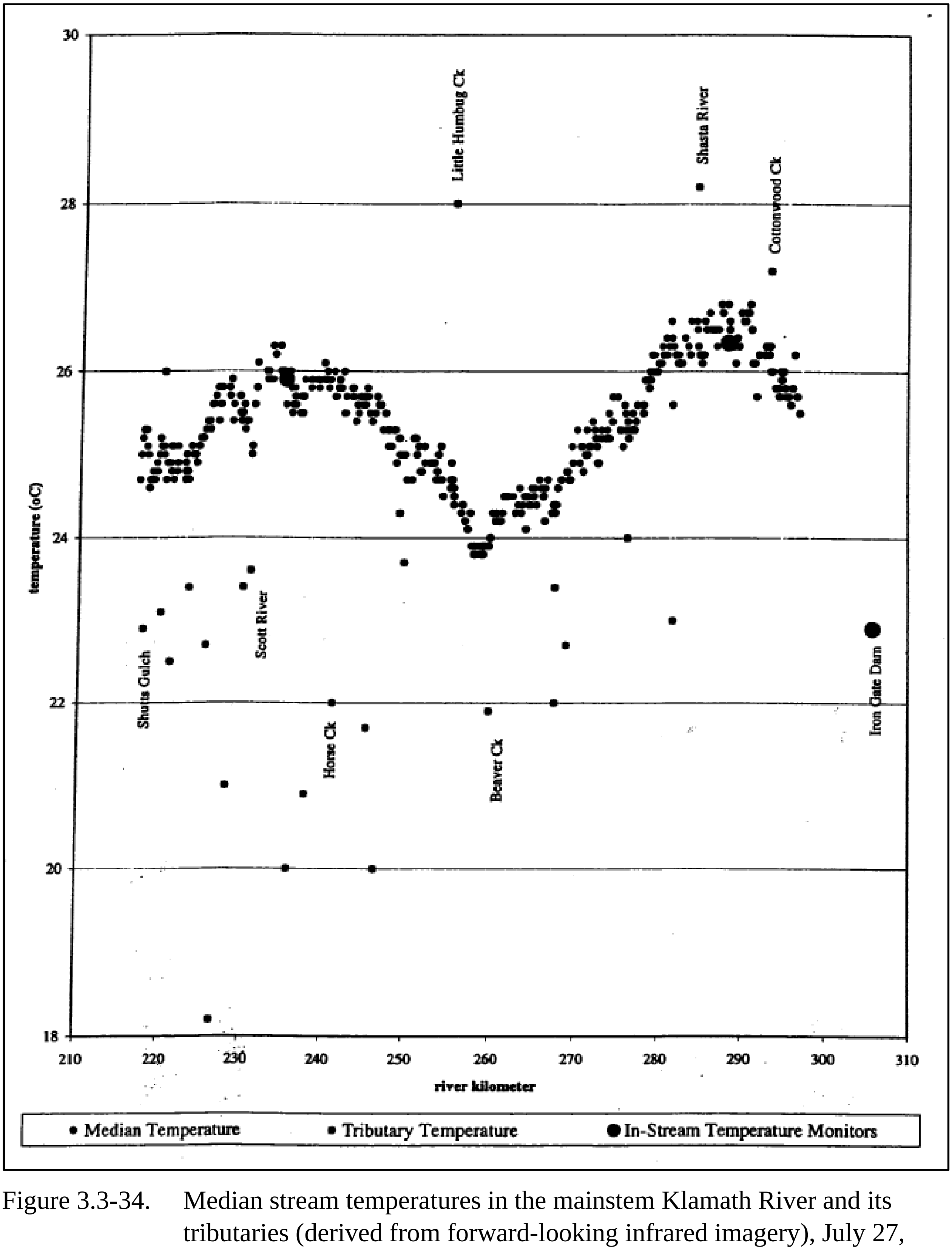


Figure 3.3-34. Median stream temperatures in the mainstem Klamath River and its tributaries (derived from forward-looking infrared imagery), July 27, 1998 (Source: McIntosh and Li, 1998)

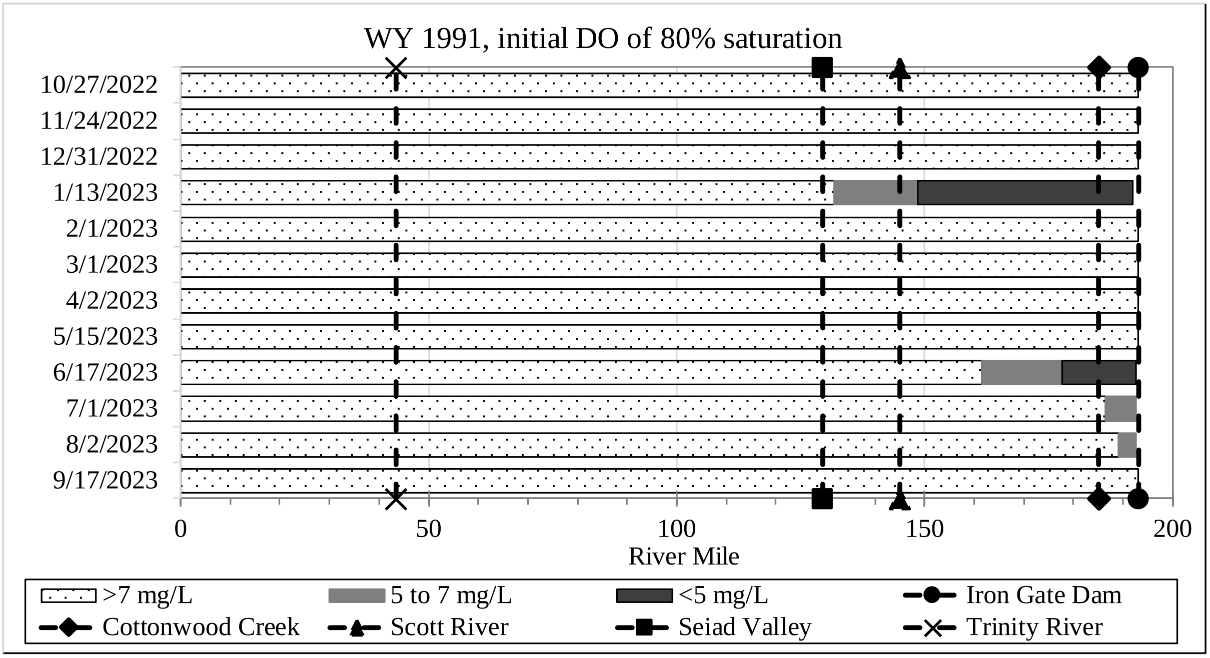


Figure 3.3-35. Longitudinal portrayal of estimated dissolved oxygen concentration ranges in the Lower Klamath River during the drawdown water year with high short-term suspended sediment concentration and dissolved oxygen concentration at the Iron Gate Dam site for the Coho salmon median impact year, WY 1991 (Source: KRRC, 2021f)

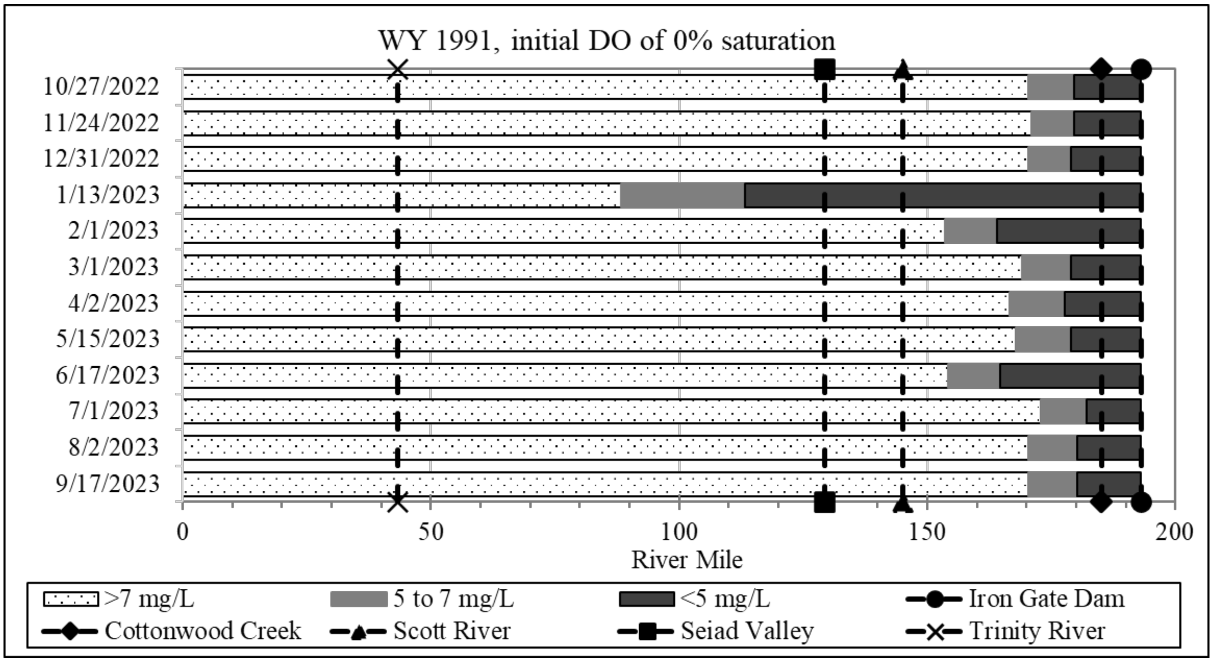


Figure 3.3-36 Longitudinal portrayal of estimated dissolved oxygen concentration ranges in the Lower Klamath River during the drawdown water year with high short-term suspended sediment concentration and dissolved oxygen concentration at the Iron Gate Dam site for the Coho salmon severe impact year, WY 1970 (Source: KRRC, 2021f)

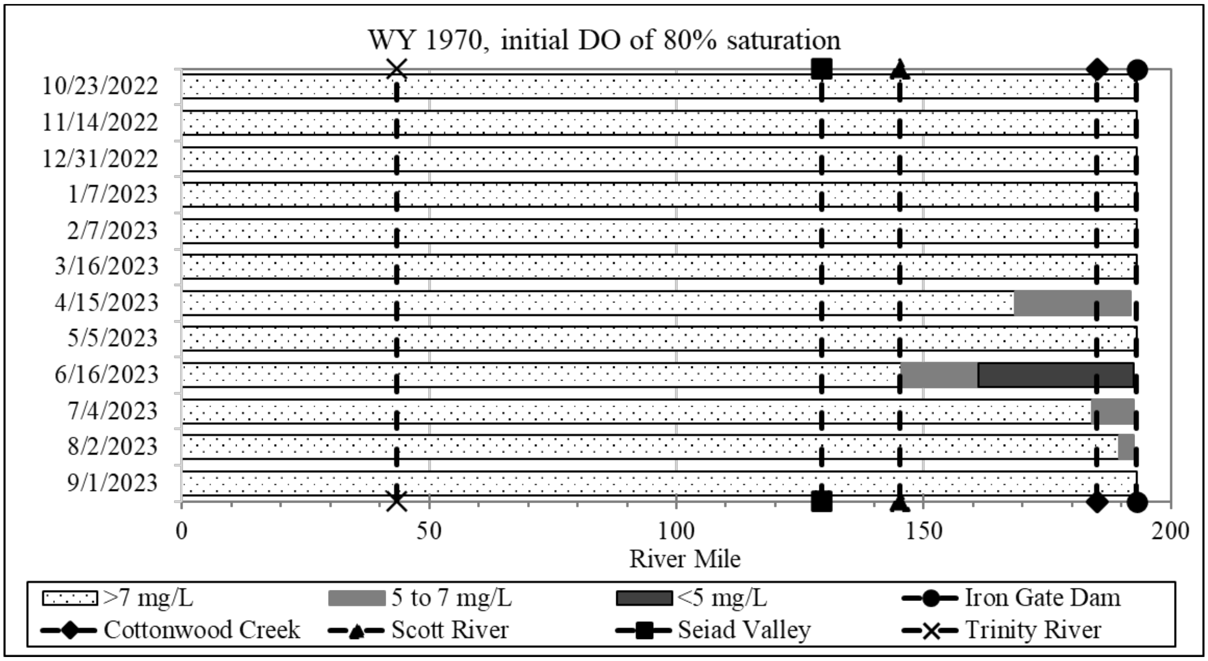


Figure 3.3-37. Longitudinal portrayal of estimated dissolved oxygen concentration ranges in the Lower Klamath River during the drawdown water year with high short-term suspended sediment concentration and dissolved oxygen concentration at the Iron Gate Dam site for the Coho salmon median impact year, WY 1991 (Source: KRRC, 2021f)

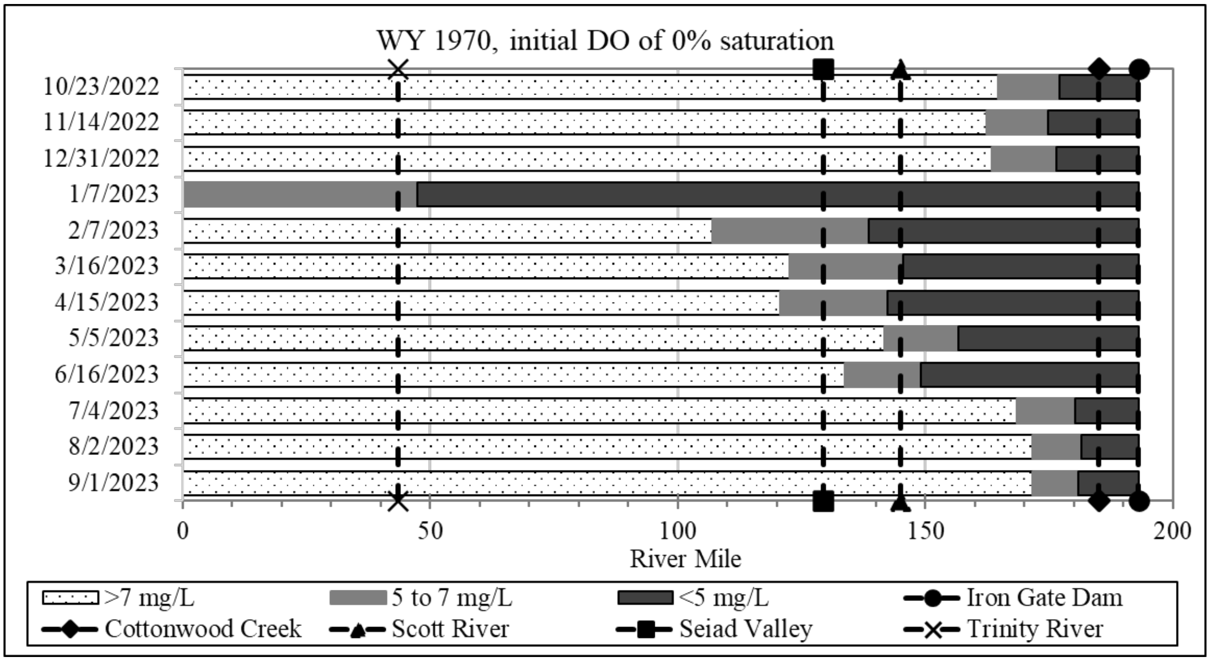
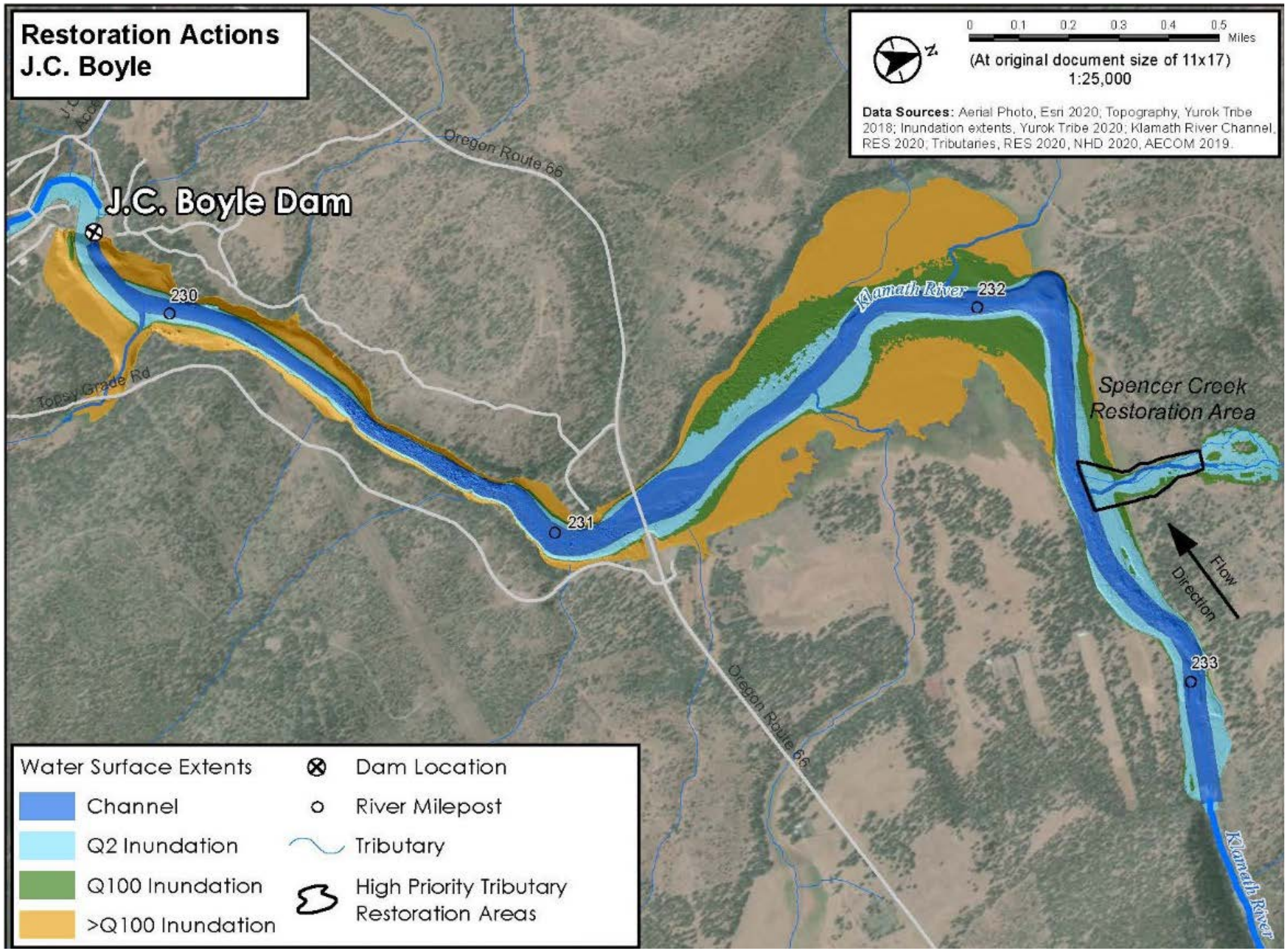
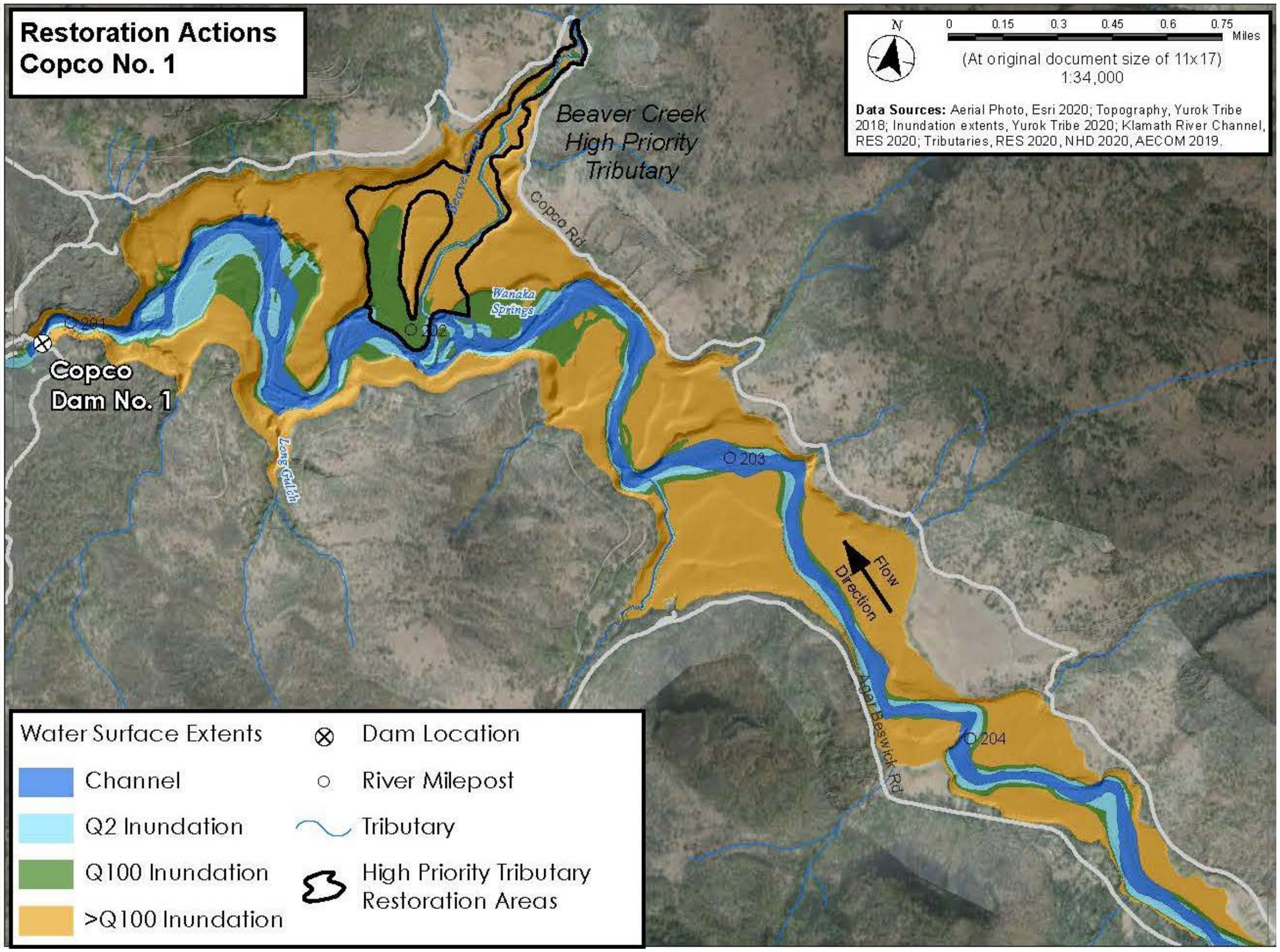


Figure 3.3-38. Longitudinal portrayal of estimated dissolved oxygen concentration ranges in the Lower Klamath River during the drawdown water year with high short-term suspended sediment concentration and dissolved oxygen concentration at the Iron Gate Dam site for the Coho salmon severe impact year, WY 1970 (Source: KRRC, 2021f)



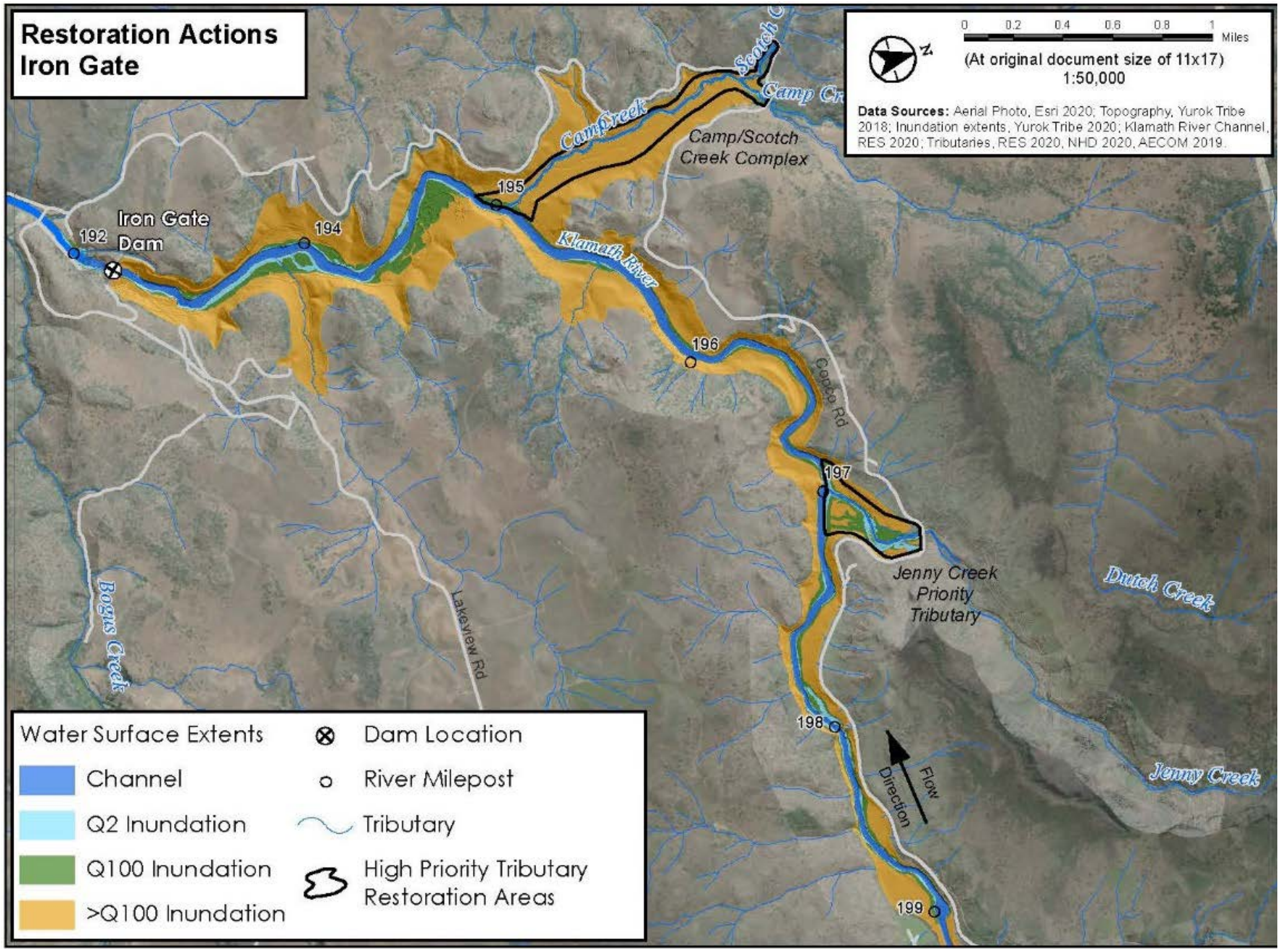
Note: Flood inundation was estimated by the Yurok Tribe in 2020.

Figure 3.3-39. Map of estimated post-drawdown location for Klamath River and tributary channels, estimated extent of 2-year (Q2) and 100-year (Q100) flood inundation, and areas of high-priority restoration actions within the J.C. Boyle Reservoir footprint (Source: KRRC, 2021d)



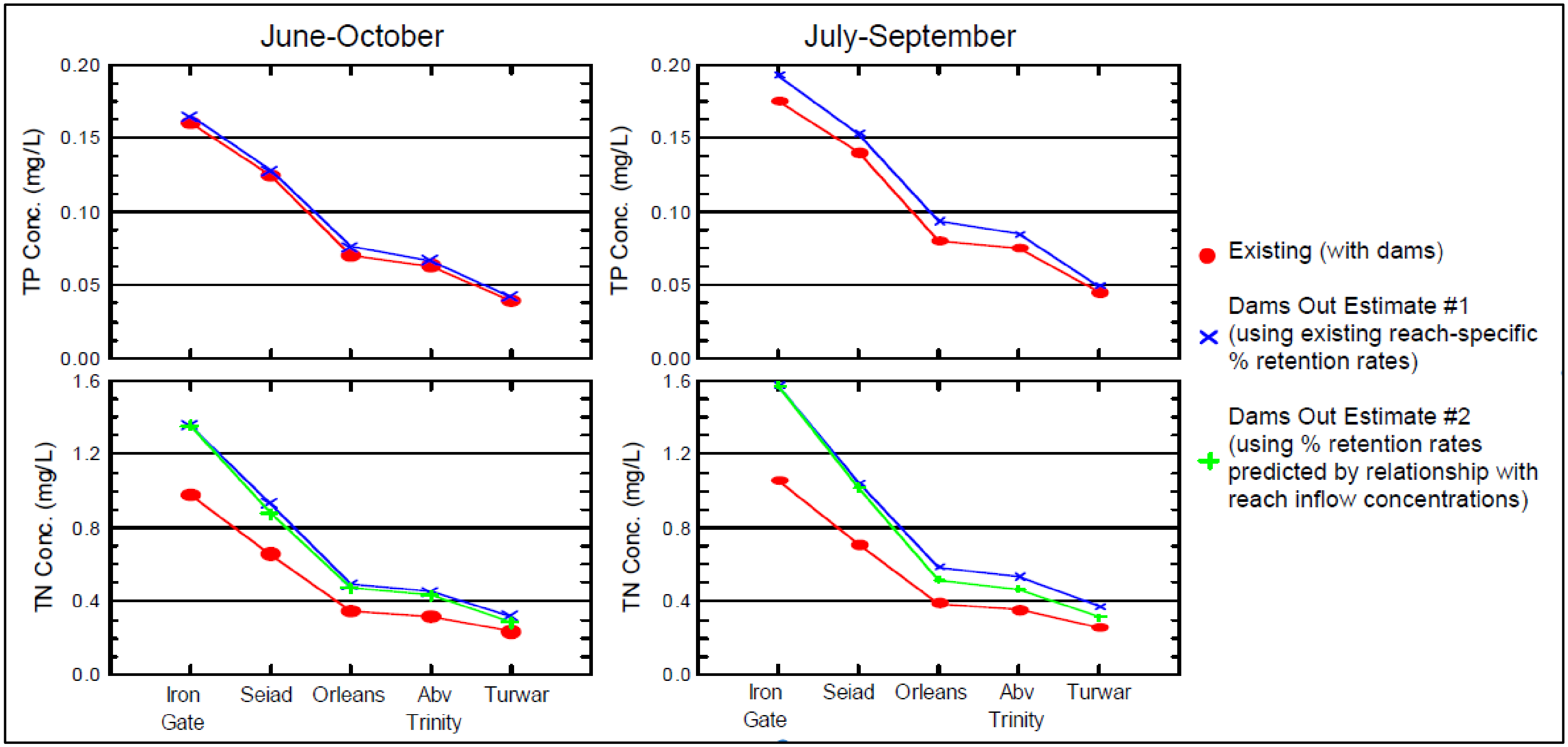
Note: Flood inundation was estimated by the Yurok Tribe in 2020.

Figure 3.3-40. Map of estimated post-drawdown location of Klamath River and tributary channels, estimated extent of 2-year (Q2) and 100-year (Q100) flood inundation, and areas of high-priority restoration actions within the Copco No. 1 Reservoir footprint (Source: KRRC, 2021d)



Note: Flood inundation was estimated by the Yurok Tribe in 2020.

Figure 3.3-41. Map of estimated post-drawdown location of Klamath River and tributary channels, estimated extent of 2-year (Q2) and 100-year (Q100) flood inundation, and areas of high-priority restoration actions within the Iron Gate Reservoir footprint (Source: KRRC, 2021d)



Notes: Dams-out estimate #1 is based on existing percent retention rates for each reach. Dams-out estimate #2 is based on the percent retention rates predicted by the relationship between reach inflow concentration and percent retention rates and was only applied to total nitrogen (TN) because total phosphorus (TP) had a weak relationship between inflow concentration and percent retention.

Figure 3.3-42. Comparison of total phosphorus and total nitrogen concentrations between the USGS gages below Iron Gate Dam and at Turwar under existing conditions and estimated with the Lower Klamath Project dams removed, 2007–2008 (Source: Asarian et al., 2010)

3.4 AQUATIC RESOURCES

3.4.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for aquatic resources includes the Klamath River extending from Keno Dam to the Pacific Ocean and its tributaries within that reach. Although restoration of fish passage through the reach could enable some salmon and steelhead to migrate to areas upstream of Keno Dam, we consider it unlikely that any runs of anadromous fish could become established upstream of Keno Dam in the near future due to persistent, adverse water quality conditions in Keno Reservoir and Upper Klamath Lake. The temporal extent of our effects analysis ranges from short-term effects of drawdown and dam removal, including high SSCs that are expected to persist for several months after drawdown and have effects on aquatic resources, to permanent improvements in water quality, including a reduction in the incidence of fish disease and access for anadromous fish to historical habitat in the Klamath River and its tributaries between Iron Gate and Keno Dams.

3.4.2 Affected Environment

This section describes the existing condition of aquatic resources within the project area, including aquatic habitats, resident and anadromous fish populations, and macroinvertebrates that have the potential to be affected by the proposed action. For anadromous fish, we also include sections on hatchery operations, fish diseases, and fisheries management. Additional information regarding the status, biology, and occurrences of federally listed fish covered in this section (coho salmon, green sturgeon, and eulachon) is provided in section 3.6, *Threatened and Endangered Species*.

3.4.2.1 Aquatic Habitat

The facilities associated with the Lower Klamath Project extend from J.C. Boyle Dam to Iron Gate Dam (the hydroelectric reach). In addition to this reach, we describe aquatic habitat conditions in Upper Klamath Lake and its tributaries, Keno Reservoir, and the Keno reach because of their influence on downstream flows and water quality conditions and their historical use by anadromous fish. We also describe existing habitat conditions in the Lower Klamath River and its tributaries due to the potential effects of the proposed action on downstream anadromous fish spawning and rearing habitats and the migration corridor that extends downstream to the Klamath River estuary.

Upper Klamath Lake and its Tributaries

Upper Klamath Lake is a very large, shallow, and nutrient-rich lake (NAS, 2004). When it is at its normal maximum level, it has a surface area of about 67,000 acres, a volume of 603,000 acre-feet, and a mean depth of only 9 feet, although there are substantial areas where depths exceed 20 feet. The lake supports several large marshes along its margins, although approximately 40,000 acres of the marshland surrounding the lake have been drained and converted to agricultural production. The Williamson and

Wood Rivers are the largest and second largest tributaries to Upper Klamath Lake, respectively. The Sprague River is tributary to the Williamson River, and the Sycan River is tributary to the Sprague River (Hamilton et al,. 2011). These tributaries currently provide habitat for redband trout, bull trout, shortnose sucker, Lost River sucker, and other species. Historically these tributaries provided substantial habitat for Chinook salmon and steelhead (Hamilton et al., 2005, 2016). Important flow contributions from springs into these tributaries provide cool summer baseflows with water temperatures and DO levels generally adequate to support cold-water fish habitat requirements (Hamilton et al., 2011).

Since 1921, water levels in Upper Klamath Lake have varied over a range of about 6 feet, and drawdown of about 3 feet from the original minimum water level has occurred in years of severe water shortages. Since about 1992, Reclamation has maintained higher lake levels developed in consultation with FWS to protect the federally listed Lost River and shortnose suckers (NAS, 2004). Lake levels and irrigation diversions are also managed to meet seasonal minimum flows downstream of Iron Gate Dam to protect the federally listed coho salmon.

Although Upper Klamath Lake was historically eutrophic, large-scale watershed development from the late 1800s through the 1900s has likely contributed to the current hypereutrophic condition in the lake. This legacy, combined with current nutrient loading from the watershed and lake sediment, facilitates extensive cyanobacteria blooms that typically result in large diel fluctuations in DO and pH, high concentrations of the hepatotoxin microcystin, and toxic levels of un-ionized ammonia during bloom decomposition. Together, these conditions create a suboptimal environment for native aquatic biota. Indeed, in recent decades, Upper Klamath Lake has experienced serious water quality issues that have resulted in fish die-offs, as well as redistribution of fish in response to changes in water quality (KRRC, 2021f).

Despite the occurrence of poor water quality conditions, Upper Klamath Lake supports a fishery for large rainbow trout that consistently produces trout in excess of 10 pounds (Messmer and Smith, 2002). Prior to construction of the project dams, Upper Klamath Lake and its tributaries supported both resident and anadromous fish populations. Section 3.4.2.2, *Anadromous Fish Populations*, summarizes available information on historic use of Upper Klamath Lake and its tributaries by anadromous fish.

Reclamation A Canal

The headworks of the A canal, which is the primary diversion point on Upper Klamath Lake for Reclamation’s Klamath Irrigation Project, is located approximately 0.3 miles upstream of Link River Dam.

The A canal can divert up to 1,150 cfs during the peak of the irrigation season. The canal was equipped with fish screens in 2003 to protect the federally listed sucker species from entrainment. The fish screens include a primary pumped bypass that returns fish to Upper Klamath Lake and a secondary gravity flow bypass that can be used to route fish to the Link River immediately below Link River Dam. The secondary bypass was included to provide managers with the flexibility to bypass fish to the Link River when adverse water quality conditions exist in Upper Klamath Lake near the outlet of the primary bypass.

Link River

The 1.2-mile-long segment of the Klamath River that extends from Link River Dam to Keno Reservoir is commonly known as the Link River. The streambed in this reach is mostly bedrock, and at lower flows, the river breaks into smaller braided channels. PacifiCorp measured the slope of the channel at about 1.1 percent and identified a conspicuous bedrock-cored mid-channel island located just downstream of the dam, with low, narrow terraces on either bank (FERC, 2007).

Link River Dam currently has a state-of-the-art fish ladder suitable for trout, suckers, and anadromous fish migrations, and Reclamation manages the flows released from Upper Klamath Lake into the Link River to meet flow requirement downstream of Iron Gate Dam as specified in the NMFS 2002 BiOp. The amount of water that must be released into the Link River to meet the required flows is affected by irrigation diversions, return flows, and accretions from springs and tributaries between the Link River and Iron Gate Dam. These accretion flows typically amount to about 300 to 500 cfs during low precipitation periods in the summer and fall.

PacifiCorp has an agreement with Oregon DFW to maintain an instantaneous minimum flow of 90 cfs downstream of Link River Dam. This minimum flow is increased to 250 cfs from July 27 through October 17 to comply with a requirement of the 2002 FWS BiOp to provide this flow when water quality conditions are adverse. Water quality conditions in Link River are similar to those in Upper Klamath Lake, and include periods of high water temperatures, low DO levels, and high pH levels (see section 3.3, *Water Quality*).

Keno Reservoir and Keno Reach

Keno Reservoir is narrow and confined within a diked channel that was once part of Lower Klamath Lake. The reservoir is 20.1 miles long, has a surface area of 2,475 acres, an average depth of 7.5 feet, a maximum depth of 20 feet, and a total storage capacity of 18,500 acre-feet. Water levels in Keno Reservoir are normally maintained within 0.5 foot of elevation 4,085.5 feet during the irrigation season, although the reservoir may be drawn down by another 2 feet for two to three days in April or May to allow irrigators to conduct maintenance on pumps and canals that draw water from the reservoir.

Water quality conditions in Keno Reservoir are heavily influenced by the high nutrient content of inflowing water from Upper Klamath Lake, wastewater effluent from the City of Klamath Falls, return water from the Klamath Irrigation Project, and accumulated wood waste from lumber mill operations. Summer water quality is generally poor with heavy algae growth, high temperatures (> 20°C) and pH (an average pH of 8.2 with a peak pH of 9.4), and low DO (4.5 to 8.8 mg/l). Respiration demands from abundant algal populations combined with decomposition of organic matter can result in near-complete anoxia during certain time periods, and fish kills are sometimes observed in and downstream of Keno Reservoir.

Keno Dam is equipped with a 24-pool weir and orifice type fish ladder, which rises 19 feet over a distance of 350 feet and is designed to pass trout and other resident fish species. PacifiCorp has an agreement with Oregon DFW to release a minimum flow of 200 cfs at the dam per Article 58 of its existing license. The average daily flow released from Keno Dam generally follows the instream flow requirements downstream of Iron Gate Dam, less anticipated accretion flows.

Downstream of Keno Dam, the Klamath River flows freely for 4.7 miles until it enters J.C. Boyle Reservoir. This section runs through a canyon area with a relatively high gradient of 50 feet/mile (1 percent) (PacifiCorp, 2000). The channel is generally broad, with rapids, riffles, and pocket water among rubble and boulders. Steep banks and alternating bedrock terraces confine the channel. Marginal islands occur sporadically, usually associated with bedrock protrusions or accumulations of coarse cobble and boulders. The Keno reach exhibits substantial bedrock control with little riparian vegetation influence. Pebble counts confirm that this is primarily a sediment transport reach; however, local geologic controls provide sheltered depositional areas where relatively fine sediment is deposited and temporarily stored in the channel. The downstream end of this reach is characterized by the transition from the Keno Gorge to the lower gradient and more open topography that holds J.C. Boyle Reservoir.

Although summer water temperatures in the Keno reach are generally warmer than optimum for trout (the 7-day mean maximum daily water temperature in the reach can rise as high as 25°C), turbulence maintains DO levels that support a rainbow trout fishery.

J.C. Boyle Reservoir and Bypassed Reach

J.C. Boyle Reservoir is 3.6 miles long, has a surface area of 420 acres, an average depth of 8.3 feet, a maximum depth of 40 feet, and a total storage capacity of 3,495 acre-feet. The upstream portion of the reservoir is largely characterized by shallow water and a gently sloping shoreline with dense amounts of aquatic vegetation during the summer. The shoreline includes several wetland areas. Water levels in J.C. Boyle Reservoir are normally maintained within 5.5 feet of full pool, and water level fluctuations of 1 to 2 feet can occur daily in the reservoir, depending on project operations. Spencer Creek, a tributary of the Klamath River that enters the upstream end of the reservoir, provides suitable spawning habitat for rainbow trout and supports all life stages of suckers (larvae, juvenile, and adult), including the federally listed shortnose sucker and Lost River sucker (Desjardins and Markle, 2000).

The powerhouse intake structure is equipped with vertical traveling screens (0.25-inch mesh) with high-pressure spray cleaners. Any screened fish are diverted with a bypass flow of 20 cfs that is released downstream of the dam. A pool and weir fishway approximately 569 feet long with 63 pools is located at the dam for upstream fish passage.

The J.C. Boyle bypassed reach is 4.3 miles long and has a relatively steep gradient of approximately 2 percent, with habitat types consisting largely of rapids, runs, and pools. There is a minimum flow requirement of 100 cfs immediately downstream of the dam, and approximately 225 cfs of spring water enters the bypassed reach about 1 mile downstream of the dam. The substrate is dominated by large boulders and cobble, with limited areas that include gravel.

The J.C. Boyle peaking reach is 17.3 miles long and extends from the J.C. Boyle Powerhouse to the upper extent of Copco No. 1 Reservoir. The 11-mile section located in Oregon is federally designated as a Wild and Scenic River. The 6.2-mile section located in California is designated as a Wild Trout Area by California DFW, and the entire 17.3-mile reach is managed as a wild trout fishery. Peaking operations affect flows in this reach, with flows increasing daily during peak energy demand.

Copco No. 1 Reservoir

Copco No. 1 Reservoir is 4.5-miles long, has a surface area of 1,000 acres, an average depth of 34 feet, a maximum depth of 108 feet, and a total storage capacity of 33,724 acre-feet. Water levels in Copco No. 1 Reservoir are normally maintained within 6.5 feet of full pool, and daily fluctuations due to peaking operation of the J.C. Boyle and Copco No. 1 developments are typically about 0.5 feet. Copco No. 1 Dam does not include any fish passage facilities.

The reservoir is in a canyon and is quite large and deep compared to Keno and J.C. Boyle Reservoirs. It contains several coves with more gradual slopes, and large areas of thick aquatic vegetation are common in shallow areas. Nearshore riparian habitat is generally lacking due to the cliff-like nature of shorelines, and only small, isolated pockets of wetland vegetation exist. As discussed in section 3.3, *Water Quality*, water quality in the reservoir is generally degraded during the summer, and a predictable sequence of algae blooms occur as temperatures warm, including large blooms of the nitrogen-fixing blue-green algae *Aphanizomenon flos-aquae*.

Copco No. 2 Reservoir and Bypassed Reach

Copco No. 2 Reservoir is approximately 0.25 miles long and has a total storage capacity of only 73 acre-feet. The bypassed reach is 1.5 miles long and located in a deep, narrow canyon. The channel consists of bedrock, boulders, large rocks, and occasional pool habitat. Copco No. 2 Dam does not include any fish passage facilities. Downstream of Copco No. 2 Dam, the Copco No. 2 bypassed reach is characterized by a confined, boulder- and bedrock-dominated channel. The average gradient of the reach is about

1.9 percent. Boulder-cobble bars have become dominated by mature alders but also include individual sycamore and maple trees, and these bar features dominate the channel cross section. Because of the steep canyon topography, the river in this reach is strongly influenced by the lava flow on the north (right bank) side of the river; there are minimal floodplains in this reach. At RM 196.9, Copco No. 2 Powerhouse discharges water back into the Klamath River, and, roughly coincident with this location, the reach ends at Iron Gate Reservoir.

Iron Gate Reservoir

Iron Gate Reservoir is 6.8 miles long, has a surface area of 944 acres, an average depth of 62 feet, a maximum depth of 167 feet, and a total storage capacity of 50,941 acre-feet. The reservoir has generally steep shorelines except for a few coves with more gradual slopes. Large areas of thick aquatic vegetation are common in shallow areas. Nearshore riparian habitat is generally lacking, except at the mouths of Jenny and Camp Creeks, where well-developed riparian habitat occurs. Small, isolated pockets of wetland vegetation exist around the perimeter of the reservoir. Water quality in the reservoir during the summer is generally quite poor; large blooms of the *Aphanizomenon flos-aquae* occur annually, and surface water temperatures are warm. Iron Gate Dam does not include any fish passage facilities.

Lower Klamath River

The Iron Gate development reregulates flow fluctuations caused by peaking operation of the upstream developments to provide stable flows in the Lower Klamath River. The powerhouse is located at the dam and has a maximum hydraulic capacity of 1,735 cfs.

The current license stipulates a minimum flow release at the dam of 1,300 cfs from September through April; 1,000 cfs in May and August; and 710 cfs in June and July. However, since 1997, PacifiCorp has operated the project to provide flow releases dictated by Reclamation’s annual operations plans. Ramping rates downstream of Iron Gate Dam are limited to 50 cfs per 2 hours not to exceed 150 cfs in 24 hours when flows are 1,750 cfs or less, and 135 cfs per hour not to exceed 300 cfs in 24 hours when flows exceed 1,750 cfs.

Downstream of Iron Gate Dam to Seiad Valley (RMs 190.1–130), the river flows through a narrow valley cut into Cascade volcanic rocks; it has alluvial features with frequent bedrock outcrops in the bed. The reach is characterized by alternating coarse cobble-boulder bars and cobble runs. The average gradient ranges from about 0.16 to 0.4 percent in the first 5 miles below Iron Gate Dam. A narrow, discontinuous floodplain and extensive high terraces border the channel. Small deltas have formed at the tributary confluences with the Klamath River that are composed of finer grained material than the mainstem. At RM 184 (near the Klamathon Bridge), the valley begins to widen, and by the confluence with Cottonwood Creek (RM 182.1) the river is flowing through a broad valley, formed by the intersection of the Klamath and Cottonwood drainages.

Less than a mile downstream of Cottonwood Creek the valley again constricts, with a V-shaped valley formed by bedrock and colluvial material. Downstream of Interstate-5 (at RM 179.2), the river begins to cut through the Klamath province, and the channel is steeper and bedrock-controlled, with limited accumulations of alluvium. In this section of river, the channel is confined between canyon walls with a cobble-gravel bed and well-developed pool-riffle morphology flanked by discontinuous floodplain and minimal terraces.

The Klamath River from Seiad Valley to the Pacific Ocean (RMs 130–0) maintains similar channel conditions to those in the reach from the Scott River to Seiad Valley, albeit with a progressively larger channel and lower gradient. Bedrock outcrops constrict the river at some locations, and larger rapids are formed by boulder bars/cascades (e.g., landslide debris, debris fan deposits, bedrock and a major constriction of the valley at Sugarloaf Mountain produce Ishi Pishi Falls [RM 66.5], upstream of the mouth of the Salmon River). Major tributaries entering the Klamath River include the Salmon River at RM 66.0 and the Trinity River at RM 40.0. Numerous smaller creeks enter on both banks. Steep tributaries entering the river occasionally contribute sediment via debris torrents, with resultant alluvial fans forming at their mouths. The tributaries also have a substantial influence on the flow volume, water temperatures and turbidity levels in the lower portions of the Klamath River.

Lower Klamath River Tributaries

The tributaries downstream of Iron Gate Dam provide important spawning and rearing habitat for fall and spring Chinook salmon, coho salmon, and steelhead. Table 3.4-1 describes the condition of habitat in Bogus Creek and the Shasta, Scott, Salmon, and Trinity Rivers. Additional information on the use of Bogus Creek and other smaller tributaries by anadromous fish is provided in section 3.4.2.2, *Anadromous Fish Populations*.

3.4.2.2 Anadromous Fish Populations

Anadromous fish species currently found in the Klamath River and its major tributaries downstream of Iron Gate Dam include Chinook salmon, coho salmon, chum salmon, coastal rainbow trout (steelhead), Pacific lamprey, green sturgeon, and eulachon.

Chinook Salmon

Historically, large numbers of Chinook salmon spawned in the tributaries to Upper Klamath Lake, including the Sprague, Williamson, and Wood Rivers (Hamilton et al., 2005). Most accounts suggest the spring run was the dominant life-history type in the river system prior to development; however, Hamilton et al. (2005) indicated that a fall-run may have also used the tributaries to Upper Klamath Lake. Hamilton et al. (2005) also cited several reports of Chinook salmon spawning in tributaries between Upper Klamath Lake and Iron Gate Dam including Spencer, Shovel, Fall, and Jenny Creeks. Large runs of spring-run Chinook salmon also returned to the Shasta, Scott, and

Salmon Rivers (Moyle et al., 1995). The runs in the Upper Klamath River Basin are thought to have been in substantial decline by the early 1900s and were eliminated by the completion of Copco No. 1 Dam in 1917 (California Water Board, 2020a; Snyder, 1931).

Huntington (2004) estimated that the Klamath River and its tributaries between Upper Klamath Lake and Iron Gate Dam historically (prior to dam construction) provided 68 miles of habitat for Chinook salmon, the Sprague River system provided 307 miles of Chinook salmon habitat, the Williamson River system provided 47 miles of Chinook salmon habitat, and the Wood River and other small tributaries to Upper Klamath Lake provided 148 miles of Chinook salmon habitat. Huntington (2004) also estimated that the historical returns of adult Chinook salmon to areas upstream of Upper Klamath Lake were between 149,734 and 438,023 fish per year and were most likely in the lower end of this range. Since 2005, Chinook salmon returns coast-wide have been historically low due to recent drought conditions and warm ocean conditions (Daly et al., 2017). From 2001 to 2020 the average annual return of Chinook salmon to Iron Gate Hatchery was 14,970 salmon and generally exhibited a decreasing trend (PFMC, 2021a).

Spring-run Chinook Salmon

Under existing conditions, spring-run Chinook salmon are found primarily in the Salmon and Trinity Rivers and in the mainstem Klamath River downstream from these tributaries during migratory periods, although a few spring-run fish are occasionally observed in other areas (California Water Board, 2020a; Stillwater Sciences; 2009). Upstream migration is observed during two time periods, spring (April through June) and summer (July through August). Adults spawn from mid-September to late October in the Salmon River and from September through early November in the South Fork Trinity River (Stillwater Sciences, 2009). Emergence begins in March and continues until early June (West et al., 1990). Age-0 juveniles rearing in the Salmon River emigrate at various times of the year, with one of the peaks of outmigration occurring in April through May (Olson, 1996). It is unclear how much time outmigrating age-0 juveniles spend in the Klamath River mainstem and estuary before entering the ocean (California Water Board, 2020a).

Fall-run Chinook Salmon

Fall-run Chinook salmon in the Klamath River Basin migrate as far upstream as Iron Gate Dam to spawn; however, they are primarily distributed downstream from Seiad Valley. The largest number of spawners are found in the Trinity River (36 percent), Bogus Creek (11 percent), Shasta River (7 percent), Scott River (7 percent), and the Salmon River (3 percent), based on escapement data collected from 1978 to 2002 (FERC, 2007).

NMFS considers fall-run Chinook salmon present downstream of the Trinity River-Klamath River confluence to belong to the SONCC salmon evolutionarily significant unit (ESU).[137] Fall and spring-run Chinook salmon upstream of the Trinity River confluence are both considered to be part of the Upper Klamath-Trinity Rivers Chinook salmon ESU. Neither ESU is currently listed under the ESA. NMFS announced a 12-month finding on August 17, 2021, that listing the Southern Oregon and Northern California Coastal spring-run Chinook salmon populations as threatened or endangered ESUs is not warranted (NMFS, 2021a).

Adult fall-run Chinook salmon in the Klamath River typically spawn within a few days or weeks of arriving on the spawning grounds, and juveniles emerge from the gravel in spring and move downstream within a few months, to rear in the mainstem or estuary. This life-history strategy allows them to take advantage of extensive high-quality spawning and rearing areas in which temperature conditions may become unfavorable by late summer (Moyle, 2002). Snyder (1931) referred to the run as a summer-run, because fish started entering the estuary and lower river in early July and the run peaked in August before declining in September. Today, the run peaks in early September and continues through late October (NAS, 2004). The run timing reported by NAS is consistent with angler harvest rates reported in Hopelain (2001), which peaked between the last week in August and the first week in September from 1984 through 1987. NAS (2004) suggests that this shift in run timing may be a response to mainstem water temperatures becoming less favorable to adult salmon in the summer, or perhaps due to excessive harvest of early run fish.

Even with the current run timing, water temperatures during the spawning run can be stressful to migrating salmon and may result in increased mortality of spawning adults or reduced egg viability. Literature reviewed by Bartholow (1995) suggests that water temperatures between 6 and 14°C are optimal for adult migration and that chronic exposure of migrating adults to 17 to 20°C water can be lethal, although they can endure temperatures as high as 24°C for short periods. Adult spring Chinook salmon typically migrate at 3.3 to 13.3°C, summer Chinook salmon migrate at 13.9 to 20.0°C, and fall Chinook salmon migrate at 10.6 to 19.4°C (Bell, 1991). In the lower portions of the Klamath River, water temperatures during the spawning migration typically approach a maximum of 21°C or higher in August and September, and occasionally exceed 26°C in the mid-reaches of the Klamath River (FERC, 2007). High water temperatures appear to contribute to the incidence of disease outbreaks that may cause substantial mortality of migratory juvenile and adult fall-run Chinook salmon, including the major kill of adult salmon that occurred in September 2002. There have been multiple other fish kills since then, including one that occurred in the spring/summer of 2021 (Yurok, 2021).

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[137] NMFS defines ESUs as a Pacific salmon population or group of populations that is substantially reproductively isolated from other conspecific populations and that represents an important component of the evolutionary legacy of the species. The ESU policy (56 FR 58612) for Pacific salmon defines the criteria for identifying a Pacific salmon population as an ESU, which can be listed under the ESA.

Fall-run Chinook salmon reach their upstream spawning grounds within two to four weeks after they enter the river, after which they spawn and die. Spawning normally peaks during mid-October and is complete by the middle of November (NAS, 2004). Time to emergence is dependent on the temperature regime. In the mainstem Klamath River, alevins can emerge from early February through early April, but peak times vary from year to year. After they emerge, fry disperse downstream, and many then take up residence in shallow water on the stream edges, often in flooded vegetation, where they may remain for various periods. As they grow larger, they move into faster water. Some fry, however, keep moving after emergence and reach the estuary for rearing.

Fall-run Chinook salmon fry rear in the mainstem at temperatures of 19 to 24°C (NAS, 2004). That pattern is consistent with the thermal tolerances of juvenile Chinook salmon, which can feed and grow at continuous temperatures up to 24°C when food is abundant and other conditions are not stressful (Myrick and Cech, 2001). Under constant laboratory conditions, optimal temperatures for growth are around 13 to 16°C. Continuous exposure to temperatures of 25°C or higher is invariably lethal, although the time until mortality depends on the acclimation temperature of the fish (McCullough, 1999). Juveniles can, however, tolerate higher temperatures (28 to 29°C) for short periods (NAS, 2004). Depending on their thermal history, fish in wild populations may experience high mortality at temperatures as low as 22 to 23°C (McCullough, 1999). In the Lower Klamath River, the presence in late summer of refugia[138] that are 1 to 4°C cooler than the mainstem and lower temperatures at night increase the ability of fry to grow and survive. The abundance of invertebrate food also makes the environment bioenergetically favorable, although intense competition for food and space may occur around the refuge pools (NAS, 2004).

Fall-run Chinook salmon in the Klamath River Basin exhibit three juvenile life-history types: Type I (ocean entry at age-0 in early spring within a few months of emergence); Type II (ocean entry at age-0 in fall or early winter); and Type III (ocean entry at age-1 in spring) (Sullivan, 1989). According to Scheiff et al. (2001), the peak outmigration of fall-run Chinook salmon smolts occurs in June and July in the Klamath River (figure 3.4-1) and from June through August in the Trinity River (figure 3.4-2). In both rivers, the outmigration timing is similar for wild and hatchery sub-yearling (age 0+) smolts. Juvenile Chinook salmon are found in the Klamath estuary from March through September, over which time new fish constantly enter and older fish leave (NAS, 2004).

Under existing conditions, adult and juvenile fall-run Chinook salmon are distributed throughout the Klamath River downstream from Iron Gate Dam. The total escapement of fall-run Chinook salmon natural spawners from 1978 to 2020 to the Klamath River and its tributaries (excluding the Trinity River), has averaged 26,124 fish over this time period (figure 3.4-3). The total spawning escapement estimate of adult

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[138] National Oceanic and Atmospheric Administration describes thermal refugia as ≥2° C cooler than surrounding waters (NOAA, 2021).

fall-run Chinook salmon to the Iron Gate Hatchery for the same period has averaged 13,156 fish (figure 3.4-4). From 2008 to 2020 the estimated natural escapement for adult fall-run Chinook salmon to the Klamath River between Iron Gate Dam and Shasta River averaged 4,648 fish (figure 3.4-5).

Coho Salmon

Coho salmon are native to the Klamath River Basin and are thought to have once been abundant and widely distributed in the mainstem Klamath River and its tributaries, although historical numbers and the extent of their upstream distribution is unknown due to uncertainty regarding species identification in historical reports and the dominance of the fishery for Chinook salmon (Snyder, 1931; NAS, 2004). Snyder (1931) reported that coho salmon may have migrated into the tributaries upstream of Upper Klamath Lake. Hamilton et al. (2005) noted that early reports on the distribution of salmon in the Klamath River did not clearly differentiate between Chinook and coho salmon, and usage of tributaries by coho salmon was documented as far upstream as Jenny and Fall Creeks. Based on knowledge of the types of habitats preferred by the species, they conclude that coho salmon would probably have used Spencer Creek, which now flows into the upper part of J.C. Boyle Reservoir.

NMFS considers naturally spawned coho salmon in the Klamath River Basin to be part of the federally threatened Southern Oregon/Northern California Coasts (SONCC) coho salmon ESU. We provide further information about this ESU in section 3.6, *Threatened and Endangered Species*, and table 3.6-1 but analyze the environmental effects on coho salmon in this section below. Under existing conditions, coho salmon are distributed throughout the Klamath River downstream of Iron Gate Dam, and spawn primarily in tributaries (Trihey and Associates, 1996; NRC 2004). Iron Gate Dam currently blocks access to approximately 76 miles of spawning, rearing, and migratory habitat for SONCC coho salmon (Reclamation, 2011a).

Coho salmon use the mainstem Klamath River for some or all their life-history stages (spawning, rearing, and migration). However, the majority of returning adult coho salmon spawn in the tributaries (Magneson and Gough, 2006; NMFS, 2010). Some fry and age-0+ juveniles enter the mainstem in the spring and summer following emergence (Chesney et al., 2009). Large numbers of age-0 juveniles from tributaries in the mid-Klamath River move into the mainstem in the fall (October through November) (Soto et al., 2008; Hillemeier et al., 2009). Juvenile coho salmon have been observed to move into non-natal rearing streams, off-channel ponds, the Lower Klamath River, and the estuary for overwintering (Soto et al., 2008; Hillemeier et al., 2009). Some proportion of juveniles remain in their natal tributaries to rear while others rear in tributary confluence pools in the mainstem Klamath River (NRC, 2004). Typical juvenile habitat consists of pools and runs in forested streams where there is dense cover in the form of logs and other large, woody debris.

Bell (1991) reported optimum rearing temperatures are from 12 to 14°C, although juvenile coho salmon can, under some conditions, live at 18 to 29°C for short periods (McCullough, 1999; Moyle, 2002). Early laboratory studies in which juvenile coho salmon were reared under constant temperatures indicated that exposure to temperatures over 25°C, even for short periods, can be lethal (Brett, 1952). NAS (2004) reports that juvenile coho salmon can survive and grow at high daily maximum temperatures provided that (1) food of high quality is abundant so that foraging uses little energy and maximum energy can be diverted to the high metabolic rates caused by high temperatures, (2) refugia areas of low temperature are available so that exposure to high temperatures is not constant, and (3) competitors or predators are largely absent so that the fish are not forced into physiologically unfavorable conditions or energetically expensive behavior (such as aggressive interactions).

None of the Klamath River coho salmon populations that could be potentially affected by the proposed action are considered viable (NMFS, 2013). Each population falls well short of abundance thresholds set by the technical recovery team's viability criteria (NMFS, 2014a). By not meeting the low-risk annual abundance threshold, all Klamath River coho salmon populations are likewise failing to meet spatial structure and diversity conditions consistent with viable populations. Several of these populations have also recently failed to meet the high-risk abundance thresholds, underscoring the critical nature of recent low adult returns (NMFS, 2013). Williams et al. (2006) described nine historical coho salmon populations in the Klamath River Basin, including what he referred to as the Upper Klamath River (tributaries and mainstem Klamath River from Iron Gate Dam downstream to Portuguese Creek, excluding the Shasta and Scott Rivers); Shasta River; Scott River; Mid-Klamath River (tributaries and mainstem Klamath River from Portuguese Creek downstream to the Trinity River, excluding the Salmon River); Salmon River; three population units in the Trinity River watershed (Upper Trinity River, Lower Trinity River, and South Fork Trinity River); and Lower Klamath River (tributaries and mainstem Klamath River from the Trinity River downstream to the Klamath River mouth). Six of the nine populations are considered at high risk of extinction, and three are considered at moderate risk of extinction.

Data available in California DFW's coho "megatable" provides some additional context to recent population trends of SONCC coho in the Klamath River Basin. Estimates for the total run size of naturally and hatchery-produced coho salmon for the Klamath River Basin between 2004 and 2018 have ranged from a maximum of 46,302 (2004) to a minimum of 1,243 (2017) (California DFW, 2019a) (figure 3.4-6).

Estimates of naturally spawned coho salmon in the Klamath River are based on the sum of various monitoring surveys that include the mainstem Klamath River, Salmon River Basin, Scott River Basin, Shasta River Basin, Bogus Creek, and miscellaneous Klamath River tributaries downstream of the Yurok Reservation (figure 3.4-7) (California DFW, 2019a). While these estimates of total run size and Klamath natural spawners are useful in providing historical context and determining trends in abundance, they should not be considered representative of an actual population estimate for all Klamath River coho.

The FWS Arcata Fish and Wildlife Office and the Karuk Tribe of California annually monitor the outmigration of juvenile coho on the mainstem Klamath River from March through June. Four trapping sites are located upstream of the Shasta River confluence and include one frame net trap near the Bogus Creek confluence, one frame net near the I-5 bridge near Yreka, and one rotary screw trap both upstream and downstream of the I-5 bridge near Yreka. Counts of young-of-year coho and coho one year or older from 2012 to 2020 have ranged from 0 to 601 fish (table 3.4-3).

Steelhead

Historically, the Klamath River supported large populations of steelhead, the anadromous form of rainbow trout. Steelhead were distributed throughout the mainstem and the principal tributaries such as the Shasta, Scott, Salmon, and Trinity River Basins, and many of the smaller tributary streams. Steelhead were also likely found in the tributaries upstream of Upper Klamath Lake, although precise information on the upstream limit of their distribution is not available. Hamilton et al. (2005) notes that in watersheds where both Chinook salmon and steelhead are present, the range of steelhead is usually the same, if not greater than the range of Chinook salmon. Hardy and Addley (2001) state that before 1900, runs of steelhead in the Klamath River Basin may have exceeded several million fish. They cite more recent run size estimates of 400,000 fish in 1960; 250,000 in 1967; 241,000 in 1972; and 135,000 in 1977.

NMFS considers all steelhead in the Klamath River Basin to be part of the Klamath Mountains province ESU. In its most recent status review for the Klamath Mountains province steelhead ESU, NMFS (2001) indicates that most California populations showed a precipitous decline to very low abundance around 1990 and stayed at low levels through 1999, but a modest increase in abundance was noted in 2000. Escapement estimates of summer steelhead to the Salmon River (see figure 3.4-8) are consistent with the trend noted by NMFS, and in the Salmon River this trend continued in 2002. The increased return of summer steelhead from 2000 to 2002 coincides with a period of strong returns of adult salmon and steelhead to the region caused by favorable ocean conditions that existed between 1998 and 2001. Moyle et al. (2015) assessed the status of Klamath Mountains province steelhead ESU and concludes that the species was at high risk of becoming a critical concern species, that its range and abundance have been significantly reduced, and that existing habitat and populations continue to be vulnerable in the short-term. Based on Iron Gate Hatchery escapement data analyzed by Quinones (2011), steelhead exhibited a statistically significant ($P = 0.0004$) decreasing trend from 1963 to 2008. Between 2007 and 2016, adult steelhead returns to Iron Gate Hatchery have ranged from a low of 4 in 2016 to a high of 212 in 2007, with a recent 10-year average of 104 fish (KRRC, 2018). Information on the abundance of winter steelhead, which is considered the most abundant form, is very limited due to logistical difficulties in sampling adults during the winter season (NMFS, 2001). Moyle et al.

(2015) note that winter steelhead are the predominate run in the nearby Smith River (which enters the Pacific Ocean to the north of the Klamath River) and that there are no recent or long-term abundance estimates for the Klamath Basin.

Steelhead fry emerge from the gravel in the spring, and most spend 2 years in fresh water before going to sea. The rest spend either 1 or 3 years in fresh water (Hopelain, 1998). Juvenile steelhead occupy virtually all accessible habitats in which conditions are physiologically suitable. Although spawning occurs mainly in tributaries, the juveniles distribute themselves widely, and many move into the mainstem. Juveniles feed primarily on invertebrates, especially drifting aquatic and terrestrial insects, but fish (including small salmon) can be an important part of the diet of larger individuals. Aggressive 2-year-old steelhead (6 to 7 inches) often dominate in pools (NAS, 2004).

Both resident and anadromous forms of rainbow trout exhibit a high degree of thermal tolerance compared to most other salmonids. Preferred temperatures are usually from 15 to 18°C, but juvenile rainbow trout regularly persist in water where daytime temperatures reach 26 to 27°C (Moyle, 2002). Long-term exposure to temperatures that are continuously above 24°C, however, is usually lethal. Persistence in thermally stressful areas requires abundant food. Smith and Li (1983) found that juvenile steelhead persisted in a small California stream in which daytime temperatures sometimes reached 27°C for short periods by moving into riffles where food was abundant.

Migrant sampling conducted from 1997 through 2000 at Big Bar on the Klamath River (RM 49.7) and at Willow Creek on the Trinity River (RM 21.1) indicates that the peak outmigration of steelhead smolts occurs from early April through mid- June in both rivers, with smaller numbers of steelhead smolts continuing to migrate through September, especially in the Trinity River (Scheiff et al., 2001). Klamath steelhead spend one to four winters in the ocean before they return to spawn. About 30 percent of the steelhead in the Klamath spawn a second time after another year at sea, and about 5 percent survive to spawn a third time (Hopelain, 1998). The FWS Arcata Fish and Wildlife Office and the Karuk Tribe of California annually monitor the outmigration of juvenile steelhead on the mainstem Klamath River from March through June. Counts of young-of-year steelhead and steelhead one year or older from 2012 to 2020 have ranged from 0 to 669 fish at the same four sites on the Klamath River upstream of Shasta River as noted above for coho salmon (table 3.4-4).

Green Sturgeon

Green sturgeon inhabit nearshore marine waters from Mexico to the Bering Sea. NMFS has identified two distinct population segments (DPSs) within their range: a northern coastal segment consisting of populations spawning in coastal watersheds northward of and including the Eel River, and a southern segment consisting of coastal or Central Valley populations spawning in watersheds south of the Eel River. The Klamath River supports the largest remaining spawning population of Northern DPS green sturgeon, which also spawn in the Umpqua, Rogue, and Eel Rivers. The Southern DPS green sturgeon, which has not been documented in the Klamath River, is federally listed as threatened (see section 3.6, *Threatened and Endangered Species*).

Green sturgeon enter the Klamath River to spawn from March through July (NAS, 2004). Most spawning occurs from the middle of April to the middle of June in the lower mainstems of the Klamath and Trinity Rivers in deep pools with strong bottom currents. While green sturgeon have been observed migrating into the Salmon River, they are not thought to ascend the Klamath River beyond Ishi Pishi Falls (RM 66) (Moyle, 2002; NMFS, 2005). Juveniles stay in the river until they are 1 to 3 years old, when they move into the estuary and then to the ocean.

Optimal water temperatures for juvenile green sturgeon growth are from 15 to 19°C, and temperatures above 25°C have been reported to be lethal (Mayfield, 2002, as cited by NAS, 2004). Figures 3.3-6 and 3.3-7 in section 3.3, *Water Quality,* show that water temperature downstream of Iron Gate Dam has rarely exceeded 25°C, and in the Lower Klamath River downstream of Ishi Pishi Falls, water temperature from June through October typically exceeded 18°C from 2009 through 2017 about 60 to 70 percent of the time. Outmigrant juveniles are captured each year in screw traps at Big Bar (RM 49.7) on the Klamath River and at Willow Creek (RM 21.1) on the Trinity River (Scheiff et al., 2001). After leaving the river, green sturgeon spend 3 to 13 years at sea before returning to spawn, often moving long distances along the coast (NAS, 2004).

Green sturgeon support small Tribal fisheries by the Yurok Tribe in the Klamath River and the Hoopa Valley Tribe in the Trinity River (table 3.4-5). Although Yurok and Hoopa Valley Tribal catch has remained relatively constant in recent years, commercial and sport harvest has been greatly reduced by newly imposed fishing regulations in Oregon and Washington. In California, commercial fisheries for sturgeon are prohibited and regulations prohibiting the recreational harvest of green sturgeon took effect in March 2006.

Pacific Lamprey

Pacific lamprey are found in Pacific Coast streams extending from Alaska to Baja California. They currently occur throughout the mainstem Klamath River and its major tributaries downstream of Iron Gate Dam. The extent of their historical upstream distribution is uncertain due to the occurrence of several resident species of lamprey in the upper parts of the basin. Hamilton et al. (2005) note that Pacific lamprey can migrate long distances, and generally show a similar distribution as anadromous salmon and steelhead.

Pacific lamprey are anadromous nest builders that, like Pacific salmon, die shortly after spawning. They enter the Klamath River at all times of the year and cease feeding as they migrate upstream. They spawn at the upstream edge of riffles in sandy gravel. Lamprey eggs hatch in approximately 2 to 4 weeks, and then the larvae (ammocoetes) drift downstream to backwater areas where they burrow into the substrate and commence feeding, tail embedded and head exposed, on algae and detritus. Juveniles remain in fresh water for 5 to 7 years before they migrate to the sea at a length of about 6 inches and transform into adults (Moyle, 2002). They spend 1 to 3 years in the marine environment, where they parasitize a wide variety of ocean fishes, including Pacific salmon, flatfish, rockfish, and pollock. Their degree of fidelity to their natal streams is unknown (FWS, 2004).

Larson and Belchik (1998) interviewed 20 Yurok Tribal elders about the historic and current Tribal ceremonial lamprey fishery in the Klamath River. Most of those interviewed reported daily catches as high as 300 to 1,500 lamprey per person per day before the run declined between the late 1960s and the late 1980s. Reported catches since the decline have not exceeded 100 fish, with most respondents indicating that a catch of 20 lamprey was considered an extremely good catch. Pacific lamprey are collected regularly in screw traps fished in the Klamath River at Big Bar and in the Trinity River at Willow Creek.

Eulachon

Eulachon is an anadromous smelt species that reaches the southern end of its range at the Klamath River. The Southern DPS of eulachon is federally threatened and is discussed further in section 3.6, *Threatened and Endangered Species*.

Other Anadromous Species

NAS (2004) reports that coastal cutthroat trout occur mainly in the smaller tributaries of the Klamath River within about 22 miles of the estuary; this species also has been observed farther upstream in tributaries to the Trinity River (Moyle et al., 1995). Sea-run adults enter the river for spawning in September and October, and juveniles rear in fresh water for 1 to 3 years before going to sea during April through June.

Other anadromous fish species that occur in the Klamath River Basin include chum salmon, white sturgeon, and American shad. NAS (2004) reports that periodic observations of adult chum salmon and regular collection of small numbers of young suggest that this species continues to maintain a small population in both the Klamath and Trinity Rivers, though it has never been present in large numbers.

3.4.2.3 Resident Fish Populations

Upper Klamath Lake and its tributaries support two species of suckers that are federally listed as endangered (Lost River and shortnose suckers) and two local populations of bull trout,[139] which are federally listed as threatened (see section 3.6,

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[139] The Upper Klamath Lake core area comprises the northern portion of the lake and its immediate major and minor tributaries. This core area includes two existing local bull trout populations in Threemile Creek and Sun Creek. Sun Creek originates in Crater Lake National Park and currently supports the largest local population in the Upper Klamath Lake core area (FWS, 2015b).

Threatened and Endangered Species). Other native fish species present upstream of Link River Dam include rainbow trout, Klamath largescale sucker, Klamath smallscale sucker, Klamath speckled dace, blue chub, tui chub, Pacific lamprey, Klamath lamprey, Klamath-Pit brook lamprey, and several species of sculpin (Oregon DFW, 1997).

Non-native gamefish found in Upper Klamath Lake include brown trout, brook trout, largemouth bass, white crappie, black crappie, Sacramento perch, brown bullhead, and sunfish (table 3.4-2). Oregon DFW manages the trout fishery in Upper Klamath Lake, its major tributaries, and in the Klamath River downstream to the California state line (including the Keno and J.C. Boyle Reservoirs) for natural production; no hatchery fish are stocked in these waters (Oregon DFW, 1997).

Fish populations in the Link River and Keno Reservoir are limited primarily to species that are able to tolerate poor water quality conditions, including blue chub, tui chub, and fathead minnows. Endangered shortnose and Lost River suckers have also been documented in Keno Reservoir (PacifiCorp, 2004e). The fish community in J.C. Boyle and Copco No. 1 Reservoirs is dominated by chub species, fathead minnows, bullheads, yellow perch, and rainbow trout, while fish populations in Iron Gate Reservoir are dominated by golden shiners, tui chub, pumpkinseed sunfish, yellow perch, and largemouth bass (PacifiCorp, 2004a). Federally listed shortnose and Lost River suckers, and hybrids of these two species, are present in J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs.

3.4.2.4 Benthic Macroinvertebrates

In fall 2002, PacifiCorp sampled benthic macroinvertebrate populations at 101 transects within 21 riverine study reaches between Link River Dam and the Shasta River and at 18 transects within 6 study reaches in Fall Creek. PacifiCorp also sampled 5 transects in each of the larger reservoirs (Keno, J.C. Boyle, Copco No. 1, and Iron Gate). In the spring of 2003, PacifiCorp again sampled seventeen of these riverine sites and conducted targeted bivalve species surveys in the Keno reach, the J.C. Boyle peaking reach, and Klamath River downstream of Iron Gate Dam. The results of the surveys indicate that invertebrates are abundant throughout these areas, with typical densities ranging between 4,000 and 8,000 invertebrates per square meter. Maximum densities were observed in the Keno reach (figure 3.4-9), while the diversity of mayflies, stoneflies, and caddisflies (important prey taxa for fish species) generally increased in the downstream direction (figure 3.4-10). Dominant aquatic insects in riverine reaches included caddisflies, blackfly, midges, and mayflies. The invertebrate community in reservoirs was dominated by species that are more tolerant of impaired water quality conditions, especially in Keno Reservoir, which showed a high abundance of invertebrates but low diversity as the community was dominated by a few species.

PacifiCorp reported finding 11 species of bivalves during the general invertebrate sampling and focused bivalve sampling. Table 3.4-6 shows the sampling sites where each species was found. The only large bivalve species found were the Oregon floater and the western ridged mussel. The only species found that has a special management status was the montane peaclam, which is considered a federal species of concern and a Forest Service sensitive species. The montane peaclam is classified as an S1 (extremely endangered in known range) species in the California Natural Diversity Database (CNDDB) and by the Oregon Natural Heritage Program (ONHP).

3.4.2.5 Hatchery Production

Iron Gate Hatchery

The Iron Gate Hatchery was built in 1961 as mitigation for the loss of spawning areas in the Klamath River and its tributaries between the Iron Gate and Copco No. 1 developments. The adult salmon ladder, trap, and spawning facility were built at the base of the dam and began operation in 1962. The egg incubation, rearing, maintenance, and administration facilities, as well as staff residences, were constructed in March 1966 about 400 yards downstream. The current production goals and release dates for fall Chinook and coho salmon and steelhead are presented in table 3.4-7.

California DFW operates Iron Gate Hatchery, and PacifiCorp funds 80 percent of the total operating costs to satisfy its annual mitigation goals for fall Chinook salmon fingerlings, coho salmon yearlings, and steelhead yearlings. Beginning in 1979, portions of the fall Chinook salmon fingerling production have been reared to the yearling stage for release in November. Funding for yearling production at Iron Gate is determined on a yearly basis.

For all species cultured, only fish that volitionally enter the hatchery are used as brood stock. Generally, this has been the practice since the hatchery began operation. The annual egg allotment for all species is distributed throughout the duration of the spawning run in proportion to the instantaneous magnitude of the run. Maintaining genetic diversity by distributing the egg allotment throughout the spawning run takes precedence over meeting numeric production goals.

Wild spawners are commonly integrated into the hatchery egg take to minimize genetic digression between hatchery and wild stocks. All adult steelhead processed in the hatchery are returned to the river, and all juvenile salmon and steelhead that are produced have historically[140] been released directly into the Klamath River from the hatchery.

Figures 3.4-11 through 3.4-13 show the historical production of juvenile fish at Iron Gate Hatchery from 1965 to 2001 for fall Chinook salmon, coho salmon, and steelhead, respectively. Coho salmon and steelhead fingerling releases were discontinued for the most part in the early 1980s.

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[140] In the summer of 2021, for the first time in its 55-year history, Iron Gate Fish Hatchery did not release salmon smolts into the Klamath River. Hatchery management cited the river's exceptionally poor water quality and high fish disease risk as reasons for holding hatchery smolts until conditions improved in the fall.

Chinook salmon production fluctuated substantially in the years preceding 1989. Numbers of Chinook salmon smolts ranged from 454,546 in 1965 to 12,727,288 in 1985. The period from 1977 through 1984 had relatively low production, well below production goals. More recently, from 2002 through 2014, smolt and yearling production has averaged 4,772,157 and 948,032 fish respectively (table 3.4-8; PFMC, 2019).

Coho salmon production at this facility has ranged from zero to 200,000 yearling smolts. The production goal of 75,000 yearlings has been met in 26 of 37 years, or 70 percent of the time from 1965 to 2001. Production was frequently below the production goal during the 1970s. Production in the 1980s was usually above this target, with much greater numbers in the late 1980s. Since 1994, production has been maintained close to production goals.

Steelhead production has varied widely at Iron Gate Hatchery through the years ranging from a high of 642,857 yearlings in 1970 to a low of 10,702 in 1997. Production has declined steadily since the peak year in 1970, and the production goal of 200,000 smolts has not been met since 1991. Fingerling releases have been made in past years, but not since 1988. During the 1980s, fingerling releases of 200,000 to 300,000 were common with a peak of one million fingerlings released in 1970. Iron Gate Hatchery has not produced steelhead since 2012.

Figure 3.4-4 shows the number of adult fall-run Chinook salmon returning to Iron Gate Hatchery of the duration of the spawning season from 1978 through 2020. The values shown do not include jacks (defined as fish less than 22 inches long). From 1963 to 1999, fall Chinook salmon returns to the hatchery ranged from 954 in 1969 to 22,681 in 1995, with a generally increasing trend. In 2000 and 2001, record numbers of Chinook salmon returned to Iron Gate Hatchery, with 71,151 returning in 2000. From 2001 to 2020 the average annual return was 14,970 Chinook salmon and generally exhibited a decreasing trend.

Coho salmon returns to Iron Gate Hatchery have ranged from zero to 4,097 from 1962- to 2018, with an average return of 969 (figure 3.4-14). What has changed the most are the magnitude of the peak years, such as 1996/1997 when over 4,000 adult coho salmon returned to the hatchery. These peak years are interspersed with returns as low as a few hundred fish. From 1997 to 2018 the average return was 861 coho salmon and from 2008 to 2018 the average return was 442 salmon. Since the 1997 peak of 4,097, returns have steadily declined.

Steelhead returns have been erratic but showed a precipitous decline in the early 1990s. Based on Iron Gate Hatchery escapement data analyzed by Quinones (2011), steelhead exhibited a statistically significant ($P = 0.0004$) decline from 1963 to 2008. Between 2007 and 2016, adult steelhead returns to Iron Gate Hatchery have ranged from a low of 4 in 2016 to a high of 212 in 2007, with a recent 10-year average of 104 fish (KRRC, 2018).

Fall Creek Hatchery

The California Oregon Power Company built the Fall Creek Hatchery in 1919 as compensation for the loss of spawning grounds due to the construction of Copco No. 1 Dam. Six of the original rearing ponds remain (two above Copco Road and four below the road). California DFW last used these ponds from 1979 through 2003 to raise approximately 180,000 Chinook salmon yearlings, which California DFW released into the Klamath River at Iron Gate Hatchery. Yearling production at the Fall Creek rearing facility was terminated in 2003 when California DFW moved all fish production to Iron Gate Hatchery (KRRC, 2021f).

Trinity Hatchery

The Trinity River Hatchery, located at the base of Lewiston Dam, began operation in 1963 to compensate for salmon and steelhead spawning and rearing habitat losses upstream of Lewiston Dam and farther upstream above Trinity Dam. Trinity River Hatchery produces spring and fall Chinook salmon, coho salmon, and steelhead.

Trinity River Hatchery releases approximately 1 million juvenile spring Chinook salmon and roughly 1 to 3 million juvenile fall Chinook salmon each year. Releases usually occur in late May to early June, with fish reaching the estuary 1 to 2 months later (NAS, 2004). The Trinity River run of up to several thousand adult spring Chinook salmon each year apparently consists primarily of returning Trinity River Hatchery fish (NAS, 2004). Since 1991, California DFW estimates that the natural-origin spring-run Chinook salmon likely averages 5,700 fish per year, and when hatchery-origin fish are included, averages around 14,874 (California DFW, 2017a).

The Trinity River Hatchery also produces coho salmon and winter steelhead. The hatchery has released an average of about 525,000 coho salmon smolts per year in recent years (NAS, 2004). Coho salmon smolts are released between about mid-March and early May and reach the estuary at the same time as wild smolts, peaking in late May and early June. The average coho escapement at the Trinity River Hatchery from 1997 to 2015 was over 6,000 coho salmon, nearly three times the 1983 goal of 2,100 salmon (California DFW, 2017a). About 800,000 winter-run steelhead smolts were produced each year and released in late March; most of them reach the estuary in late April along with wild steelhead smolts (NAS, 2004). In 2014, steelhead production was decreased from 800,000 to no more than 448,000 steelhead (California DFW, 2019b). NAS (2004) suggests that the run of coho salmon to the Trinity River is likely dominated by hatchery-produced fish. The average number of winter-run steelhead in the Trinity River between 1977 and 2016 was estimated at 14,701 fish, which were approximately 75 percent hatchery origin in the recent past (California DFW, 2017a).

3.4.2.6 Fisheries Management

The Pacific Fisheries Management Council (PFMC) manages ocean harvest up to 200-miles offshore and uses the Pacific Coast Salmon Fishery Management Plan to guide decision-making regarding harvest for Chinook and coho salmon, and amendments are frequently made to keep management objectives and best practices up to date. The PFMC does not regulate ocean harvest for steelhead, as this species is rarely caught in marine environments (FERC, 2007).

The Yurok and Hoopa Valley Tribes have federal rights to the fishery resources of their reservations. Specifically, the Tribes have rights to support a moderate standard of living or 50 percent of the total available harvest of Klamath-Trinity based salmon, whichever is less. Of the 50 percent Tribal fisheries allocation for Klamath River stocks, 80 percent are designated for the Yurok Tribe and the remaining 20 percent to the Hoopa Valley Tribe.

3.4.2.7 Diseases Affecting Salmon and Steelhead

In the past decade, the salmon populations in Klamath River have continuously declined, in part due to disease outbreaks associated with environmental stress (high water temperatures and low flows), as these conditions favor the life cycle of several pathogens. The most common pathogens in the Klamath River are either viral such as *Haematopoietic necrosis*, bacterial such as bacterial kidney disease and columnaris *(Flavobacterium columnare)*, external protozoan parasites such as ich (*Ichthyopthirius multifilis),* or myxozoan parasites such as *Ceratonova shasta* (*C. shasta*) and *Parvicapsula minibicornis (P. minibicornis)*. *Columnaris* bacteria is common worldwide and present at all times in the aquatic environment.

The life cycles of both *C. shasta* and *P. minibicornis* involve initial infection of a polychaete worm that releases actinospores into the water column when temperatures are above 10°C in late March to early April (Bartholomew and Foott, 2010), followed by infecting salmon gills (figure 3.4-15). Once on the gills, the spores travel through the bloodstream, eventually reaching the intestines and causing enteronecrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction and mortality (Bartholomew et al., 1989; Bartholomew et al., 2017). The parasite replicates and matures to the myxospore stage over the course of 18 to 25 days (Benson, 2014). Myxospores shed by the dying and dead salmon are consumed by annelids, which reside on the surface of the channel bed, and the cycle is repeated. The longevity of actinospores is inversely related to temperature, but actinospores have been detected in the Upper Klamath Basin between 10 and 22°C and peak production occurs at approximately 17°C (Hurst et al., 2011).

Susceptibility to *C. shasta* is also influenced by the genetic type, genotype, of *C. shasta* encountered by the fish (Som et al., 2016). The results of Atkinson and Bartholomew’s (2010) analysis of the association of *C. shasta* genotypes with different salmonid species, including Chinook and coho salmon, steelhead, rainbow trout, and redband trout is presented in table 3.4-9. Because the parasites are endemic to the watershed, the native salmonid populations have some level of resistance to the disease (California Water Board, 2020a).

Disease Incidence and Associated Mortality of Juvenile Salmonids

Ceratomyxosis, the disease caused by *C. shasta*, has been identified as the most significant disease for juvenile salmon in the basin (Nichols et al., 2003). Foott et al. (2002) found that over 40 percent of Chinook salmon smolts sampled from the Lower Klamath River in 2001 were diagnosed with severe ceratomyxosis, and the incidence of *C. shasta* infection has ranged from 29 to 43 percent in juvenile Chinook salmon collected in the Klamath estuary (Foott et al., 2002; Nichols et al., 2003). Nichols and Foott (2005) estimated that 45 percent of the juvenile fall Chinook salmon that outmigrated in 2004 were infected with *C. shasta*, and 94 percent of the population was infected with *P. minibicornis*. They conclude that the high incidence of fish infected with both pathogens suggests that the majority of the *C. shasta* infected juvenile Chinook salmon would not survive. Monitoring results in 2005 reported by Nichols indicate that infection rates of juvenile fall Chinook salmon with *C. shasta* increased to levels that exceeded 70 percent by late April, and infection rates for *P. minibicornis* ranged between 94 and 100 percent from late April through at least mid-May. Ceratomyxosis has been shown to persist in juvenile salmon after they enter salt water, and Foott et al. (2004) conclude that most smolts with detectable infection are likely to die from the disease. Studies of outmigrating coho salmon smolts by Beeman et al. (2008) estimated that mortality rates were between 35 and 70 percent in the Klamath River near Iron Gate Dam.

Although infection with *C. shasta* does not appear to occur in the Trinity River, there is evidence that Chinook salmon smolts from the Trinity River become infected and diseased with ceratomyxosis after they enter the Klamath during their outmigration. In the summer of 2002, 19 percent of marked Trinity River Hatchery Chinook salmon smolts collected in the estuary were found to be infected with *C. shasta* (Nichols et al., 2003).

Klamath River steelhead are relatively resistant to ceratomyxosis. Bartholomew and Courter (2007) report that based on limited comparisons conducted in 2005, coho salmon are somewhat less resistant to ceratomyxosis than native trout and fall Chinook salmon. In that study, 39 percent of the coho salmon became infected, and mortality was 26 percent compared with 11 percent infection and 2 percent mortality in Chinook salmon at 90 days post-exposure, when fish were held at 13°C.

Oregon State University (2004) studied the prevalence of *C. shasta* within the project area extending from Keno Reservoir downstream to the confluence with Beaver Creek, a tributary that enters the Klamath River near RM 161, 29 miles downstream of Iron Gate Dam. Sentinel studies documented infection at all sites except for Keno Reservoir. Infections were observed in the Keno reach; in J.C. Boyle Reservoir, bypassed reach, and peaking reach; in the Copco No. 2 bypassed reach; and in the Klamath River upstream of Beaver Creek. Mortality rates caused by *C. shasta* during a 70-day post-exposure holding period were less than 22 percent for most groups, with the exceptions of a 59 percent mortality rate observed for fish that were exposed during July in the J.C. Boyle bypassed reach and mortality rates of 75 and 90 percent for fish that were exposed in June and July respectively, in the Klamath River upstream of Beaver Creek.

Additional sampling was conducted using a recently developed assay technique called the Quantitative Polymerase Chain Reaction assay, which can measure *C. shasta* concentrations in water. Results from sampling at 19 locations along the Klamath River from the mouth to the Williamson River, generally mirrored the results of the sentinel studies. *C. shasta* was detected at all sites except Keno Reservoir, and the highest concentration was found in the mainstem Klamath River upstream of Beaver Creek (Oregon State University, 2004).

Oregon State University (2004) also conducted sampling to evaluate the abundance of *Manayunkia speciosa*, the polychaete that has been identified as an alternate host for both *C. shasta* and *P. minibicornis* (Bartholomew and Cone, 2006). Polychaetes were found to be most abundant in the river and in riverine sections of reservoirs. Stocking (2006) reported that polychaetes were especially abundant in fine benthic organic matter that is deposited in low velocity areas, primarily at the head of the project reservoirs and where the Williamson River enters Upper Klamath Lake. Within riverine areas, the microhabitat associated with the highest concentration of the polychaete was in *Cladophora spp*., a type of algae that forms mats by adhering strongly to any hard substrate, including cobbles and boulders in riverine areas. Stocking and Bartholomew (2007) observed that mats of *Cladophora spp*. contained large quantities of fine benthic organic material and diatoms, which provide a food source for the polychaetes.

Annual prevalence of *C. shasta* has been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (True et al. 2016). Table 3.4-10 includes a summary of juvenile Chinook salmon prevalence of infection over 10 years at the Kinsman rotary screw trap located 45 river miles downstream of Iron Gate Dam between the Shasta River and the Scott River; a reach of the Klamath River often referenced as the “infectious zone” (True et al., 2015). Depending on river conditions (e.g., flow and water temperature), the infectious zone may extend from Iron Gate Dam to downstream of Seiad Valley (True, 2013 and Bartholomew et al., 2017), although areas of high infection prevalence can also extend farther downstream in the Klamath River.

Biologists from FWS and the Karuk and Yurok Tribes sampled outmigrating juvenile Chinook salmon in the Klamath River from March through July of 2021 to monitor the prevalence of *C. shasta* infection. Infection rates varied widely across weekly samples and reach and were as high as 100 percent infected (table 3.4-11). Estimated mortality rates were as high as 63 percent.

Disease Incidence and Associated Mortality of Adult Salmonids

For adult salmon, disease has been less frequent and of a different nature. The effects of *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) are generally not as harmful as the observed effects of the myxozoan parasites on juveniles (California Water Board, 2020a). However, during the last half of September 2002, a major fish kill occurred in the lower 36 miles of the Klamath River. The primary cause of the fish kill was a disease outbreak from Ich and columnaris (Guillen, 2003; California DFW, 2003; NAS, 2004).

Based on surveys conducted by FWS during the 2002 fish kill, Guillen (2003) estimated that a total of 33,527 adult anadromous salmonids were killed, including 32,533 fall Chinook salmon, 629 steelhead, 344 coho salmon, and one coastal cutthroat trout. Approximately 21.7 percent of the fall Chinook salmon, 38.7 percent of the steelhead, and 91.5 percent of the coho salmon were determined to be of hatchery origin. Guillen (2003) considered these estimates to be conservative, and California DFW (2004a) suggest that the actual losses might have been twice as high as those reported above.

Based on an analysis of fish run timing, river flows, and water quality conditions that occurred in 2002, FWS concludes that a combination of factors resulted in conditions that led to the fish kill (Guillen, 2003). These included an early peak in the return of a large run of fall Chinook salmon and low river discharges that apparently did not provide suitable attraction flows for migrating adult salmon, resulting in large numbers of fish congregating in the warm waters of the lower river. Guillen (2003) concludes that the high density of fish, low discharges, warm water temperatures, and possible extended residence time of salmon created optimal conditions for parasite proliferation and precipitated an epizootic of Ich and columnaris.

3.4.2.8 Essential Fish Habitat

NMFS (2021b) defined the areas to be affected directly or indirectly by the proposed action as extending into the Pacific Ocean 1.5 miles north, south, and west of the mouth of the Klamath River. This includes areas designated as essential fish habitat (EFH) for various life-history stages of Pacific Coast groundfish, coastal pelagics, and Pacific salmon. EFH for Pacific Coast groundfish is defined in the PFMC's fishery management plan (PFMC, 2020); EFH for coastal pelagic species is described in the PFMC (2021a) fishery management plan. Within the area of potential project effects, EFH for both species includes estuaries. The inland extent of the estuary is defined as the mean high water level, or the upriver extent of saltwater intrusion; the seaward extent of estuary habitat areas of particular concern extends to the estuary-influenced offshore areas of continuously diluted seawater (PFMC, 2020). EFH for Pacific salmon is described in the PFMC (2021b) fishery management plan. EFH for Chinook salmon and coho salmon in the Klamath Basin has been designated for the mainstem Klamath River and its tributaries from its mouth to Keno Dam, and upstream to Lewiston Dam on the

Trinity River. This EFH includes the water quality and quantity necessary for successful spawning, fry, and parr habitat for coho salmon and Chinook salmon; freshwater EFH consists of four major components related to the species' life cycle: (1) spawning and incubation;(2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

3.4.3 Effects of the Proposed Action

3.4.3.1 Effects of Changes in Water Temperature on Aquatic Resources

Water temperature is a critical attribute of freshwater habitat used by anadromous salmonids, as they require cool, clean water for spawning, rearing, and migration. Elevated water temperatures can reduce growth, affect migration, delay and shorten the spawning season, impair reproductive success, and alter the timing of important life-history events (California Water Board, 2020a; Hamilton et al., 2011). Elevated water temperatures can also lower DO levels and cause salmonids to become more susceptible to disease, including those caused by parasites (Wood et al., 2006).[141] Anadromous salmonids, depending on the species and location, typically tolerate water temperatures in the range of 0 to 25°C (Brett, 1971; Richter and Kolmes, 2005). However, their survival and reproduction may become impaired by water temperatures higher than 18°C (EPA, 2003). Acute thermal effects are expected to occur in salmonids as mean daily water temperatures begin to exceed 20°C (Bartholow, 2005).

The overall purpose of the proposed action is to facilitate large-scale fisheries restoration by addressing system-wide limiting factors, including a lack of fish passage, high summer and fall water temperatures, blockage of access by dams to cool-water temperature refugia, blue-green algae blooms, impaired sediment supply and transport, and other factors. Effects on water temperature and access to additional cool-water temperature refugia are a central objective of the proposed action.

High summer water temperatures are a concern in the mainstem Klamath River under existing conditions, as they are elevated with a greater frequency and remain elevated for longer periods of time than water temperatures in adjacent coastal salmonid bearing streams (Bartholow, 2005). Bartholow (2005) noted that, if observed increases in water temperature over the last several decades in the Klamath River continue, some salmon and steelhead populations may decline to levels insufficient to ensure survival of the population. Several commenters expressed concern that removing the dams and reservoirs could cause water temperatures in the Klamath River to become less suitable for salmon by increasing downstream water temperatures during the summer. However,

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[141] Elevated water temperatures have been associated with fish kills in the Klamath River downstream from Iron Gate Dam during low flow periods in late summer (Hardy and Addley, 2001).

the findings of our analysis of the many studies and modeling efforts conducted on this topic do not support that contention.

KRRC's Water Quality Management Plan and Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan include provisions to monitor water temperature to assess effects of dam removal on water temperature in the mainstem Klamath River.

Our Analysis

Under existing conditions, J.C. Boyle Reservoir does not thermally stratify (FERC, 2007) and does not provide a source of cold water to downstream river reaches during the summer (NRC, 2004). Copco No. 1 and Iron Gate Reservoirs thermally stratify beginning in April or May, and the surface and bottom waters do not mix again until October or November (Raymond 2008, 2009, 2010). During the summer, surface water temperatures in these reservoirs can reach 25°C (PacifiCorp, 2004d). Although cooler water can be found at depths greater than 6 to 10 meters below the surface of these reservoirs during periods when they are stratified, the depth of the intakes in both reservoirs, about 9 to 10 meters below the surface, typically results in discharge of warm, epilimnetic water from the respective powerhouses. Use of a powerhouse intake barrier/thermal curtain in Iron Gate Reservoir can reduce the water temperature by up to 2°C (PacifiCorp, 2017c); however, water temperatures downstream of Iron Gate Dam still frequently exceed 20°C in July and August (table 3.3-13).

Under existing conditions, water temperatures in the mainstem Klamath River between Iron Gate Dam and the Scott River can approach 26°C during the summer and begin to warm to stressful levels for cold-water fish species in June. In addition, water temperatures throughout the Lower Klamath River frequently exceed the EPA 7DADM temperature guidelines of 20°C for the protection of salmonid adult migration; 16°C for juvenile rearing; and 13°C for spawning, incubation, and emergence (see figure 3.3-8). High water temperatures cause both adult and juvenile salmonids to be more susceptible to mortality from diseases that are prevalent in the Lower Klamath River. As a result, substantial losses of juvenile and adult salmonids have occurred in recent years during their migration through the Lower Klamath River, and losses are especially severe during low water years with periods of sustained high water temperatures. Furthermore, water temperatures are not expected to improve in the near future because air temperatures in the Klamath River Basin are expected to increase from 1.1 to 2.0°C from 2035 through 2045 and from 2.6 to 4.0°C later in this century, with greater increases in the summer months and lesser increases in the winter (Barr et al., 2010). Increases of this magnitude could ultimately lead to the continued decline and possible extinction of anadromous salmonids in the Klamath River Basin.

Under the proposed action, dam removal would restore a more normative water temperature regime in the Lower Klamath River, as the large thermal mass of the project's reservoirs would no longer delay water temperature warming in the spring and cooling in the fall. Tributaries and springs including Fall, Shovel, and Spencer Creeks and Big Springs would flow directly into the mainstem Klamath River (instead of into the reservoirs), creating plumes of cooler water that could be used as refugia for fish during summer and fall. These refugia areas are often 2 to 6°C cooler than the surrounding river environment (NRC, 2004; Sutton, 2007; Antonetti et al., 2017; Faukner et al., 2019), and adult salmon and steelhead are known to temporarily use cold-water refugia to escape warm summer river temperatures to help them successfully migrate into and out of important spawning and rearing habitats. These refugia would also likely provide slightly warmer and more stable winter water temperatures conducive to the growth of overwintering salmonids (Hamilton et al., 2011).

As described in section 3.3, *Water Quality*, we reviewed the output from three different numeric computer models (PacifiCorp, 2005; NCRWQCB, 2010; and Perry et al., 2011) to determine the likely future effects of changes in water temperature on important anadromous fish species in the Klamath River Basin.[142] Under the proposed action, simulations using all three models indicate that water temperatures downstream of Iron Gate Dam would be warmer in the spring and early summer and cooler in the fall. In particular, the water temperatures are expected to be 2 to 10°C cooler during August through December and 2 to 5°C warmer during January through March than under the existing conditions (see figures 3.3-5 and 3.3-30). Just downstream of the Iron Gate Dam site, water temperatures would be about 2ºC warmer in May and 4ºC cooler in October. At the confluence with the Scott River, the differences would be diminished, but there would still be a slight warming (<1ºC) in the spring and cooling (1 to 2ºC) in the late summer and fall (Perry et al., 2011).

Overall, implementation of the proposed action would allow anadromous salmonids access to cool-water habitats available upstream of the Iron Gate Dam site, including groundwater-fed areas that are resistant to water temperature increases caused by climate change (Hamilton et al., 2011). Dam removal would also eliminate the thermal lag in the mainstem Klamath River caused by the thermal mass of the reservoirs and reestablish a water temperature regime that is more in sync with historical salmon and steelhead migration and spawning periods (Hamilton et al., 2011). Adult fall-run Chinook salmon migration and spawning in the mainstem would no longer be delayed due to high water temperatures, likely reducing pre-spawn mortality. While the higher water temperatures expected in the mainstem during summer (June through August) could act to increase physiological stress and reduce growth rates for those fish that remain in the mainstem during the summer (i.e., some coho salmon and steelhead), access to newly available cool-water refugia upstream of the Iron Gate Dam site would diminish the severity of these effects and help to improve spatial distribution and genetic diversity. Increased fluctuations in diurnal water temperatures would also enable juveniles to move from cool-water refugia to forage in the mainstem at night when

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[142] Water temperature modeling results were compared to the thermal tolerances of focal species and associated life stages to determine relative suitability for these species under the proposed action.

temperatures are cooler (Dunne et al., 2011). The influence of the proposed action on water temperatures would decrease with distance downstream from the Iron Gate Dam site, and it is unlikely that dam removal would have detectable effects on water temperatures in the Klamath River Estuary and Pacific Ocean nearshore environment.

Additional benefits associated with increased spring water temperatures include increased growth for juvenile salmonids (Dunne et al., 2011). Increased growth confers higher overwintering survival (Quinn and Peterson, 1996) and increases the size of smolts, which has been shown to increase ocean survival (Bilton et al., 1982; Henderson and Cass, 1991; Lum, 2003; Jokikokko et al., 2006; Muir et al., 2006). In addition, larger smolts produce larger adults (Henderson and Cass, 1991; Lum, 2003), which have higher fecundity than smaller adults (Weitkamp et al., 1995; Fleming, 1996; Heinimaa and Heinimaa, 2004). Furthermore, smolts are likely to move out earlier (Holtby, 1988) and faster (Moser et al., 1991) during spring with warmer water temperatures, which would reduce their exposure to parasites and disease.

Cooler fall water temperatures would benefit upstream migrant adults and juvenile redistribution to overwintering habitats by providing a broader window of suitable water quality during migration. Water temperatures in the fall would be less stressful and more favorable for adult and juvenile coho salmon in the mainstem. Adult coho salmon may be able to migrate upstream earlier (Dunne et al., 2011) although water temperatures in the late fall and winter are typically not limiting adult migration.

Results from the water temperature model also show that dam removal appears to temper the ongoing trend of increased water temperatures to some extent (Perry et al., 2011). According to Barr et al. (2010), air temperatures in the Klamath River Basin are expected to increase by 1.1 to 2.0°C in 2035–2045 and 2.6 to 4.0°C later in this century, with greater increases in the summer months and lesser increases in the winter (Barr et al., 2010). In addition, HEC-5Q model simulations presented in Perry et al. (2011) indicate that water temperatures in the Lower Klamath River have increased by about 0.5°C per decade since the early 1960s. Bartholow (2005) states that this trend seems unrelated to any change in hydrology below Iron Gate Dam but is consistent with measured basin-wide increases in air temperature. Under the proposed action, future water temperature increases would be less than if the dams remain in place with the current flow regime as required by the 2010 BiOp (see figure 3.3-33).

Overall, when compared to existing conditions, the proposed action would improve the water temperature regime for anadromous fish spawning, rearing, and migrating in the mainstem Klamath River and provide access to additional cool-water refugia, providing a permanent, significant benefit to anadromous fish. These improvements would begin to be realized during reservoir drawdown and would continue into the foreseeable future as anadromous fish runs become reestablished in historical habitat upstream of the Iron Gate Dam site. The proposed action's effects on water temperatures suitable to support salmon and steelhead in the Klamath River Basin would be permanent, significant, and beneficial.

3.4.3.2 Effects on Diseases Affecting Salmon and Steelhead

Under existing conditions, anadromous salmonids in the Klamath River Basin are exposed to various pathogens that cause infection and increase mortality. Fish infections of myxozoan parasites *C. shasta* and *P. minibicornis* are of particular concern because they regularly result in substantial mortality of Chinook and coho salmon (Fujiwara et al., 2011; True et al., 2013). These parasites require two hosts to complete their life cycle—a fish and a polychaete worm. In addition, fish diseases, including Ich (from *Ichthyophthirius multifiliis*) and columnaris disease (from *Flavobacterium columnare*), are known to frequently infect Klamath River salmon and steelhead. While these parasites and diseases are present throughout the Klamath River Basin, they appear to cause the most severe mortality in the mainstem Lower Klamath River with the highest rates of infection within about 50 miles downstream of Iron Gate Dam (Stocking and Bartholomew, 2007; Bartholomew and Foott, 2010).

In 2021, for the first time in its 55-year history, Iron Gate Fish Hatchery did not release Chinook smolts into the Klamath River during the summer, and instead retained smolts at three hatcheries before releasing them in the fall. Hatchery management cited the river's exceptionally poor water quality and high fish disease risk as reasons for holding hatchery smolts until conditions improved in the fall. The decision was the result of a very large juvenile fish kill on the mainstem Klamath River that began in May 2021. As many as 97 percent of salmon captured in a screw trap in the Klamath River by fishery biologists from the Yurok Tribe were infected with *C. shasta*, including many that were dead when collected. California DFW estimated that drought conditions and disease outbreak would have killed an estimated 90 percent of the young fish if released in the spring, as is the standard practice.

During project scoping, several commenters stated that dam removal would reduce the incidence of salmon disease in the Lower Klamath River, while others believed that it would increase the frequency and rate of infection.

Our Analysis

According to Bartholomew and Foott (2010), the primary factors contributing to salmon infected with *C. shasta* and *P. minibicornis* include: water temperatures greater than 15°C, adult overcrowding and high carcass densities in areas of high infection, the amount of time juveniles spend in the infectious zone, and the presence of fine sediment that provides optimal habitat for the polychaete worm intermediate host; planktonic food sources released from hydroelectric reach reservoirs providing abundant food resources to polychaete worms; and proximity of annelid colonies to spawning areas.

Under the proposed action, removal of the four mainstem dams would likely reduce the incidence of fish disease in the Lower Klamath River through several mechanisms. The initial increase in suspended and coarse sediments entering the river in the drawdown year would scour the riverbed, deposit coarse sediment, and reduce the overall density of polychaete worms in the Lower Klamath River (Bartholomew and Foott, 2010). While significant aggradation of the river channel would only extend about 8 miles downstream of the Iron Gate Dam site, additional sediment transport would also occur farther downstream. Over time, a more natural sediment transport regime would reduce the quantity and quality of available habitat for polychaete hosts. NMFS (2021b) reports that periodic scour and substrate disturbance are considered to be integral for managing disease induced mortality of juvenile and adult salmonids (Alexander et al., 2014; Curtis et al., 2021). Other studies (Malakauskas et al., 2013; Wright et al., 2014; Alexander et al., 2016) have shown that worm host distribution and abundance decreases when their preferred habitat is substantially disturbed. In addition, the abundance of algae (e.g., *Cladophora*) and other forms of planktonic species in the Klamath River, food sources for the polychaete intermediate host, would be considerably reduced when reservoirs are removed. Thus, a more natural sediment transport would likely reduce densities of *C. shasta* and *P. minibicornis* in the mainstem and their polychaete host, which should reduce salmon mortalities and morbidities from these diseases (NMFS, 2021a). Polychaete populations in sand-silt habitats would be reduced the most, while polychaete populations attached to *Cladophora* or on vertical surfaces (bedrock) would be fairly protected (Bartholomew and Foott, 2010). Therefore, disease transmission rates to salmon and polychaete hosts, respectively, are likely to decrease post-dam removal (NMFS, 2021a).

The proposed action would also result in warmer water temperatures in the spring and early summer and cooler water temperatures in the fall (2 to 10°C cooler during August through December and 2 to 5°C warmer during January through March), compared to existing conditions. Just downstream of the Iron Gate Dam site, water temperatures would be about 2ºC warmer in May and 4ºC cooler in October. Ray et al. (2012) compared fish disease progression at four temperatures representative of spring/summer migration conditions and demonstrated that elevated water temperatures consistently resulted in higher mortality and faster mean days to death. Under the proposed action, a more natural temperature regime is expected to alleviate these adverse effects. This effect is expected to occur quickly after dam removal and continue long term. With earlier temperature increases in the spring, salmon smolts are also likely to move downstream earlier in the spring (Hoar, 1951; Holtby, 1988) and at a faster rate (Moser et al., 1991), thereby reducing juvenile and smolt exposure to actinospore infection.

In addition, the proposed action would reduce both fish and carcass density in areas of high infection by providing access to additional mainstem and tributary spawning and rearing habitat upstream of Iron Gate Dam. Restoring access to the upstream reaches for anadromous fish via dam removal would allow adult fall Chinook and coho salmon to distribute along a greater length of the river, reducing crowding and exposure to disease pathogens in the reach between Iron Gate Dam and the Shasta River.

A recent study linked the prevalence of infection in juvenile Chinook salmon released from Iron Gate Hatchery in the spring with peak actinospore densities measured in the fall and the spring (NMFS, 2021a; Robinson et al., 2020). This may suggest that the release of hatchery Chinook salmon when there is a high likelihood of infection not only results in low survival of those hatchery fish but may exacerbate the disease effects for other populations and that reducing hatchery production would increase the survival of both wild and hatchery fish. Thus, increased survival of wild juvenile salmon in addition to other ecological and genetic beneficial effects of wild salmon would be associated with phasing out hatchery production.

While the proposed action could introduce infected anadromous salmon to upstream habitat currently used by resident fish species, infected anadromous salmon are likely to have a less than significant effect on resident fish species. Resident fish above the dams have evolved with *C. shasta* and are currently exposed to the same pathogens that occur downstream of Iron Gate Dam, and therefore are unlikely to be affected by infected anadromous salmonids.

Based on the above information, implementing the proposed action would substantially reduce fish disease outbreaks that can have severe effects on salmon populations in the Lower Klamath River. Therefore, the proposed action would have a significant, permanent, beneficial effect on salmonid populations in both the short and long term in the Klamath River by reducing the frequency and severity of disease incidence.

3.4.3.3 Effects of Changes in Suspended Sediment Concentrations on Aquatic Resources

High suspended sediment[143] concentrations (SSCs) have the potential to kill or adversely affect the physiology and behavior of fish and other aquatic biota. The most commonly observed effects on salmonids reported in the scientific literature include: (1) avoidance of turbid waters in homing adult anadromous salmonids, (2) avoidance or alarm reactions by juvenile salmonids, (3) displacement of juvenile salmonids, (4) reduced feeding and growth, (5) physiological stress and respiratory impairment, (6) damage to gills, (7) reduced tolerance to disease and toxicants, (8) reduced survival, and (9) direct mortality (Newcombe and Jensen, 1996). As the transported sand and fine sediments settle on the streambed, they can also reduce the survival of incubating eggs and developing alevins in salmonid redds by impeding inter-gravel flow as well as the emergence of fry (California Water Board, 2020a).

To minimize the potential adverse effects of short-term increases in SSCs on anadromous fish, KRRC proposes to implement its Reservoir Drawdown and Diversion Plan. The plan describes the timing and sequencing of drawdown and dam removal, which is designed to flush fine sediments from the historical river channel in the reservoir

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[143] The term suspended sediment refers to settleable suspended material in the water column. Bed materials, such as gravels and larger substrates, are discussed in section 3.1.2, *Geology and Soils*.

reaches as rapidly as possible so that the duration of adverse effects on downstream biota (especially salmon) is as limited as possible. KRRC's Reservoir Drawdown and Diversion Plan would time the drawdown and mobilization of sediments to coincide with seasonal high flows so that fine sediment would remain suspended as it passes through the Lower Klamath River and Klamath estuary to the Pacific Ocean. KRRC also proposes to use a process called sediment jetting and other methods to expedite the mobilization of sediment from the historical river channel within former project reservoir reaches. Following reservoir drawdown, KRRC would stabilize reservoir sediments that are not in the historical river channel by implementing revegetation efforts detailed in its RAMP and, to limit erosion from areas disturbed during deconstruction, using measures described in its proposed Erosion and Sediment Control Plan (KRRC, 2021h).

KRRC would also implement its Juvenile Salmonids and Pacific Lamprey Rescue and Relocation Plan, a subplan of the Aquatic Resources Management Plan (KRRC, 2021j). Prior to drawdown, to reduce potential adverse effects on juvenile coho salmon from SSCs released during drawdown and dam removal, KRRC would capture and relocate as many juvenile coho salmon as possible from the mainstem Klamath River. KRRC would monitor SSCs at two locations in the Lower Klamath River from March 1 to July 1 during the reservoir drawdown year.[144] KRRC would also monitor water temperature and fish behavior at the confluences of 13 tributaries between Iron Gate Dam and Seiad Creek to help assess the effects of SSCs on important fish species and inform the need for additional mitigation (i.e., relocation). KRRC would schedule weekly calls with the Aquatic Resources Group to review SSCs, water temperature, and fish behavior data at these locations to determine if capture and relocation efforts are needed to minimize adverse effects on important anadromous fish populations. KRRC's plan has identified relocation sites in proximity to each tributary confluence monitoring area; final selection would be based on capture location, species, life stage, and habitat conditions at the relocation sites. During the drawdown year, California DFW would also modify the release timing of coho salmon smolts from Iron Gate Hatchery to reduce smolt exposure to high SSCs in the Klamath River.

Our Analysis

Under the proposed action, dam removal is expected to release 1.2 to 2.9 million metric tons of fine sediment into the Klamath River downstream of Iron Gate Dam (NMFS, 2021b; Reclamation, 2011a), resulting in higher SSCs than would occur under existing conditions. Increasing SSCs would begin with the initiation of drawdown and would continue to rise throughout the spring runoff period as material behind the dams is mobilized downstream. Because elevated SSCs are expected throughout the mainstem Klamath River during drawdown and dam removal, any resident or anadromous fish

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[144] USGS Klamath River Below Iron Gate Dam CA gage (No. 11516530) and USGS Klamath River Near Seiad Valley CA gage (No. 11520500).

spawning, rearing, or migrating in the mainstem during this period would be exposed to higher-than-normal SSCs.

As described in section 3.3, *Water Quality*, SSCs in the Klamath River immediately downstream of J.C. Boyle Dam (as determined using Reclamation's SRH-1D sediment transport model) would have peak values of about 4,000 to 6,000 mg/l within one to two months of reservoir drawdown, and concentrations would decrease to below 100 mg/l within six to ten months following drawdown. SSCs downstream of Copco No. 1 Dam would peak at about 14,000 to 16,000 mg/l within one to two months of the initiation of reservoir drawdown and would decrease to less than 1,000 mg/l within two months. SSCs 0.5 miles downstream of the Iron Gate Dam site would peak at about 15,000 mg/l in all water year types, generally be less than 1,000 mg/l by September of the drawdown year, and generally be less than 15 mg/l above background levels by July of the following year. However, the proposed maximum drawdown rate of 5 feet per day, which is higher than the drawdown rate of 1-3 feet per day assumed in Reclamation's modeling, and sediment jetting during drawdown, are expected to increase the peak SSCs 0.5 miles downstream of Iron Gate Dam from about 15,000 mg/l to about 20,000 mg/l, but would reduce the duration of SSCs above 100 mg/l. Inflows from tributaries, and to a lesser degree, springs, would dilute SSCs as they move downstream in the Klamath River, especially during high runoff periods. Consequently, the elevation in sediment concentrations due to the proposed action would be relatively minor in the Klamath River estuary and insignificant in the nearshore marine environment (Reclamation, 2011a).

In the following sections, we describe the potential short-term and long-term effects of elevated SSCs that would be caused by the proposed action on focal fish species found in the Klamath River. These anadromous species are the same as those evaluated in California Water Board's Final EIR (2020a) and include spring and fall-run Chinook salmon, coho salmon, steelhead (summer and fall/winter runs), Pacific lamprey, and green sturgeon.[145]

According to Sigler et al. (1984), yearling and older salmonids (such as salmon and steelhead) can survive high SSCs for considerable periods of time, and acute lethal effects generally occur only if concentrations exceed 20,000 mg/l. Relatively short-term (days rather than weeks) exposures to increases in SSCs under 500 to 600 mg/l are not likely to result in substantial direct mortality to either juvenile or adult anadromous salmonids in the Klamath River (Newcombe and Jensen, 1996). However, if the duration of exposure is extended for weeks or months, direct mortality (10 to 20 percent of individuals exposed) is expected (Newcombe and Jensen, 1996).

Potential population-level effects of high SSCs resulting from the proposed action for a given fish species not only depend on their abundance, distribution, and life stage,

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[145] These species are historically native to the Klamath River, are listed or proposed for listing under the federal or state Endangered Species Acts, or have high economic or public interest value.

but also on the timing, duration, and concentration of suspended sediment released during drawdown and removal activities. Accordingly, KRRC used Reclamation's sediment transport model to forecast the magnitude and duration of SSCs for discrete periods corresponding to each species' life-history stages, and then applied the results of Newcombe and Jensen (1996) to assess effects of SSCs on aquatic species. The resulting severity of adverse effects calculation provided a ranking of the effects of SSCs on various taxonomic groups of fish and life stages within these groups (table 3.4-12). The product of this approach was a location, species, and life stage-specific prediction of the severity of adverse effects for each year in the hydrologic record using the SSC predictions of Interior and California DFG (2012).

As noted in California Water Board (2020a), the sediment modeling results are very sensitive to hydrology. Effects on individual species (discussed below) during winter are predicted to be more severe during a dry year when sediment releases would be less diluted by surface flows. Effects during spring are more severe during a wet year, when it is predicted that the reservoirs could refill during winter, delaying the release of suspended sediment until they drop during the spring (Reclamation, 2011a). We focus our analysis on anticipated SSCs that would occur during median conditions for fish (50 percent exceedance probability). Additional information describing "mild conditions" for fish (90 percent exceedance probability) and "extreme conditions" for fish (10 percent exceedance probability) are available in California Water Board (2020a).

As described above and in section 3.3, *Water Quality*, under the proposed action peak SSCs in portions of the Klamath River downstream of the Iron Gate Dam site are expected to exceed 20,000 mg/l for hours or days, depending on hydrologic conditions during facility removal, but would generally be less than 1,000 mg/l by September of the drawdown year, and less than 15 mg/l above background levels by July of the year following drawdown. The high initial SSCs would affect anadromous fish species in various ways; however, any adverse effects would be generally limited to less than one year following the initiation of dam removal. In addition, these deleterious effects would be minimized through implementation of the Juvenile Salmonids and Pacific Lamprey Rescue and Relocation Plan. Implementation of this mitigation measure would reduce focal fish species' exposure to SSCs and the magnitude of drawdown effects on them. After the first year following dam removal, the flow would be confined within the historical river channel and no longer be able to access the remaining fine sediment left on the floodplain, unless there was an extremely high flood event. As a result, the SSCs in the Klamath River after the first year would be similar to existing conditions with minimal effect from dam removal under most hydrological conditions. Note also that the project's dams/reservoirs would no longer trap any SSCs resulting from landslides or other disturbances in the Upper Klamath River Basin. These SSCs would be transported downstream through the reservoir reach and into the Lower Klamath River.

In the following section, we summarize the predicted effects of these predicted SSCs on each focal anadromous fish species found in the Klamath River.

Fall-run Chinook Salmon

Under existing conditions, adult fall-run Chinook salmon enter Klamath River from August through October, when SSCs are generally low, and typically take two to four weeks to reach their spawning grounds. Fall-run Chinook salmon spawning peaks in late October and declines by the end of November (Shaw et al. 1997). The proposed action is predicted to result in up to 100 percent mortality of eggs in the mainstem Klamath River spawning during drawdown and dam removal, as the sediments released during dam removal would likely smother the eggs by adhering to the chorion (Greig et al. 2005, Levasseur et al. 2006). The effect of fine sediment on spawning success is unlikely to persist beyond the summer of the drawdown year, although SSCs during fall migration could be high enough to cause moderate physiological stress and impaired homing (under least or most likely impacts on fish), to major physiological stress (under worst impacts on fish) (table 3.4-13).

According to California Water Board (2020a) and KRRC (2021f), approximately 2,100 fall-run Chinook redds could be lost in the mainstem Klamath River under the proposed action assuming either the most likely or worst impacts on fish scenario. Because many fall Chinook salmon that enter the Klamath River spawn in tributaries, this would represent approximately 8 percent of all anticipated redds in the Klamath River Basin. Based on their proximity to the Iron Gate Hatchery, it is expected that many of the redds affected would have been constructed by fish of hatchery origin. As a result, the loss of these redds would have a less than significant, adverse effect on natural fall-run Chinook populations.

Approximately 60 percent of by fall-run Chinook salmon in the Klamath River Basin exhibit the Type I life history, in which they enter the ocean within a few months of emergence in early spring. Under the proposed action, Type I fall-run Chinook salmon fry produced in the tributaries to the Klamath River would be exposed to elevated SSCs as they migrate to the marine environment through the Lower Klamath River. In years 1 and 2 of dam removal, these conditions would likely result in moderate (under least impacts on fish) to major physiological stress (under most likely or worst impacts on fish), which is a slightly higher level of effect than predicted from SSCs that occur under existing conditions (table 3.4-13). Prolonged exposure to higher SSCs could also affect early marine survival of juvenile salmonids by reducing growth and the size at which the smolts enter the ocean (Bilton, 1984).

Juvenile Type II fall-run Chinook salmon (approximately 40 percent of the fry produced) remain to rear in the tributaries in which they were spawned and would only be exposed to suspended sediment in the mainstem Klamath River during their outmigration to the ocean in the fall. Under the proposed action, SSCs during this period would only be slightly higher than existing conditions under most of the hydrological conditions that were modeled, except for the worse impacts on fish scenario,[146] in which case SSCs would be high enough to cause major physiological stress (table 3.4-13).

Given the above information, the proposed action would have a short-term, significant and unavoidable adverse effect on fall-run Chinook salmon in the Klamath River, as elevated SSCs would result in the complete loss of many fall-run Chinook redds and eggs in the drawdown year and would likely reduce spawning success and egg survival in the following year but would be unlikely to persist in subsequent years. High SSCs would also cause moderate to major physiological stress in adult and juvenile fall-run Chinook migrating in the mainstem Klamath River during the drawdown year. These adverse effects on adult and juvenile fall-run Chinook would only be slightly higher than those experienced under existing conditions (which result in mortality due to a combination of factors including high water temperatures, degraded water quality, and disease).

While the adverse effects on fall Chinook salmon spawning success in the drawdown year would be substantial, it should be noted that the proposed action would provide a permanent benefit to the fall Chinook salmon fishery by restoring access to at least 76 miles of historic anadromous fish habitat in the hydroelectric reach, restoring the recruitment of gravel (i.e., the natural process of gravel transport and deposition), and improving water quality in the hydroelectric reach and in the Lower Klamath River. It would also likely reduce fish disease by decreasing the population of annelid worms that serve as an alternate host for *C. shasta*. Consequently, implementation of the proposed action is expected to have a long-term, significant, beneficial effect on the quality and quantity of available spawning, rearing, and migration habitat for fall-run Chinook salmon in the Klamath River.

Spring-run Chinook Salmon

Under existing conditions, spring-run Chinook salmon are found primarily in the Salmon and Trinity Rivers and in the mainstem Klamath River downstream from these tributaries during migratory periods (California Water Board, 2020a; Stillwater Sciences; 2009). Consequently, the proposed action has the potential to affect spring-run Chinook salmon returning to or emigrating from these river systems.

Under the proposed action, high SSCs during upstream migration would likely result in impaired homing and could cause major physiological stress to adult spring-run Chinook salmon; however, adults migrating later in the season (July through August)

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[146] This scenario represents the worst impacts on fish of potential sediment-related impacts to the species and life stage. It uses SSCs and durations with a 10 percent exceedance probability. This means that under this rare, worst-impacts-on-fish scenario, the probability of these concentrations and durations being equal to or greater than this level for each assessed species and life stage in any one year is 10 percent, and the probability of them being less than this level is 90 percent.

would experience minor (under least or most likely impacts on fish) to moderate physiological stress (under worst impacts on fish). Even under the worst impacts on fish scenario, SSCs would only be slightly higher than under existing conditions, causing moderate stress on spring-run-run Chinook salmon (table 3.4-14).

Because spring-run Chinook salmon do not spawn in the mainstem Klamath River under existing conditions, the egg through fry life stages are not anticipated to be affected by elevated SSCs resulting from the proposed action (table 3.4-14). In addition, juvenile spring-run Chinook salmon are believed to mainly rear in tributaries (West, 1991; Dean, 1994, 1995), reducing the likelihood of exposure to suspended sediment in the mainstem Klamath River. However, SSCs encountered during their outmigration in the mainstem Klamath River would likely result in short-term stress and reduced growth rates, but these fish would suffer little or no mortality.

Given the above information, the effects of elevated SSCs on migrating spring-run Chinook salmon in the Klamath River would be adverse, significant, and unavoidable in the short term. However, these effects would not persist beyond the drawdown year, and implementation of the proposed action would facilitate volitional access into over 76 miles of historic anadromous fish habitat within the hydroelectric reach, which could lead to the eventual recolonization of historical spring-run Chinook habitat farther upstream in the Upper Klamath River Basin, should water quality conditions improve sufficiently in Upper Klamath Lake and Keno Reservoir to allow colonization. The proposed action would also reduce fish disease, improve water quality, and create a more natural flow and water temperature regime in the Lower Klamath River. Together, these outcomes would provide a long-term, significant, beneficial effect on spring-run Chinook in the Klamath River Basin.

Coho Salmon

Although coho salmon migrate as far upstream as Iron Gate Dam, they are primarily distributed within tributaries downstream from the Shasta River. Adult coho salmon enter the Lower Klamath River between late September and mid-December, with peak upstream migration occurring between late October and mid-November. In most years, all adult coho salmon have entered tributaries prior to December 15, although in some years (e.g., Scott River in 2009) most fish were delayed until between December 15 and January 1. Therefore, most adult coho salmon would already be in tributaries when reservoir drawdown begins. Even though the Copco No. 1 Reservoir drawdown, scheduled to begin on November 1 would elevate SSCs downstream of Iron Gate Dam, it would not be nearly to the degree that would occur after January 1. As a result, under the most likely and worst impacts on fish scenarios, effects of the proposed action on migrating adult coho salmon are anticipated to be slightly higher than those experienced under existing conditions but would remain in the sublethal range (table 3.4-15). Those coho salmon that do spawn in the mainstem Klamath River, as well as their progeny, would likely suffer 60 to 80 percent mortality. However, even under existing conditions, very high mortality (20 to 60 percent) is expected due to the effects of existing SSCs on these life stages (in addition to other sources of mortality).

Because very few coho salmon spawn and rear in the mainstem Klamath River downstream of Iron Gate Dam, it is unlikely that dam removal would directly affect egg or alevin development, with the exception of any redds constructed in the mainstem immediately prior to and one year following drawdown and dam removal. Any coho salmon redds that are built in the mainstem, as well as their progeny, would suffer up to 100 percent mortality. However, coho salmon spawning in the mainstem Klamath River occurs to a much more limited extent than in tributaries Soto et al. (2016) and Magneson and Gough (2006) found all mainstem redds were constructed within approximately 1 river mile of a tributary mouth, highlighting the importance of tributary confluences in spawning. KRRC's proposed Tributary-Mainstem Connectivity Plan includes monitoring that would reduce effects of the proposed action on mainstem spawning by ensuring that suspended sediment deposition does not block access into important spawning streams. Furthermore, restoration of spawning habitat would be ensured by KRRC's completion of a spawning habitat evaluation in the hydroelectric reach and newly accessible tributaries following reservoir drawdown and dam removal, and if necessary, would include future spawning gravel augmentation projects.

While most coho salmon fry rear in the tributaries to the Lower Klamath River, some age-0 fry are known to outmigrate from tributaries to the mainstem in late spring and early summer. Under the proposed action, KRRC (2021f) estimates a 14-day period of SSC exposure for outmigrating juvenile coho salmon in the Klamath River. Such short-term exposure would result in mostly sublethal, and in some cases lethal, effects on a portion of the juvenile coho salmon rearing in, or outmigrating from, the mainstem Klamath River during late winter, spring, and summer of the drawdown year. Any juvenile coho that remain in the mainstem Klamath River during the spring and summer following dam removal would be exposed to SSCs that are expected to result in 20 to 40 percent mortality (table 3.4-15) under the worst impacts on fish scenario, slightly higher than predictions for existing conditions. These effects, in addition to possible exposure to diseases and the elevated temperatures often recorded in the mainstem Klamath River during summer, could result in high mortality for all populations that have some juveniles that remain in the mainstem Klamath River during the spring and summer following dam removal.

Coho salmon smolts outmigrate from the tributaries to the ocean beginning in late February, although most natural-origin smolts outmigrate to the mainstem Klamath River during April and May. Under the proposed action, SSCs in the Lower Klamath River during the drawdown year would be higher during spring than under existing conditions, and coho salmon smolts are likely to suffer moderate to major stress and reduced feeding depending on scenario (table 3.4-15). However, more than 80 percent of the coho salmon smolts produced in the Klamath River Basin originate from the Trinity River and other Lower Klamath River tributaries and use the lower mainstem Klamath River solely as a migration corridor. Under existing conditions, coho salmon smolts outmigrating from the

Lower Klamath River tributaries currently have high mortality rates (35 to 70 percent), presumably as a result of poor water quality conditions and disease (Beeman et al., 2007, 2008). This condition, in conjunction with the potential for physiological stress and reduced growth resulting from the proposed action, could result in even higher mortality (>70 percent) in the spring of the year when reservoir drawdown and dam removal occurs. However, after the initial high SSCs subside, mortality rates are likely to be reduced from existing levels in the long term due to improved water quality and reduced disease incidence.

Given the above information, implementation of the proposed action is expected to have a significant, unavoidable, adverse effect on coho salmon spawning, rearing, and migrating in the Lower Klamath River in the short term (during the drawdown year). Although no single-year class is expected to be lost, all coho salmon populations migrating or rearing in the Lower Klamath River would encounter SSCs that are elevated when compared to existing conditions and that are likely to cause varying levels of direct mortality, impaired homing, increases in physiological stress, and reduced feeding and growth, all of which could affect the overall fitness and survival of individuals. However, effects resulting in mortality are expected to occur only during the drawdown year. Following drawdown, SSCs would quickly be reduced and reach background conditions by year 3 (KRRC, 2021f).

In the long term, the proposed action would restore coho salmon access to at least 76 miles of additional habitat within the hydroelectric reach (Interior, 2007; NMFS, 2007), including approximately 53 miles in the mainstem, and tributaries such as Fall, Jenny, Shovel, and Spencer Creeks, and others; and approximately 22.4 miles currently inundated by the project reservoirs (Cunanan, 2009). It would also restore the natural process of gravel transport and deposition in the Klamath River and improve water quality in the reservoir reach and downstream of the Iron Gate Dam site.

The release of sediment from behind the dams would help create more natural substrate characteristics in the hydroelectric reach and increase the number of spawning sites available for coho salmon relative to current conditions. These same dynamics would also support habitat complexity and likely reduce the incidence of fish disease by decreasing the population of annelid worms that serve as an alternate host for *C. shasta*.

After the four dams are removed, the reformation of river channels in the hydroelectric reach reservoirs is expected to benefit BMIs by providing more suitable substrates than currently exist (KRRC, 2021f). As a result, suitable habitats formed in the hydroelectric reach would be opened to additional colonization by BMIs through rapid dispersal by drift from upstream populations in current riverine reaches and/or dispersion of adult life stages. Increased habitat availability for BMI populations is anticipated to increase food availability for juvenile coho salmon downstream of Iron Gate Dam as BMI freely drift or migrate downstream of the hydroelectric reach.

Given the above information, implementation of the proposed action is expected to improve the quality and quantity of available spawning, rearing, and migration habitat for coho salmon in the Klamath River in the long term. The proposed action would also improve water temperature and water quality conditions and enhance benthic invertebrate production. As a result, the overall effect of the proposed action on coho salmon would have a long-term, significant, beneficial effect on coho salmon.

Steelhead

Nearly all steelhead entering the Klamath River spawn in tributaries located downstream from Seiad Valley (NRC, 2004). Adult summer-run steelhead enter and migrate up the Klamath River from March through June (Hopelain, 1998). Under the proposed action, SSCs in the mainstem Klamath River would be higher than under existing conditions, most likely resulting in increased physiological stress and impaired homing (table 3.4-16). However, the summer-run steelhead that spawn in the Trinity River and other downstream tributaries would likely be exposed to only slightly higher effects from SSCs than under existing conditions because they only use the Klamath River as a migration corridor and would be exposed to high SSCs for a short period. Furthermore, SSCs in the migration corridor would be reduced by the effects of dilution by inflows from the Trinity River and the other major tributaries that enter the Lower Klamath River downstream of the hydroelectric reach.

Adult winter-run steelhead enter the Klamath River in late summer and fall and migrate and remain in the mainstem Klamath River through fall and winter. These adult steelhead would likely be exposed to higher SSCs than under existing conditions and may experience stress that could make them more vulnerable to disease or predation. However, since no winter-run steelhead spawning occurs in the mainstem Klamath River under existing conditions, the egg, alevin, and fry life stages are not anticipated to be affected by suspended sediment resulting from the proposed action (table 3.4-16).

Post-spawning adult steelhead migrate downstream in the spring to return to the sea, typically from April through May. Under the proposed action, SSCs during this time period would be higher than under existing conditions, and major- but sublethal stress is likely under all scenarios.

Juvenile steelhead rear in the mainstem Klamath River, tributaries to the Klamath, and the estuary. Since more than 90 percent of juvenile steelhead smolt at age-2, those juveniles leaving tributaries to rear in the mainstem Klamath River would be exposed to elevated SSCs resulting from the proposed action through both winter and spring compared to existing conditions, with major physiological stress predicted for all scenarios (table 3.4-16). Because nearly all steelhead spawn in tributaries, the egg, alevin, and fry life stages are not anticipated to be significantly affected by SSCs resulting from the proposed action.

Therefore, the proposed action would have a significant and unavoidable adverse effect on adult and juvenile steelhead migrating in the Lower Klamath River in the short term (primarily during the drawdown year). However, in the long term, implementation of the proposed action would permanently restore steelhead access to at least 76 miles of additional habitat within the hydroelectric reach (Interior, 2007; NMFS, 2007). It would also restore more normative aquatic habitat conditions downstream of the Iron Gate Dam site and reduce the incidence of fish disease. Consequently, in the long term, implementation of the proposed action is expected to improve the quality and quantity of available spawning, rearing, and migration habitat for steelhead in the Klamath River. As a result, the proposed action would have a permanent, significant, beneficial effect on steelhead.

Pacific Lamprey

Anadromous Pacific lamprey enter the Klamath River throughout the year, although their numbers peak in early winter (December through February). As a result, many adults could be directly affected by increased suspended sediment concentration in winter and early spring, likely causing increased stress and impaired homing ability. However, given their relatively broad distribution in the Klamath River Basin, the proportion of the Pacific lamprey population that would be potentially exposed to high SSCs is expected to be low.

Juvenile Pacific lamprey (ammocoetes) rear for a variable number of years before outmigrating to the ocean. As a result, suspended sediment resulting from the proposed action could affect multiple year-classes of the population. While it is assumed that mortality would be higher than under existing conditions, the broad spatial distribution of Pacific lamprey in the Klamath River Basin, including mid-Klamath River tributaries such as the Trinity and Scott Rivers, suggests that a large portion of the rearing ammocoete population would not be affected by dam removal.

Juvenile Pacific lamprey (ages 2 to 10) outmigrate to the ocean from the mainstem Klamath River and tributaries rear-round, with peaks in late spring (late May to mid-June) and fall (October and November). Exposure to suspended sediment from the proposed action is anticipated to be only slightly higher during the spring and fall migration than under existing conditions.

Given the above information, the proposed action would have a short term, significant and unavoidable adverse effect on a small portion of Pacific lamprey year-classes in the Klamath River Basin due to effects associated with exposure to high suspended sediment concentrations. In the long term, the measures included in the proposed action are expected to provide a permanent, significant benefit to Pacific lamprey by increasing their viability through: (a) extending the range and distribution of the species; (b) providing additional spawning and rearing habitat; (c) increasing the genetic diversity of the species; and (d) increasing the abundance of the Pacific lamprey population. In addition, the return to a temperature regime and flows that more closely mimic natural patterns would likely benefit Pacific lamprey, which evolved under those conditions.

Green Sturgeon

Given their known distribution in the basin, the proposed action would have the highest potential effect on Northern DPS green sturgeon in the mainstem Klamath River downstream from Ishi Pishi Falls (at the confluence with the Salmon River). While very little information is available describing the effects of high SSCs on green sturgeon, most life stages are more resilient to poor water quality conditions than salmonids.

Adult green sturgeon typically enter the Klamath River beginning in mid-March, and under the proposed action, are likely to be exposed to long durations of high SSCs that would result in major physiological stress under all scenarios. However, up to 75 percent[147] of the mature adult green sturgeon population (as well as 100 percent of sub-adults) can be assumed to be in the ocean during dam removal year 2 and avoid effects associated with the proposed action. Another behavior that may influence the effects of the proposed action is that green sturgeon appear to forego spawning migrations if environmental conditions are less than optimal (CALFED, 2007).

The proposed action may adversely affect the spawning, egg, and larval stages in a variety of ways, and it is generally believed that silt can prevent eggs from adhering to one another, reducing egg viability (EPIC et al., 2001, as cited in California DWR, 2003). Fine sediment deposition on the channel bed may reduce availability of exposed cobble surfaces for eggs to adhere to, and incubating eggs could be exposed to higher SSCs for longer periods than under existing conditions. This could reduce production from the mainstem Klamath River to an unknown degree, although spawning is common downstream from the confluence with the Trinity River, where SSCs resulting from the proposed action should be similar to existing conditions. Green sturgeon production from the Trinity River, which is estimated to be approximately 30 percent of total production from the Klamath River Basin (Scheiff et al., 2001), would be unaffected by the proposed action.

Under the proposed action, juvenile green sturgeon rearing downstream from Orleans in dam removal year 2 are anticipated to be exposed to higher SSCs for longer periods than under existing conditions (table 3.4-5). However, juvenile green sturgeon exposed to high SSCs in the Connecticut River showed no apparent physiological stress, despite the fact that several other sturgeon species suffered gill infections during these same events (B. Kynard, pers. comm., 2008). In addition, juvenile green sturgeon rearing is common downstream from the Trinity River, where SSCs would be similar to existing conditions.

Because there would be no predicted substantial decrease in green sturgeon abundance of a year class, or substantial decrease in habitat quality or quantity, implementation of the proposed action would have a less than significant effect on the green sturgeon population in the short term. In the long term, the green sturgeon

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[147] Green sturgeon in the Klamath River spawn approximately once every four years.

population may benefit from the more normative ecological processes that would develop under the proposed action; however, these beneficial effects are difficult to determine given the limited information regarding the distribution and abundance of this species in the action area.

3.4.3.4 Effects of Suspended Sediment on Benthic Macroinvertebrates

Benthic macroinvertebrates (BMI) are small aquatic animals and the aquatic larval stages of insects. Suspended sediment and turbidity can cause stress to BMI populations through impaired respiration; reduced feeding, growth, and reproductive abilities; and reduced primary production (Lemly, 1982; Vuori and Joensuu, 1996). BMIs are the primary food source for most freshwater fish species, and therefore, changes in abundance, distribution, or community structure can affect fish populations. For example, a diminished food supply can limit growth of salmonids. Growth is critical to juvenile salmonids because a larger size fish often has a survival advantage during the overwintering period, smolt outmigration, and ocean residence.

KRRC's proposal to conduct reservoir drawdown during the seasonal high-flow period and the use of sediment jetting to expedite the transport of suspended sediment during and after dam removal would minimize adverse effects on BMIs.

Our Analysis

During the project planning process, KRRC evaluated the potential short-term and long-term effects of the proposed action on BMIs using output from the SRH-1D sediment transport model (provided by Reclamation) (Huang and Greimann, 2010). Effects on BMIs were based on water quality determinations (e.g., DO, toxicity) and evaluated in the same manner as described for fish.

In the short term, the proposed action would likely result in a reduction in abundance of BMIs in the Klamath River downstream of the Iron Gate Dam site to the confluence with the Salmon River. However, BMI populations are expected to recover quickly because of the many sources for recolonization and their rapid dispersion through drift or aerial dispersal of adults. Full recovery of BMI communities is typically observed within a year following disturbance (Tsui and McCart, 1981; Anderson et al., 1998).

In the long term, the proposed action would restore riverine connectivity, and rehabilitate and increase availability of riverine habitat within the hydroelectric reach. The reestablishment of river channels in formerly impounded reaches and unimpeded sediment transport downstream of the Iron Gate Dam site under the proposed action would benefit BMIs by providing more suitable substrates (e.g., gravel) than under existing conditions. Thus, new, suitable habitats created in the former hydroelectric reach would be opened to colonization by BMIs through rapid dispersal by drift from upstream populations within current riverine reaches and/or dispersal by adult life stages. In addition, recolonization would occur rapidly from existing BMI populations within the many tributary rivers and streams of the Klamath River. BMI populations are expected to recover quickly from short-term, adverse effects and provide additional sources of food to fish.

Overall, the proposed action would have a short-term, significant and unavoidable adverse effect on BMIs. However, in the long term, the proposed action would restore habitat connectivity and rehabilitate and increase the amount of available riverine BMI habitat within the reservoir reach. The reversion to unimpeded sediment transport downstream of the Iron Gate Dam site would also substantially improve BMI habitat conditions and increase their abundance throughout the mainstem Klamath River, resulting in a permanent, significant beneficial effect on BMIs. In turn, coho salmon and other freshwater fish would benefit from an increased food supply.

Following dam removal, high rates of sediment deposition could result in declines in mussel populations and remove species from the mussel community in downstream reaches (Sethi et al., 2004). On a short-term basis, some mussels may be killed during in-water deconstruction activities, and mussels located between Iron Gate Dam and Cottonwood Creek are expected to experience moderate to high mortality from the initial movement of bedload material until equilibrium of sediment transport processes occurs. Freshwater mussels would benefit from restored connectivity for fish host species throughout the hydroelectric reach, which would provide a permanent and significant benefit for freshwater mussels.

3.4.3.5 Effects of Changes in Dissolved Oxygen on Aquatic Resources

Adequate concentrations of dissolved oxygen are critical for the survival of salmonids and they have evolved very efficient physiological mechanisms for obtaining and using oxygen in the water to oxygenate the blood and meet their metabolic demands. Reduced concentrations of dissolved oxygen can affect growth and development of different life stages of salmon, including eggs, alevins, and fry, as well as the swimming, feeding and reproductive ability of juveniles and adults. These adverse effects can in turn affect fitness and survival by altering embryo incubation periods, decreasing the size of fry, increasing the likelihood of predation, and decreasing feeding activity. Under extreme conditions, low dissolved oxygen concentrations can be lethal to salmonids. Laboratory studies have demonstrated that dissolved oxygen concentrations of 7.0 mg/l or greater result in little to no population impairment for salmonids (Davis, 1975; EPA, 1986; Carter, 2005).

As described in section 3.3, *Water Quality*, drawdown and removal of the four project reservoirs would alter DO concentrations in the hydroelectric reach and in the Lower Klamath River, as suspended sediment contains organic matter that contribute to oxygen depletion in the water when decomposing. Lower DO levels have the potential to adversely affect aquatic biota and may not comply with applicable water quality standards. Several commenters expressed concern that the proposed action could adversely affect DO in the Lower Klamath River.

Our Analysis

Under existing conditions, much of the hydroelectric reach and the Lower Klamath River are listed as impaired by low DO concentrations, as the nutrient-rich conditions in Copco No. 1 and Iron Gate Reservoirs cause seasonal algal blooms that contribute to low DO in the hypolimnion hydroelectric reach and in the Lower Klamath River (see table 3.3-6 and figure 3.3-10). While low DO concentrations generally exceed minimum dissolved oxygen requirements for salmonids and other cold-water species (Asarian and Kann, 2013), annual minimum dissolved concentrations from 2001 to 2011 were as low as 3.5 mg/l at Iron Gate Dam (Asarian and Kann, 2013). The lowest dissolved concentrations occur from mid-July through September within 1 river mile downstream of Iron Gate Dam (PacifiCorp, 2018).

During the project planning process, KRRC, in consultation with NMFS, used dissolved oxygen thresholds of 5 mg/l and 7 mg/l to determine the potential downstream distances of DO impairment that is expected under best- and worst-case scenarios.[148] KRRC and NMFS used 7 mg/l as a DO concentration that has no expected impairment on aquatic habitat for salmonids. KRRC and NMFS also used a 5 mg/l threshold value to provide consistency with previous Klamath River dam removal DO analyses (Stillwater Sciences, 2011; Reclamation, 2012a; California Water Board, 2020b) that used 5 mg/l as a minimum value below which short-term fish effects are likely to be acute and may cause harm or mortality (Stillwater Sciences, 2011).

Under the proposed action, DO concentrations downstream of the reservoirs would be reduced during reservoir drawdown due to the mobilization and downstream transport of anoxic sediments. KRRC analyzed the short-term effects (<2 years) of the proposed action on DO levels by updating an existing numerical model to predict short-term DO levels in the Klamath River downstream of Iron Gate Dam (Stillwater Sciences, 2011).

According to KRRC (2021f), DO concentrations downstream of the Iron Gate Dam site would be generally less than 5 mg/l during high SSC events that would occur in mid-January and mid-June under the median impact year (1991) and mid-June under the severe impact year scenario (1970). The mid-January event would occur as a result of sediment mobilization associated with reservoir drawdown. The model simulations predict that DO concentrations would be as low as 0.2 mg/l approximately 1.2 miles downstream from Iron Gate Dam. However, DO concentrations would rebound to conditions where salmonids can survive with moderate impairment to oxygen related functions (5 mg/l) (e.g., swimming ability) at RM 148.6 and to fair conditions for adult

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[148] Initial oxygen concentrations are based on either high (best case) initial saturation conditions (80% saturation) or low (worst case) initial saturation conditions (0% saturation). These concentrations bracket the range of dissolved oxygen conditions that could be expected in the Klamath River downstream of Iron Gate Dam during the reservoir drawdown.

and juvenile salmonids (7 mg/l) at RM 131.8. Depleted DO conditions of 5 mg/l at RM 148.6 could last for three consecutive days while it would take six days for the dissolved oxygen concentrations to increase to the 7 mg/l threshold. In January of the severe impact year scenario, the initial mobilization of sediments is expected to be reduced due to reservoir inflows exceeding the outlet tunnel capacity of the dam. Consequently, effects on DO levels would not be as severe as under the median impact year scenario.

In June of the median impact year modeling scenario, a DO level of 0.0 mg/l is expected to occur 0.6 miles downstream of the Iron Gate Dam site, with modeled DO levels returning to the 5 mg/l level at RM 177.8 (just downstream of Shasta River confluence) and to the 7 mg/l level by RM 161.6 (between the Shasta and Scott River confluences). Conversely, the effects on DO levels in June of the severe impact year scenario are predicted to be greater than June of the median impact scenario, as more sediment would still be released from Iron Gate Reservoir combined with releases associated with the removal of the Copco No. 1 cofferdam. The DO levels in June of the severe impact year scenario would be the same as the previous scenario (0.0 mg/l 0.6 miles downstream of the Iron Gate Dam site). However, the model predicts that DO levels at 5 mg/l concentration would not be met until RM 161.0 (between the Shasta and Scott River confluences) and the 7 mg/l concentration not until RM 145.5 (just upstream of Scott River confluence). KRRC anticipates that the low DO conditions close to the Iron Gate Dam site may last for up to two months depending on the water temperatures, while DO levels farther downstream may only be below 5 mg/l for 9 days but below 7 mg/l for up to 47 consecutive days.

In the year following drawdown when the earthen coffer dams and associated facilities are being removed, sediments are not expected to contain a high percentage of organic matter. The vast majority of silt and smaller sized material would have already been evacuated from the formerly inundated reservoir sites during the drawdown period. Therefore, low DO levels are not anticipated to be a major issue in the second year.

Given the above information, it is likely that the proposed action would result in significant and unavoidable short-term adverse effects on anadromous salmonids in the mainstem Klamath River from decreases in DO associated with sediment evacuation. Adverse effects could include acute mortality to impaired function (increases in physiological stress, reduced feeding and growth, reduced swimming performance), all of which would affect the overall fitness and survival of individuals. These conditions resulting in adverse effects would occur only during the drawdown year when the reservoir sediments and associated organic matter are evacuated. The effects of low DO levels and simultaneous high SSCs on anadromous fish are intertwined. Therefore, we analyze the range of adverse effects described section 3.4.3.3, *Effects of Changes in Suspended Sediment Concentrations on Aquatic Resources*, resulting from the proposed project by focusing on changes in DO levels.

In the long-term, the proposed action would result in more natural sediment transport and hydrologic processes in the former reservoir reach and downstream of Iron Gate Dam, which would create more natural substrate characteristics, increase the number and quality of spawning sites, enhance food resources, and improve water quality for coho salmon. These ecological improvements, including more favorable DO concentrations, are expected to enhance the viability of anadromous fish populations. Therefore, the proposed action would have a permanent and significant beneficial effect on anadromous fish in the Klamath River Basin.

3.4.3.6 Effects of Contaminants on Aquatic Resources

Pesticides (organochlorines and polycyclic aromatic hydrocarbons) and heavy metals are toxic to fish and may be taken in through gills, skin, and contaminated prey. They are also a threat to food safety, as fish can bioaccumulate many of these contaminants making them unsafe for human consumption. In rivers and streams, contaminants can be flushed through the system or retained in sediments, particularly organic materials that settle to the bottom of reservoirs. Under the proposed action, sediment released from the project reservoirs, and their associated organic and inorganic contaminants, have the potential to adversely affect fish and other aquatic biota in the Klamath River (KRRC, 2021f; Reclamation, 2011a). Based on our review of the Commission's record for the Lower Klamath Project, the EPA (Region 9) has been coordinating closely for several years with other federal and state regulatory agencies in an effort to address this concern.

Our Analysis

As described in section 3.3, *Water Quality*, Gathard Engineering Consulting (GEC) (2006) conducted initial chemistry testing of the reservoir sediments in 2004 and 2005, and the results from that testing were used to create a more comprehensive sampling and testing plan which was carried out in 2009 and 2010. The testing found that no sediment samples contained metals, pesticides, herbicides, PCBs, DDT or dioxins at concentrations above screening levels. The only contaminants detected above screening levels were ethylbenzene and xylenes in one sample from Copco No. 1 Reservoir. These are common VOCs found in oils and gasoline, which likely come from recreational boats, and are expected to volatilize if resuspended. Shannon and Wilson (2006) theorize these compounds are present because they are bound to organics in the sediments.

EPA Region 9 was intensively involved in development of the 2009 and 2010 sampling and testing plan, and in interpretation of the results of that testing. This work culminated with publication in 2011 of Interior's Screening-Level Evaluation of Contaminants in Sediments from Three Reservoirs and the Estuary of the Klamath River, 2009-2011 (CDM, 2011). The 2011 report determined that the chemical and toxicological properties of the sediments behind the dams would not cause significant adverse environmental effects downstream of the project upon their release. These findings were in turn an important aspect of Interior's Klamath Facilities Removal Final EIS/EIR in December 2012, which recommended removal of the dams. EPA strongly supported removal of the dams and confirmed that the quality data provided in the sediment studies to date were adequate for making the decision to remove the dams. However, the EPA also noted that there could be a need for additional sediment testing in the future, to support final permitting. On August 25, 2020, the EPA issued a letter stating the existing sediment quality data are adequate for the Corps to complete the 404 permit process. EPA determined the downstream release of sediment would result in short- and long-term, less than significant effects from a chemical contaminate or toxicological standpoint and would not result in significant, adverse environmental or human health effects.

The key points relevant to EPA's determination include:

1) Comprehensive sediment testing completed in 2010 indicated that the reservoir sediments contained generally low levels of chemical contaminants, were not acutely toxic, and were relatively homogenous. As such, it was determined at the time that the unavoidable release of sediments upon removal of the dams would not result in significant adverse effects in relation to any of the several exposure pathways evaluated.

2) In the decade since the reservoir sediments were comprehensively tested, sedimentation has continued. Measurements have been made of net sedimentation rates in each reservoir, which were used to estimate that a combined total volume of approximately four million cy of new sediment had been deposited, which may represent an increase of between 20 and 30 percent since testing.

3) Nonetheless, the existing data are considered representative of this newly deposited sediment because:

- There have been no significant spills or land use changes around or upstream of the reservoirs since testing in 2010 that are expected to affect the quality of incoming or existing reservoir sediments; and
- The patterns of net deposition and erosion now known to exist in each reservoir indicate that sediment is fairly extensively reworked, which would result in mixing the new and existing sediments and averaging any (unlikely) chemical concentration differences that might exist.

Given the above information, exposure to contaminants from sediment releases associated with the proposed action would likely have a less than significant, adverse effect on aquatic resources in both the short and long term.

3.4.3.7 Effects on Fish Habitat Access

Anadromous fish require access to suitable spawning and rearing habitat to complete their life cycle, and in California, they often require access to thermal refugia during the warmest periods of the year. In the project vicinity, these thermal refugia are typically located in areas of spring water inflow, and in the tributaries to the mainstem Klamath River.

Under existing conditions, fall-run Chinook salmon, coho salmon, and steelhead use the Lower Klamath River and its tributaries for some or all their life-history stages (spawning, rearing, and migration). The project dams currently block fish passage into historic habitat located upstream of Iron Gate Dam. This lack of passage is considered to be a major contributing factor to the decline of anadromous fish populations in Klamath River Basin.

Under the proposed action, reservoir drawdown and dam removal would release large amounts of sediment into both the hydroelectric reach and the Lower Klamath River. As this sediment is transported downstream, it has the potential to form short-term obstructions that could block access of anadromous fish into important spawning and rearing habitat in the mainstem Klamath River and its tributaries. Numerous commenters note that J.C. Boyle described the presence of a 31-foot-high lava ledge located near the J.C. Boyle Dam site that may have prevented anadromous fish from accessing upstream habitat in historic times and could continue to block access after the J.C. Boyle Dam is removed. However, there are many credible accounts of salmon reaching Upper Klamath Lake and its tributaries prior to dam construction (FWS, 2021a; Hamilton, 2005; Hamilton et al., 2016; and Fortune et al., 1966). Furthermore, Boyle (1913 and 1976) did not provide any definitive indication that a 31-foot-tall lava dam (or similar barrier) existed around the time of construction of the Copco No. 1 Dam. Therefore, we do not further consider this issue.

To address the effects of sediment on aquatic habitat access, KRRC proposes to implement its Tributary-Mainstem Connectivity Plan to ensure adult salmonids and Pacific lamprey continue to have access to important mainstem and tributary spawning habitat (KRRC, 2021f). Under this plan, KRRC would evaluate the sediment conditions at nine tributary-mainstem confluences (four sites in the hydroelectric reach and five sites[149] in the 8-mile reach of the Klamath River extending from Iron Gate Dam to Cottonwood Creek), for two years following reservoir drawdown. The monitoring frequency would be variable based on the season and year and would be developed in consultation with the Aquatic Resources Group. If any tributary confluence blockages are identified during monitoring, KRRC would remove the obstructions, in consultation with the resource agencies, to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

KRRC would also implement (and update) its Spawning Habitat Availability Report and Plan, a subplan of the Aquatic Resources Management Plan. The plan

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[149] At the confluence locations of the five fish-bearing streams within the reach (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek), and at the Shovel Creek confluence with the Klamath River above Copco No. 1 Reservoir.

describes the habitat surveys and spawning habitat target metrics[150] KRRC would use to inform the need for spawning habitat enhancements to offset the loss of spawning habitat in the Klamath River following reservoir drawdown. The updated plan would describe the results of the habitat surveys in the reservoir reach[151] (typical reach characteristics, the total amount of available spawning habitat, all human-made fish barriers encountered during the surveys), and the timing of the implementation of spawning habitat enhancement activities if such activities are determined to be necessary. The Spawning Habitat Availability Report and Plan focuses primarily on the potential effects on Chinook salmon and steelhead. If, based on the surveys, one or more of the target metrics have not been met in the reservoir reach, KRRC would, in consultation with the Aquatic Resources Group, determine if gravel augmentation or other actions to improve spawning and rearing habitat are appropriate. In addition, KRRC may also take certain actions in connection with the implementation of the Reservoir Area Management Plan, including fish passage barrier removal, installation of large woody material, riparian planting for shade coverage, gravel augmentation, wetland construction or enhancement, and cattle exclusion fencing.

KRRC’s Fish Presence Monitoring Plan (KRRC, 2021j) is designed to document adult anadromous fish presence within the hydroelectric reach and its tributaries following dam removal. The surveys would target adult coho salmon, spring-run and fall-run Chinook salmon, steelhead, and Pacific lamprey, as these species were historically found upstream of Iron Gate Dam (Hamilton et al., 2005). Specifically, KRRC would monitor fish presence (adults, redds, or carcasses) in the formerly inundated portions of Camp-Scotch Creek complex, Jenny Creek, and Beaver Creek; and in the mainstem Klamath River from RM 291.6 to the confluence with Shovel Creek. The surveys would begin shortly after reservoir drawdown and would continue for up to four consecutive years. KRRC would cease monitoring in a given tributary, and in the mainstem Klamath River downstream from that tributary, if surveys document the presence of anadromous fish.

Our Analysis

Under the proposed action, dam removal would reestablish anadromous fish access into at least 76 miles of historical habitat, including the hydroelectric reach, with the potential for future colonization of habitat in tributaries to Upper Klamath Lake if water quality conditions in Upper Klamath Lake and Keno Reservoir improve in the

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[150] Access to 44,100 cubic yards of additional spawning habitat in the mainstem would offset the potential loss of 2,100 Chinook salmon redds (mainstem target), and access to approximately 4,700 cubic yards of spawning habitat in key tributaries would offset the potential loss of 179 steelhead redds (tributary target).

[151] Including the mainstem Klamath River and Jenny, Fall, Shovel, and Spencer creeks.

future (California Water Board, 2020a; FWS, 2020c). The proposed action would restore more natural flows, sediment characteristics, and water quality conditions in the hydroelectric reach and the Lower Klamath River. Over the long-term, these conditions would increase the distribution and genetic diversity of anadromous fish, improve spawning and rearing habitat, enhance macroinvertebrate production, and reduce the incidence and severity of fish disease. However, in the short term, the erosion of accumulated sediment within the hydroelectric reach might form obstructions that could block or impede upstream fish passage into important tributaries downstream of the Iron Gate Dam site or interfere with the recolonization of spawning and rearing habitat at tributaries in the former reservoir reach.

During the project planning process, KRRC used the SRH-1D sediment model (provided by Reclamation) to evaluate the effects of reservoir drawdown and dam removal on sediment transport in the Klamath River and to identify locations where sediment aggradations have the greatest potential to adversely affect fish passage. The model simulated conditions in the study area over a two-year period beginning on October 1 of the pre-drawdown year. Based on the results of this assessment, bed loads would coarsen over the two-year period following dam removal, as flows transport fine sediments and erode the river channel to its pre-dam elevation.

Based on the results of this assessment, sediment aggradation and subsequent erosion have the potential to interfere with, or block, fish passage in the mainstem and at tributary confluences located downstream of J.C. Boyle Reservoir. According to California Water Board (2020a), changes in bedload downstream of the Iron Gate Dam site would be limited to an 8-mile reach extending to Cottonwood Creek, or 4 percent of the channel length of the mainstem Klamath River downstream from Iron Gate Dam. However, the most severe effects would be limited to a small portion of the total channel length (0.5 mile, or less than 1 percent of the channel downstream from Iron Gate Dam). As described in KRRC’s Fish Presence Monitoring Plan, several tributaries in the hydroelectric reach have viable anadromous fish habitat, including Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek (Huntington, 2006). Other tributaries that historically provided anadromous fish habitat include Beaver Creek (Interior, 2007), Camp Creek and Scotch Creek (referred to as the Camp-Scotch Creek complex) (Hamilton et al., 2005). More than 40 miles of potential salmonid spawning habitat would also become available in the mainstem Klamath River following dam removal (Huntington, 2006). KRRC proposes to conduct anadromous fish presence monitoring in the Camp-Scotch Creek complex, Jenny Creek, and Beaver Creek channel lengths within the former reservoir footprints, and in a reach of the mainstem Klamath River from RM 291.6 to the confluence with Shovel Creek.

Following dam removal, state and federal resource agencies and Tribal fisheries programs, would cooperatively monitor the recolonization of anadromous fish upstream of Iron Gate Dam. KRRC would contact the California Water Board, the Natural Resources Conservation Board, California DFW, and the NMFS a minimum of four weeks prior to each survey, to provide agency staff the opportunity to participate in the monitoring effort. KRRC would also coordinate with the Oregon DFW, California DFW, and NMFS on a quarterly basis (approximately every three months) to facilitate the sharing of new information.

As described in section 2.1.2.9, *Aquatic Resources Management Plan*, the measures in KRRC's proposed Tributary-Mainstem Connectivity Monitoring Plan were developed to aid in the identification and removal of any project-related fish migration barriers that could develop in the former reservoir areas and dam footprints, and in the mainstem Klamath River between Iron Gate Dam and Cottonwood Creek. As such, implementing KRRC's Tributary-Mainstem Connectivity Monitoring Plan would ensure that adult salmonids and Pacific lamprey entering the Klamath River have access to important spawning and rearing habitats and that these species have access to cold-water refugia and from high SSCs during dam removal and seasonal high water temperatures.

In addition, the measures included in KRRC's Fish Presence Monitoring Plan (KRRC, 2021j), would document adult anadromous fish presence within the former hydroelectric reach and its tributaries following dam removal. This monitoring program would also provide information to identify the status of restoration goals and inform additional adaptive management actions that may be implemented to improve fish access.

Reporting the results of these surveys to the resource agencies would facilitate their involvement in the process and would allow input into the need for any further actions that may be required to meet fish passage goals. Furthermore, ceasing monitoring in a given tributary, or in the mainstem Klamath River downstream from that tributary, if surveys document the presence of anadromous fish, would allow KRRC to prioritize fish passage issues that may develop within the hydroelectric reach or in the Klamath River downstream of Iron Gate Dam. As a result, this monitoring program would likely benefit juvenile and adult anadromous salmonids, and Pacific lamprey, by helping to restore and maintain access to habitat within the hydroelectric reach, including at least 13.9 miles of tributary habitats and several other recognized thermal refugia areas, including the J.C. Boyle bypassed reach and Jenny and Fall Creeks.

Therefore, barriers formed by sediments mobilized by the proposed action could have a less than significant, adverse effect on fish habitat access in the short term, and this effect would be minimized by KRRC's proposed measures. In the long term, the proposed action would have a significant, beneficial effect because dam removal would provide anadromous fish species access into their historic spawning and rearing habitat located upstream of the Iron Gate Dam site.

3.4.3.8 Effects of Changes in Hatchery Operations

Several commenters expressed concern that discontinuation of operations at Iron Gate Hatchery would adversely affect salmon fisheries, and the City of Yreka expressed concern that coho salmon produced at the Fall Creek Hatchery would return primarily to Fall Creek, which could affect the City's ability to continue meeting its need for consumptive water supply. To address this concern, the City of Yreka recommends that coho salmon produced at the hatchery be imprinted with ß-phenylethyl alcohol or morpholine for at least 14 days during smoltification and lured into unfamiliar streams scented with these odors when they return from the ocean as adult salmon.

At the recommendation of NMFS and the California DFW, KRRC would transfer all fish production from Iron Gate Hatchery to Fall Creek Fish Hatchery, following its Hatcheries Management and Operation Plan.[152]

Our Analysis

Under the proposed action, the Chinook salmon annual production targets at Fall Creek Hatchery would be reduced from 900,000 yearlings (current production target at Iron Gate Hatchery) to 250,000 yearlings and from 5.1 million sub-yearlings (current production target at Iron Gate Hatchery) to 3 million sub-yearlings (table 3.4-18). This decrease in production would benefit wild Chinook salmon in the Klamath River Basin several ways because juvenile hatchery-origin Chinook are known to compete with naturally produced fish for food and limited space (i.e., thermal refugia) (Flagg et al., 2000). Smaller hatchery releases also would reduce wild fish exposure to *C. shasta*, a fish disease that spreads quickly in hatcheries and is prevalent in the river basin.

While KRRC and NMFS expect salmonids to quickly repopulate habitat upstream of Iron Gate Dam following dam removal, as was observed after barrier removal on the Elwha, White Salmon, Cedar, and Rogue rivers, full utilization of this habitat (and associated juvenile production) would develop over time (NMFS, 2021b). Consequently, the proposed action does not include the use of hatchery eggs or juveniles to “seed” the newly available habitats. Given the high level of uncertainty associated with recolonization rates, we recommend KRRC and the resource managers consider the City of Yreka’s recommendation to imprint coho salmon to return to other tributaries, and also to allocate a portion of the juvenile salmon produced at Fall Creek Hatchery to accelerate the recolonization process (as needed for at least 5 years). These fish could be deferentially marked and then released directly into tributaries or placed in temporary holding pens for imprinting and acclimation.

Given the above information, the proposed action’s changes in hatchery operations during, and for eight years following dam removal, would likely facilitate the repopulation of newly available Chinook and coho salmon habitat upstream from Iron Gate Dam and help contribute to the recovery and long-term persistence of SONCC coho in the Klamath River Basin. It is also likely that progeny from these programs would continue to support some ocean and in-river fisheries.

If hatchery production at Fall Creek is terminated in the future, the elimination of hatchery-produced fall-run Chinook and coho salmon would likely result in a reduction in adult returns in post-dam removal years for an indeterminate period of potentially 1 to 10

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[152] To implement the proposed Hatcheries Management and Operations Plan, hatchery operations must be functional prior to drawdown of Iron Gate Reservoir.

years (i.e., short term) before the benefits of dam removal are realized. Consequently, implementation of the proposed action would have a significant, permanent, adverse effect on the number of hatchery fall-run Chinook salmon produced in the Klamath River Basin. However, in the long term, the expected increase in production from improved habitat conditions would likely be higher than what would be lost due to the decommissioning of Iron Gate Hatchery. Furthermore, in its BiOp for the surrender and decommissioning of the Lower Klamath Project (NMFS, 2021b), NMFS notes that California DFW, Oregon DFW and the Klamath Tribes are drafting anadromous species reintroduction plans that discuss the potential for modified hatchery operations in the Klamath River to continue beyond the length of time proposed (eight years). Hatchery operations beyond eight years (or potentially cessation of hatchery operations earlier than eight years if warranted) would depend on the level of natural production occurring throughout the Klamath River (including newly available upstream habitat) as indicated by monitoring efforts. Although the specific plans being prepared are not yet finalized, NMFS recognizes that it is reasonably certain that hatchery production would continue to occur at some level beyond eight years if expectations for repopulation of newly available spawning habitat and improved productivity throughout the Klamath River system are not being met.

3.4.3.9 Effects on Commercial, Recreational and Tribal Fisheries

Salmon produced in the Klamath River Basin contribute to an important mixed-stock commercial fishery in the coastal waters south of Cape Falcon, Oregon, and support significant in-river Tribal, subsistence, and recreational fisheries. However, frequent closures and/or fishing curtailments (associated with low abundance) over the past 30 years have substantially reduced harvest opportunities. For example, from 1986 through 1989, the average harvest of age-3 and age-4 Klamath River fall Chinook salmon was 234,753 in ocean fisheries and 60,900 in river fisheries (PFMC, 2008). From 1990 through 2006, the average harvest level declined by 88 percent in the ocean fisheries, and by 58 percent in the river fisheries (PFMC, 2008). In 2006, more than 700 miles of the Oregon and California coast were closed to salmon fishing to protect the weak Klamath stocks in a mixed-stock ocean fishery; and in 2008, federal authorities declared the West Coast ocean salmon fishery a failure. The commercial fleets that rely on these salmon populations consist largely of small, independently owned and operated trollers that harvest salmon originating from different rivers in California and include SONCC coho and Klamath River fall- and spring-run Chinook salmon.

Klamath River Native American Tribes have also been adversely affected by restrictions and closures placed on their subsistence, commercial, and ceremonial salmon fisheries. These restrictions and closures have resulted in disruptions to traditional diets and substantial cultural impacts to Tribal members.

Furthermore, the salmon and steelhead produced in the Lower Klamath River support a local multi-million-dollar recreational fishing industry. However, recreational fishery regulations such as closed seasons are common in the Klamath Management Zone

(KMZ) when fall Chinook salmon abundance is low. As a result, effort and landings in all areas have generally declined from the 1980s to the 1990s. Factors contributing to this decline include more conservative management policies to protect weak stocks (including two Chinook salmon and three coho salmon stocks listed under the ESA), and a 1993 opinion by the Department of the Interior Solicitor reserving 50 percent of Klamath-Trinity River salmon for the Yurok Tribe and Hoopa Valley Tribe. Effort and landings rebounded during 2001-2005; however, fishery regulations have been unusually restrictive in more recent years. The restrictions triggered by Sacramento River fall Chinook salmon concerns were particularly stringent, including near-closure of the California fishery in 2008-2009 and additional restrictions in Oregon as well. From 2001 to 2010, trips on charter vessels averaged 25 percent of total salmon angler trips south of Cape Falcon, 7 percent in the KMZ-CA (excluding 2008, when the KMZ-CA was closed), and 3 percent in the KMZ-OR (KRRC and PacifiCorp, 2020).

As noted in the previous section, several commenters expressed concern that the proposed action could adversely affect these commercial, Tribal, and recreational fisheries due to the effects of released sediment and reduced hatchery production. Some commenters also expressed concern about losing the ability to use water stored in the project reservoirs to provide flushing flows to reduce disease incidence, but the water used for this purpose in the past has been provided from Upper Klamath Lake, not the project reservoirs. Some commenters also expressed views that the reservoirs improve downstream water quality and reduce disease incidence, but we found no evidence to support these views during our review of the many studies related to these issues.

While KRRC does not propose specific measures to address commercial, recreational, or Tribal fisheries in California, the overall purpose of the proposed action is to facilitate large-scale fisheries restoration in the Klamath River Basin by addressing system-wide limiting factors including a lack of fish passage, high summer and fall water temperatures, blue-green algae blooms, disease incidence, impaired sediment supply and transport, and other factors. KRRC also states that the proposed action is expected to increase the abundance of naturally spawned salmon in the Klamath River Basin.

Our Analysis

Under existing conditions, the Lower Klamath Project facilities are a major contributing factor to the decline of anadromous fish populations in Klamath River Basin. The project degrades water quality in the Klamath River (e.g., temperature, pH, dissolved oxygen, and nutrient alterations); promotes fish disease; and blocks access to potentially hundreds of river miles of historical anadromous fish habitat upstream of Iron Gate Dam (California Water Board, 2020b). While the current production targets at Iron Gate Hatchery are intended to mitigate at least some of these effects, recent downward trends in adult salmon abundance (harvest and abundance) do not look promising for future fisheries. However, the fish produced at Iron Gate Hatchery do contribute to higher harvest rates than what would happen if there were no hatchery stocks in the fishery.

Under the proposed action, it is expected that anadromous fish populations would begin to recolonize historical habitat upstream of the Iron Gate Dam site shortly after dam removal and would begin to benefit from improved habitat conditions in the hydroelectric reach and the Lower Klamath River. At the same time, reduced hatchery production and the potential discontinuation of hatchery production eight years after dam removal, would likely decrease the number of fish that are available harvest, especially if restrictions are placed on the exploitation of fish needed to recolonize historic habitat.

While it is very difficult to predict the effects of the proposed action on salmon abundance in the Klamath River Basin (due to potential changes in tributary and ocean habitat conditions, fisheries management, climate change, and other stochastic events), computer modeling by Oosterhout (2005) suggests that dam removal would substantially increase the number of fall-run Chinook salmon spawners over a 50-year period. Additional population capacity and modeling efforts described in Huntington (2006), Dunsmoor and Huntington (2006), Hendrix (2011), and Lindley and Davis (2011) also support this conclusion. Of these models, the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) life-cycle model (Hendrix, 2011) is the most intensive and robust conducted to date, because it explicitly addressed the proposed action, used stock-recruitment data from the Klamath River, incorporated variability in watershed and ocean conditions, and presented estimates of uncertainty.

As described in California Water Board (2020b), Hendrix (2011) applied EDRRA to forecast the abundance of Chinook salmon for both the proposed action and continuation of existing conditions for the years 2012 to 2061.[153] The EDRRA Chinook salmon life-cycle model assumes that current management rules established by the PFMC for management of Klamath River Chinook salmon would remain in place throughout the 50-year period of analysis.

The EDRRA model predicts the proposed action would substantially increase adult Chinook salmon escapement in the Klamath Basin compared to existing conditions (median increase greater than 30,000). The potential for ocean harvest was also predicted to be greater under the proposed action due to increased Chinook salmon adults in ocean, and the probability of low escapement leading to fishery closures would be reduced under the proposed action.

While NMFS (2021, as cited in KRRC, 2021f) predicted the proposed reduced hatchery production could result in a slight (1.5 percent) reduction in the long-term adult salmon abundance in the South of Cape Falcon Exclusive Economic Zone and a 0.6 percent decrease in ocean harvest (a significant short-term decrease in harvestable Chinook), we conclude the proposed action is likely to help sustain the fishery in the long run, and that after recolonization progresses, natural production is likely to partially to fully compensate for the loss of hatchery production.

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[153] The EDDRA model did not incorporate potential climate change effects.

Coho salmon have been harvested in the past in both coho and Chinook-directed Ocean fisheries off the coasts of California and Oregon. However, stringent management measures, which began in the late 1980s, reduced coho salmon harvest substantially. The prohibition of coho salmon retention in commercial and sport fisheries in all California waters began in 1994 (NMFS, 2021b), and only small numbers of coho salmon continue to be harvested in sanctioned Tribal harvest for subsistence, ceremonial, and commercial purposes by the Yurok, Hoopa Valley, and Karuk Tribes. While the tributaries to the Klamath River provide a greater amount of juvenile coho summer and winter rearing areas and adult spawning habitat than the mainstem, the measures included in the proposed action would restore coho salmon access to at least 76 miles of additional habitat (Interior, 2007; NMFS, 2007), including approximately 53 miles in the mainstem, and tributaries such as Fall, Jenny, Shovel, and Spencer Creeks, and others; and approximately 22.4 miles of riverine habitat currently inundated by the hydroelectric reach reservoirs (Cunanan, 2009). In the long term, the effects of the proposed action are expected to benefit coho salmon in the Klamath River Basin. As these coho populations begin to exploit these new and/or improved habitats, their numbers are expected to increase, and they would likely contribute to the recovery of the SONCC ESU.

Given the above information, implementation of the proposed action would likely have a long-term, significant effect on commercial, Tribal, and recreational fisheries because the decommissioning and removal of the Lower Klamath Project facilities is be expected to increase the production of wild salmon in the Klamath River Basin. However, it is not known if this increase in abundance would ultimately lead to an increase in harvest opportunities because the management of these fisheries is the responsibility of the Klamath River Basin fisheries managers, including State regulatory agencies and Tribal partners. In addition, other factors such as ocean conditions can have a pronounced effect on the number of adult salmon that return to their natal rivers.

3.4.3.10 Effects on Essential Fish Habitat

The proposed action would have a minor, temporary, adverse effects on Pacific Coast groundfish EFH and coastal pelagic EFH from elevated SSCs, which is likely to become diluted and dissipate rapidly once it reaches the ocean. Therefore, the proposed action is expected to have only minimal effects on the physical, chemical, and biological resources in the Klamath River estuary and the marine environment.

The proposed action would have significant temporary adverse effects on EFH designated for Pacific salmon. Effects on adult and juvenile migration habitat would occur from elevated SSCs and lowered DO concentrations. Similarly, short-term effects on the spawning and incubation component of salmon EFH would occur, but long-term benefits would result from improved water quality and water temperature conditions and uninterrupted sediment supply downstream of Keno Dam. Although there would be short-term, negative effects on spawning habitat, the long-term effects on this EFH component would be significant and beneficial. Lastly, the quality of juvenile rearing habitat would be reduced in the Klamath River due to the adverse effects of sediment deposition and low dissolved oxygen, leading to reduced pool availability and food resources for less than two years; however, the proposed action would ultimately improve the juvenile rearing component of EFH by restoring the processes that provide food resources to juvenile salmon development, including increased leaf litter and woody debris for macroinvertebrates, coarse sediment replenishment that hosts macroinvertebrate habitat, increased marine-derived nutrients, and coarse sediment replenishment that hosts macroinvertebrate habitat sites. A more natural sediment transport regime would also increase channel complexity, promote pool formation, increase rearing habitat in side channels, and facilitate lower incidence of pathogens that cause disease.

NMFS (2021b) reviewed the likely effects of the proposed action on EFH and concludes that the action would adversely affect the EFH of Pacific Coast groundfish, coastal pelagic, and salmon EFH. However, they found that in spite of short-term, adverse effects, the proposed action would enhance the quality of EFH over the long term, and the proposed action already contains adequate measures to avoid or minimize short-term, adverse effects. NMFS therefore provided no additional conservation recommendations.

3.4.4 Effects of the Proposed Action with Staff Modifications

Appendix I of the Definite Plan (KRRC, 2018a), as amended (letter from KRRC to California Water Board dated October 10, 2018) included a proposed measure to coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on its reconnaissance, KRRC proposed to salvage a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek and relocate the salvaged mussels to reduce project effects on the freshwater mussel community. Salvaged mussels would be relocated to the Klamath River downstream from the Trinity River confluence, or upstream of Copco Reservoir in the J.C. Boyle Dam to Copco Reservoir reach. KRRC anticipated that the freshwater mussel salvage and translocation effort would require 10 days. KRRC predicted the percentage of the existing mussel beds that would be salvaged and translocated based the available habitat in the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. About 15,000 to 20,000 mussels were planned for translocation. During the course of these actions, KRRC did not anticipate that the entire population of mussels residing below Iron Gate Dam would be recovered. This measure does not appear to be included in the most recent version of the resource management plans filed with the Commission on December 14, 2021.

Salvage and transport of mussels would reduce the number of mussels affected by sediment deposition and provide source populations that would increase mussel species diversity and facilitate mussel colonization in stream reaches upstream of Iron Gate Dam. Therefore, consistent with California Water Board 401 Condition 6, staff recommends

KRRC modify the Aquatic Resources Management Plan to include salvage and transport of freshwater mussels.

KRRC has committed to fund the operation of the Fall Creek Hatchery for eight years, but it is unclear whether ownership of the hatchery would be transferred to the State of California or another entity, and whether hatchery production would continue afterwards. We recommended that KRRC file a revised Hatchery Management and Operations Plan to clarify the facility's future ownership and the potential that production would continue beyond eight years. Continuation of hatchery production beyond eight years would better ensure that the abundance of salmon available for harvest is not diminished if the number of fish produced via restoration of access to historical habitat does not fully compensate for the elimination of hatchery production within eight years.

3.4.5 Effects of the No-action Alternative

Under the no-action alternative, the Lower Klamath Project would remain in place, and PacifiCorp would continue to operate it under its current annual license. The existing FERC license has no requirements for additional fish passage or implementation of any mandatory conditions that are currently before the Commission, as described in its Final Environmental Impact Statement for Hydropower License (FERC, 2007). PacifiCorp would continue to coordinate with Reclamation to operate the Lower Klamath Project in compliance with the existing NMFS and FWS (2012) biological opinions issued for Reclamation's Klamath Irrigation Project Operations Plan. PacifiCorp would also continue to fund the operation of the Iron Gate Hatchery. Upstream fish passage would remain blocked by Iron Gate Dam; water temperatures, water quality, and sediment conditions in the Lower Klamath River would remain suboptimal for fish and supportive of fish disease; Chinook salmon returns to the Klamath River would continue to be dependent on hatchery production and are likely to continue to decline; and the commercial, recreational, and Tribal fisheries would remain adversely affected by ongoing restrictions and low harvest rates. Furthermore, the project reservoirs would continue to trap bedload and reduce spawning habitat quantity and quality below Iron Gate Dam. Any contaminants that may be present in reservoir sediments at the four facilities would also remain in place. These existing conditions, in combination with other limiting factors (e.g., ongoing increases in water temperature) would likely further reduce the distribution and abundance of salmonids, including ESA-listed species, and other important fish species. In the long term, if water temperatures continue to increase at the rate observed over the last 70 years (0.5°C per decade), as is expected based on global circulation models, this is likely to lead to a severe decline in both native and hatchery-produced salmon populations in the Klamath River within several decades. Thus, in summary, the no-action alternative would have long-term significant adverse effects on salmon and steelhead due to ongoing project effects on water quality (temperature, DO, pH, algae blooms), the quantity and quality of habitat that is accessible for spawning and rearing, and the combination of project-related factors that contribute to fish diseases that cause substantial fish mortality.

Table 3.4-1. Miles of salmon and steelhead habitat in Klamath River tributaries (Source: staff)

Tributary Name	Location Along Klamath River (RM)	Salmon and Steelhead Habitat	Notes
Bogus Creek	185	Miles of habitat not determined. However, estimated run sizes of salmon are substantial (run sizes of coho salmon from 2007 to 2012 ranged from 6 to 409; run sizes of fall Chinook salmon from 2006 to 2015 ranged from 2,353 to 12,930 [California DFW 2015, 2017c, cited from California Water Board, 2020a]).	
Shasta River	176.6	The Shasta River currently provides approximately 35 miles of fall Chinook salmon habitat, 38 miles of coho salmon habitat, and 55 miles of steelhead habitat (Hardy and Addley, 2001).	Dwinnell Dam, at RM 37 on the Shasta River, eliminated access to about 22 percent of the habitat that was historically available to salmon and steelhead in the Shasta River.
Scott River	143	Including tributaries, the Scott River Basin presently has about 59 stream miles of habitat suitable for fall Chinook salmon, 88 miles of habitat suitable for coho salmon, and 142 miles of habitat suitable for steelhead (Hardy and Addley, 2001).	Cumulative water withdrawals in conjunction with groundwater pumping during the agricultural season currently limit upstream migration of fall Chinook salmon to the lower 42 miles of the mainstem Scott River (Hardy and Addley, 2001).

Tributary Name	Location Along Klamath River (RM)	Salmon and Steelhead Habitat	Notes
Salmon River	66	The Salmon River supports an estimated 140 miles of fall Chinook salmon habitat and 100 miles of coho salmon and steelhead habitat (NAS, 2004).	The Salmon River is often considered one of the most pristine watersheds within the Klamath River Basin, and a high percentage of the watershed is protected under a wilderness designation.
Trinity River	40	Hardy and Addley (2001) estimated that the mid-Trinity River Basin (Lewiston Dam to the confluence with the South Fork Trinity) has about 140 stream miles of habitat suitable for Chinook and coho salmon, and about 225 miles of steelhead habitat. They also estimate that the South Fork Trinity has 115 stream miles of habitat suitable for Chinook and coho salmon, and about 190 miles of steelhead habitat.	Construction of the Trinity River Diversion in the early 1960s eliminated access for anadromous fish to habitat upstream of Lewiston Dam (at RM 109), which diverts water to the Central Valley Project.

Table 3.4-2. Fish species collected in the Upper and Lower Klamath River (Source: KRRC, 2020; FERC, 2007)

Family	Scientific Name	Common Name	Upstream of Iron Gate Dam[2]	Downstream of Iron Gate Dam[2]
Petromyzontidae (Lampreys)	*Lampetra lethophaga*	Pit-Klamath brook lamprey	R	
	Lampetra similis	Klamath lamprey	R	
	Lampetra tridentate	Pacific lamprey	R	A
Acipenseridae (Sturgeons)	*Acipenser medirostris*	Green sturgeon		A
	Acipenser transmontanus	White sturgeon		A
Clupeidae (Herrings)	*Alosa sapidissima*	American shad		A
	Clupea pallasi	Pacific herring		O
Cyprinidae (Minnows and Carps)	*Gila bicolor*	Tui chub	R	R
	Gila coerulea	Blue chub	R	R
	Notemigonus crysoleucas	Golden shiner	R	R
	Pimephales promelas	Fathead minnow	R	
	Rhinichthys osculus	Klamath speckled dace	R	R
	Carassius auratus	Goldfish	R	
	Richardsonius balteatus	Redside shiner	R	
Catostomidae (Suckers)	*Catostomus rimiculus*	Klamath smallscale sucker	R	R
	Catostomus snyderi	Klamath largescale sucker	R	R
	Chasmistes brevirostris	Shortnose sucker	R	R

Family	Scientific Name	Common Name	Upstream of Iron Gate Dam[2]	Downstream of Iron Gate Dam[2]
		Shortnose sucker x smallscale sucker	R	
	Deltistes luxatus	Lost River sucker	R	
Ictaluridae (Catfishes)	*Ameiurus natalis*	Yellow bullhead	R	R
	Ameiurus nebulosus	Brown bullhead	R	R
	Ictalurus punctatus	Channel catfish	R	
Osmeridae (Smelts)	*Hypomesus pretiosus*	Surf smelt		O
	Hypomesus transpacificus	Delta smelt		R
	Spirinchus thaleichtys	Longfin smelt		O
	Thaleichthys pacificus	Eulachon		A
Salmonidae (Trouts and Salmon)	*Oncorhynchus clarkii*	Cutthroat trout		R
	Oncorhynchus gorbuscha	Pink salmon		A
	Oncorhynchus keta	Chum salmon		A
	Oncorhynchus kisutch	Coho salmon		R,A
	Oncorhynchus mykiss	Coastal rainbow trout/steelhead		R,A
	Oncorhynchus mykiss gairdneri	Redband rainbow trout	R	
	Oncorhynchus nerka	Sockeye salmon		O,A
	Oncorhynchus nerka kennerlyi	Kokanee		R
	Oncorhynchus tshawytscha	Chinook salmon		A

Family	**Scientific Name**	**Common Name**	**Upstream of Iron Gate Dam[2]**	**Downstream of Iron Gate Dam[2]**
	Salmo trutta	Brown trout	R	R
	Salvelinus fontinalis	Brook trout	R	R
	Thymallus arcticus	Arctic grayling		R
Atherinidae (Silversides)	*Atherinops affinis*	Topsmelt		O
Gasterosteidae (Sticklebacks)	*Gastersteus aculeatus*	Threespine stickleback		R
Cottidae (Sculpins)	*Clinocottus acuticeps*	Sharpnose sculpin		O
	Cottus aleuticus	Coastrange sculpin		R
	Cottus asper	Prickly sculpin		R
	Cottus klamathensis	Marbled sculpin	R	R
	Cottus princeps	Klamath Lake sculpin	R	
	Cottus tenuis	Slender sculpin	R	
	Leptocottus armatus	Pacific staghorn sculpin		R
Centrarchidae (Sunfishes)	*Archoplites interruptus*	Sacramento perch	R	R
	Lepomis cyanellus	Green sunfish	R	R
	Lepomis gibbosus	Pumpkinseed	R	R
	Lepomis macrochirus	Bluegill	R	R
	Micropterus salmoides	Largemouth bass	R	R
	Pomoxis annularis	White crappie	R	
	Pomoxis nigromaculatus	Black crappie	R	
Percidae (Perches)	*Perca flavescens*	Yellow perch	R	R

Family	**Scientific Name**	**Common Name**	**Upstream of Iron Gate Dam^2**	**Downstream of Iron Gate Dam^2**
Surfperches	*Cymatogaster aggregate*	Shiner perch		O
Gobiidae (Gobies)	*Clevelandia ios*	Arrow goby		O
Pleuronectidae (Righteye Flounders)	*Platichthys stellatus*	Starry flounder		R

Note: R = resident, A =anadromous, O =occasional marine visitor

Table 3.4-3. Young-of-year and 1+ year old coho salmon collected using frame nets and rotary screw traps in the Klamath River, March through June 2012–2020 (Source: FWS, 2021b)

	Bogus Frame		**Rotary Screw Trap Upstream I-5**		**Rotary Screw Trap Downstream I-5**		**I-5 Frame**	
Year	**YoY**	**1+**	**YoY**	**1+**	**YoY**	**1+**	**YoY**	**1+**
2020	421	0	8	212	11	116	18	6
2019	112	39	8	461	16	289	62	23
2017	16	0	11	4	5	10	0	0
2016	33	1	14	37	17	17	182	0
2015	88	15	31	105	11	51	118	11
2013[a]	400	11	9	17	2	36	14	2
2012	601	80	49	92	69	72	12	1

Note: YoY = young of year

[a] 2013 data were presented as catch per unit effort. Yearly totals were calculated as catch per unit effort multiplied by the number of sampled days each week, followed by summation of weekly totals.

Table 3.4-4. Young-of-year and 1+ year old steelhead collected using frame nets and rotary screw traps in the Klamath River from March through June 2012–2020 (Source: FWS, 2021b)

	Bogus Frame		**Rotary Screw Trap Upstream I-5**		**Rotary Screw Trap Downstream I-5**		**I-5 Frame**	
Year	**YoY**	**1+**	**YoY**	**1+**	**YoY**	**1+**	**YoY**	**1+**
2020	556	1	347	193	343	103	351	9
2019	316	8	125	13	212	7	126	1
2017	29	6	8	26	7	20	0	0
2016	5	3	15	8	5	8	6	1
2015	669	3	232	9	167	4	201	0
2013[a]	262	12	14	33	8	22	18	0
2012	270	23	21	74	40	54	0	5

Note: YoY = young of year

[a] 2013 data were presented as catch per unit effort catch per day. Yearly totals were calculated as catch per unit effort multiplied by the number of sampled days each week, followed by summation of weekly totals.

Table 3.4-5. Number of green sturgeon harvested in California, Oregon, and Washington, 1985–2003 (Source: NMFS, 2005, as cited in FERC, 2007)

	California			Oregon[c]				Washington[d]								
	Klamath[b]					Columbia River[c]		Willapa Bay			Greys Harbor					
Year	**SF Bay[a]**	**Yurok**	**Hoopa[f]**	**Sport**	**Trawl**	**Sport**	**Comm.**	**Comm.**	**Sport**	**Treaty[e]**	**Comm.**	**Sport**	**Treaty[e]**	**Trawl**	**Other Treaty[e]**	**Total**
1985	Few	351	10		726	533	1,600	1,289			227		5	348	67	5,156
1986	Few	421	30	153	190	407	6,000	925		1	626		3	142	167	9,065
1987	Few	171	20	170	124	228	4,900	877			770		8	52	349	7,669
1988	Few	212	20	258	120	141	3,300	1,598	4		609	4	1	34	213	6,514
1989	Few	268	30	202	210	84	1,700	461	4		870	12	2	133	91	4,067
1990	Few	242	20	157	143	86	2,200	953	2		734	4	9	66	120	4,736
1991	Few	312	11	366	242	22	3,190	957	0		1,527	0	3	99	59	6,788
1992	Few	212	3	197	94	73	2,160	1,002	0		737	0	3	66	4	4,551
1993	Few	417	36	293	250	15	2,220	290	32		542	112	3	37	20	4,267
1994	Few	293	6	160	154	132	240	268	13	6	17	25	22	5	1	1,342
1995	Few	131	6	78	29	21	390	78	8		374	96	7	3	65	1,286
1996	Few	119	8	210	182	63	610	129	24		137	70	132	1	7	1,692
1997	Few	306	16	158	400	41	1,614	16	4		316	105	198	6	19	3,199
1998	Few	335	10	103	77	73	894	65	12	2	25	28	55	0		1,692
1999	Few	204	28	73	21	93	967	9	5		0	29	58	4		1,491
2000	Few	162	31	15	12	32	1,224	224	5		0	38	50	3		1,796
2001	Few	268	10	NA	17	50	342	106	9		0	27	32	1		862
2002	Few	273	5	NA	14	51	163	0	48		7	0	131	4		696
2003	Few	287	16	NA	17	52	46	43	NA		2	NA	46	5		514
2004			12	NA												

Table 3.4-6. Bivalve species reported during macroinvertebrate sampling and focused bivalve surveys in Keno Reservoir, Keno reach, hydroelectric reach, and below Iron Gate Dam (Source: PacifiCorp, 2004a, as cited in FERC, 2007)

Scientific Name	**Common Name**	**Keno Reservoir**	**Keno Reach**	**J.C. Boyle Reservoir**	**J.C. Boyle Bypassed Reach**	**J.C. Boyle Peaking Reach**	**Copco Reservoir**	**Copco Bypassed Reach**	**Fall Creek**	**Iron Gate Reservoir**	**Iron Gate Dam to Shasta River**
Musculium lacustre	lake fingernail clam	x		x			x				
Pisidium spp.	unidentified peaclam		x		x	x					
Pisidium casertanum	ubiquitous peaclam				x	x		x	x		x
Pisidium insigne	tiny peaclam								x		
Pisidium ultramontanum	montane peaclam					x					x
Pisidium variabile	triangular peaclam		x	x		x	x				x
Sphaerium securis	pond fingernail clam		x								
Sphaerium simile	grooved fingernail clam	x		x		x				x	
Anodonta oregonensis	Oregon floater[a]	--	x		--	--	--	--	--	--	x
Anodonta californiensis	California floater			x							
Gonidia angulata	western ridged mussel[a]	--	x	--	--	x	--	--	--	--	x

[a] The unionid mussels *Anodonta oregonensis* and *Gonidia angulata* in the Keno, J.C. Boyle peaking, and Iron Gate to Shasta River reaches were identified during a summer 2003, bivalve field survey that focused only on these three reaches.

Table 3.4-7. Target salmon and steelhead production at the Iron Gate Hatchery (Source: KRRC, 2021f)

Species	Type	Number	Target Release Dates
Fall Chinook Salmon	Smolt	5,100,000	April 1–June 15
	Yearling	900,000	October 15–November 20
Coho Salmon	Yearling	75,000	March 15–May 1
Steelhead	Yearling	200,000	NA[a]

[a] Iron Gate Hatchery has not produced steelhead since 2012.

Table 3.4-8. Number of smolt and yearling fall-run Chinook salmon released from Iron Gate Hatchery for 2002 to 2014 broods (Source: PFMC, 2019)

Brood Year	Smolt	Yearlings	Iron Gate Hatchery Total
2002	5,116,165	1083,902	6,200,067
2003	5,182,092	685,819	5,867,911
2004	5,369,792	842,848	6,212,640
2005	6,171,838	874,917	7,046,755
2006	5,364,332	984,271	6,348,603
2007	5,290,005	1,104,870	6,394,875
2008	3,983,360	773,583	4,756,943
2009	4,528,056	855,000	5,383,056
2010	3,953,247	1,053,482	5,006,729
2011	4,665,888	1,148,850	5,814,738
2012	4,136,672	979,668	5,116,340
2013	4,481,905	993,717	5,475,622
2014	3,794,691	943,489	4,738,180

Table 3.4-9. *Ceratomyxa shasta* genotypes identified in the Klamath Basin and affected fish species (Source: Atkinson and Bartholomew, 2010, as cited in FERC, 2007)

***C. shasta* genotype**	**Distribution**	**Affected Species**	**Notes**
Type 0	Upper and Lower Klamath Basin	Native steelhead, rainbow and redband trout	Usually occurs in low densities, is not very virulent, and causes little or no mortality.
Type I	Lower Klamath Basin	Chinook salmon	If the Type I genotype were carried into the Upper Klamath Basin, only Chinook would be affected.
Type II	Klamath Lake, Upper and Lower Klamath Basin	Coho salmon in Lower Klamath Basin and non-native rainbow trout	The “biotype” found in the Upper Klamath Basin does not appear to affect coho salmon in sentinel studies.
Type III	Assumed widespread in Klamath Basin based on presence in fish	All salmonid species	Prevalence of this genotype is low, and it infects fish but does not appear to cause mortality.

Table 3.4-10. Prevalence of infection by *Ceratonova shasta* in juvenile Chinook salmon captured in the Klamath River by reach, March–June 2021 (Source: FWS, 2021c)

Date	**Number of Samples**	**Number of Infected Salmon**	**Percent Infected**	**Percent of Infected Salmon with DNA Copy Greater than 3.0 log[a]**
Shasta River to Scott River Reach				
3/23-24/2021	30	0	0%	N/A
3/30/2021	30	1	3%	0%
4/6/2021	60	0	0%	N/A
4/13/2021	60	9	15%	0%
4/20/2021	60	26	43%	0%
4/27/2021	60	47	78%	15%
5/4/2021	60	58	97%	63%
5/11/2021	41	40	98%	59%
5/20/2021	51	34	67%	14%
5/25-26/2021	27	22	81%	15%
6/1-2/2021	4	4	100%	50%
Scotts River to Salmon River Reach				
4/5/2021	20	2	10%	0%
4/12/2021	21	0	0%	N/A
4/19/2021	20	5	25%	0%
4/26/2021	21	15	71%	0%
5/3/2021	21	17	81%	10%
5/17/2021	20	15	75%	15%
5/24-25/2021	19	13	68%	5%
Salmon River to Trinity River Reach				
4/9/2021	9	5	56%	0%
4/15/2021	20	12	60%	0%
4/22-23/2021	2	0	0%	N/A
4/28-29/2021	11	5	45%	9%

Date	Number of Samples	Number of Infected Salmon	Percent Infected	Percent of Infected Salmon with DNA Copy Greater than 3.0 log[a]
5/5-6/2021	8	6	75%	25%
5/11-12/2021	24	20	83%	38%
5/18/2021	20	19	95%	50%
5/26-27/2021	21	21	100%	33%
6/2/2021	20	17	85%	5%
6/7-8/2021	29	22	76%	3%
6/15-16/2021	41	32	78%	0%
6/20/2021	20	15	75%	15%
6/28/2021	19	12	63%	16%
Trinity River to Estuary Reach				
7/2/2021	20	7	35%	5%
7/8/2021	22	14	64%	27%

Table 3.4-11. Annual-level *C. shasta* infection prevalence estimates for wild and/or unknown origin juvenile Chinook salmon passing the Kinsman rotary screw trap site (Source: KRRC, 2021f)

Year	Origin	Prevalence of Infection	Infection Population Estimate Lower Confidence Limit	Infected Population Estimate	Infected Population Estimate Upper Confidence Limit
2005	All	0.41	0.26	0.38	0.47
2007	All	0.28	0.07	0.10	0.15
2008	All	0.6	0.43	0.51	0.58
2009	All	0.5	0.50	0.58	0.66
2010	Wild/Unknown	0.23/0.15	0.02	0.04	0.07
2011	Wild	0.2	0.07	0.11	0.17
2012	Wild/Unknown	0.06/0.00	0.04	0.08	0.24
2013	Wild	0.18	0.03	0.06	009
2014	Wild	0.67	0.12	0.18	0.26
2015	Wild/Unknown	0.66/0.96	0.20	0.29	0.39
2016	Wild/Unknown		0.01	0.03	0.08
2018	Wild/Unknown		0.06	0.10	0.15
2019	Wild/Unknown		0.06	0.09	0.14

Table 3.4-12. Scale of the severity of ill effects associated with elevated suspended sediment (Source: Newcombe and Jensen, 1996)

Severity	Category of Effect	Description of Effect
0	Nil effect	No behavioral effects
1	Behavioral effects	Alarm reaction
2		Abandonment of cover
3		Avoidance response
4	Sublethal effects	Short-term reduction in feeding rates; Short-term reduction in feeding success
5		Minor physiological stress; Increase in rate of coughing; Increased respiration rate
6		Moderate physiological stress
7		Moderate habitat degradation; Impaired homing
8		Indications of major physiological stress; Long-term reduction in feeding rate; Long-term reduction in feeding success; Poor condition
9	Lethal effects	Reduced growth rate; Delayed hatching; Reduced fish density
10		0–20 percent mortality; Increased predation; Moderate to severe habitat degradation
11		>20–40 percent mortality
12		>40–60 percent mortality
13		>60–80 percent mortality
14		>80–100 percent mortality

Table 3.4-13. Predicted suspended sediment effects on life stages of fall-run Chinook salmon for proposed action for the Klamath River at Iron Gate Dam (RM 193.1) and Seiad Valley (RM 132.7) (Source: California Water Board (2020a), appendix E)

Life-history Stage	Effects on Production (Existing Conditions)	Effects on Production (Proposed Action)
Adult upstream migrants	Behavioral effects such as alarm reaction or avoidance under most conditions.	Moderate to major physiological stress and impaired homing depending on scenario.
Spawning, incubation, and fry emergence	Long duration of exposure could result in delayed growth to greater than 20 to 40 percent mortality depending on conditions; ~8 percent of adults spawn in the mainstem downstream from Iron Gate Dam.	Suspended sediment may result in nearly 100 percent mortality of all progeny from mainstem spawning under all scenarios (approximately 2,100 redds, or approximately 8 percent of production).
Juvenile rearing	Minor to major stress depending on conditions.	No juvenile progeny anticipated from mainstem due to adverse effects during incubation. All other juveniles rear in tributaries.
Type I outmigration	Minor to moderate physiological stress and reduced growth depending on conditions; applies to ~60 percent of total production.	Moderate to major physiological stress and reduced growth depending on scenario. Applies to ~60 percent of total production.
Type II outmigration	Behavioral effects such as avoidance to minor physiological stress depending on conditions; applies to ~40 percent of total production.	Moderate to major physiological stress depending on scenario. Applies to ~40 percent of total production.
Type III outmigration	Moderate stress to reduced growth depending on conditions for Type III (yearling) outmigrants (<1 percent of production).	Major stress to reduced growth depending on scenario. (0 to 189 smolts, or less than 1 percent of production).

Table 3.4-14. Predicted Suspended Sediment Effects on Spring-run Chinook Salmon for Klamath River at Orleans (RM 60) (Source: California Water Board (2020a), appendix E)

Life-history Stage	Effects on Production (Existing Conditions)	Effects on Production (Proposed Action)
Adult spring migration (Apr 1–June 30) 14 days of exposure to median SSCs for the period	Impaired homing to major physiological stress for adults returning to Salmon River. Majority (~95 percent on average) of adults enter Trinity River and would be exposed to higher concentrations for shorter durations.	Impaired homing to major physiological stress for adults returning to Salmon River. Majority (~95 percent on average) of adults enter Trinity River and would be exposed to higher concentrations for shorter durations.
Adult summer migration (Jul 1–Aug 31) 2 days of exposure to median SSCs for the period	Behavioral to minor physiological stress to the ~50 percent of the summer migration returning exclusively to the Trinity River.	Minor to moderate physiological stress depending on scenario to the ~50 percent of the summer migrants returning to Trinity River.
Spawning, incubation, and fry emergence (Sept 1–Feb 28)	Spring run do not generally spawn in the mainstem; no effect on this life stage is anticipated.	Spring run do not generally spawn in the mainstem; no effect on this life stage is anticipated.
Juvenile rearing	Juveniles primarily rear in tributaries; no effect is anticipated.	Juveniles primarily rear in tributaries; no effect is anticipated.
Type I outmigration (Apr 1–May 31) 30 days of exposure to lowest SSCs for the period	Moderate to major stress for Type I fry (~80 percent of production) in smolt outmigration from Salmon River. Majority (~95 percent) of juveniles outmigrate from Trinity River and are exposed to higher concentrations.	Major stress and possibly reduced growth rates under a worst impacts on fish scenario for Type I fry (~80 percent) in smolt outmigration from Salmon River. Majority (~95 percent) of juveniles outmigrate from the Trinity River and would be exposed to lower concentrations.

Life-history Stage	Effects on Production (Existing Conditions)	Effects on Production (Proposed Action)
Type II outmigration (Oct 1–Nov 15) 30 days of exposure to lowest SSCs for the period	Minor to moderate stress for Type II smolts from the Salmon River (~20 percent) during downstream migration. Majority (~95 percent) of juveniles outmigrate from Trinity River and are exposed to higher concentrations.	Moderate physiological stress for Type II smolts from the Salmon River (~20 percent) during downstream migration. Majority (~95 percent) of juveniles outmigrate from Trinity River and are also exposed to no SSCs from proposed action.
Type III outmigration (Jan 15–May 31) 30 days of exposure to lowest SSCs for the period	Moderate to major stress for Type III fry from Salmon River (<1 percent) during downstream migration. Majority (~95 percent) of juveniles outmigrate from Trinity River and are exposed to higher concentrations for shorter durations. Outmigrate from Trinity River and are exposed to higher concentrations for shorter durations.	Major stress to reduced growth rates for Type III smolts from Salmon River (less than 1 percent of the total smolt population from the Salmon River).

Table 3.4-15. Predicted suspended sediment effects on coho salmon for the Klamath River at Seiad Valley (RM 132.7) (Source: California Water Board (2020a), appendix E)

Life-history Stage	Effects on Production (Existing Conditions)	Effects on Production (Proposed Action)
Adult upstream migrants (Sept 1–Jan 1) 30 days of exposure to median SSCs for the period	Moderate to major stress and impaired homing for adults migrating upstream (~4 percent of all populations exposed).	Moderate to major stress and impaired homing for adults migrating upstream (~4 percent of all populations exposed).
Spawning, incubation, and fry emergence (Nov 1–Mar 14) 60 days of exposure to highest SSCs for the period	No modeling of suspended sediment infiltration into gravel was conducted. Available information suggests 20 to 60 percent mortality of spawning adults, incubating eggs, and emergent fry in the mainstem; typically, a small percentage of the percent of the Upper Klamath River Population spawns in the mainstem as opposed to tributaries.	60 to 80 percent mortality of progeny from mainstem spawning. (<13 redds, or 0.7–26 percent of Upper Klamath River Population unit natural escapement).
Age-1 juveniles during winter (Nov 15–Feb 14) Exposure to highest SSCs for the period	Moderate to major stress and reduced growth rates depending on conditions for age 1 juveniles rearing the mainstem. An unknown but assumed small number of all juveniles (<1 percent) rear in mainstem during winter.	20 to 40 percent mortality for age 1 juveniles from the dam removal year 1 cohort rearing in the mainstem depending on scenario. An unknown but assumed small number (<1 percent) of juveniles rear in mainstem during winter.

Life-history Stage	Effects on Production (Existing Conditions)	Effects on Production (Proposed Action)
Age-0 juveniles during summer (Mar 15–Nov 14) Exposure to highest SSCs for the period	Major stress to some mortality depending on conditions for age 0 juveniles rearing in mainstem.	20 to 40 percent mortality for age 1 juveniles from dam removal year 1 cohort rearing in mainstem during late spring and early summer. Avoidance behavior anticipated to result in small number (<1 percent) of juveniles rearing in mainstem during dam removal year 2.
Age 1 juvenile outmigration (Feb 15–May 31) 20 days of exposure to median SSCs for the period	Moderate to major stress and reduced growth rates depending on conditions for smolts.	Moderate to major stress and possibly reduced feeding depending on scenario for smolts outmigrating from Upper Klamath, Mid-Klamath, Shasta River, and Scott River populations during early spring.

Table 3.4-16. Predicted suspended sediment effects on steelhead for the Klamath River at Seiad Valley (RM 132.7) (Source: California Water Board (2020a), appendix E)

Life-history Stage	**Effects on Production (Existing Conditions)**	**Effects on Production (Proposed Action)**
Adult summer upstream migrants and runbacks (Mar 1–June 30) 30 days of exposure to median SSCs for the period	Major stress, avoidance of turbidity, and possibly impaired homing.	Major stress and impaired homing for adult migrants. The ~55 percent that migrate to the Trinity River or tributaries farther downstream would not be as affected.
Adult winter upstream migrants (Aug 1–Mar 31) 30 days of exposure to median SSCs for the period	Major stress and potential for impaired homing.	Major stress, impaired homing, and possibly some mortality (0–20 percent for adult migrants).
Adult runbacks (Apr 1–May 30) 30 days of exposure to median SSCs for the period	Major stress to downstream-migrating adults; effect dependent on time it takes runbacks to return downstream to the sea.	Moderate to major stress to downstream-migrating adults; effect would depend on timing of outmigration in relation to suspended sediment pulse.
Half-pounder residence (Aug 15–Mar 31) 90 days of exposure to median SSCs for the period	Major stress, and possibly reduce growth or some mortality (0–20 percent) depending on conditions. Proportion of run that returns as half-pounders is unknown. Fish may escape exposure to high suspended sediment in the mainstem by entering tributaries.	Mortality ranging from 0 to 40 percent depending on scenario. Majority remain in tributaries and would not be affected.
Spawning though emergence (Dec 1–June 1) Exposure to highest SSCs for the period	No mainstem spawning.	Spawning occurs in tributaries; no effect.

Life-history Stage	Effects on Production (Existing Conditions)	Effects on Production (Proposed Action)
Age 0 juvenile rearing (Mar 15–Nov 14) Exposure to highest SSCs for the period	Major stress to reduced growth rates for portion of age 0 juveniles rearing in mainstem (~60 percent of run upstream of Trinity River).	Major stress, reduced growth to 20 percent mortality depending on scenario (up to 843 juveniles or approximately 3 percent of population basin-wide age 0 production in a worst impact on fish scenario). Approximately 40 percent rear in tributaries and would not be affected.
Age 1 juvenile rearing (year-round) Exposure to highest SSCs for the period	Major stress, reduced growth rates, to mortality (0–20 percent) depending on conditions for portion of age 1 juveniles rearing in mainstem (~60 percent of run upstream of Trinity River).	0 to 40 percent mortality depending on scenario (up to 6,314 juveniles or approximately 11 percent of population basin-wide age 1 production in a most likely or worst impact on fish scenario).
Age 2 juvenile rearing (Nov 15–Mar 31) Exposure to highest SSCs for the period	Age 2 in the mainstem (~40 percent of run upstream of Trinity River) expected to experience major stress to reduced growth rates depending on conditions.	0 to 40 percent mortality depending on scenario (up to 5,303 juveniles or approximately 10 percent of population basin-wide age 2 production in a most likely or worst impact on fish scenario).
Juvenile/smolt outmigrants (Mar 1–May 1) 20 days of exposure to lowest SSCs for the period	Major stress, reduced growth rates, to mortality (0–20 percent) depending on conditions.	Major stress and reduced growth. Approximately 57 percent outmigrate from Trinity River and would have less exposure.

Table 3.4-17. Population estimates and attributes for listed and potential hybrid suckers in the Lower Klamath Project reservoirs (Source: KRRC, 2021j)

Population Estimate Attributes	**J.C. Boyle**	**Copco No. 1**	**Iron Gate**	**All 3 Reservoirs Combined**
Total suckers captured (fall 2018 through spring 2020)	95	98	29	222
Total suckers PIT-tagged and available for recapture (fall 2018, spring 2019, fall 2019, spring 2020)	71	83	27	181
Total tagged suckers recaptured (fall 2018 through spring 2020)	3	3	2	8
Recapture efficiency (# recaptured / # tagged)	4.2%	3.6%	7.4%	4.4%
Chapman Method - population estimate	1,727	2,078	279	4,509
Bootstrap Method - mean population estimate	2,766	3,371	399	5,540
Bootstrap Method - 95% confidence interval	±3,730	±4,508	±544	±5,991
Jolly-Seber Model - mean population estimate	864	1,235	102	2,201
Jolly-Seber Model - 95% confidence interval	±951	±1,374	±89	±2,414

Table 3.4-18. Comparison of hatchery mitigation requirements and NMFS/California DFW production recommendations at Fall Creek Hatchery (Source: KRRC, 2021f)

Species / Life Stage	**Current Production Goal (At Iron Gate Hatchery)**	**Production Goal (Post-Dam Removal)**	**Release Dates**
Coho Yearlings	75,000	Minimum of 75,000 at Fall Creek Hatchery	March 15–May 1
Chinook Yearlings	900,000	Minimum of 250,000 at Fall Creek Hatchery	Oct 15–Nov 20
Chinook Smolts	5,100,000	Up to 3,000,000 at Fall Creek Hatchery	April 1–June 15
Steelhead	200,000	0	NA

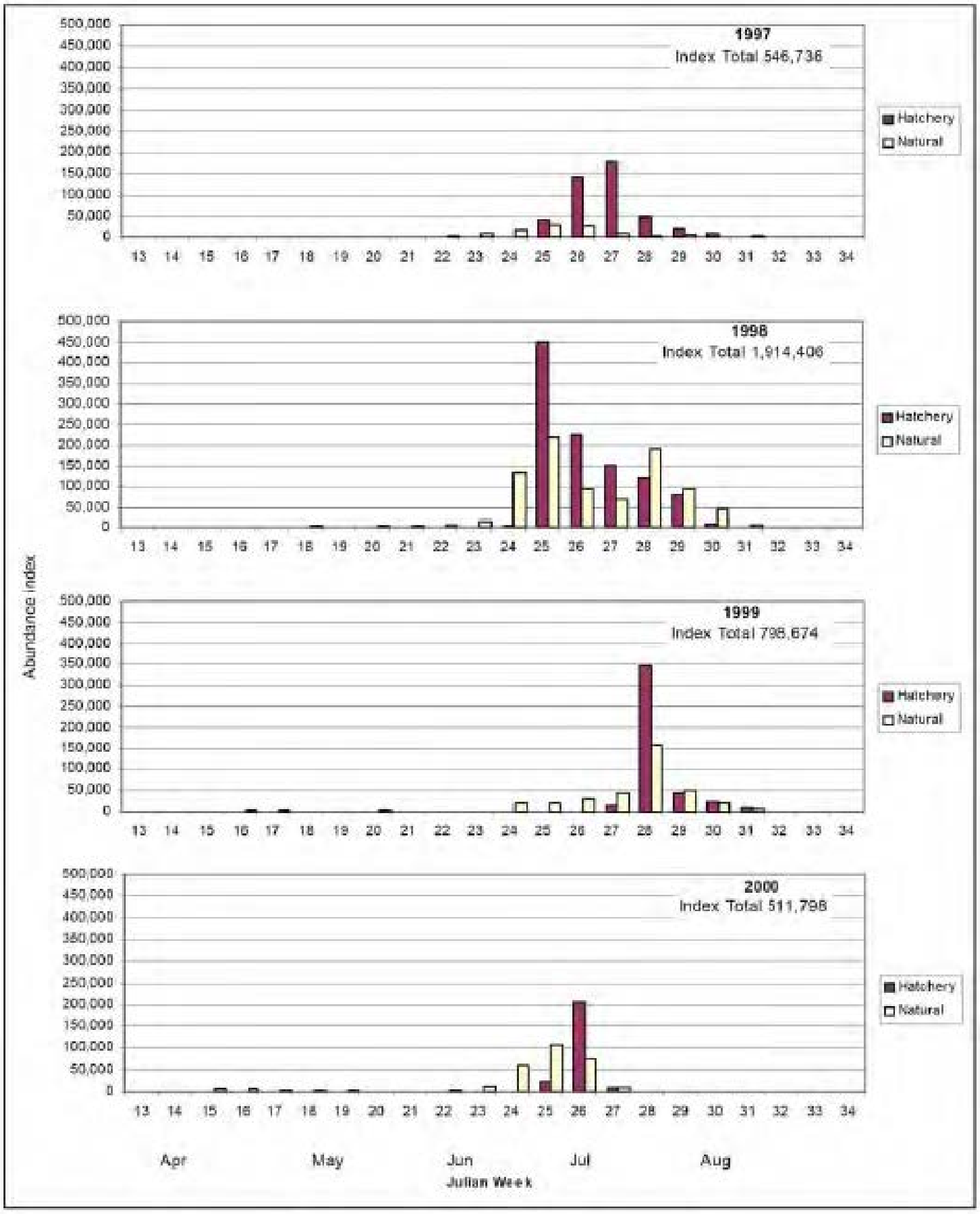

Figure 3.4-1. Weekly abundance index for natural and hatchery fall Chinook smolts during screw-trap sampling conducted at Big Bar (RM 49.7) on the Klamath River, 1997–2000 (Source: Scheiff et al., 2001, as cited in FERC, 2007)

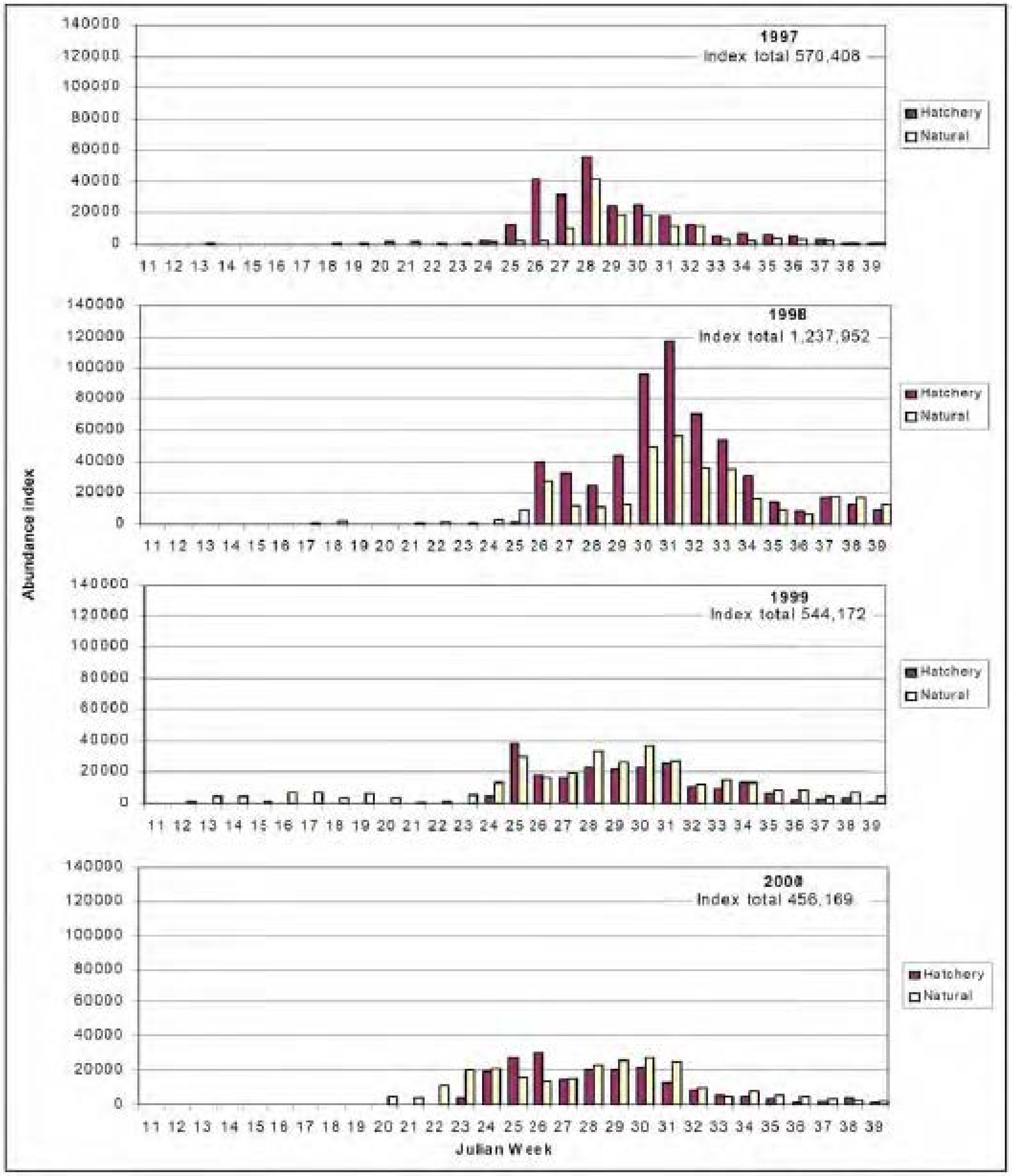

Figure 3.4-2. Weekly abundance index for fall Chinook smolts during screw-trap sampling conducted at Willow Creek (RM 21.1) on the Trinity River, 1997–2000 (Source: Scheiff et al., 2001, as cited in FERC, 2007)

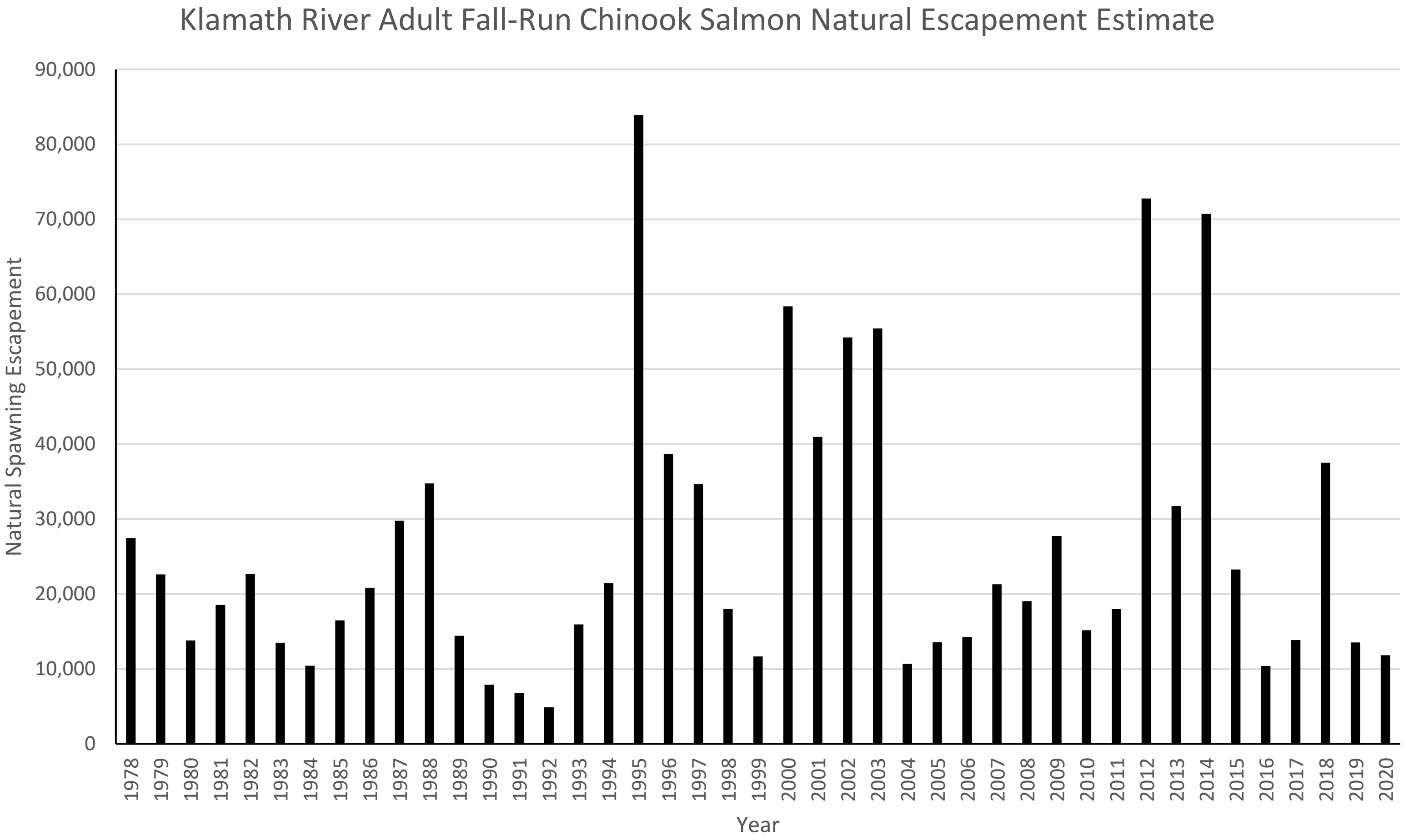

Figure 3.4-3. Estimated number of naturally spawned adult fall-run Chinook salmon returning to spawn in the Klamath River (Klamath River mainstem from Iron Gate Dam to Shasta River, Klamath River mainstem from Ash Creek to Wingate Bar, and Klamath River mainstem from Persido Bar to Big Bar) and its main tributaries (Salmon River, Scott River, Shasta River, and Bogus Creek) (Source: PFMC, 2021a)

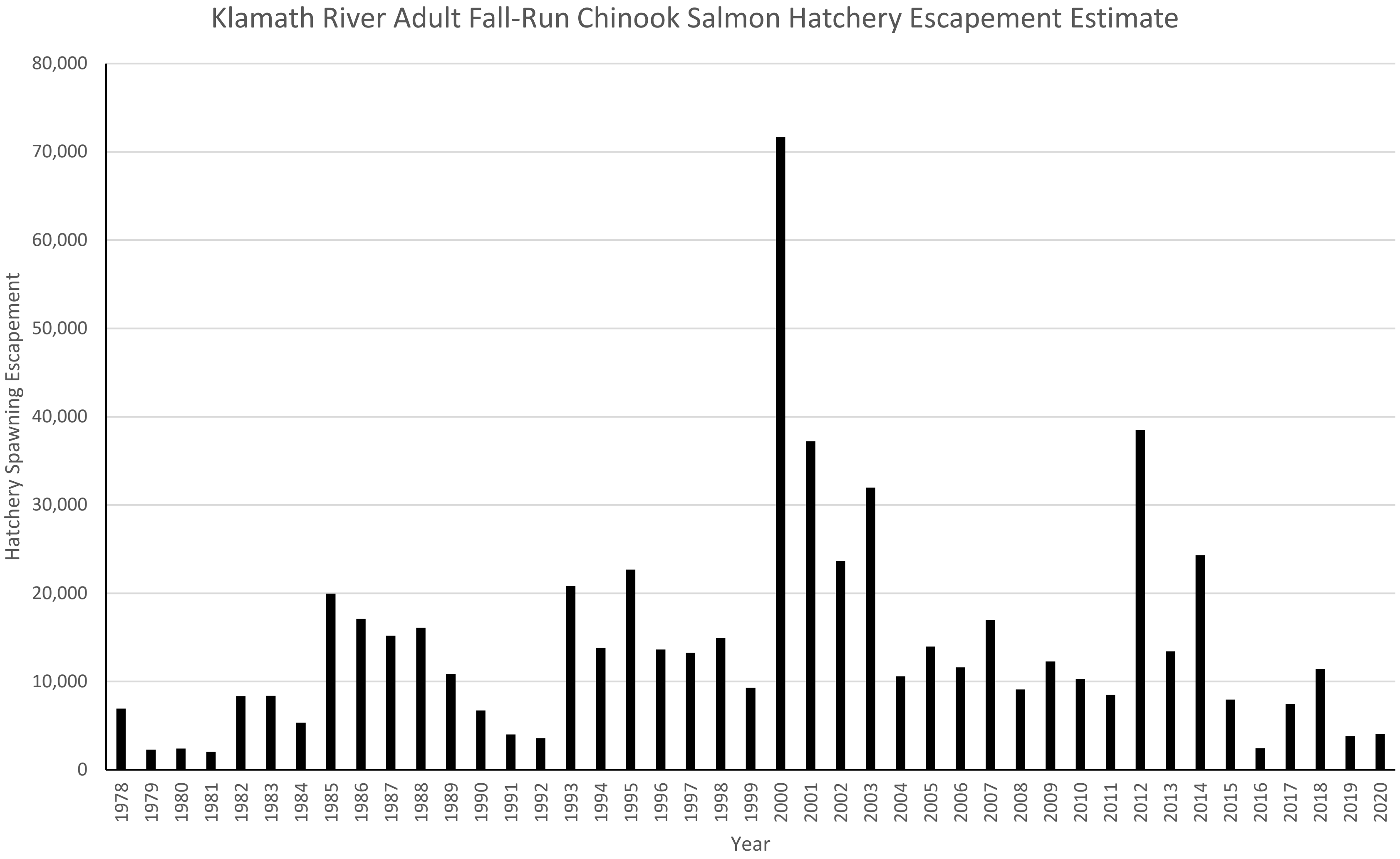

Figure 3.4-4. Estimated total number of adult fall-run Chinook salmon returning to Iron Gate Hatchery over the duration of the spawning season (Source: PFMC, 2021a)

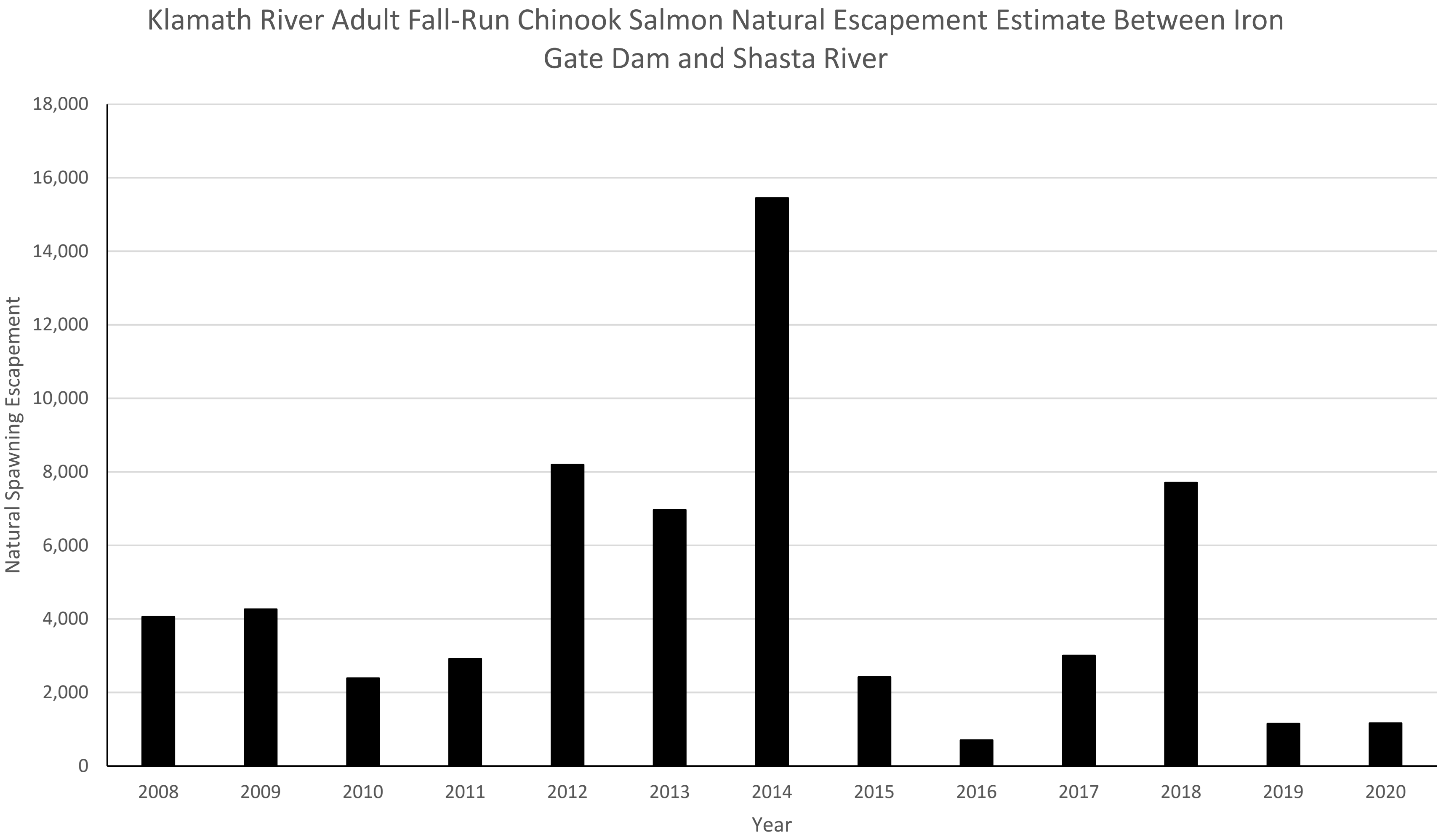

Figure 3.4-5. Estimated number of naturally spawned adult fall-run Chinook salmon returning to spawn in in the Klamath River between Iron Gate Dam and Shasta River from 2008 to 2020 (Source: PFMC, 2021b)

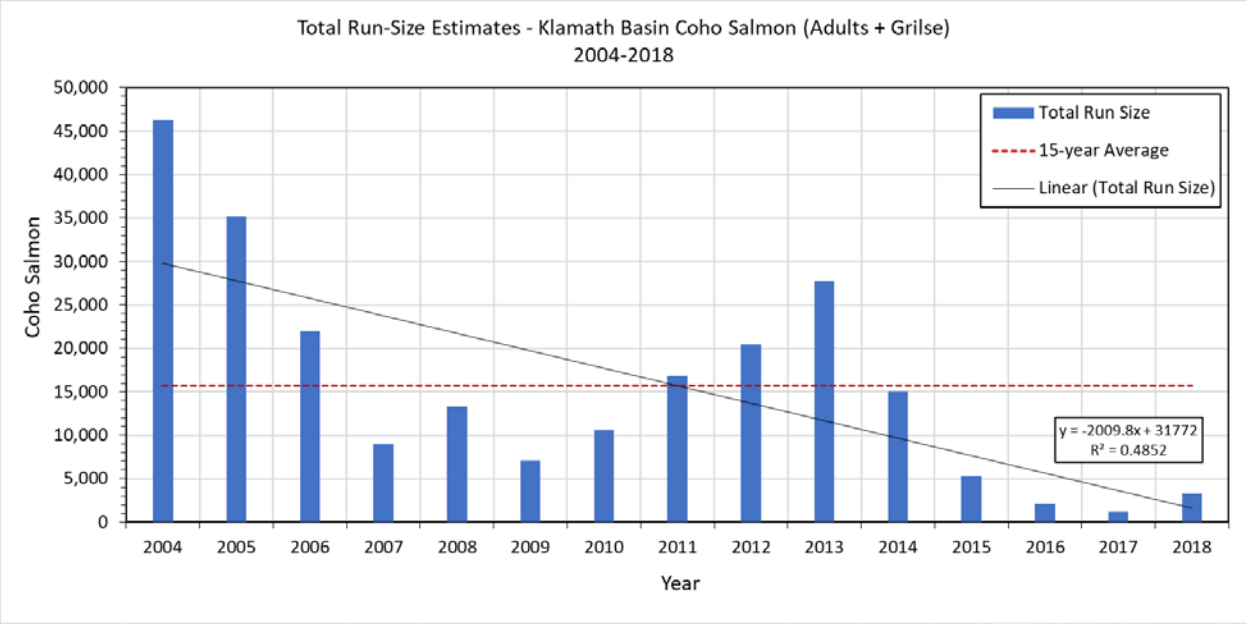

Figure 3.4-6. Estimated total number of adult coho salmon returning to spawn in the Klamath River Basin (adults and grilse), 2004–2018 (Source: California DFW, 2019a)

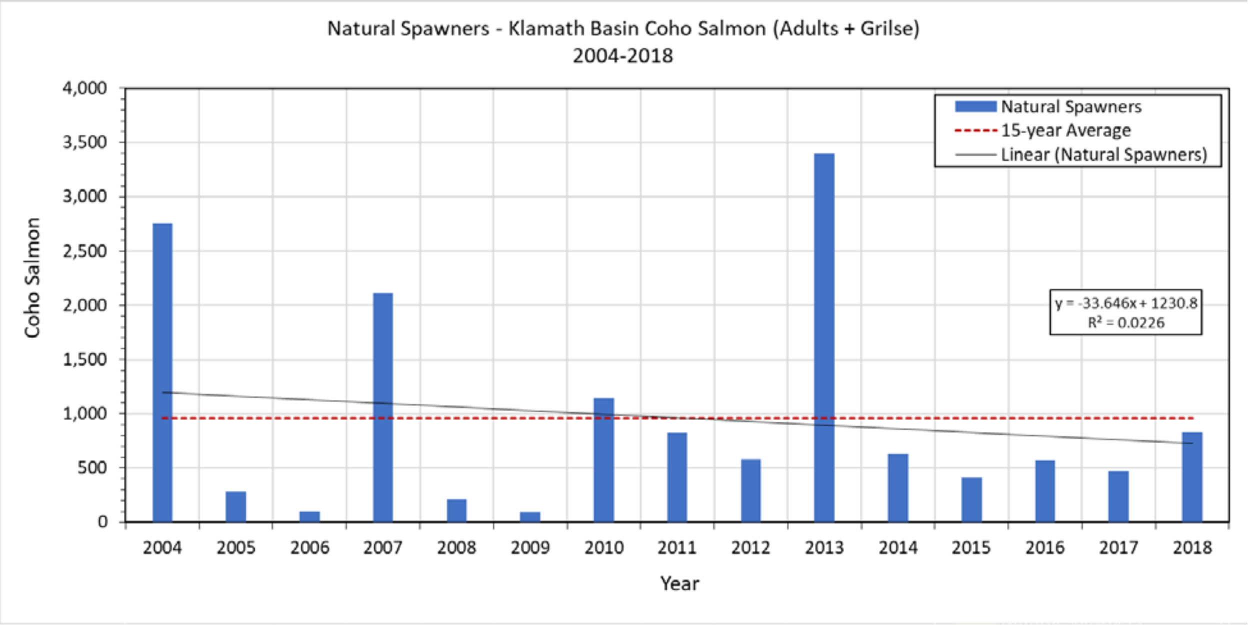

Figure 3.4-7. Estimated number of naturally spawned adult coho salmon returning to spawn in the mainstem Klamath River and selected tributaries, 2004–2018 (Source: California DFW, 2019a)

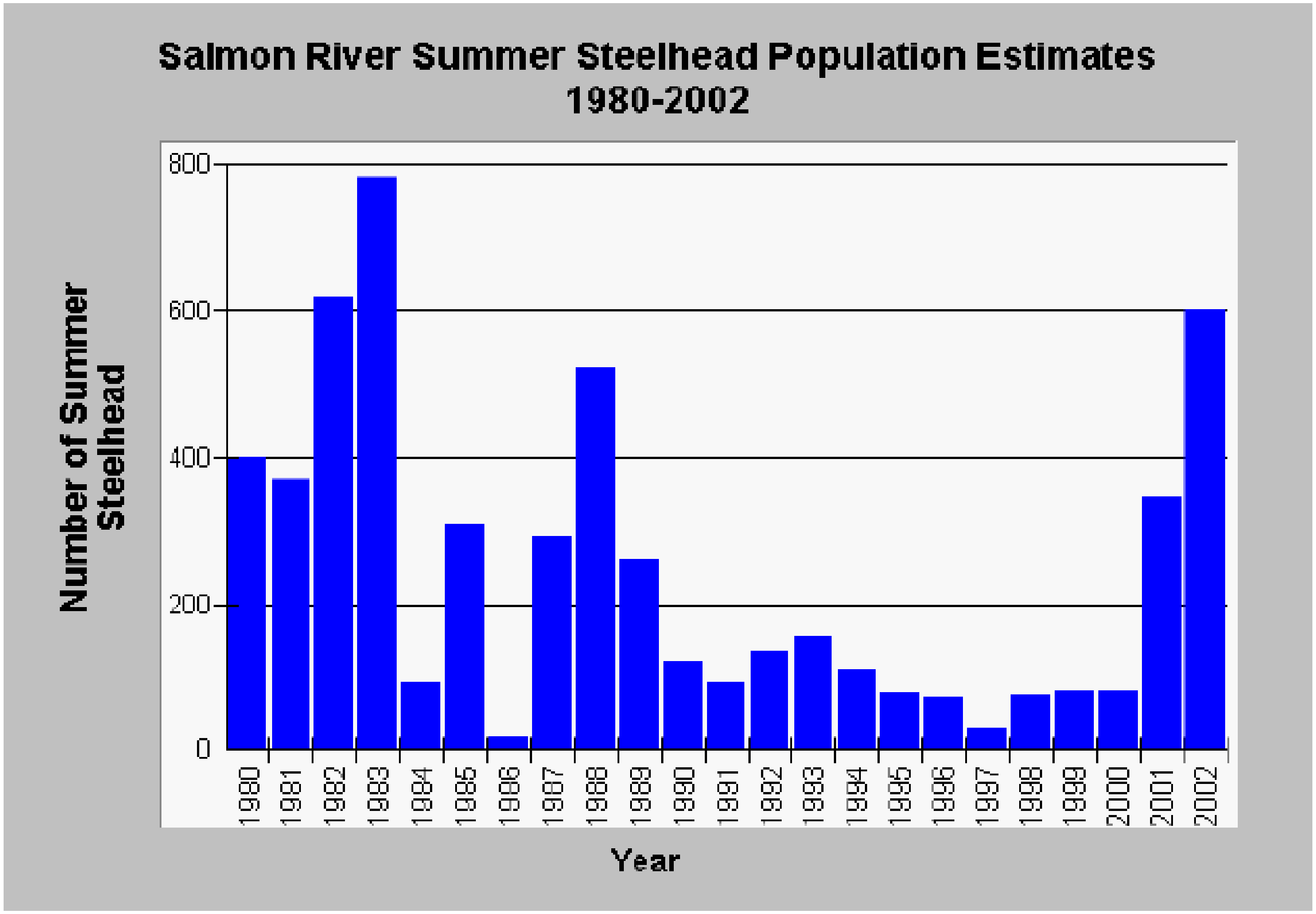

Figure 3.4-8. Estimated number of adult steelhead returning to spawn in the Salmon River, 1980–2002 (Source: FERC, 2007)

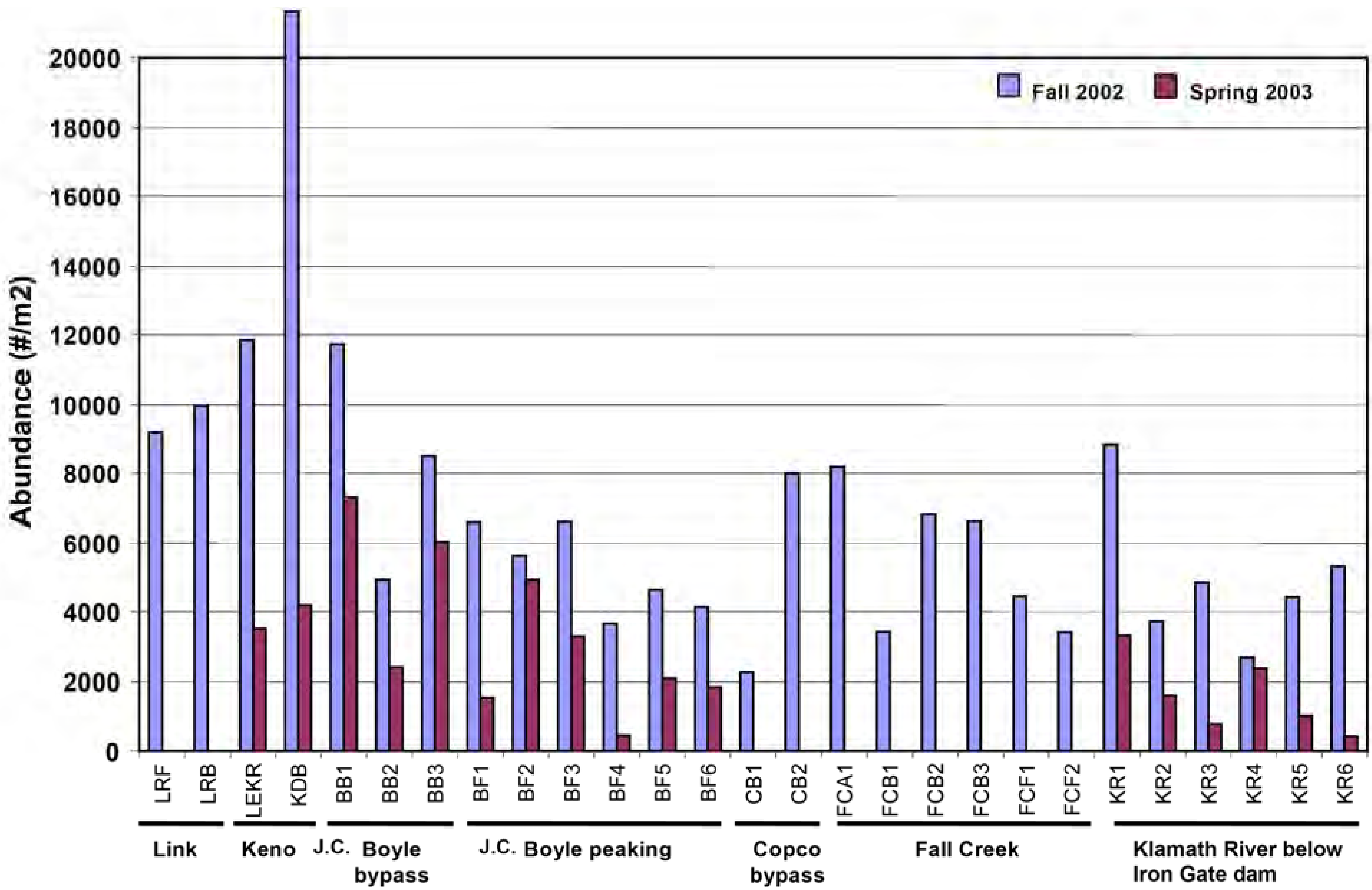

Figure 3.4-9. Invertebrate density (n/m^2) in the Klamath River between Link River and the confluence with the Shasta River, fall 2002 and spring 2003 (Source: PacifiCorp, 2004a)

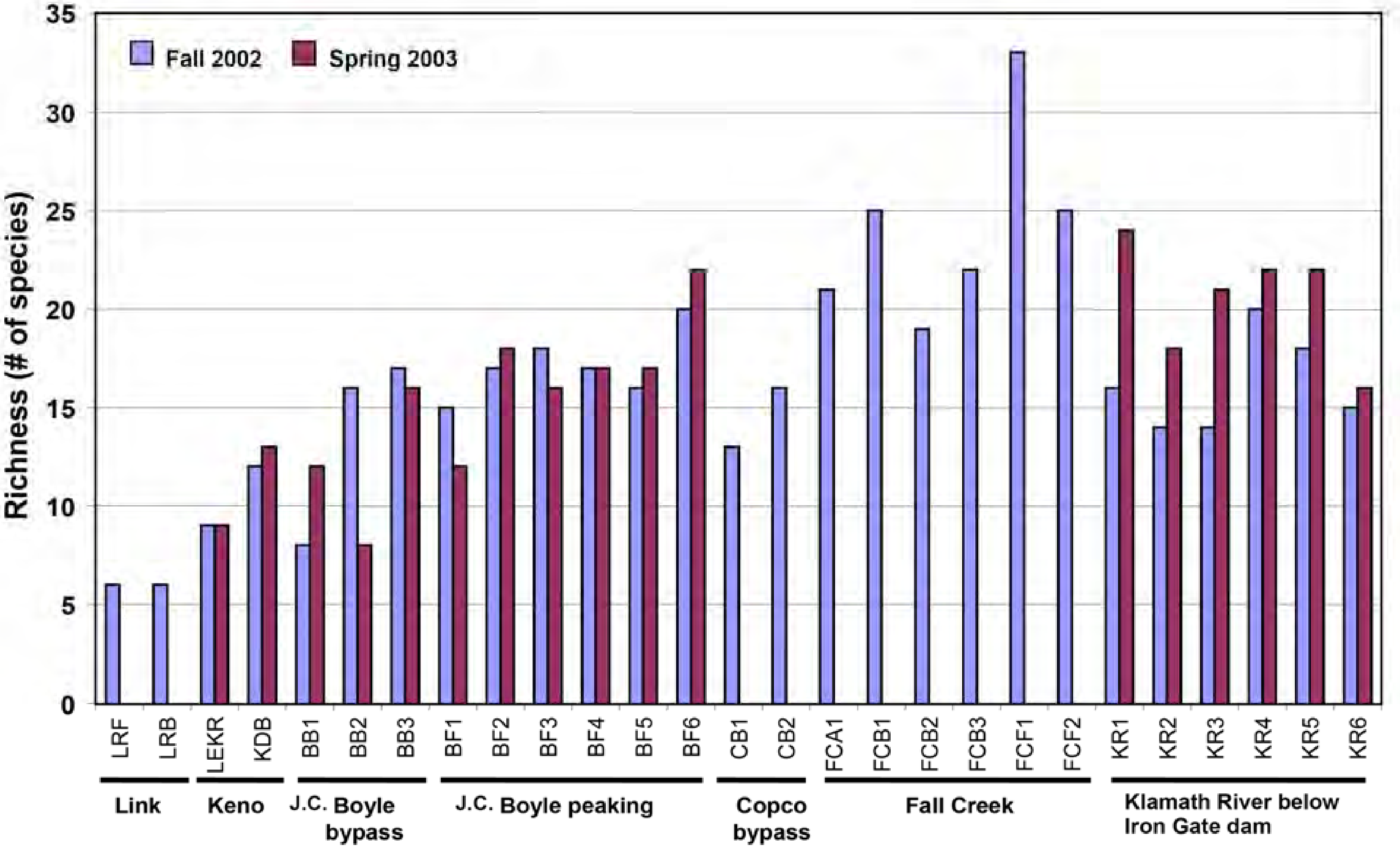

Figure 3.4-10. Number of species of mayflies, stoneflies and caddisflies (ephemeroptera, plecoptera, and tricoptera richness) in the Klamath River between Link River and the confluence with the Shasta River, fall 2002 and spring 2003 (Source: PacifiCorp, 2004a)

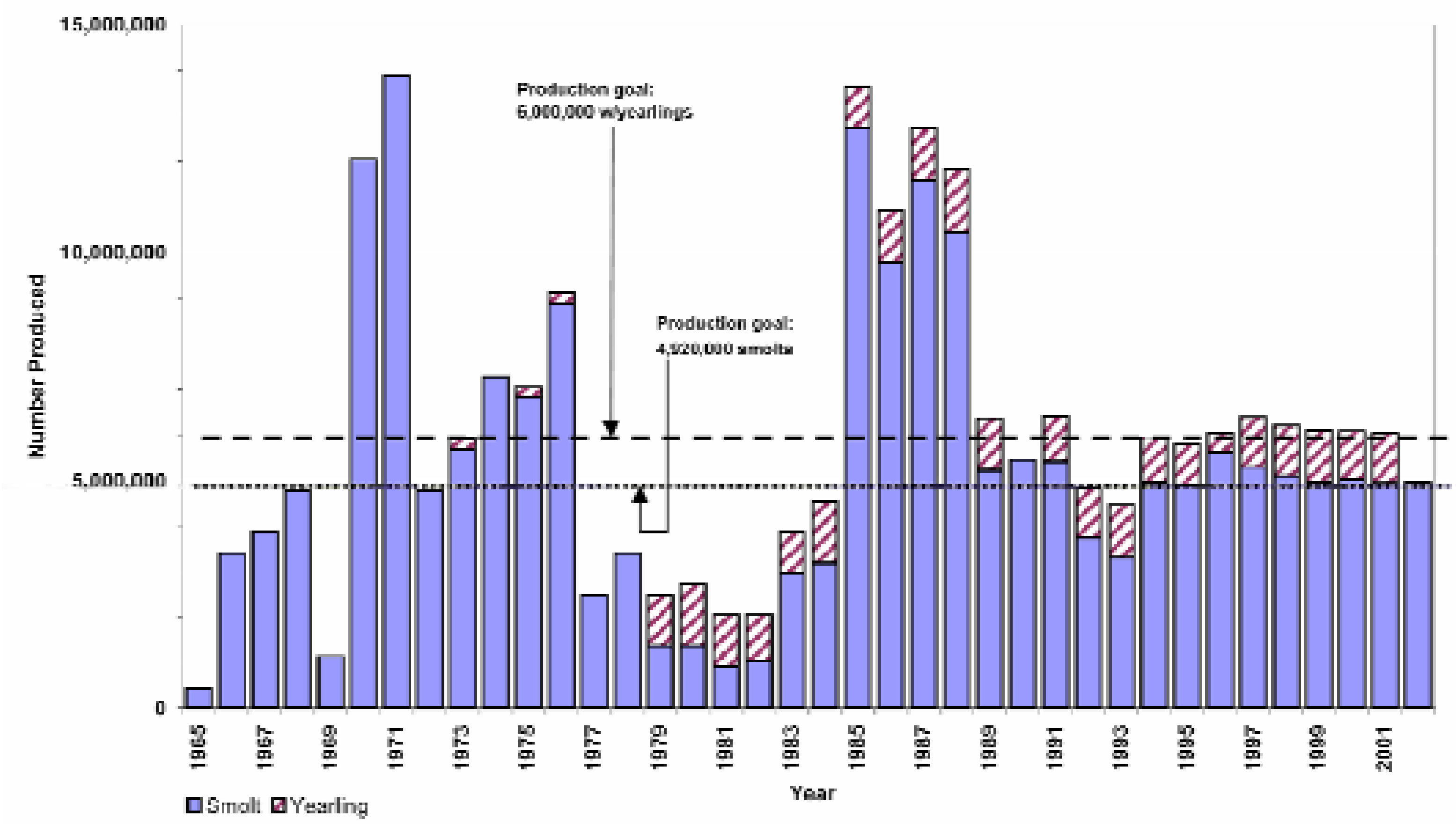

Figure 3.4-11. Number of fall Chinook salmon produced at Iron Gate Hatchery, 1965–2001 (Source: PacifiCorp, 2004a, as cited in FERC, 2007)

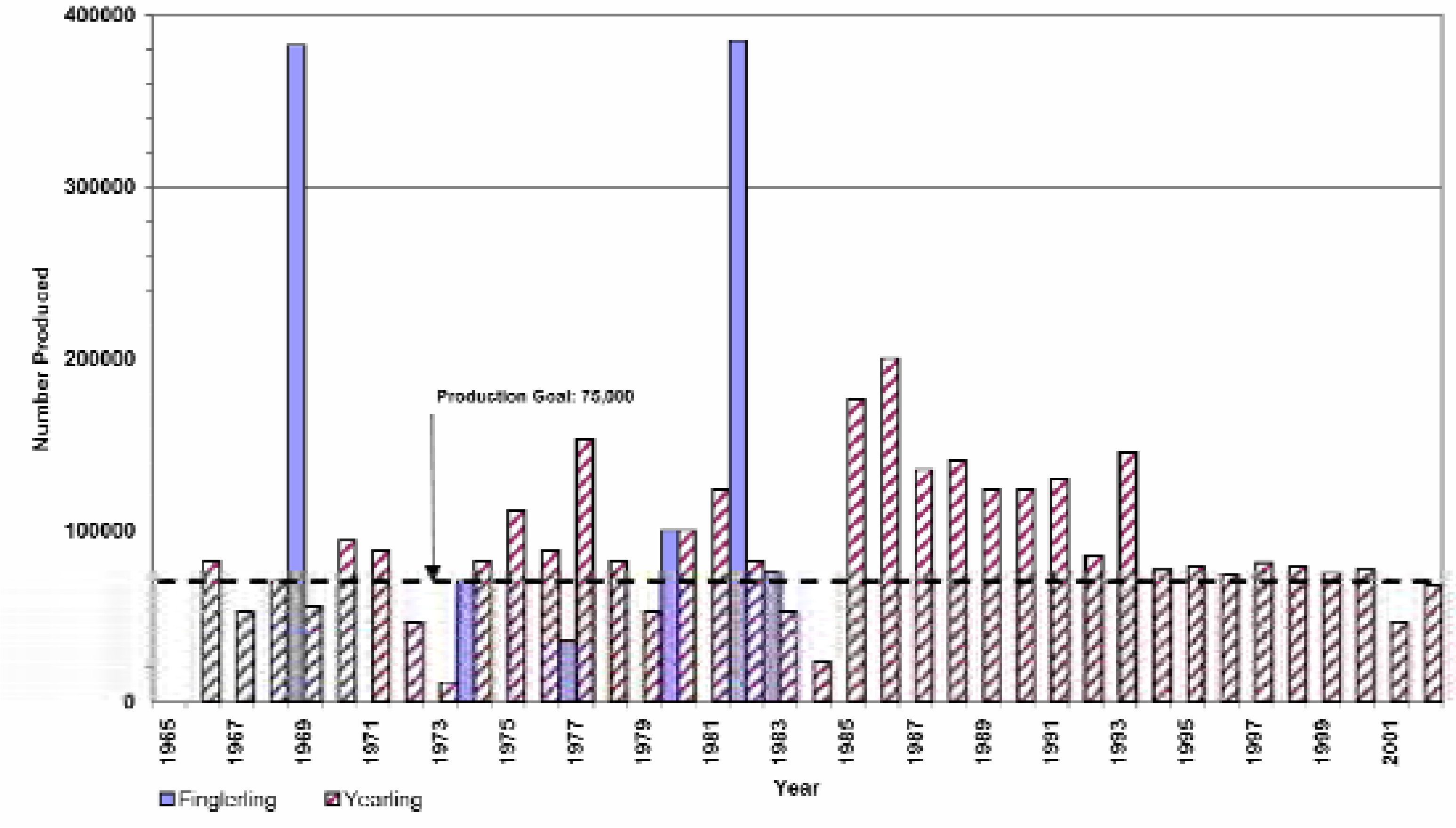

Figure 3.4-12. Number of coho salmon produced at Iron Gate Hatchery, 1965–2001 (Source: PacifiCorp, 2004a, as cited in FERC, 2007)

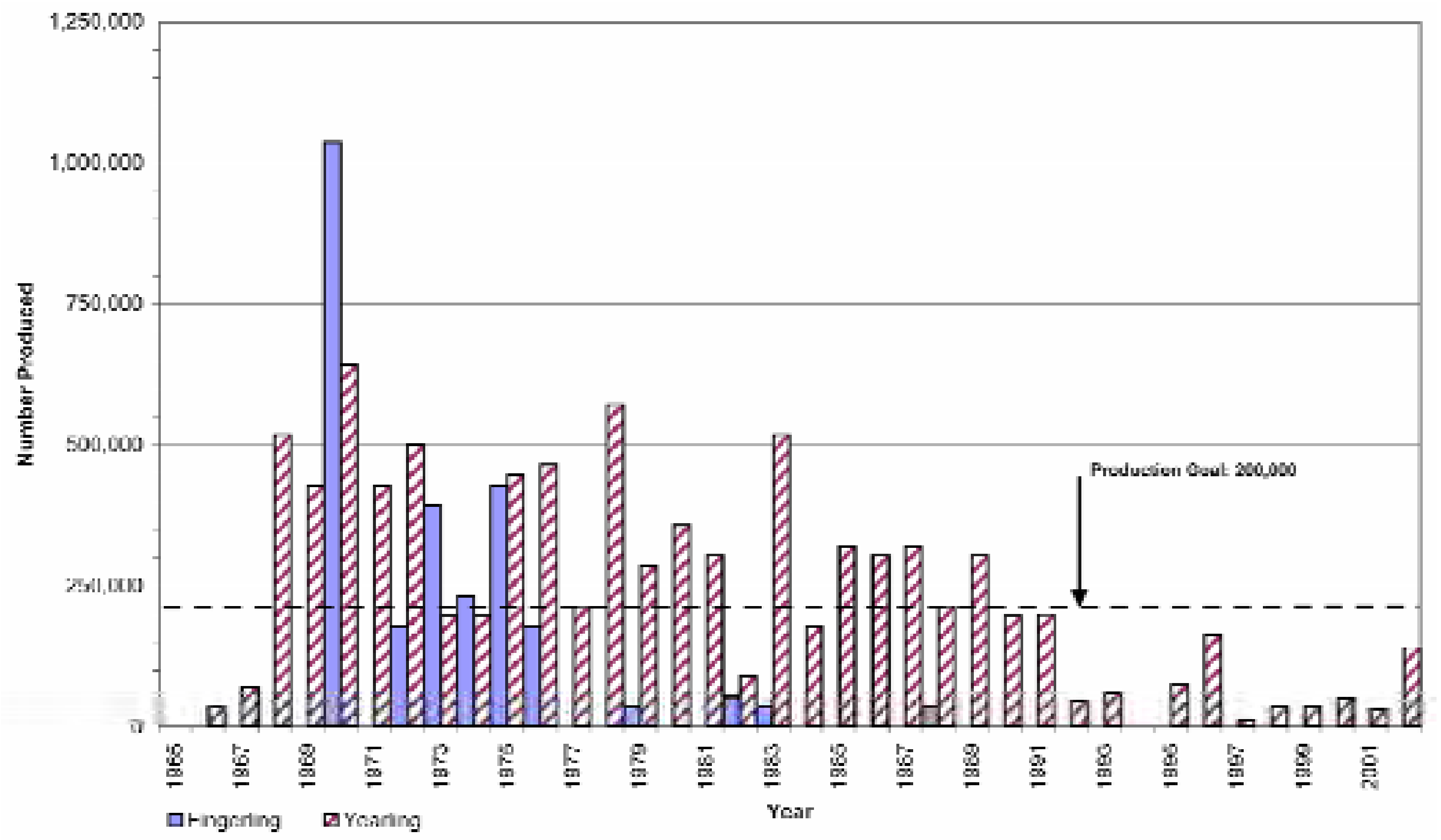

Figure 3.4-13. Number of steelhead produced at Iron Gate Hatchery, 1965–2001 (Source: PacifiCorp, 2004a, as cited in FERC, 2007)

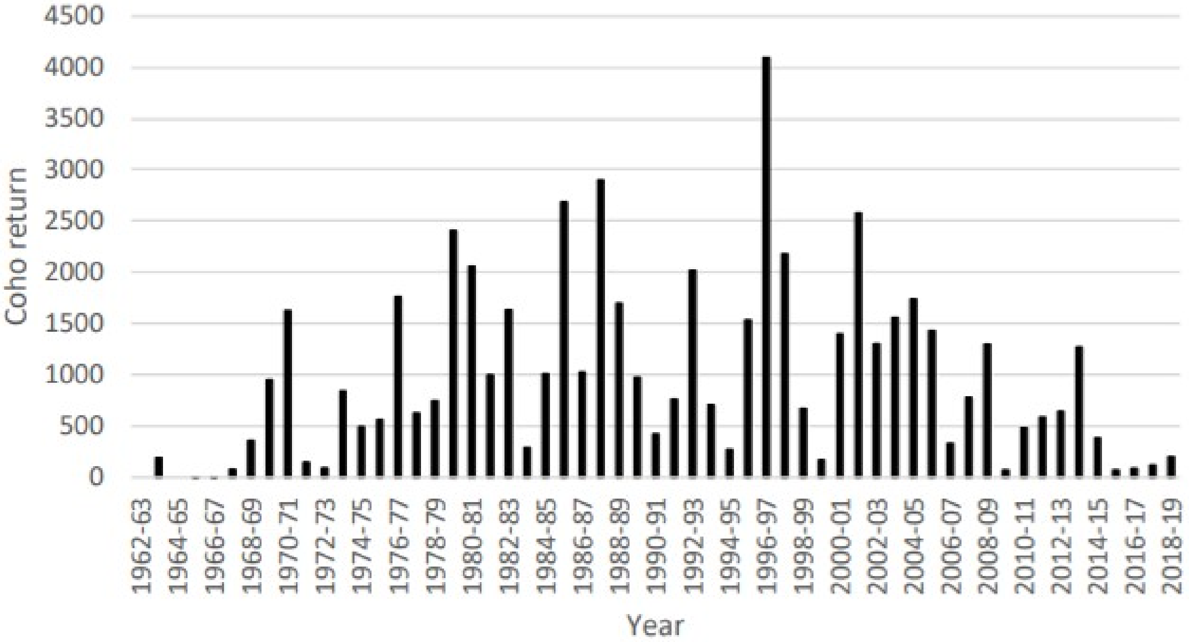

Figure 3.4-14. Number of adult coho salmon returning to Iron Gate Hatchery, 1962–2018 (Source: California DFW, 2019c)

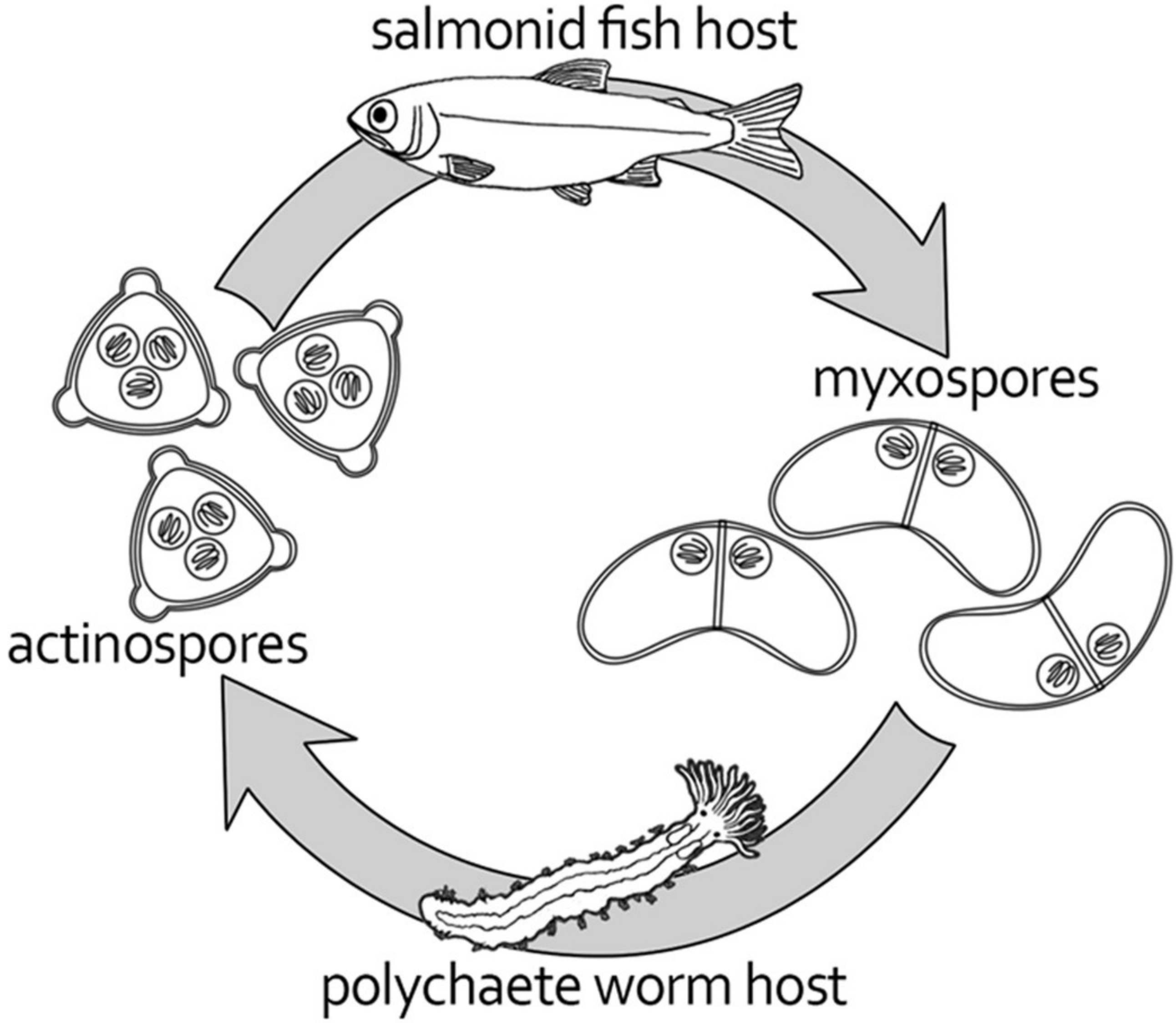

Figure 3.4-15. Life cycle of *Ceratonova shasta* showing progression from salmonid fish and polychaete worm hosts, infected by actinospore or myxospore, respectively (Source: Piriatinskiy et al., 2017)

3.5 TERRESTRIAL RESOURCES

3.5.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for botanical resources, including plant species of special concern, comprises reservoir footprints, high-priority tributaries, project dams and associated structures, disposal sites, staging areas and haul and access roads between J.C. Boyle Dam and Iron Gate Dam, and decommissioned recreation sites. The geographic scope also extends 8 miles downstream to the confluence of the Klamath River and Humbug Creek. The temporal extent of our effects analysis ranges from short-term effects on botanical resources due to drawdown and dam removal and associated structures, disposal sites, and haul and access roads to permanent revegetation in the reservoir footprint and deconstruction sites.

Our geographic scope of analysis for terrestrial resources, including animal species of special concern, except eagles and bats, includes the area within 0.25 miles of dams and structures to be removed, reservoirs, disposal sites, and haul and access roads between J.C. Boyle Dam and Iron Gate Dam. For eagles, our geographical area incorporates the viewshed with suitable nesting, roosting, or foraging habitat. For bats, our geographical area includes project facilities and associated structures. The temporal extent of our effects analysis on wildlife resources ranges from the short-term effects of drawdown and dam removal, associated structure deconstruction, disposal sites, and haul and access roads to permanent revegetation in the reservoir footprint and construction sites.

3.5.2 Affected Environment

3.5.2.1 Upland Vegetation

The Lower Klamath Project area[154] spans across 37 river miles, beginning in Oregon at J.C. Boyle Dam and ending outside Hornbrook, California, at Iron Gate Dam. This wide span of lands encompasses a diverse mix of flora and fauna due to varying eco-regions.

The Lower Klamath Project begins at J.C. Boyle Dam, located at RM 230.6 near the base of Upper Klamath Lake in southern Oregon. This eco-region is described as East and West Slope Cascades (FERC, 2007). The Lower Klamath Project area is generally within the interior valley, ponderosa pine, and mixed conifer vegetation zones. The area east of J.C. Boyle Dam generally includes vegetation typical of the East Slope Cascades physiographic province. Non-forested areas in this valley region of the Klamath River Basin are generally sagebrush steppe vegetation, wetlands, or cultivated land.

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[154] In the *Terrestrial Resources* section, the project area includes all lands within a 0.25-mile buffer of the limits of work, as defined in KRRC's 2018 Definite Plan.

The area between J.C. Boyle Dam and the California-Oregon border, which is classified as the Klamath River Canyon, has the greatest botanical diversity of any section of the Klamath River. The Klamath River Canyon includes pine, oak, juniper, and mixed conifer forest communities, with ponderosa pine and Oregon white oak as the dominant tree species (FERC, 2007). Areas of oak savannas occur but are sparse.

From J.C. Boyle Dam to the eastern end of Copco Reservoir, the Klamath River cuts through several vegetation zones as it bisects the Cascade Range, forming a steep canyon. Montane vegetation typical of the Cascades is mixed with high desert and interior valley plant communities. The area downstream of the canyon is composed of vegetation similar to that found in the interior valley of Oregon, with oak and grasslands dominating (FERC, 2007).

In 2002, PacifiCorp identified and mapped 11 upland cover types, 8 riparian and wetland habitats, 4 aquatic habitats, 2 barren habitats, and 5 kinds of agricultural or developed lands in the Lower Klamath Project. The study area for land cover typing included the Klamath River from J.C. Boyle Reservoir to the Shasta River, the area within 0.25 mile of all Lower Klamath Project facilities, reservoirs, and river reaches (PacifiCorp, 2004a). The Keno Canyon, Keno Reservoir, and Link River areas were initially included but have since been removed from the scope of the Lower Klamath Project. Calculated percentages only encompass habitat within the project area and are presented in table 3.5-1.

3.5.2.2 Riparian Vegetation and Wetlands

Wetlands play an important role in ecosystem functioning by providing habitat for plant and wildlife species, collecting, and retaining water, buffering the effects of floods, and conserving moisture for drier seasons. In the 1800s, the Upper Klamath River Basin consisted of wide expanses of wetlands and shallow lakes that delayed development by early European settlers. In the early 1900s, extensive efforts were made to drain these areas and covert them to agriculture (Most, 2020). Conversion to agricultural land use was accomplished through the construction of a series of dams, canals, ditches, and other facilities, known as the Klamath Irrigation Project, to drain, move, and store upper basin water. By the end of the twentieth century, 1,400 farms were operating on the Klamath Irrigation Project, cultivating up to 210,000 acres of wheat, barley, alfalfa, potatoes, onions, horseradish, sugar beets, and other crops in areas that were formerly wetlands.

The relative and absolute cover of wetlands is relatively low throughout the project area, measuring less than 2 percent of total vegetation except at J.C. Boyle Reservoir, where wetland cover totals 5.5 percent, or 105.1 acres of total cover. Palustrine wetland habitats (i.e., those associated with lakes as opposed to rivers) are categorized into four distinct groups: emergent, scrub-shrub, forested, and aquatic bed, which represent 55, 5, 29, and 11 percent of the total wetland area within the project area, respectively. PacifiCorp’s 2002 study (reported in PacifiCorp, 2004a) was conducted on the ground and is used for the summary of wetlands below.

In May and July 2019, KRRC conducted field surveys to identify wetland and riparian areas in accordance with the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual and the 2010 Regional Supplement (Version 2.0) for the Western Mountains, Valleys, and Coast Region (Corps, 1987, 2010). The May 2019 surveys focused primarily on limits of work (e.g., disposal areas, staging areas, or bridge replacements) as part of the proposed action and where hydrology sources were identified to be independent of the Klamath River or Lower Klamath Project reservoirs. The July 2019 surveys focused on wetlands along and adjacent to reservoir shorelines and sections of the Klamath River within the limits of work (KRRC, 2020).

In California, California DFW's jurisdiction includes ephemeral, intermittent, and perennial watercourses, and can extend to habitats adjacent to watercourses. To delineate California DFW's jurisdictional boundaries, KRRC wetland scientists mapped riparian areas associated with relatively permanent (e.g., reservoir, river, perennial stream, spring, or pond) and semi-permanent (e.g., ephemeral channels) waterbodies within the limits of work. Riparian areas generally had hydrophytic vegetation but failed to meet one or more of the remaining wetland parameters (i.e., hydrology and hydric soils), and thus were classified as non-wetland, riparian habitat. KRRC wetland scientists determined the upslope edge of riparian areas by mapping the line where vegetation transitioned from hydrophytic vegetation to vegetation more representative of dry, upland areas in terms of species composition and density.

In Oregon, following direction from the Oregon Department of State Lands, KRRC used the Oregon Rapid Wetland Assessment Protocol to identify wetlands where wetland hydrology is independent of the Klamath River or J.C. Boyle Reservoir. The Oregon Rapid Wetland Assessment Protocol consists of a series of field and desktop evaluations that provide a standardized, regionally tailored, rapid procedure for estimating the functions and values of wetlands occurring in the State of Oregon. This method does not include mapping riparian areas, so riparian mapping was not conducted in Oregon. Wetland investigation sites were identified in part by the PacifiCorp survey conducted in 2002 (reported in PacifiCorp, 2004a). A summary of KRRC's 2018–2019 survey findings is provided in table 3.5-2.

3.5.2.3 Invasive Plants

KRRC conducted noxious weed and invasive plant surveys in fall 2017 and spring/summer 2018 to provide current conditions of invasive plant communities at the Lower Klamath Project. The study area included the limits of work and upland and shoreline areas around the three reservoirs (J.C. Boyle Reservoir, Copco No. 1 Reservoir, and Iron Gate Reservoir). Recent survey information for each reservoir is provided in tables 3.5-3 through 3.5-5.

The 2017–2018 surveys found that yellow star-thistle and medusa head were two of the invasive plants that were dominant throughout the invasive plant study area. Yellow star-thistle dominated in 106.88 acres (18.9 percent of the proposed action uplands), and medusa head dominated in 93.19 acres (16.5 percent of the proposed action uplands). Other invasive plants dominated smaller acreages and composed a smaller percentage of the survey area (between 9 and 16 acres, or 1 to 3 percent of the project area) included cheatgrass, teasel, reed canary grass, and Himalayan blackberry (KRRC, 2019).

3.5.2.4 Wildlife

Wildlife Habitats

Human habitation over thousands of years has directly affected the Klamath River Basin. Prior to European settlement, American Indian Tribes hunted for deer and other mammalian and avian species. Following European settlement, several top carnivores such as the grizzly bear (and gray wolf) were systematically eradicated from the area. Land was developed for agricultural use, which decreased available wildlife habitat prior to the construction of the dams (KRRC and PacifiCorp, 2020).

In recent history, land use practices, including logging and fire suppression, have continued to shape wildlife habitat in the region, reducing habitat connectivity and increasing understory growth in forest stands. Currently, the Klamath River Basin is a natural migration corridor for many wildlife species and contains a variety of habitat types including riparian corridors, wetlands, late-successional conifer forests, chaparral, and grasslands.

Over the next 50 to 100 years, warming climate conditions are expected to further modify wildlife habitat. Climate change in the Klamath River Basin is predicted to include increased annual average air temperatures; warmer, drier summers; warmer, wetter falls and winters; and an increase in extreme precipitation events and heat waves and extreme rain events—all of which are predicted to alter wildlife habitat in the Klamath River Basin. For example, the distribution and abundance of tree and shrub species has been changing and will continue to change, with drought-tolerant species becoming more dominant and the elevation of the tree line in high-elevation forests increasing (Lawler and Mathias, 2007; Halofsky et al., 2019). Drought-driven disturbances that cause large-scale vegetation changes, such as wildfire and insect outbreaks, have been exacerbated by climate change and are predicted to increase (Dalton et al., 2013; Mote et al., 2019; May et al., 2018), leading to altered structure and function of most ecosystems in the region. Riparian areas and groundwater-dependent ecosystems will be especially vulnerable to higher air temperature, reduced snowpack, and altered hydrology.

Terrestrial wildlife distributions are expected to change in response to changing physiological temperature constraints, changes in habitat, food availability, new predators or competitors, and new diseases and parasites (Lawler and Mathias, 2007). Animal species that use a narrow range of preferred habitats, like sagebrush shrublands, riparian areas, or mature forests, will be the most vulnerable to large-scale species shifts and more disturbance (Halofsky et al., 2019).

Mammals

PacifiCorp conducted a variety of field studies (track surveys, photographic bait stations, and live trapping) in 2002 and 2003 to assess the status of mammalian species in the vicinity of the Lower Klamath Project. In 2017, 2018, and 2019, KRRC conducted additional terrestrial wildlife surveys within the project area. Field teams recorded wildlife behaviors, particularly breeding activity (KRRC, 2019). Mammals commonly observed in the project area include beaver, muskrat, otter, mink, racoon, bobcat, gray fox, and coyote. A full list of mammal species encountered during surveys is provided in KRRC (2021f).

Big game species (managed by Oregon and California wildlife agencies for sport hunting) in the project area include black-tailed deer, mule deer, elk, black bear, and cougar. Recent populations of elk and deer show decreasing trends because of severe winters, timber harvest, livestock grazing, wildlife, fire suppression, reservoirs, predation, and poaching. Within the project area, canyon and mid-elevation hillsides and plateaus between J.C. Boyle Powerhouse and Iron Gate Dam are considered important deer wintering habitat (City of Klamath Falls, 1989, as cited in PacifiCorp, 2004a). Surrounding Iron Gate are 2,235 acres of habitat with wedgeleaf ceanothus and mountain mahogany, which are two important deer-browsing species in winter ranges. The habitat immediately adjacent to Iron Gate Reservoir is sparse and of limited value as wildlife habitat (BLM, 2003b, as cited in FERC, 2007). However, a substantial amount of suitable wildlife habitat is available within the Copco No. 2 bypassed reach (1,136 acres), and J.C. Boyle peaking reach (10,517 acres) (PacifiCorp, 2004a).

Black bears were observed during surveys in the J.C. Boyle bypassed reach but likely inhabit most of the project area. Compared to average bear density numbers in Oregon, the density near J.C. Boyle Dam is considered high in the western end and medium towards the eastern end (Oregon DFW, 1993, as cited in FERC, 2007). Bear populations are expected to be highest in montane chaparral, montane hardwood, and mixed conifer forests (FERC, 2007). Mountain lions were nearly extirpated from the project area, but the population has been increasing. In the project area, mountain lion population densities are considered medium when compared to state averages (FERC, 2007).

KRRC conducted a series of bat surveys between 2017 and 2019 at facilities that would be affected by dam removal. These surveys included emergence surveys, acoustic surveys, and inspections for bats that may use project structures such as buildings, bridges, and diversion tunnels. Bat activity was recorded at 16 structures, including: 10 buildings around Copco No. 1 and Copco No. 2 Dams; the diversion tunnel at Copco No. 1; three buildings at Iron Gate Dam; the Iron Gate Dam diversion tunnel; and one building at J.C. Boyle Dam. Biologists conducted evening emergence surveys for bats from June 12 through 15, 2019, at J.C. Boyle, Iron Gate, and Copco structures (appendix D of KRRC, 2020). KRRC biologists observed evening emergences of *Myotis* species, big brown bat and hoary bat; with most bats observed considered a *Myotis* species.

Abundant guano was found in three different structures (two structures at Copco No 1 and 2, and one at the J.C. Boyle), but no bats were present when surveys were conducted. KRRC biologists reported a substantial maternity roost at the C-12 gatehouse at Copco No. 1 and a presumed maternity roost at the J.C. Boyle spillway control center. Table 3.5-6 provides a summary of the bat survey results.

Birds

In 2002 and 2003, PacifiCorp conducted avian circular plot surveys, facility surveys, and reservoir surveys, and reviewed Klamath Bird Observatory data from avian censuses and mist-netting conducted in areas surrounding the project to document avian species' diversity and abundance in the Lower Klamath Project area. KRRC conducted additional terrestrial surveys between 2017 and 2019 to provide more information on special status species in the project area (see section 3.5.2.6, *Special Status Wildlife Species*).

PacifiCorp observed 47 species of water birds, including 19 species of open-water marsh and wading birds, and 25 waterfowl species (KRRC and PacifiCorp, 2020). The project reservoirs provide breeding and overwintering habitat for water-dependent bird species. The greatest numbers of waterfowl and wading birds were observed on Copco No. 1 Reservoir, followed by J.C. Boyle and Iron Gate Reservoirs with the greatest numbers observed from April through June. In addition to providing habitat for water birds at the project reservoirs, water from the project is sometimes "borrowed" by Reclamation to meet its obligations in the Lower Klamath River so it can divert water from its Klamath Irrigation Project, located in the upper basin, to supplement natural inflow to the Tule Lake National Wildlife Refuge, located about 40 miles east of Copco No. 1 Reservoir near Tule Lake, California. The refuge encompasses 39,116 acres and is a significant staging area for migrating waterfowl during spring and fall migrations (FWS, 2021d). See section 3.2.3.3, *Effects of Changes in Water Quantity on Water Supply, Diversions, and Water Rights.*

In addition to water birds, the project area supports 19 bird of prey species because of its diversity and diversity of habitats, based on studies conducted in 2002 and 2003 by PacifiCorp (PacifiCorp, 2004a). In 2018 and 2019, KRRC conducted bald and golden eagle occupancy and productivity surveys in the project area. The surveys targeted both suitable nesting habitat and historically used eagle nest sites. In 2019, biologists reported 10 occupied eagle nests with nestlings present, 9 of which were within 2 miles of limits of work or 0.5-miles of a haul road. Golden eagles occupied two nests, and bald eagles occupied eight. All occupied nests produced young (KRRC, 2019). In addition to the occupied nests, biologists identified 11 vacant nests during the 2019 surveys. Six were presumed golden eagle nests and five were likely bald eagle nests (KRRC, 2021f). Bald eagle nest sites were most commonly found around J.C. Boyle Reservoir, while golden eagle nest sites were most commonly located near Copco No 1 and Iron Gate Reservoirs. KRRC biologists also reported 17 occupied osprey nests during the surveys.

Other birds encountered during surveys in the project area included 93 passerine species, 8 woodpecker species, and 5 gamebird species. Only a few of a passerine species were confirmed as breeding (by nests or young observed), but a high percentage were observed during the May and June surveys, suggesting the presence of breeding populations. A full list of species recorded during the surveys is provided in KRRC's Lower Klamath Project BA (2021f).

Reptiles and Amphibians

PacifiCorp used literature reviews, surveys of potential pond-breeding areas, and stream and terrestrial habitat surveys to identify amphibians and reptiles in the project area. Five amphibian and 16 reptile species were reported during these surveys (PacifiCorp, 2004a). Amphibians were primarily encountered at upland sites that were hydrologically disconnected from the Klamath River. Pacific giant salamander, both adults and larvae, were the only stream-dwelling amphibian species documented in the J.C. Boyle bypassed reach (PacifiCorp, 2004a). The J.C. Boyle peaking reach had both the largest number and highest species diversity of terrestrial reptiles. The western fence lizard and common garter snake were the most abundant reptile species encountered in any of the wildlife surveys. A full list of species recorded during the surveys is provided in KRRC's Lower Klamath Project BA (2021f).

3.5.2.5 Special Status Plant Species

KRRC conducted field surveys of special status plant species in 2018 and 2019 (KRRC, 2020). KRRC defined special status species as those that are listed federally and/or by the state as threatened/endangered, and species on the ONHP Lists 1 to 4 or the California Rare Plant Rank 1 to 4. In addition, KRRC also included species classified as sensitive plants by BLM and the Forest Service (KRRC, 2020). Although all special status plant species observed were reported, KRRC biologists targeted those special status plant species with the potential to occur in the project area, based on historical records and a review of state and federal plant databases, including, but not limited to, the Oregon Biodiversity Information Center, the CNDDB, and the FWS Information for Planning and Consultation database. Nine special status plant species were reported in the project area (KRRC, 2020). Table 3.5-7 presents a list of special status plants identified with potential to occur in the project area and focused survey areas. Table 3.5-8 provides a list of species reported during surveys and by reservoir.

3.5.2.6 Special Status Wildlife Species

Special status wildlife species include species listed as sensitive by the Forest Service or BLM, Bald and Golden Eagles protected under the federal Bald and Golden Eagle Protection Act, state-listed threatened or endangered species, and California species of special concern. Species federally listed as threatened or endangered under the ESA and candidates for federal listing status are discussed in section 3.6, *Threatened and Endangered Species*.

KRRC performed terrestrial surveys in 2017, 2018, and 2019 (KRRC, 2019; 2020) to establish the potential presence of special status species. Biologists established transects that covered the project area. KRRC biologists conducted surveys by walking the transects and recording all wildlife observations, including direct visual and auditory observations, scat, and other signs of presence. Field teams recorded wildlife behaviors, particularly breeding activity. In addition to land-based transects, biologists surveyed reservoir shorelines and open water by boat to record observations of aquatic and semi-aquatic species (e.g., waterfowl, wading birds, amphibians). Biologists noted all special status species seen or heard, and their approximate number, location, and behavior (e.g., roosting, loafing, foraging, courtship, mating, incubating eggs, or feeding young). Additionally, the California Water Board developed a list of special status species known or with the potential to occur in the project area (California Water Board, 2020a). Table 3.5-9 presents an integrated list of special status wildlife species from the California Water Board and KRRC surveys (California Water Board, 2020a; KRRC, 2019; 2020); this table identifies 6 invertebrate species, 5 amphibian species, 2 reptile species, 20 bird species, and 8 mammal species.

3.5.3 Effects of the Proposed Action

3.5.3.1 Restoration of Vegetation Within Reservoir Footprints

Removal of the project dams and draining the reservoirs would create exposed, unvegetated soils susceptible to erosion and colonization by invasive species. These areas would include about 258.6 acres at J.C. Boyle, 862.4 acres at Copco No. 1 Reservoir, and 836.6 acres at Iron Gate (KRRC, 2021c). Erosion of barren soil could result from precipitation or wind and could result in decreased water quality in the Klamath River, reduced air quality, and undesirable dust.

To manage revegetation of the reservoir footprints following drawdown, KRRC prepared a Reservoir Area Management Plan (RAMP), included as appendix J in the amended application for surrender of license (KRRC, 2021d). The plan was prepared in consultation with state and federal resource management agencies and the Karuk and Yurok Tribes.

During scoping, several commenters critiqued aspects of the plans for revegetating lands included in the RAMP. Some commenters expressed concern that failure of revegetation efforts could lead to dust storms and exposure to toxins contained in the reservoir sediments. One commenter questioned how the native seeds and plants planned for restoration would survive without water given the current drought situation and commented that residents were not consulted during preparation of mitigation plans.

Our Analysis

Given the relative scarcity of large-scale dam removal and reservoir bottom restoration projects, the science behind revegetation strategies under these conditions is under development. In most cases, peer-reviewed literature is from case studies associated with the removal of smaller dams in more humid environments than the Klamath River, like Wisconsin, Colorado, and New Hampshire (Shafroth et al., 2002; Orr and Stanley, 2006; Auble et al., 2007; Lisius et al., 2018). One year following removal of a small dam within the Lassen Volcanic National Park in northern California, the exposed reservoir bed was dominated with perennial herbs and grasses and species richness between the reservoir study plots and adjacent reference sites were identical (Rohdy, 2013).

The 2011 removal of the Glines Canyon Dam on the Elwha River in northwest Washington exposed 425 acres of valley floor, including valley wall, terrace, and floodplain landforms. Vegetation restoration activities were focused on the valley wall and terrace landforms, while the floodplain was left to revegetate naturally. Active revegetation restoration activity occurred in 144 acres of the 253 acres of exposed valley wall and terrace landforms. These areas were planted and reseeded with locally sourced wild seed and plant materials. Woody species were planted at a rate of 1,200 plants per acre over two years. Seed rates ranged from about 18 seeds per square foot on fine sediments (silt and clay substrates) to about 50 seeds per square foot on coarse sediments (sand, gravel, and cobble substrates) (Chenoweth et al., 2021). By 2017, vegetation cover on fine sediments was close to 100 percent and varied between about 0 and 80 percent on coarse sediments, with a mean of 25 percent. Species richness was also affected by substrate texture (with means of 23.4 species per location on fine sediments and 15.8 species per location on coarse substrates). Woody stem densities reached a mean density of about 14,000 stems per acre on fine sediments and 2,000 stems per acre on coarse sediments (Chenoweth et al., 2021). Much of the stem density on fine sediments was derived from natural colonization during drawdown (Chenoweth et al., 2021).

Following the 2011 removal of Condit Dam on the White Salmon River in Southern Washington, PacifiCorp revegetated 48 acres of reservoir sediments using about 86 pounds of seed per acre and 347 planted trees per acre (PacifiCorp, 2011a, PacifiCorp, 2019b). Trees were planted in a uniform distribution across the restoration area. In 2016, PacifiCorp's Revegetation and Wetland Management Plan Final Report (2012–2016) indicated that while there were areas within individual planting locations that had gaps in cover or tree density, riparian areas quickly developed, and canopy cover for willows and other woody vegetation increased annually. The planted areas in the former reservoir met the 80 percent ground cover performance criteria, and the average tree density of 202 trees/acre exceeded the 150 tree/acre criteria (PacifiCorp, 2019b).

As described in section 3.1.2.6, *Reservoir Substrate Composition*, the Lower Klamath Reservoir substrates are predominantly composed of fine silt and clay sediments. Coarse gravel and cobble components were not identified during sediment sampling, except for the upper 500 feet of Copco No. 2 Reservoir, which is dominated by cobble and boulders. Based on the success of seed germination and establishment in similar soils on the Elwha, and the higher proposed seed density at the Lower Klamath Project, we anticipate KRRC's proposed seeding would result in high reduction of bare ground within one growing season. Seeding is expected to stabilize soils and prevent soil erosion and nuisance dust. However, we recognize success would also be dependent on soil moisture availability and nutrient chemistry, which could differ substantially from the Elwha and Condit projects. KRRC's proposed monitoring would identify areas where seeding was less successful and provide information necessary for adaptive management. KRRC's proposed adaptive management measures, including reseeding and additional irrigation, mulching, composting, and fencing, are reasonable measures that would mitigate the most likely causes of poor seed germination and plant establishment.

KRRC's proposed quantity of tree and shrub plantings, in terms of plants per acre, is considerably lower than those used at the Elwha and Condit restoration projects (see section 2.1.2, *Proposed Environmental Measures*, table 2.1-5). However, KRRC's proposed planting scheme would emphasize generation of multi-species patches by planting woody species in more dense clusters rather than a uniform distribution across the restoration site. This restoration technique has been effective in a variety of ecosystems where abiotic stressors can inhibit establishment of new vegetation and mimics the patchwork distribution of early establishment of vegetation in areas of primary succession, such as that following volcanic eruptions or glacial receding. Similar planting schemes have been shown to be successful in salt marshes (Silliman et al., 2015), gypsum soils (Navarro-Cano et al., 2015), and semi-arid steppes (Maestre et al., 2001). KRRC's proposed planting scheme would result in clusters of dense woody vegetation interspersed with more open herbaceous areas. The vegetation patches create microsites more suitable to vegetation growth and dispersal by creating more shade and increased leaf litter, which lowers surface temperatures, helps retain soil moisture, and promotes development of microbial activity (Navarro-Cano et al., 2019), promoting soil development. Therefore, we find this method to be suitable for the project area, where long-term inundation is expected to have limited soil fungi and microbial life beneficial to the establishment of upland communities. Development of the soil fungal (mycorrhizal) network and soil microbes are particularly important in the development of oak woodlands (Southworth et al., 2009, Devine et al., 2007) and promote growth in ponderosa pine (Steinfeld et al., 2003) and Douglas fir, particularly during times of drought (Bingham and Simard, 2011).

KRRC's proposed monitoring methods would provide annual snap shots of vegetation characteristics in the revegetated reservoir areas. The proposed sampling scheme would provide data from both the tree and shrub planted patches and the seeded herbaceous areas between the clustered plantings. Metrics proposed for quantitative monitoring, including species richness, tree and shrub density, percent of vegetation cover, and percentage of non-native species relative to native species and the proposed reporting would inform KRRC, the Commission, and resource management agencies of the extent to which revegetation activities are meeting stated goals and providing ecological functions like soil stabilization, development of wildlife habitat, and out-competing invasive species.

We anticipate that the proposed revegetation, monitoring, and adaptive management of the reservoir areas would provide for early stabilization of soils and meet the stated objectives in a three-to-six-year period. While full development of the oak woodland, chaparral, and yellow pine forest areas would require decades to reach maturity, the proposed RAMP would guide establishment of early successional vegetation communities and guide trajectory to the desired mature communities. Therefore, we find the proposed action would have an unavoidable, short-term, significant, adverse effect, but a long-term, significant, beneficial effect on vegetation within the reservoir footprints.

3.5.3.2 Restoration of Vegetation in Disturbed Uplands

Activities associated with access development and deconstruction of the project facilities would disturb existing vegetation and soils. The resulting disturbed areas would create potential suitable habitat for invasive species and soil erosion. Use of heavy machinery in these areas could compact soils and impede natural establishment of native plants.

KRRC's RAMP includes measures for restoring areas temporarily disturbed during deconstruction activities. The plan includes grading to recontour these areas to match neighboring conditions, installing sediment and erosion control BMPs (included in appendix C of the RAMP), and revegetating with upland seed mixes. The plan includes specific measures to be used at concrete disposal sites, staging areas and temporary access roads, hydropower demolition areas, the J.C. Boyle canal, J.C. Boyle scour hole, and project recreational areas. Measures include ripping and disking soils after demolition, where appropriate, to facilitate establishment of seed mixes.

BLM encourages KRRC to integrate the scour hole into the restoration plan and revegetate this site with native plants, and states that restoration efforts for the canal demolition area should include a planting plan with associated metrics for plant establishment and survival. BLM also states that the site should be contoured as much as possible to reflect the original grade.

KRRC will apply for, obtain, and comply with the California NPDES Construction General Permit issued by NCRWQB. The Construction General Permit includes temporary and permanent BMPs and monitoring to regulate stormwater runoff to surface waters. As part of the Construction General Permit, KRRC will develop a SWPPP. A Notice of Termination will be filed with respect to the SWPPP with the NCRWQB (and copied to the California Water Board and California DFW). Once NCRWQB approves the Notice of Termination, no further monitoring will be required in California.

Our Analysis

Deconstruction and disposal of the project features would require widening access roads; clearing laydown, storage, and disposal areas; and using heavy machinery. These activities would affect and remove existing vegetation and create the potential for erosion and invasive species colonization. While the extent of these areas is not quantified, we anticipate they would by small relative to the area of similar vegetation surrounding the project. KRRC's RAMP includes measures to minimize adverse effects on existing vegetation by delineating avoidance areas and protective buffers to protect root zones. Following demolition, the plan includes measures to restore these areas by regrading to match surrounding areas, ripping and disking soils to promote establishment of native species, seeding and planting with native species, and controlling invasive plants. The RAMP specifically addresses restoration of the J.C. Boyle canal and J.C. Boyle scour hole, although specific planting plans for these areas are not described in detail. Incorporating these areas into the final restoration plan, including placement of erosion control devices and planting schemes, would provide stakeholders the opportunity to comment on the site-specific implementation and ensure enough planning occurs to increase the likelihood of restoration success. With implementation of these measures, the proposed action would have an unavoidable, short-term, significant, adverse effect on upland vegetation. The restored areas would be included in the RAMP monitoring efforts, and the long-term effect on upland vegetation would be significant and beneficial.

3.5.3.3 Invasive Species

As described previously, the proposed action includes activities that would remove existing vegetation and drain existing waterbodies. These actions would result in the creation of open areas with bare soils, providing ideal conditions for introduction and spreads of invasive plants. KRRC's RAMP includes a variety of measures to minimize potential for increases in invasive species populations in the project area. Prior to initiation of land clearing activities or reservoir draining, KRRC would identify existing populations of invasive species in areas surrounding the project and treat these areas to eliminate potential sources propagules[155] for invasive plants. Treatments would generally focus on mechanical methods, including hand pulling, mowing, tilling, shading, and solarization. In some cases, especially for species where mechanical methods are less successful, KRRC would apply of herbicides to treat these areas. The RAMP includes a description of which species and circumstances would warrant the use of herbicides and includes BMPs to limit the potential for unintended adverse effects of herbicide use on native vegetation and wildlife. The RAMP also includes a variety of measures to limit potential for project activities to transport propagules into the project area, including the use of weed-free mulching materials, screening fill materials for invasive propagules, washing vehicles to limit potential for transporting invasive propagules to the project area, and training staff to identify and remove invasive weeds. As described above, following the completion of reservoir draining and demolition activities, KRRC would revegetate areas of bare soil, applying native seed mixes and planting native species.

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[155] Propagules include seeds, roots, or vegetative matter that have the potential to grow into a new mature plant.

Monitoring and adaptive management of these revegetated areas would include annual surveys for and removal of any invasive species that establish with in the reservoir footprints or temporary disturbance areas.

Our Analysis

Draining project reservoirs and clearing existing vegetation would create potential for invasive species colonization in the project area. KRRC's RAMP includes a multitude of measures to reduce potential sources of invasive species propagules in areas surrounding the project, minimize potential for project activities to transport propagules into the project area, and survey for and eliminate any invasive species identified within the project area following the completion of deconstruction and reservoir drawdown. The RAMP also identifies BMPs to limit potential for herbicide applications from inadvertently affecting native plants, wildlife, and aquatic resources. The plan also includes adaptive management of invasive species in the project area and would be reassessed three to four years following reservoir drawdown. With implementation of the measures included in the proposed action, the project would have a short-term, unavoidable, significant, adverse effect on native vegetation resulting from competition with non-native, invasive species. However, there would be a long-term, significant, beneficial effect on native vegetation in the project area by controlling existing invasive plant populations and minimizing potential for invasive plant establishment.

3.5.3.4 Wetlands and Riparian Vegetation

Wetland vegetation is dependent on hydric soils that develop when there is standing water or high groundwater levels present during at least a portion of the year creating anoxic conditions. Removing the project dams and draining the reservoirs would alter water availability in wetlands that have developed around the margins of the reservoirs. Creating access for heavy machinery needed during the demolition and removal of project facilities would also require crossing wetland areas, disturbing vegetation and altering topography. Removal of penstocks would also alter local hydrology and remove water sources for local wetlands supported by penstock leakage.

KRRC proposes to implement measures in its RAMP and Terrestrial Wildlife Management Plan (TWMP) to protect existing wetlands where possible and promote establishment of new wetlands where hydrologic conditions would be suitable post-dam removal. KRRC anticipates implementation of these plans would provide for no net loss in wetland acreage.

KRRC's proposed wetland protection measures include establishing a 20-foot buffer around non-reservoir-dependent wetlands and placing fencing around wetlands that are adjacent to the construction limits of work to eliminate access by machinery, vehicle, or by foot. Maps of the locations of these areas are provided in appendix A, figure 6 in KRRC's TWMP (KRRC, 2021k). Following reservoir draining, KRRC would conduct sediment mapping using drones (as a component of its Water Quality Monitoring and Management Plan) and regrade the reservoir beds to ensure tributaries maintain hydrologic connectivity with the river channel and floodplain and create floodplain swales and side channels. KRRC also proposes to increase floodplain roughness by adding large woody material and riparian woody plant materials (cuttings and rooted plants) to promote microsite conditions suitable for establishing wetland and riparian vegetation. Wetland and riparian species common to the region are included in the seed mixes and planting lists.

Our Analysis

During reservoir drawdown, high flows in the Klamath River and sediment deposition between Iron Gate Dam and the confluence of the Klamath River and Humbug Creek (about 8 river miles downstream of Iron Gate Dam) would change current channel morphology through processes of bedload transport and deposition. These effects would be limited to areas within the 100-year floodplain. The river flows associated with reservoir drawdowns would result in some erosion between the bankfull (1.5 year flood) channel and the 100-year flood level. This erosion would likely remove some riparian vegetation, predominantly herbaceous species and potentially young tree saplings. Occasional toppling of mature trees located along the channel banks may occur if erosion undercuts banks. As the reservoir-draining flows recede, sediment deposition would occur, leaving areas of bare alluvium, typically silts and sands. These areas would provide optimum sites for seedling establishment, particularly for riparian tree species like cottonwood and willow, which require full sun and bare mineral soil for germination (Mahoney, 1998; Scott et al., 1997). Recent deposits would also provide habitat for seed germination of pioneer herbaceous species, potentially including some invasive species. These processes commonly occur in free-flowing rivers; riparian vegetation species are adapted to survive and reproduce under these conditions (Braatne et al., 1996).

Following dam removal and reservoir drawdown about 57.1 acres of wetlands and 15.5 acres of riparian vegetation dependent on reservoir hydrology would be disconnected from their water sources. Over time, as the soils in these areas dry, wetland vegetation would die and be replaced with upland vegetation. New wetlands would develop on the reservoir beds adjacent to the new river channel where the water table elevation is conducive to the development of hydric soils (Van Der Valk, 1981; Som et al., 2018).

KRRC’s proposed sediment surface mapping, grading, seeding, and planting plans would initiate the development of wetland and riparian vegetation structure at appropriate locations in the landscape where abiotic conditions present following reservoir draining are favorable. Over the long term, returning the Klamath River to a free-flowing river would restore natural processes including sediment transport and seasonal flooding that promote development of riparian vegetation (Mahoney and Rood, 1998; Shafroth et al., 2002; Polzin and Rood, 2006).

In its response to the Commission's request for additional information, KRRC stated it expects restoration efforts to create 19.2 acres of palustrine wetlands and 306.8 acres of riparian vegetation. These acreages would meet KRRC's goals stated in the RAMP of a 1:1 mitigation ratio for riparian areas. While the acreage of palustrine wetlands lost within the limits of work would exceed the estimated acreage of created wetlands following restoration activities, the combination of natural recruitment and active restoration is expected to create a significant net gain in riparian habitat within the limits of work in California. KRRC anticipates using this net gain of riparian area to mitigate the remaining wetland losses in California at a 3:1 mitigation ratio in accordance with the California Water Board's General Order 2020-0039 for out-of-kind, in-watershed mitigation. The 19.2 acres of created wetlands would leave a need to mitigate for 32.5 acres of lost wetlands. The estimated creation of 306.8 acres of riparian wetlands exceeds the 15.5 acres needed for 1:1 mitigation of lost riparian areas and the 97.5 acres needed to mitigate for 32.5 acres of lost wetlands at a 3:1 ratio. Therefore, we expect the KRRC's wetland and riparian mitigation goals are attainable.

Following dam removal, flows in the Klamath River would be driven by precipitation and snowmelt and return to a flow regime typical to free-flowing streams in the region. The post-dam removal flow regime is anticipated to include spring floods associated with melting snowpack, followed by low base flows during the summer and higher flows in fall associated with fall rains. As discussed above, riparian vegetation would benefit from the return to a natural flow regime that creates microsites for riparian tree seed establishment.

Conducting post-restoration wetland delineations in year 7 or 8, as KRRC proposes, would determine whether restoration efforts successfully meet the mitigation goals presented in the RAMP. If the results of the post-restoration delineation indicate the mitigation requirements have not been met, KRRC's proposal to consult with the habitat restoration group to develop an adaptive management plan, for regulatory agency approval, would provide for the creation of additional wetlands to meet the criteria. Over the short term, the proposed action would have an unavoidable, significant, adverse effect on wetlands and riparian vegetation resulting from draining reservoirs, but there would be no net loss of wetland and riparian habitat in the long term.

3.5.3.5 Special Status Plants

KRRC's 2019 Annual Terrestrial Resources Survey Report (KRRC, 2020) identifies nine species of special status plants encountered during surveys of areas near the limits of work. Special status species were identified adjacent to access roads, within potential disposal sites, and along reservoir shorelines. Project activities have potential to affect habitat for special status plants by altering soil moisture, increasing dust, or compacting soils with the use of heavy machinery. Direct injury or mortality could also occur during vegetation removal and surface grading.

KRRC's TWMP includes measures to limit project effects on sensitive plants, including reviewing current sensitive plant lists prior to construction, salvaging and transplanting sensitive plants, and monitoring.

Following the completion of project design, KRRC proposes to update the list of special status plants with the potential to occur in wetland and riparian habitats as part of the pre-drawdown phase of the project. If feasible, KRRC would salvage plants in reservoir-dependent wetlands for transplant to areas adjacent to the new river channel following reservoir drawdown. KRRC would develop a monitoring program for any special status plant species that could be affected and identify and implement avoidance measures in areas of known special status plant occurrence in the TWMP. If effects on a special status plant occur, KRRC would confer with California DFW prior to determine their preferred BMP.

Our Analysis

Draining the reservoirs would alter water availability for multiple populations of special status plants associated with wetland habitats. Road widening, heavy machinery traffic, and soil disturbance also have potential to injure or destroy individuals. KRRC's proposed measures to update surveys and attempt to salvage wetland-associated species to the river channel would reduce potential effects. Modifying work areas to avoid disturbance to areas with special status plants would also reduce the potential for adverse effects. However, some disturbance to these species would be unavoidable, transplanting has an unknown success rate, and loss of special status plant species would be unavoidable, short term, significant, and adverse. Following completion of dam removal, new wetlands would develop in the Klamath River floodplain that would provide suitable habitat for reestablishment of special status plants. Therefore, the proposed action would have a permanent, significant, and beneficial effect on special status plant species.

3.5.3.6 Wildlife Habitat

Draining the project reservoirs would alter wildlife habitat by reducing lentic habitat and wetlands supported by current groundwater levels and increasing upland and lotic habitat. Deconstruction of project facilities would also affect wildlife habitat with increased noise, vehicle traffic, digging and filling and general earth-moving activities. These activities have potential to increase levels of disturbance, injury, and mortality to individuals occurring in the project area. Loss of storage at the project could affect water "borrowing" agreements between Reclamation and KRRC.

To manage these potential adverse effects, KRRC has prepared two state-specific TWMPs, one for Oregon and one for California. These plans include pre-deconstruction/reservoir-draining surveys, timing restrictions on vegetation disturbance activities, designation of protective buffers, wildlife relocation measures, and reporting.

Our Analysis

In general, the proposed action would have the greatest effect on species that are dependent on the existing reservoirs for breeding, shelter, or stopover habitat. These species include aquatic and semi-aquatic reptiles and amphibians, wading birds, and waterfowl. Depending on the timing of reservoir drawdown, these species would experience short-term, significant, and unavoidable adverse effects associated with habitat loss and the need to relocate to suitable habitat. During this period, individuals would be exposed to increased stress and susceptibility to predation and death. Depending on timing and species life histories, individuals would also experience disruption in hibernation and breeding activities. However, over the long term, restoration of a free-flowing Klamath River would continue to provide habitat for many of these species and have a permanent, significant, beneficial effect. Restoration of the reservoir footprints to upland habitat would also provide additional habitat for upland species including terrestrial reptiles, small mammals, big game species, and upland nesting birds. As further discussed in section 3.2.3.3, *Effects of Changes in Water Quantity on Water Supply, Diversions, and Water Rights*, removal of the reservoirs would reduce water loss associated with evapotransporation, which could offset the need for water from Reclamation's Klamath Irrigation Project to meet flow requirements in the Lower Klamath River. As such, some water from the Klamath Irrigation Project would still be available to supplement natural flows in the Tule Lake National Wildlife Refuge. Therefore, the proposed action would have permanent, significant, beneficial effects on upland species. Loss of the reservoirs associated with the proposed action would result in unavoidable, significant, and adverse effects on lentic habitat in the project area; however, with the presence of similar lentic habitat in the region, species affected would be able to relocate to suitable habitat near the project area, resulting in a permanent, less than significant, to permanent, significant, beneficial effect depending on the species' life requirements. We discuss potential effects on the proposed action and the related components of the TWMPs on wildlife in the following sections.

3.5.3.7 Reptiles and Amphibians

Draining project reservoirs would remove habitat for aquatic and semi-aquatic reptiles and amphibians living in and around the reservoirs. As water levels decline, individuals would be required to abandon existing habitat and relocate to suitable habitat elsewhere. Such movements would increase stress, increase potential for predation as animals are forced to leave sheltered habitats, and potentially interrupt hibernation or breeding behavior.

To provide protection for non-listed reptiles and amphibians, if KRRC observes native reptiles or amphibians in the TWMP boundaries during visual encounter surveys for western pond turtles (discussed in more detail in section 3.6.3, *Threatened and Endangered Species, Effects of the Proposed Action*) or during construction activities, the reptile or amphibian would be avoided and encouraged to leave the area on its their own. If the amphibian or reptile is not capable of leaving the work area of its own volition or does not promptly leave the work area, KRRC would attempt to relocate the individual outside the work area, to the extent practicable. These actions would occur in coordination with construction activities to avoid delays to construction. To minimize potential effects of deconstruction activities, KRRC would put up fencing around work areas with potential to entrap wildlife, such as open trenches or pipes. Work crews would place escape ramps in or block any material open hole or trench left open overnight. KRRC would ensure all constructed holes or trenches are inspected daily for entrapped wildlife throughout the construction period and prior to fill. Any wildlife discovered would first be allowed to escape voluntarily. If an entrapped individual will not or is unable to voluntarily escape, KRRC would use its best professional judgment in removing and relocating the entrapped individual, if practicable.

Our Analysis

Draining the project reservoirs would require reptiles and amphibians to leave existing habitat and search for shelter elsewhere as favorable habitat becomes unsuitable. These periods would result in short-term stress and could increase potential mortality associated with competition for suitable habitat and predation during periods of exposure. Deconstruction activities would create potential for accidental burial of reptiles and amphibians seeking shelter in exposed trenches, pipes, or waste disposal areas. KRRC's measures included in the TWMPs would reduce potential effects by conducting visual encounter surveys to identify animals at risk. Allowing animals to relocate on their own, if possible, would reduce potential for stress, disease, or injury associated with capture and human handling. However, if animals are unable to relocate, transporting individuals to suitable habitat would reduce potential for predation or desiccation. Fencing work areas where deconstruction activities could pose a risk to reptiles and amphibians and inspecting areas prior to fill, as proposed, would minimize potential for these effects. Therefore, the short-term effects of the proposed action on individual reptile and amphibians would be significant and adverse. Long-term or population-level effects would be permanent, less than significant, and beneficial or adverse, depending on species (terrestrial or aquatic, respectively).

3.5.3.8 Nesting Birds

KRRC's proposal would include draining existing reservoirs and removing existing vegetation to widen roads, clear storage areas, develop water disposal areas, and provide clearance around project facilities where deconstruction activities would occur. These activities have potential to disturb nesting birds if the actions occur during the nesting season.

KRRC's TWMPs include multiple measures to reduce the potential for adverse effects on nesting birds, including conducting surveys for nests and implementing timing restrictions on vegetation removal to avoid activities during the nesting season. The TWMPs also include BMPs to limit effects of construction on nesting birds.

Our Analysis

KRRC prepared its TWMPs in consultation with California DFW and Oregon DFW to identify appropriate nesting seasons for birds in the project area and develop avoidance measures to minimize potential disturbance to nesting birds. Avoiding vegetation removal during the proposed time periods would minimize disturbance activities during the nesting season. Conducting surveys to identify areas of nesting activity, as proposed, would identify areas where extra caution during deconstruction is necessary. Monitoring bird behavior at active nests would allow trained personal to determine whether activities are causing undo stress and may create potential for nest abandonment or reduced breeding success. Altering deconstruction schedules and consulting with state wildlife management agencies, as needed would minimize potential for project activities to affect nesting birds. Therefore, the short-term, adverse effect of KRRC's proposal on nesting birds would be less than significant. The proposed action would have permanent, significant, beneficial effect on nesting birds.

3.5.3.9 Sensitive Wildlife Species

Bald and Golden Eagles

As detailed in the 2019 Annual Terrestrial Resources Survey Report (KRRC, 2020) several bald and golden eagle nest sites are located in proximity to the project work limits. Potential effects of the project on eagles include removal of foraging habitat associated with the reservoirs, potential removal of nest or roost trees, and noise disturbance related with construction activities.

In its TWMP, KRRC notes that it is in the process of consulting FWS to develop an eagle conservation plan and Eagle Act Permit in accordance with the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). KRRC expects to file the plan with the Commission in December 2021. However, no additional detail was provided prior to the issuance of this draft EIS.

Our Analysis

Bald and golden eagles are known to nest in proximity to the project area. Both species are federally protected under the Bald and Golden Eagle Protection Act, administered by FWS. FWS has published guidelines for the management of bald eagles, including recommended distances for noise buffers in proximity to active nests based on topography and anticipated noise intensities (FWS, 2007). Eagles are particularly susceptible to noise disturbance during the nesting season and may abandon nest sites if disturbance is too great, resulting in nest failure. During removal of project facilities, the use of heavy machinery, blasting, and material transport would create noises that may disturb eagles within a 1-mile radius in open habitats (FWS, 2007). We anticipate that any eagle conservation plan and Eagle Act Permit developed in consultation with FWS would include surveys for nesting eagles and timing restrictions to minimize potential for project-related noise to disturb nesting eagles. We also anticipate an Eagle Act Permit would include a statement authorizing unavoidable effects. Removal of the project reservoirs would remove foraging habitat for bald eagles. However, restoration of the reservoir footprints to open grasslands and shrublands would create foraging habitat for golden eagles. A free-flowing Klamath River would continue to provide foraging habitat for bald eagles and restoring salmon runs to the project area and would also increase foraging resources for bald eagles. Therefore, we find the adverse effects of the proposed action on bald eagles and golden eagles would be less than significant in the short term, with permanent, significant, beneficial effects for both bald and golden eagles.

Bats

Removal of the four dams and associated structures, and associated deconstruction activities, would displace bats at roosting, hibernating, and maternity colony sites in the project area. Multiple bat species may experience disturbances from construction-related noise and may experience alterations to roosting habitat in areas where tree removal is required for equipment access. Roosting, hibernation, and maternity colony habitat sites would also be lost through the removal of project-related structures.

KRRCs TWMPs include multiple measures to prevent adverse effects on bats, including phased removal of trees and structures and creation of artificial roosting structures to offset roosting areas that would be destroyed during demolition and closing of project tunnels.

Our Analysis

As described above, bats are known to roost, hibernate, and have maternity colonies in several project facilities that would be removed under the proposed action. Bats may also roost in the bark of trees that may need to be removed to provide access for deconstruction vehicles. KRRC’s proposed surveys, timing restrictions, and phased approach to the demolition of structures and removal of trees would minimize potential for direct injury and mortality during deconstruction activities. Following removal, bats would need to find suitable roosting habitat elsewhere. However, the extent to which suitable bat habitat is readily available in the surrounding area is not evident. Closing access to the diversion tunnels, removing gate houses, and demolishing project structures would remove roosting, hibernation, and maternity colony sites for several thousand bats. Relocating to suitable roosting, hibernating, and maternity colony sites, if available, would result in increased stress and competition to individuals and maternity colonies and is likely to result in some level of mortality. KRRC’s TWMPs do not include proposed mitigation for these effects. Therefore, the proposed action would have unavoidable, short-term, significant, and adverse effects and would have long-term, less than significant, adverse effects on bats.

3.5.4 Effects of the Proposed Action with Staff Modifications

The effects on terrestrial resources in the project area under the proposed action with staff modifications would be the same as discussed for the proposed action, with the exceptions discussed below.

KRRC's proposed RAMP is generally consistent with the specifications in California Water Board WQC condition 14 and Oregon DEQ WQC condition 6. However, Oregon DEQ WQC condition 6 (b)(ii) specifies data collection for the area of invasive exotic vegetation and native vegetation cover occur twice annually but does not specify when sampling should occur. In the RAMP, KRRC states that only one period of sampling is proposed because after the onset of dry summer conditions, most annual herbaceous species die and are not identifiable. We agree these conditions would make identification of herbaceous species difficult and may inhibit data collection on species richness. However, we expect the majority of tree and shrub mortality to occur in the summer dry period. Under the proposed methodology, this mortality would not be detected until the following sampling period in late spring, past the ideal planting window if results indicate additional planting is warranted. Including a second sampling period in early fall, prior to the onset of woody species dormancy, would identify mortality rates following the driest portion of the year and allow for a more accurate assessment of woody species survival and assessment of the need for additional planting. If monitoring determines additional planting of woody species is warranted, plant material could then be collected in late fall/early winter and be available for planting in early spring, up to a year earlier than under the proposed methodology.

Additionally, California Water Board WQC condition 14 specifies the restoration plan include a detailed description of proposed restoration activities (e.g., grading, planting, swales, wetland construction) and preliminary maps identifying proposed locations for restoration activities. If conditions following reservoir drawdown warrant, California Water Board WQC condition 14 would require KRRC to update the map within two months following reservoir drawdown, if conditions warrant revisions to the planting plan. While the proposed RAMP included in the amended surrender application includes maps of proposed restoration communities at each reservoir, the maps do not include the detail specified in the California Water Board's conditions. Providing detailed maps that identify areas of grading, water runoff control measures, planting, seeding, mulching, and irrigation areas for agency review and Commission approval prior to initiating reservoir drawdown would ensure adequate planning has been completed to initiate restoration efforts and improve potential for restoration success.

Therefore, consistent with Oregon DEQ WQC condition 6, staff recommends KRRC modify the RAMP to include two periods of vegetation sampling each year. One sampling period should occur in late spring or early summer as proposed. The second sampling period should occur in late fall, but prior to onset of woody vegetation dormancy. Consistent with California Water Board WQC condition 14, staff recommends the revised RAMP include detailed maps that identify areas of grading, water runoff control measures, planting, seeding, mulching, and irrigation areas. These maps should include final limits of work zones, delineated wetlands within areas of proposed disturbance, the reservoir footprints, the J.C. Boyle canal and scour hole, and all areas of temporary disturbance where revegetation activities would occur. Effects of the proposed action with staff's modifications would be the same as for the proposed action, except staff's recommended modifications to the RAMP would provide for more timely adaptive management and facilitate stakeholder review of the planting plan. With implementation of these measures, the short-term effects of the proposed action with staff modifications on vegetation would be less than significant, and adverse. The restored areas would be included in the RAMP monitoring efforts, and effects on vegetation would be long term, significant, and beneficial.

KRRC's RAMP includes annual surveys for and control of invasive species. However, because many invasive plant species are quick to mature and produce high volumes of seed, including two annual surveys for invasive species in the RAMP, as specified in Oregon DEQ condition 6 would further reduce potential for invasive plants to go unrecorded and spread to larger and harder to control populations. Therefore, staff recommends KRRC conduct surveys for invasive plants in early summer and mid-fall and treat populations observed during the surveys. Long-term, adverse effects of invasive species on native vegetation associated with the proposed action with staff modifications would be less than significant.

KRRC's 2019 Annual Terrestrial Resources Survey Report (KRRC, 2020), filed as part of the TWMP, quantifies and maps the reservoir-dependent and non-reservoir-dependent wetlands in the project area and the anticipated work limits. However, because final project design was not complete at the time of the survey, there is potential for adjustments in the work limits to include previously un-delineated wetlands. Reviewing the final work limits in comparison to the limits at the time of the 2019 delineations would identify areas where additional delineations may be needed to fully capture wetlands in areas of proposed disturbance. Including these areas in a final RAMP, consistent with California Water Board WQC condition 14, would ensure all wetlands are accounted for and facilitate calculations of potential effects on provide for no net loss, as proposed. With implementation of these measures, the proposed action with staff modifications would have a significant and unavoidable adverse effect on wetlands in the short term because of reservoir drawdowns. The restored areas would be included in the RAMP monitoring efforts, and long-term effects on wetlands and riparian vegetation would be permanent, significant, and beneficial.

KRRC's California TWMP includes maps of suitable relocation areas for western pond turtle. However, both the California and Oregon TWMPs also propose relocation activities for other reptiles and amphibians encountered within the limits of disturbance. Identifying suitable habitats and updating both TWMPs with maps of suitable relocation habitats for non-listed reptiles and amphibians would be beneficial to ensure field staff know where suitable habitat exists. This would limit handling time and reduces stress to relocated individuals. With implementation of these measures, the proposed action with staff modifications would have a less than significant, adverse effect on reptiles in the short term and long term.

KRRC notes that it is in the process of consulting with FWS to develop an eagle conservation plan and Eagle Act Permit in accordance with the Bald and Golden Eagle Protection Act; however, no details were available at the time this draft EIS was prepared. Staff recommends the bald and golden eagle management plan include surveys; timing restrictions on vegetation clearing and construction noise; monitoring of active eagle nests; coordination with FWS, California DFW, and Oregon DFW; and reporting as described in California Water Board WQC condition 17. We conclude short-term, adverse effects of the proposed action with staff modifications on bald and golden eagles would be less than significant, with permanent, significant, beneficial effects for both eagle species.

In its EIR, the California Water Board includes recommendations to reduce potential effects on bats. Many of the recommendations from the California Water Board's EIR are incorporated in KRRC's TWMPs; however, the following recommendations are not included:

- If demolition occurs at a time when a structure is occupied by a maternity colony or hibernating colony and exclusion was deemed infeasible, the California Water Board recommends KRRC develop a plan in coordination with a qualified bat biologist and approved by California DFW to carefully remove the occupied bat habitat at a time when it would have the least effect on bats present and in a manner that avoids bat injury and mortality. The California Water Board recommends demolition occur when bats are active, and weather is fair outside between September 1 and October 15. During this period, activities to remove the occupied habitat may occur when evening temperatures are greater than 45°F and no more than 0.5 inch of rainfall is predicted within the following 24 hours. During demolition activities, the California Water Board recommends a qualified bat biologist shall be present on-site.
- If an on-site biologist conducts a daily preconstruction survey of a structure previously assessed as not providing habitat for bats and finds a few bats (and confirmed neither a hibernacula or maternity colony), a qualified bat biologist with experience handling bats and approved by California DFW may capture and release the bat(s) at dusk during suitable weather (i.e., not raining, temperatures greater than 45°F).
- KRRC would conduct post-construction monitoring of the mitigated enhanced or replacement bat roosts multiple times of the year and depend on the type of roost being created. At a minimum, KRRC would conduct roost surveys seasonally (four times per year). Monitoring surveys may include, but are not limited to, emergence surveys, acoustic monitoring, and guano observation.

- Monitoring would occur for at least five years or until the mitigation can be considered successful. At year 3, artificial bat roosts meeting the success criteria (described below) may be eliminated from the monitoring. Criteria shall be considered successful through concurrence with California DFW or their designated representatives. The mitigated enhanced and/or replacement bat roosts would be successful if the following occurs: (1) the mitigation roost provides the function(s) of the demolished roost (i.e., maternity, hibernacula) and (2) the roost is occupied by a similar composition of species and number of bats that were present in the demolished roost (H.T. Harvey and Associates, 2004). If this standard is not met, KRRC would coordinate with California DFW, as appropriate, to ascertain the potential need for further measures (e.g., modifications to the mitigation roost(s), additional monitoring).

While KRRC's TWMP includes a stipulation that if bat-containing building removal cannot occur during ideal time periods, removal would occur when nighttime temperatures are above 45°F, it is not clear as written whether the removal would occur at night, when bats are active and not roosting in the structure. The TWMP also does not include any weather criteria for the removal period under these circumstances. Modifying the TWMP to explicitly state removal would occur when bats are active and when less than 0.5 inch of rain is predicted within the following 24 hours, as the California Water Board recommends, would reduce the potential for bats to be occupying structures at the time they are removed or sealed and would be more likely to survive exposure, because wet weather can increase potential for hypothermia. However, if structures are occupied by bats in their maternity state, juvenile bats may be unable to vacate the roost prior to demolition. Should it be necessary to remove structures with bat activity between April 16 and August 31, conducting pre-disturbance surveys to determine whether maternity colonies are present, and prohibiting removal of any structures supporting maternity colonies during this period, would reduce potential adverse effects on juvenile bats.

Instead of permanently barricading entrances to portal outlets, tunnels, and other water conveyance structures, KRRC could install bat gates to prevent people from accessing the structures while still providing access for bats. Bat gates consist of horizontal metal bars welded to vertical bars and installed over the entrance of caves and tunnels. Allowing bats to continue to access these areas after license surrender would greatly reduce short-term and potential long-term, adverse effects on bats.

Across the United States, white-nose syndrome (WNS) has been causing large declines in bat populations, especially the little brown bat. WNS is caused by a fungus that infects bats while they hibernate for the winter. It covers their nose, wings, and ears with a white fuzz that invades the bat's skin and causes them to wake from hibernation and burn essential fat reserves that often leads to starvation. The potential occurrence of

WNS and its deadly impacts on bats is of great concern given its steady westward spread across North America since being detected on bats in New York in 2006. The disease reached southwest Washington in 2016 and was documented in California in 2019 (WNS Response Team, 2019). When conducting surveys of project facilities, or monitoring of new roost habitat, project staff could potentially spread WNS from one location to another. Including a measure in the TWMPs that would require project staff entering areas with potential bat activity to follow the National White-Nose Syndrome Decontamination Protocol (WNS Response Team, 2020) would prevent spreading the disease and reduce potential adverse effects on bats.

Staff recommends the TWMP be modified to add additional criteria to the potential removal of structures containing bats during the April 16 and August 31 period. If it is necessary to remove structures during this period, conducting surveys to determine whether the structure is occupied as a maternity roost and prohibiting removal of structures with maternity roosts would reduce potential adverse effects on juvenile bats. In the absence of maternity roosts, ensuring removal would occur when bats are active (i.e., at night) and when less than 0.5 inch of rain is predicted within the following 24 hours would reduce potential adverse effects on adult bats. Additionally, use of bat gates to close portal outlets, tunnels, and other water conveyance structures and development and monitoring of new bat roosting habitat, consistent with recommendations in the California Water Board’s EIR, to mitigate for the reduction in bat roosting habitat associated with the demolition of structures and sealing of entrances to project facilities. Requiring staff entering areas with potential bat activity to follow the National White-Nose Syndrome Decontamination Protocol (WNS Response Team, 2020) would also be appropriate to reduce potential for surveyors to spread the disease while conducting pre-deconstruction surveys or monitoring new roosting habitat. Adverse effects of KRRC’s proposal with staff modifications on bats would be significant in the short term, and permanent and less than significant in the long term.

3.5.5 Effects of the No-action Alternative

Under the no-action alternative, the reservoirs would remain inundated and provide habitat for aquatic reptiles and amphibians and water-dependent birds. There would be no change in riparian vegetation or wetlands. There would be no efforts to control invasive plant species in the project area. The project reservoirs would continue to provide water storage that could be ”borrowed” by Reclamation to supplement water availability at the Lower Klamath and Tule Lake National Wildlife refuges. Project structures would remain in place and continue to provide roosting, hibernating, and maternity colony sites for bats. Effects of the no-action alternative on terrestrial resources range from adverse to beneficial depending on the species.

Table 3.5-1. Upland cover types mapped in the Lower Klamath Project area (Source: KRRC and PacifiCorp, 2020)

CHWR Vegetation Cover Types	Acres	Description, Dominant Species, and Location
All upland tree habitats	26,176	Definition: More than 10 percent total cover by tree species; common around Iron Gate Reservoir.
Montane hardwood oak	5,071	Moderately open tree canopy, dense shrub layer, and dense herbaceous layer. Yellow star-thistle and medusahead occur in approximately 25 percent of stands in the project vicinity. Most abundant around Iron Gate Reservoir, Copco Reservoir, and along J.C. Boyle peaking reach.
Montane hardwood oak-conifer	8,638	Dense tree cover, sparse shrub layer, moderately open herbaceous layer. Most abundant along the J.C. Boyle peaking and bypassed reaches, at Copco Reservoir, at Fall Creek, and along Copco No. 2 bypassed reach.
Montane hardwood oak-juniper	8,968	Open tree layer, sparse shrub layer, dense herbaceous layer. Yellow star-thistle and medusahead occur in 45 percent of stands, primarily around Iron Gate and Copco Reservoirs and along Copco No. 2 bypassed reach. Most abundant cover type in the Lower Klamath Project vicinity.
Ponderosa pine	1,853	Moderate canopy cover, relatively sparse shrub cover, moderately open herbaceous layer. Most abundant at J.C. Boyle Reservoir.
Juniper	881	Open canopy, shrub, and herbaceous layers range from sparse to dense. Most abundant along Link River and along J.C. Boyle peaking reach.
Mixed conifer	700	Dense tree cover is often two-layered, with an open shrub layer and a moderately sparse herbaceous layer. Approximately 70 percent of stands are along J.C. Boyle bypassed reach.
Lodgepole pine	64	Lodgepole pine stands occur along J.C. Boyle bypassed reach and at J.C. Boyle Reservoir as a result of replanting following timber harvest. Sparse tree layer and shrub layer with a dense herbaceous layer.

CHWR Vegetation Cover Types	Acres	Description, Dominant Species, and Location
All upland shrub habitats	4,087	Definition: More than 10 percent total cover by shrub species and less than 0 percent total cover by tree species.
Mixed chaparral	4,014	Requires occurrence of two or more shrub species, each covering 5 percent or more of the area. Very few trees, moderate shrub layer, herbaceous layer varies from sparse to dense. Approximately 60 percent occurs along J.C. Boyle bypassed reach and around Copco Reservoir.
Sagebrush	72	Moderately dense shrub layer, sparse herbaceous layer. This limited habitat type occurs near J.C. Boyle Reservoir.
All upland herbaceous habitats	4,766	Definition: More than 2 percent total cover by herbaceous species and less than 10 percent total cover of tree and/or shrub species.
Annual grassland	4,442	Total shrub cover is less than 1 percent. Nine of the 11 most frequently encountered herbaceous species are introduced species; two are exotic/invasive species: medusahead and yellow star-thistle. Cheatgrass is relatively more abundant in annual grasslands along the J.C. Boyle bypassed reach. Medusahead, hairy brome, and yellow star-thistle dominate grasslands downriver of J.C. Boyle peaking reach. More than 88 percent of the annual grasslands occur along J.C. Boyle peaking reach and around Copco and Iron Gate Reservoirs.
Perennial grassland	324	Sparse shrub cover includes a wide variety of species. A total of 31 graminoid species occurs; 5 introduced annuals, 11 introduced perennials, 2 native annuals, 10 native perennials, 1 native rush, and 2 native sedges. More than 87 percent occurs around J.C. Boyle Reservoir and in the J.C. Boyle peaking and bypassed reaches.
All barren habitats	914	Definition: Less than 2 percent total cover by herbaceous, desert, or non-wildland species; less than 10 percent cover by tree or shrub species.
Rock talus	559	Most rock talus habitats are barren with small patches of vegetation where the talus is thin or at the margins of the talus patch. Two tree, 7 shrub, and 23 herbaceous plant

CHWR Vegetation Cover Types	Acres	Description, Dominant Species, and Location
		species provided sparse cover in rock talus habitats. Particularly abundant along J.C. Boyle peaking and bypassed reaches.
Exposed rock	355	A wide variety of species occurs in the sparse shrub and moderate herb layers. Most abundant along J.C. Boyle peaking and bypassed reaches and Copco No. 2 bypassed reach; does not occur at Link River.
Developed and Disturbed Habitats	1,056	More than 2 percent total vegetation cover is non-wildland vegetation. Includes three developed vegetation types: residential, recreational development, and industrial, where vegetation includes plants grown for landscaping. Also includes agricultural types such as pasture and irrigated hayfields, where vegetation includes plants grown for food and/or fiber. Pastures and irrigated hayfields are distributed over 544 acres. The area along the Klamath River from Iron Gate development to Shasta River has a substantial number of pasture/irrigated hayfields.

Table 3.5-2. Wetland and riparian acreage present at the Klamath Hydroelectric reservoirs (Source: KRRC and PacifiCorp, 2020)

	Iron Gate Reservoir (Acres)	**Copco Lake (Acres)**	**J.C. Boyle Reservoir (Acres)**
Total Wetlands	21.2	12.9	40.0
Reservoir-Dependent[a] Wetlands	9.6	9.4	38.1
Non-Reservoir-Dependent Wetlands	11.6	3.5	1.9[b]
Total Riparian Vegetation	40.8	32.2	n/a
Reservoir-Dependent Riparian Vegetation	10.2	5.3	n/a
Non-Reservoir-Dependent Riparian Vegetation	30.6	26.9	n/a

[a] This total also includes acreage for areas that are dependent on dam-related infrastructure to support wetland hydrology. Riparian areas not mapped in Oregon.

Table 3.5-3. Invasive exotic vegetation in the J.C. Boyle Reservoir uplands (Source: KRRC and PacifiCorp, 2020 and staff)

Scientific Name	**Common Name**	**State Rating**	**Area (square feet)**	**Area (acres)**	**Percent Cover**
Bromus tectorum	cheatgrass	CADFA-C	288,780	6.6	4.3
Dipsacus fullonum	teasel	CAIPC-Moderate	209,250	4.8	3.1
Elymus caput-medusae	medusa head	CADFA-C CAIPC-High	190,960	4.4	2.8
Centaurea solstitialis	yellowstar thistle	CADFA-C CAIPC-High OR B List	61,690	1.4	0.9

Scientific Name	**Common Name**	**State Rating**	**Area (square feet)**	**Area (acres)**	**Percent Cover**
Cirsium vulgare	bull thistle	CADFA-C CAIPC-Moderate OR B List	49,260	1.1	0.7
Lepidium draba	whitetop	CADFA-B CAIPC-Moderate OR B List	46,510	1.1	0.7
Mentha pulegium	pennyroyal	CAIPC-Moderate	17,040	0.4	0.3
Onopordum acanthium	Scotch thistle	CADFA-A CAIPC-High OR B List	13,620	0.3	0.2
Rumex acetosella	sheep sorrel	CAIPC-Moderate	6,370	0.1	0.1
Convolvulus arvensis	field bindweed	OR B List	1,670	< 0.1	< 0.1
Linaria dalmatica	Dalmatian toadflax	CAIPC-Moderate	1,530	< 0.1	< 0.1
Rubus armeniacus	Himalayan blackberry	CAIPC-High OR B List	1,330	< 0.1	< 0.1
Acroptilon repens	Russian knapweed	CADFA-B CAIPC-Moderate OR B List	990	< 0.1	< 0.1
	Total		1,095,210	25.1	16.3

Notes:

CADFA (California Department of Food and Agriculture)-A: A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment.

CADFA-B: A pest of known economic or environmental detriment and, if present in California, it is of limited distribution.

CADFA-C: A pest of known economic or environmental detriment and, if present in California, it is usually widespread.

CAIPC (California Invasive Plant Council) High: These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

CAIPC-Moderate: These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

OR B List: Oregon Department of Agriculture B-Listed species, weeds of economic importance, which is regionally abundant, but which may have limited distribution in some counties).

Table 3.5-4. Invasive exotic vegetation extent in the Copco No. 1 Reservoir uplands (Source: KRRC and PacifiCorp, 2020 and staff)

Scientific Name	**Common Name**	**State Rating**	**Area (square feet)**	**Area (acres)**	**Percent Cover**
Centaurea solstitialis	yellowstar thistle	CADFA-C CAIPC-High OR B List	262,320	6.0	4.4
Elymus caput-medusae	medusa head	CADFA-C CAIPC-High	237,180	5.4	4.0
Phalaris arundinacea	reed canarygrass	NA	199,440	4.6	3.4
Dipsacus fullonum	teasel	CAIPC-Moderate	91,680	2.1	1.6
Bromus tectorum	cheatgrass	CADFA-C	56,790	1.3	1.0
Lepidium draba	whitetop	CADFA-B CAIPC-Moderate OR B List	8,010	0.2	0.1
Mentha pulegium	pennyroyal	CAIPC-Moderate	6,680	0.2	0.1
Cirsium vulgare	bull thistle	CADFA-C CAIPC-Moderate OR B List	2,210	0.1	< 0.1
Conium maculatum	poison hemlock	OR B List	1,260	< 0.1	< 0.1
Tribulus terrestre	puncture vine	CADFA-C CAIPC-Limited	730	< 0.1	< 0.1
Bromus madritensis ssp. rubens	foxtail chess	CAIPC-High	240	< 0.1	< 0.1

Scientific Name	Common Name	State Rating	Area (square feet)	Area (acres)	Percent Cover
Carduus nutans	musk thistle	CADFA-A CAIPC-Moderate OR B List	100	< 0.1	< 0.1
	Total		1,101,230	25.3	18.6

Notes:

CADFA (California Department of Food and Agriculture)-A: A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment.

CADFA-B: A pest of known economic or environmental detriment and, if present in California, it is of limited distribution.

CADFA-C: A pest of known economic or environmental detriment and, if present in California, it is usually widespread.

CAIPC (California Invasive Plant Council) High: These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

CAIPC-Moderate: These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

CAIPC-Limited: These species are invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

OR B List: Oregon Department of Agriculture B-Listed species, weeds of economic importance, which is regionally abundant, but which may have limited distribution in some counties).

Table 3.5-5. Invasive exotic vegetation extent in the Iron Gate Reservoir uplands (Source: KRRC and PacifiCorp, 2020 and staff)

Scientific Name	Common Name	State Rating	Area (square feet)	Area (acres)	Percent Cover
Centaurea solstitialis	yellowstar thistle	CADFA-C CAIPC-High OR B List	4,331,510	99.4	36.1
Elymus caput-medusae	medusa head	CADFA-C CAIPC-High	3,631,210	83.4	30.3
Dipsacus fullonum	teasel	CAIPC-Moderate	321,720	7.4	2.7
Bromus tectorum	cheatgrass	CADFA-C	318,740	7.3	2.7
Rubus armeniacus	Himalayan blackberry	CAIPC-High OR- B List	179,260	4.1	1.5
Convolvulus arvensis	field bindweed	OR B List	64,500	1.5	0.5
Phalaris arundinacea	reed canarygrass	NA	43,300	1.0	0.4
Conium maculatum	poison hemlock	OR B List	29,730	0.7	0.3
Xanthium spinosum	spiny cocklebur	OR B List	16,040	0.4	0.1
Tribulus terrestris	puncture vine	CADFA-C CAIPC-Limited	9,200	0.2	0.1
Isatis tinctoria	dyers woad	CADFA-B CAIPC-Moderate OR B List	3,230	0.1	< 0.1
Lepidium draba	whitetop	CADFA-B CAIPC-Moderate OR B List	2,860	0.1	< 0.1

Scientific Name	Common Name	State Rating	Area (square feet)	Area (acres)	Percent Cover
Mentha pulegium	pennyroyal	CAIPC-Moderate	150	< 0.1	< 0.1
Linaria vulgaris	butter and eggs	CAIPC-Moderate	50	< 0.1	< 0.1
Cirsium vulgare	bull thistle	CADFA-C CAIPC-Moderate OR B List	50	< 0.1	< 0.1
	Total		8,951,550	205.5	74.7

Notes:

CADFA (California Department of Food and Agriculture)-A: A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment.

CADFA-B: A pest of known economic or environmental detriment and, if present in California, it is of limited distribution.

CADFA-C: A pest of known economic or environmental detriment and, if present in California, it is usually widespread.

CAIPC (California Invasive Plant Council) High: These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

CAIPC-Moderate: These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

CAIPC-Limited: These species are invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Table 3.5-6. Bat use or evidence of bat use reported at structures surveyed, June 2017 reconnaissance and 2018 surveys (Source: KRRC and PacifiCorp, 2020)

Location and Building Name	**Suitability[a]**	**Evidence of Bat Use**	**Bat Roosting Confirmed**	**Species Confirmed**	**Survey Dates (All Years)**	**Additional Notes**
Iron Gate						
Lakeview Road Bridge	High	Yes	Yes, 200 bats estimated during summer emergence.	*Myotis yumanensis*	October 2018, June 2019	First emergence survey in June 2019
Diversion Tunnel Outlet	High	Yes	Yes, 200 bats estimated during summer emergence. Absent in winter.	*Myotis yumanensis*	February 2018 (interior), May-June 2018 (emergence only), June 2019 (emergence only)	None
Powerhouse	High	Yes	Yes, 400 bats estimated during summer emergence.	*Myotis yumanensis*	July 2017, May and June 2018, October 2018, June 2019	None
Penstock Intake Structure	High	Yes	Yes, several hundred bats roosting inside at top of	*Myotis yumanensis*	July 2017, June 2018, October 2018	None

Location and Building Name	**Suitability**[a]	**Evidence of Bat Use**	**Bat Roosting Confirmed**	**Species Confirmed**	**Survey Dates (All Years)**	**Additional Notes**
			structure in summer.			
Barn/Garage at Iron Gate Village	High	Yes	Yes, bats present in rafters/ceiling in summer.	*Myotis yumanensis*	July 2017, May and June 2018, October 2018	None
Residence 1 (occupied) blue/gray	Mod-high (attic)	Unknown	Unknown	NA	June 2017 (exterior only)	No interior survey access to occupied residences
Residence 2 (occupied) tan with green roof	Mod-high (attic)	Yes	Yes, 15 (estimated) bats found huddled behind clock on back porch in summer. Potential attic access through loose screen over vent.	*Myotis yumanensis*	July 2017 (exterior only)	No interior survey access to occupied residences
Fish Holding Facilities	Mod	No	No	NA	July 2017, June 2018, October 2018	None
Restrooms (near powerhouse)	Low to mod	No	No	NA	July 2017, June 2018	None

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
Emergency Spill Equipment shed	Low	No	No	NA	July 2018	None
Copco						
Copco No. 1 Diversion Tunnel Outlet	High	Yes	Yes, 100 bats estimated during summer emergence.	None	February 2018 inspection, June 2018 emergence	Access limitations prohibit safe, targeted placement of acoustic recording equipment at or near the mouth of the tunnel
C-12 Gatehouse at Copco No. 1	High	Yes	Yes, estimated 2,000 to 3,000 bats during summer emergence. Several dozen present in late October.	*Myotis yumanensis*	July 2017, June 2018, October–November 2018, June 2019	Maternity roost; largest roost found on project site. Gatehouses C-11 and C-12 are the only project structures found to have bats present in late

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
						October/early November
C-11 Gatehouse at Copco No. 1	High	Yes	Yes, 100 bats estimated during summer emergence. Approximately 20 bats clustered in interior roof apex in late October.	*Myotis yumanensis*	July 2017, June 2018, October–November 2018	Gatehouses C-11 and C-12 are the only project structures found to have bats present in late October/early November.
Copco No. 1 powerhouse	High	Yes	Yes, several dozen bats clustered on walls in transformer bays and small numbers in lower level in summer.	*Myotis yumanensis*	July 2017, February 2018, June 2018, October through November 2018	Abundant staining/guano on lower level but no large roosts found. Small number of Townsend's big-eared bats detected acoustically during summer emergence, but not confirmed to be present in

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
						the powerhouse.
Vacant House (light blue) on Copco Access Road	Mod	No	No	NA	July 2017	None
Maintenance Building (next to switchyard on Copco Access Road)	High	Yes	Yes, 30 bats estimated on summer emergence.	*Myotis* spp.	July 2017, June 2018, October–November 2018, June 2019	First emergence survey in June 2019. One Townsend's big-eared bat call detected on emergence.
Tin Pumphouse (across from light blue house on Copco Access Road)	Low	No	No	NA	July 2017	None
Groundwater Well House (at entrance to Copco Village)	Low to mod	No	No	NA	July 2017, October–November 2018	None
Vacant House 1 (tan)	High	Yes	Yes, small numbers of bats present	*Myotis yumanensis*	July 2017, February 2018, May and	None

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
			under exterior side panels in summer.		June 2018, October–November 2018	
Copco No. 1 Diversion Tunnel Outlet	High	Yes	Yes, 100 bats estimated during summer emergence.	None	February 2018 inspection, June 2018 emergence	Access limitations prohibit safe, targeted placement of acoustic recording equipment at or near the mouth of the tunnel.
C-12 Gatehouse at Copco No. 1	High	Yes	Yes, estimated 2,000 to 3,000 bats during summer emergence. Several dozen present in late October.	*Myotis yumanensis*	July 2017, June 2018, October–November 2018, June 2019	Maternity roost; largest roost found on project site. Gatehouses C-11 and C-12 are the only project structures found to have bats present in late

Location and Building Name	**Suitability**[a]	**Evidence of Bat Use**	**Bat Roosting Confirmed**	**Species Confirmed**	**Survey Dates (All Years)**	**Additional Notes**
						October/early November.
C-11 Gatehouse at Copco No. 1	High	Yes	Yes, 100 bats estimated during summer emergence. Approximately 20 bats clustered in interior roof apex in late October.	*Myotis yumanensis*	July 2017, June 2018, October–November 2018	Gatehouses C-11 and C-12 are the only project structures found to have bats present in late October/early November.
Copco No. 1 Powerhouse	High	Yes	Yes, several dozen bats clustered on walls in transformer bays and small numbers in lower level in summer.	*Myotis yumanensis*	July 2017, February 2018, June 2018, October through November 2018	Abundant staining/guano on lower level but no large roosts found. Small number of Townsend's big-eared bats detected acoustically during summer emergence, but not confirmed to be present in

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
						the powerhouse.
Vacant House (light blue) on Copco Access Road	Mod	No	No	NA	July 2017	None
Maintenance Building (next to switchyard on Copco Access Road)	High	Yes	Yes, 30 bats estimated on summer emergence.	*Myotis* spp.	July 2017, June 2018, October–November 2018, June 2019	First emergence survey in June 2019. One Townsend's big-eared bat call detected on emergence.
Tin Pumphouse (across from light blue house on Copco Access Road)	Low	No	No	NA	July 2017	None
Groundwater Well House (at entrance to Copco Village)	Low to mod	No	No	NA	July 2017, October–November 2018	None
Vacant House 1 (tan)	High	Yes	Yes, small numbers of bats present	*Myotis yumanensis*	July 2017, February 2018, May and	None

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
			under exterior side panels in summer.		June 2018, October–November 2018	
Copco No. 1 Diversion Tunnel Outlet	High	Yes	Yes, 100 bats estimated during summer emergence.	None	February 2018 inspection, June 2018 emergence	Access limitations prohibit safe, targeted placement of acoustic recording equipment at or near the mouth of the tunnel.
C-12 Gatehouse at Copco No. 1	High	Yes	Yes, 2,000 to 3,000 bats estimated during summer emergence. Several dozen present in late October.	*Myotis yumanensis*	July 2017, June 2018, October–November 2018, June 2019	Maternity roost; largest roost found on project site. Gatehouses C-11 and C-12 are the only project structures found to have bats present in late

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
						October/early November.
Copco No. 2 Powerhouse	High	Yes	Yes, 50 bats estimated during summer emergence.	*Myotis yumanensis*	July 2017, February 2018, June 2018, October–November 2018	Six dead Myotis adults and pups found on ground level and lower level in summer. Small number of Townsend's big-eared bats detected acoustically during summer emergence, but not confirmed to be present in the powerhouse.
Maintenance Building (next to Copco No. 2 Powerhouse)	Low	No	No	NA	July 2017, June 2018	None
Copco No. 2 Dam (concrete dam and	Low	No	No	NA	July 2017	None

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
associated structures)						
Control Center at Copco No. 2 Powerhouse	Low	No	No	NA	July 2017, February 2018, June 2018	None
J.C. Boyle						
Office/Red Barn	High	Yes	No	None	July 2017, May and June 2018, October 2018, June 2019	June 2019 survey conducted from outside of perimeter fence due to gate access constraint. Two desiccated dead *Myotis yumanensis* found in attic in 2017. No live bats found to date.
Spillway Control Center	High	Yes	Yes, several hundred bats present in summer.	*Myotis yumanensis*	July 2017, May and June 2018, October 2018	Presumed maternity roost.

Location and Building Name	**Suitability**[a]	**Evidence of Bat Use**	**Bat Roosting Confirmed**	**Species Confirmed**	**Survey Dates (All Years)**	**Additional Notes**
Fish Screen House	Mod-high	No	No	NA	July 2017, June 2018, October 2018	None
Fire Protection Building	Mod	Yes	Yes, outside only, a few bats day roosting in exterior crevices near roof edges (western side and eastern side) in summer.	*Myotis yumanensis*	July 2017, June 2018, October 2018	None
Dam Communications	Mod	No	No	NA	July 2017, June 2018, October 2018	None
J.C. Boyle Powerhouse	Mod	No	No	NA	July 2017, June 2018, October 2018	None
Maintenance Building(next to powerhouse)	Low to mod	No	No	NA	July 2017, June 2018, October 2018	None
Truck Shop	Low to mod	No	No	NA	July 2017, May 2018 and	None

Location and Building Name	Suitability[a]	Evidence of Bat Use	Bat Roosting Confirmed	Species Confirmed	Survey Dates (All Years)	Additional Notes
					June 2018, October 2018	
Headgate Control	Low to mod	No	No	NA	July 2017, June 2018	None
Gate Control and Communications	Low to mod	No	No	NA	July 2017, October 2018	None
Power Canal/Spillway	Low	No	No	NA	July 2017, June 2018	None
HazMat Storage Shed	Low	No	No	NA	July 2017	None
Pump House	Low	No	No	NA	July 2017	None
Two occupied residences	Unknown	Unknown	Unknown	NA	NA	No interior survey access to occupied residences.

Notes: NA = not applicable

[a] "High" suitability was assigned to structures with bats present and/or where signs of heavy bat use were found, or to structures that showed little or no sign of use or could not be accessed but contain external or internal features generally preferred by roosting bats, such as attics/roof spaces, soffits, fascias, weather boarding, spaces between roof felt/membrane and tiles/slates, window frames, cave/cavity walls, flashing, and the like. "Moderate" suitability was assigned to structures where no bats or very few bats were found, with little or no sign of bat use, that contain points of entry/exit and limited internal and external features preferred by roosting bats. "Low" suitability for roosting was assigned to well-sealed structures with no points of entry/exit, and generally lacking cavities, crevices, and other features generally preferred by roosting bats.

Table 3.5-7. Special status plants with potential to occur in Lower Klamath Project Area (Source: KRRC and PacifiCorp, 2020)

Species	**Status**	**Habitat**	**Location of Documented Occurrence(s)**	**Bloom Time**	**Proposed Survey Effort**
Western yellow cedar *Callitropsis nootkatensis*	Petitioned for federal listing, CNPS List 4.3	Wet to moist sites, from the coastal rainforests to rocky ridgetops near the timberline in the mountains.	NA	NA	In construction areas in suitable habitat.
Greene's mariposa-lily *Calochortus greenei*	FSC, BLM, OC, ONHP List 1, CNPS List 1B	Occurs primarily in annual grassland, wedgeleaf ceanothus chaparral, and oak and oak-juniper woodlands.	Several locations around Iron Gate Reservoir (PacifiCorp, 2004a; CNDDB, KRRC, 2019).	May through July	In construction areas in suitable habitat.
Bristly sedge *Carex comosa*	ONHP List 2	Marshes, lake shore, and wet meadows.	East Shore of J.C. Boyle Reservoir in two locations (east of dam and south of Highway 66); also, west of dam (ORBIC	May through September	Along reservoir margins and in construction areas in suitable habitat.

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
			2017, KRRC, 2019).		
Mountain lady's slipper *Cypripedium montanum*	ONHP List 4, CNPS List 4	Dry, open conifer forests, more often in moist riparian habitats.	J.C. Boyle peaking reach (location details unknown) (PacifiCorp, 2004a).	March through August	In construction areas in suitable habitat.
Gentner's fritillary *Fritillaria gentneri*	FE, CNPS List 1B	Cismontane woodland, chaparral and mixed hardwood-conifer vegetation dominated by Oregon oak.	Habitat present in the reach along Copco and Iron Gate Reservoirs; no known locations.	Late March to early April; April and May at higher elevations	In construction areas in suitable habitat.
Bolander's sunflower *Helianthus bolanderi*	BLM, ONHP List 3	Occurs in yellow pine forest, foothill oak woodland, chaparral, and occasionally in serpentine substrates or wet habitats.	South of Iron Gate Reservoir near proposed disposal site, J.C. Boyle peaking reach (location details unknown) (PacifiCorp, 2004a; KRRC, 2019).	June through October	In construction areas in suitable habitat.

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Purple-flowered Washington lily *Lilium washingtonianum ssp. purpurascens*	CNPS List 4	Forest openings, chaparral, burned clearcuts, and roadsides.	Several locations around Copco Lake, including near Copco Road along the seep area (KRRC, 2019).	June through August	Within the limits of work in suitable habitat.
Bellinger's meadow-foam *Limnanthes floccosa ssp. bellingerana*	FSC, BLM, OC, ONHP List 1, CNPS List 1B	High-elevation vernal pools in shallow soiled rocky meadows in spots that are at least partially shaded in the spring.	J.C. Boyle peaking reach (location details unknown) (PacifiCorp, 2004a).	April through June	In construction areas in suitable habitat.
Detling's silverpuffs *Microseris laciniata ssp. detlingii*	CNPS List 2	Chaparral and grassy openings among Oregon white oak trees.	One location on the western side of Iron Gate Reservoir (CNDDB, 2018; KRRC, 2019).	May and June	In construction areas in suitable habitat.
Egg Lake monkeyflower *Mimulus pygmaeus*	FSC, CNPS List 4	Occurs in damp areas or vernally moist conditions in meadows and open woods.	East of J.C. Boyle Reservoir in two locations (north of Highway 66 and southeast of	May through August	Along reservoir margins and in construction areas in suitable habitat.

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
			dam); west of dam in two locations in damp mudflats; also, west of canal near access road in one location (PacifiCorp, 2004a).		
Greene's four o-clock *Mirabilis greenei*	CNPS List 4	Dry slopes and flats among juniper and foothill woodlands, and grasslands.	Along the western side of Iron Gate Reservoir (KRRC, 2019).	May and June	Within the limits of work in suitable habitat.
Holzinger's orthotrichum moss *Orthotrichum holzingeri*	CNPS List 1B.3	Found on vertical calcareous rock surfaces and at the bases of Salix bushes just above rock that is frequently inundated by seasonally high water in dry	Just upstream of Iron Gate Reservoir on Jenny Creek (CNDDB, 2018).	NA	Where instream work could occur at Jenny Creek at bridge.

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
		coniferous forests.			
Western yampah *Perideridia erythrorhiza*	FSC, BLM, OC, ONHP List 1	Occurs in moist prairies, pastureland, seasonally wet meadows, and oak or pine woodlands, often in dark wetland soils and clay depressions.	Along three drainages into the western side of J.C. Boyle Reservoir, and in two locations west of the canal near the access road (PacifiCorp, 2004a; KRRC, 2019).	Mid-July and August	Along reservoir margins and in construction areas in suitable habitat.
Howell's yampah (Howell's false caraway) *Perideridia howelii*	ONHP List 4	Moist meadows and stream banks.	One location along the drainage southeast of J.C. Boyle Reservoir; one location along the northern side of Copco Lake north of the road (PacifiCorp, 2004a).	July and August	Along reservoir margins and in construction areas in suitable habitat.
Yreka phlox *Phlox hirsuta*	FE, CE, CNPS List 1B	Open areas on dry serpentine soils	Not known to occur near	March and April	None – suitable soils, not present

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
		and at elevations ranging from 2,500 to 4,400 feet.	construction areas; no suitable ultramafic soils occur within 0.5 mile of construction areas (NRCS, 2017).		in construction areas.
Strapleaf willow *Salix ligulifolia*	ONHP List 3	Riverbanks, wetlands, and floodplains.	One location west of J.C. Boyle Dam in a boulder flood channel in the dam release zone (ORBIC, 2017; KRRC, 2019).	March through June	Along reservoir margins and in construction areas in suitable habitat.
Fleshy sage *Salvia dorrii var. incana*	CNPS List 3	Occurs in silty to rocky soils in great basin scrub, pinyon, and juniper woodland.	Three locations around Iron Gate Reservoir (PacifiCorp, 2004a; KRRC, 2019).	May through July	In construction areas in suitable habitat.
Lemmon’s silene *Silene lemmonii*	ONHP List 3	Open pine woodlands.	J.C. Boyle peaking reach to J.C. Boyle Reservoir (location details	Spring and Summer	In construction areas in suitable habitat.

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
			unknown) (PacifiCorp, 2004a).		

Notes:

BLM: Bureau of Land Management sensitive species -species that could easily become endangered or extinct.

CE: California Endangered

CNDDB: California Natural Diversity Database

CNPS List 1A: California Native Plant Society (CNPS)-Presumed extinct in California

CNPS List 1B: rare, threatened, or endangered in California and elsewhere

CNPS List 2: rare, threatened, or endangered in California, but more common elsewhere

CNPS List 3: on the review list – more information needed

CNPS List 4: on the watch list – limited distribution

FE: Federal Endangered

FSC: Federal Species of Concern

FWS: United States Fish and Wildlife Service

OC: Candidate listing by Oregon Department of Agriculture

ONHP List 1: Oregon Natural Heritage Program threatened with extinction or presumed to be extinct throughout their entire range

ONHP List 2: threatened with extirpation or presumed to be extirpated from the State of Oregon

ONHP List 3: more information is needed before status can be determined, but may be threatened or endangered in Oregon or throughout their range

ONHP List 4: of conservation concern but not currently threatened or endangered

ORBIC: Oregon Biodiversity Information Center

Table 3.5-8. Recorded special status plant species at project reservoirs and transmission line corridors (Source: KRRC and PacifiCorp, 2020)

Species	**Location**		
	Iron Gate Reservoir	**Copco No. 1 Reservoir**	**J.C. Boyle Reservoir**
Greene’s mariposa-lily *Calochortus greenei*	Several locations in the vicinity of Iron Gate Reservoir, including within the footprint of the Iron Gate disposal site.	Along utility corridors between the Copco No. 1 and Copco No. 2 Dams, and between Copco No. 2 Dam and Daggett Road Bridge.	
Detling's silverpuffs *Microseris laciniata* ssp. *detlingii*	Present in Iron Gate disposal site east of dam; also, along utility corridor on the southeastern side of the reservoir.	Along the utility corridor between Copco No. 2 Dam and Daggett Road Bridge.	
Bolander’s sunflower *Helianthus bolanderi*	Present in the Iron Gate disposal area east of the dam; present in the transmission line corridor to west of Jenny Creek confluence.	Observed in the transmission line corridor northwest of the reservoir.	A large group was observed on the eastern shore in Klamath Sportsman’s Park.
Fleshy Sage *Salvia dorrii* var. *incana*	Two locations near Iron Gate Reservoir; both in proximity to but outside of the construction footprint for removal of utility poles.		
Western Yampah *Perideridia erythrorhiza*			North of the J.C. Boyle Dam in a dry meadow; will likely be outside the area of effect

Species	**Location**		
	Iron Gate Reservoir	**Copco No. 1 Reservoir**	**J.C. Boyle Reservoir**
			from the drawdown of the reservoir.
Bristly sedge *Carex comosa*			Observed in three locations in Klamath Sportsman Park wetlands on the eastern shore north of the Highway 66 Bridge.
Greene’s four o’clock *Mirabilis greenei*	Observed in the utility corridor on the northeastern side of the reservoir.	Observed in four locations along the northern side of the Klamath River, downstream of the Copco No. 2 Dam.	
Purple-flowered Washington lily *Lilium washingtonianum* ssp. *purpurascens*	Near the Fall Creek diversion.	Along the northern side of Copco Lake; several observations in mountain seepage -associated wetlands along the northwestern shore of the reservoir.	
Strapleaf willow *Salix ligulifolia*			Observed along the river just downstream of the J.C. Boyle Dam.

Table 3.5-9. Special status wildlife species with potential to occur in the Lower Klamath Hydroelectric project area (Source: KRRC and PacifiCorp, 2020)

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
Invertebrates			
Hooded lancetooth *Ancotrema voyanum*	BLMS	Limestone substrates, mostly in an elevation range of 550–3,100 feet	Species was documented in 1992 approximately 4 miles southwest of Orleans and approximately 0.2 miles from the Klamath River (greater than 100 river miles downstream of Iron Gate Dam).
Oregon shoulderband *Helminthoglypta hertleini*	BLMS	Found on basaltic talus slopes where ground cover/moisture is present; adapted to dry conditions during a portion of the year	Single occurrence has been documented approximately 100 river miles downstream of Iron Gate Dam (no documentation date).
Trinity shoulderband *Helminthoglypta talmadgei*	BLMS	Limestone rockslides, litter in coniferous forests, old mine tailings, and along shaded streams	Single occurrence documented at mine tailings in 1954 more than 100 river miles downstream of Iron Gate Dam (PacifiCorp, 2017a).
Siskiyou shoulderband *Monadenia chaceana*	BLMS	Lower reaches of major drainages. Talus and rockslides, under rocks and woody debris in moist conifer forests, caves, and riparian corridors in shrubby areas	Single occurrence has been documented approximately 0.25 river miles downstream of Copco No. 2 Dam in a lava rockslide (no documentation date).
Tehama chaparral *Trilobopsis tehamana*	FSS, BLMS	Rocky talus and under leaf litter or woody debris within approximately 330 feet of limestone outcrops	Two occurrences in 1990 and 1994—one sighting near the Klamath River and another along the hill slope. Both occurrences are more 20 river miles downstream of Iron Gate Dam.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
Western bumble bee *Bombus occidentalis*	FSS	Shrub, chaparral, and open grassy areas (urban parks, mountain meadows)	Six sightings from 1969 and earlier are located more than 70 river miles downstream of Iron Gate Dam.
Amphibians			
Southern torrent (southern seep) salamander *Rhyacotriton variegatus*	FSS, SSC	In and adjacent to cold, permanent, well-shaded mountain springs, waterfalls, and seeps with rock substrate	Not observed in California during the PacifiCorp surveys. Approximately 10 sightings have been recorded, approximately 50 river miles or more downstream from Iron Gate Dam typically along tributaries or at the confluence to the Klamath River; the most recent sighting was from 2007. Found to be widespread in the tributaries of the Lower Klamath River, but due to lack of suitable habitat, is not expected to occur in the mainstem of the Lower Klamath River.
Scott Bar salamander *Plethodon asupak*	ST	Rocky forested areas, especially thick moss-covered talus; elevation range of 1,500–2,000 feet	Not documented in California during the PacifiCorp surveys. Documented at four locations approximately 30 river miles downstream of Iron Gate Dam between 1996 and 2005.
Siskiyou Mountains salamander *Plethodon stormi*	ST	Loose rock talus on north-facing slopes or in dense wooded areas; also, under bark near talus	Not documented in California during the PacifiCorp surveys.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
			Documented at five locations approximately 30 river miles downstream of Iron Gate Dam between 1972 and 2003.
Pacific tailed frog *Ascaphus truei*	SSC	In and adjacent to cold, clear, moderate- to fast-flowing, perennial mountain streams in conifer forest	Not documented in California during the PacifiCorp surveys. Observed at the confluence of a tributary approximately 60 river miles downstream from Iron Gate Dam in 1989. Farther downstream, five additional sites are documented along tributaries to the Klamath or at the confluence. Widespread in tributaries of Lower Klamath River, but due to lack of suitable habitat for these species, is not expected to occur in the mainstem of the Lower Klamath River.
Northern red-legged frog *Rana aurora*	SSC	Breeds in still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow-moving stream reaches with permanent pools; uses adjacent uplands for dispersal and summer retreat	Not documented in California during the PacifiCorp surveys. A 1995 sighting was documented approximately 20 river miles upstream of the Klamath River Estuary; species located along the north bank of the Klamath River along mats of vegetation.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
Reptiles			
Northern sagebrush lizard *Sceloporus graciosus*	BLMS	Inhabits sagebrush, chaparral, juniper woodlands, and dry conifer forests	Documented during PacifiCorp surveys near the edge of a forested wetland along Iron Gate Reservoir. Documented during 2018 surveys in several areas surrounding Copco No. 1 Reservoir including a large population in a rocky area to the east of Fall Creek, and Iron Gate Reservoir including Bogus Creek fish hatchery, Long Gulch Cove shoreline, Jenny Creek shorelines, and recreational areas.
California mountain kingsnake *Lampropeltis zonata*	BLMS	Inhabits a wide range of habitats, including coniferous forest, oak-pine woodlands, and riparian woodland	Observed by KRRC biologists on a rocky outcrop below the J.C. Boyle dam during 2018 surveys.
Birds			
Common loon *Gavia immer*	SSC	Breeds in forested lakes and large ponds, and inhabits a wide array of waterbodies outside of breeding season	Documented by KRRC biologists at Copco Lake during 2018 surveys.
Bank swallow *Riparia*	ST	Nests on cliffs and steep banks, often alongside large waterbodies	One individual was documented during 2018 surveys among a group of tree and cliff swallows near Copco Dam.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
American white pelican *Pelecanus erythrorhynchos*	SSC	Nests at lakes and marshes and uses almost any lake outside of the breeding season	Documented during PacifiCorp surveys—55 pelicans on Copco No. 1 Reservoir and 107 pelicans on Iron Gate Reservoir. Documented at Copco No. 1 and Iron Gate Reservoirs. Documented during 2018 surveys throughout Copco No. 1 Reservoir near the dam and in Keaton Cove and at Iron Gate Reservoir, including Mirror Cove, Juniper Point, upstream extent of the reservoir, and near the boom in front of Iron Gate Dam.
Barrow's goldeneye *Bucephala islandica*	SSC	May be found in northern California during the winter (non-breeding season) along open-water and riverine habitat. Nests in cavities, including artificial nest boxes	Documented during PacifiCorp surveys at Copco and Iron Gate Reservoirs primarily between January and April, prior to northward migration. Documented at Iron Gate Reservoir and on the Klamath River downstream of Iron Gate Dam.
Bald eagle *Haliaeetus leucocephalus*	BGEPA, BLMS, FSS SFP/SE	Large bodies of water or rivers with abundant fish; uses adjacent snags or other perches; nests and winter communal roosts in advanced-successional conifer forest within approximately 1 mile of open water	Documented during the KRRC surveys, two vacant bald eagle nests—one within 0.5 miles of Copco Reservoir and one located between 0.5–2 miles of Iron Gate Reservoir. Documented in 1997 along Klamath River, and about 2 miles from Copco Nos. 1 and 2 Dams. Documented during PacifiCorp surveys at J.C. Boyle and Copco No. 1 Reservoirs. The highest

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
			number of bald eagles (12) was found at Copco No. 1 Reservoir.
Northern harrier *Circus cyaneus*	SSC	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields	Documented during PacifiCorp surveys along Klamath River from Iron Gate Dam to Shasta River. Documented along Copco No. 1 Reservoir, along Iron Gate Reservoir and tributaries, and Klamath River downstream of Iron Gate Dam.
Northern goshawk *Accipter gentilis*	FSS, BLMS, SSC	Mature and old-growth stands of coniferous forest, middle and higher elevations; nests in dense part of stands near an opening	Documented during PacifiCorp surveys flying over J.C. Boyle peaking reach. Documented in 1981 more than 80 river miles downstream of Iron Gate Dam.
Swainson's hawk *Buteo swainsoni*	BLMS, ST	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	Documented occurrences within the project Vicinity near agricultural fields approximately 10 miles east of Copco No. 1 Reservoir.
Golden eagle *Aquila chrysaetos*	BGEPA, SFP	Open woodlands and oak savannahs, grasslands, chaparral, sagebrush flats; nests on steep cliffs or large trees	Documented during PacifiCorp surveys along lower reaches of J.C. Boyle peaking reach and Iron Gate and Copco No. 1 Reservoirs. Also documented along the Klamath River, downstream of Iron Gate Dam. Two occupied golden eagle nests were documented during the KRRC surveys within 2 miles of Copco No. 1 Reservoir and three inactive nests were documented within 2 miles

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
			of Iron Gate Reservoir. In May 2018, a golden eagle was observed at Copco No. 1 Reservoir perched on a slope on the northern shoreline, a pair was observed near a northern cove, and one was observed bathing in the shallow water.
American peregrine falcon *Falco peregrinus*	SFP	Wetlands, woodlands, cities, agricultural lands, and coastal area with cliffs (and rarely broken-top, predominant trees) for nesting; often forages near water	Documented around Iron Gate Reservoir. Documented near Iron Gate Dam along the Klamath River.
Greater sandhill crane *Grus canadensis tabida*	FSS, BLMS, ST, SFP	Forages in freshwater marshes and grasslands as well as harvested rice fields, corn stubble, barley, and newly planted grain fields	Documented nesting habitat at J.C. Boyle Reservoir in May 2018. Documented during the PacifiCorp surveys at J.C. Boyle Reservoir. Other sightings in ponds and near agricultural fields east of Yreka.
Black tern *Chlidonias niger*	SSC	Nests semi-colonially in protected areas of marshes	Documented during PacifiCorp surveys at J.C. Boyle Reservoir.
Great gray owl *Strix nebulosi*	FSS, SE	Dense, coniferous forest, usually near a meadow for foraging; nests in large, broken-topped snags	Documented during PacifiCorp surveys east of Fall Creek near Jenny Creek.
Black swift *Cypseloides niger*	SSC	Nests in moist crevices behind or beside permanent or semi-permanent waterfalls in deep canyons, on perpendicular sea cliffs above surf, and in sea caves; forages widely over many habitats	Not documented in California during the PacifiCorp surveys. Single occurrence is known from 1982 along the banks of the Klamath River, over 100 river miles downstream of Iron Gate Dam.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
Vaux's swift *Chaetura vauxi*	SSC	Redwood and Douglas fir habitats with large snags, especially forest with larger basal hollows and chimney trees	Documented during PacifiCorp surveys at Copco No. 1 and Iron Gate Reservoirs, along the J.C. Boyle peaking reaches, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River.
Olive-sided flycatcher *Contopus cooperi*	SSC	Primarily advanced-successional conifer forests with open canopies	Documented during PacifiCorp surveys along Iron Gate Reservoir and J.C. Boyle peaking reach. Observed during 2018 surveys at the northern coves and riparian woodlands at Copco No. 1 Reservoir.
Willow flycatcher *Empidonax traillii*	FSS, SE	Dense brushy thickets within riparian woodland often dominated by willows and/or alder, near permanent standing water; uses brushy, early-succession forests (e.g., clearcuts) in the Pacific Northwest	Documented during PacifiCorp surveys in riparian and wetland habitats along shoreline of Copco No. 1 and Iron Gate Reservoirs, along J.C. Boyle peaking reach, and along Klamath River from Iron Gate Dam to Shasta River. Documented near Iron Gate Reservoir at Jenny Creek in 2008. Observed during 2018 surveys at Copco No. 1 Reservoir in northern cove at the confluence of West Fork Beaver Creek, Beaver Creek, and East Fork Beaver Creek in fringe willow.
Tricolored blackbird *Agelaius tricolor*	SE, SSC	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a	A single sighting in 2011 at Copco No. 1 Reservoir and potential for the species to occur

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
		protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey	due to the potential presence of suitable habitat (open foraging area adjacent to aquatic habitat). Flock of approximately 25 observed in an agricultural field along Yreka Ager Road, located approximately 12 miles southwest of the Bogus Creek Fish Hatchery.
Yellow warbler *Setophaga petechia*	SSC	Open canopy, deciduous riparian woodland close to water, along streams or wet meadows	Documented during PacifiCorp surveys at all Lower Klamath Project reservoirs and reaches. Documented along the Klamath River downstream of Iron Gate Dam. Observed around Copco No. 1. Reservoir and most frequent in riparian woodlands and hillside seep areas and at Iron Gate Reservoir, including Bogus Creek fish hatchery, Brush Creek, Camp Creek, and Jenny Creek.
Yellow-breasted chat *Icteria virens*	SSC	Early successional riparian habitats with a dense shrub layer and an open canopy	Documented during PacifiCorp surveys in wetland and riparian habitats along J.C. Boyle peaking reach, at Copco No. 1 Reservoir, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Documented during 2018 surveys in the northern cove of Iron Gate Reservoir near Camp Creek and Horseshoe Ranch Wildlife Area, and at Fall Creek and along the southern portion of Copco No. 1 Reservoir, near Ager-Beswick Road east of Keaton Cove.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
Mammals			
Western mastiff bat *Eumops perotis californicus*	SSC	Variety of habitats including desert scrub, chaparral, oak woodland, ponderosa pine, mid-elevation conifer (e.g., giant sequoia); roosting habitat mostly associated with significant rock features; forages seasonally at high elevations	Not documented in California during PacifiCorp surveys. Documented at Medicine Lake, Siskiyou County. Range includes the Primary Area of Analysis.
Townsend's western big-eared bat *Corynorhinus townsendii*	FSS, BLMS, SSC	Roosts in cavities, usually tunnels, caves, buildings, and mines, but also rock shelters, preferentially close to water Caves near water's edge are favored	Not documented in California during the PacifiCorp surveys. Two documented occurrences in 1997 at bridges approximately 40 river miles downstream of Iron Gate Dam. Suitable habitat (e.g., human-made structures) is present in the limits of work. Structures providing habitat for a non-special status bat (*Yuma myotis*) were documented at Copco No. 1 Powerhouse and Iron Gate south gatehouse, which may support other bat species.
Spotted bat *Euderma maculatum*	BLMS, SSC	Roosts in cracks, crevices, and caves, usually high in fractured rock cliffs solitary or in small groups	Suitable habitat for this species (e.g., large dam faces) may be present in the limits of work. Although not documented during PacifiCorp roost surveys, species speculated to be rare, but widely distributed, and as a result may be in Primary Area of Analysis.

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
Pallid bat *Antrozous pallidus*	FSS, BLMS, SSC	Roosts in rock crevices, live or dead tree hollows, mines, caves, and a variety of vacant and occupied structures or buildings	Not documented in California during PacifiCorp surveys; however, the presence of a roost site was documented by one dead individual (*Yuma myotis*), and that it is possible that sites with confirmed evidence of bat use support aggregations of more than one species. No CNDDB occurrences are documented within the Primary Area of Analysis. Suitable habitat is present in the limits of work. Structures providing habitat for a non-special status bat species (*Yuma myotis*) were documented at the Copco No. 1 Powerhouse and the Iron Gate south gatehouse, which, along with other structures, trees, rock crevices in the area, may support other bat species.
Fringed myotis *Myotis thysanodes*	BLMS, FSS	Roosts in crevices, cavities, and foliage in a wide variety of habitats including rock crevices, caves, mines, buildings and bridges, and large-diameter snags	Not documented in California during PacifiCorp surveys; however, it was noted that the presence of a roost site was documented by one dead individual (*Yuma myotis*), but sites with confirmed evidence of bat use support aggregations of more than one species. No CNDDB occurrences are documented within the Primary Area of Analysis. Suitable habitat is present in the limits of work. Structures providing habitat for *Yuma myotis* were documented at Copco No. 1 Powerhouse

Species	Status	Habitat Association	Available Habitat and Occurrence Information within the Project Area
			and Iron Gate south gatehouse, which, along with other structures, trees, rock crevices in the area, may support other bat species. Habitat for *Myotis* species inside Copco No. 1 C-12 gatehouse as a maternity roost of more than 2,000 Myotis spp. (species not identified) confirmed in June 2018 and several hundred bats (species not identified) also roosting at Copco No. 1 diversion tunnel and Iron Gate diversion tunnel.
Long-eared myotis *Myotis evotis*	BLMS	Roosts in bridges, buildings, under exfoliating tree bark, and in hollow trees, caves, mines, cliff crevices, sinkholes, rocky outcrops on the ground	Not documented in California during PacifiCorp surveys; however, it was noted that the presence of a roost site was documented by one dead individual (*Yuma myotis*), but sites with confirmed evidence of bat use support aggregations of more than one species. Suitable habitat (e.g., human-made structures) is present in the limits of work. Habitat for *Myotis* species inside Copco No. 1 C-12 gatehouse as a maternity roost of more than 2,000 *Myotis* spp. (species not identified) was confirmed in June 2018 and several hundred bats (species not identified) also roosting at Copco No. 1 diversion tunnel and Iron Gate diversion tunnel.

Species	**Status**	**Habitat Association**	**Available Habitat and Occurrence Information within the Project Area**
Yuma myotis *Myotis yumanensis*	BLMS	Roosts in bridges, buildings, cliff crevices, caves, mines, and trees	Structures providing habitat for *Yuma myotis* were documented at the Copco No. 1 Powerhouse and the Iron Gate south gatehouse. Habitat for *Myotis* species inside Copco No. 1 C-12 gatehouse as a maternity roost of more than 2,000 *Myotis* spp. (species not identified) was confirmed in June 2018 and several hundred bats (species not identified) also roosting at Copco No. 1 diversion tunnel and Iron Gate diversion tunnel.
American badger *Taxidea taxus*	SSC	Shrubland, open grasslands, fields, and alpine meadows with friable soils	Not documented in California during PacifiCorp surveys. A single occurrence (unknown date) was documented approximately 2 miles upstream of Copco No. 1 Reservoir.

Notes: BGEPA = Federally protected under the Bald and Golden Eagle Protection Act; CNDDB = California Natural Diversity Database; FSS = Forest Service Sensitive species; BLMS = Bureau of Land Management Sensitive Species; SE = Listed as Endangered under the California Endangered Species Act; ST = Listed as Threatened under the California Endangered Species Act; SCT = State Candidate Threatened; SSC = California DFW Species of Special Concern; SFP = California DFW Fully Protected species

3.6 THREATENED AND ENDANGERED SPECIES

In this section, we describe the status and biology of federally threatened and endangered species, or candidates for listing under the ESA that may occur in the Lower Klamath Project area or may be affected by the proposed action. Information is provided about the status, occurrence, and threats to each species. Additionally, potential effects of climate change are discussed. Information about each species' range, habitat, and life history is provided in table 3.6-1.

3.6.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for threatened and endangered aquatic species includes the Klamath River extending from Keno Dam to the Pacific Ocean and its tributaries within that reach, reservoir footprint, and deconstruction sites with associated activities. The temporal extent of our effects analysis ranges from permanent draining of reservoirs and short-term effects of drawdown and deconstruction activities, including high SSCs that are expected to persist for several months after drawdown, to permanent improvements in access for coho salmon and green sturgeon to historical habitat in the Klamath River and its tributaries and reduced disease incidence within their migratory corridor in the Lower Klamath River and the restoration of more natural habitat conditions for threatened and endangered species of fish and wildlife in the Klamath River and reservoir footprints.

The geographical scope of analysis for threatened and endangered wildlife species varies depending on habitat requirements of the species. Our geographical area varies from 0.25 to 1.0 mile around deconstruction and disposal sites near any northern spotted owl activity centers; project facilities and associated structures for little brown bat; 0.25-mile area around project reservoirs for western pond turtle; project reach and the Klamath River downstream of Iron Gate for Oregon spotted frog; and disturbed sites in the hydroelectric reach for Franklin bumble bee, western bumble bee, and monarch butterfly.

3.6.2 Affected Environment

3.6.2.1 Southern Oregon/Northern California Coastal ESU Coho Salmon

The SONCC ESU of coho salmon was listed as threatened in 1997 (62 FR 24588) and includes all natural-origin populations of coho salmon in coastal streams between Cape Blanco, Oregon, and Punta Gorda, California. The SONCC coho salmon ESU includes the Klamath River drainage up to Spencer Creek. Coho salmon propagated at the Cole Rivers, Trinity River, and Iron Gate Hatcheries are considered part of the SONCC ESU (NMFS, 2001). Critical habitat was designated for coho salmon in 1999 (64 FR 24049) and consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats) in hydrologic units and counties identified in table 6 of 50 C.F.R. § 226.210. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Inaccessible reaches are those above specific dams identified in table 6 of 50 C.F.R. § 226.210, or above longstanding, naturally impassable barriers. Tribal lands are specifically excluded from critical habitat for this ESU.

In the most recent NMFS (2016a) five-year status review for the SONCC ESU, all Klamath River populations were at moderate to high extinction risk largely because of decreases in spawner densities. Available data from research and monitoring populations in this ESU indicate that spawner abundance has substantially declined since the previous status review, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now rare or absent (Williams et al., 2011; NMFS, 2016a). The ESU is considered likely to become endangered within the foreseeable future and there is heightened risk to the persistence of the ESU as population viability parameters continue to decline (NMFS, 2021b).

Project Occurrence—The distribution and abundance of coho salmon populations in the Klamath River Basin is discussed in section 3.4.2.2, *Anadromous Fish Populations*. Williams et al. (2006) describe nine historical coho salmon populations in the Klamath River Basin, including: (1) the Klamath River and its tributaries from Iron Gate Dam downstream to Portuguese Creek, excluding the Shasta and Scott Rivers; (2) the Shasta River; (3) the Scott River; (4) the Klamath River and its tributaries from Portuguese Creek to the Trinity River excluding the Salmon River; (5) the Salmon River; (6) the Upper Trinity River; (7) the Lower Trinity River; (8) the South Fork Trinity River; and (9) the Lower Klamath River and its tributaries and from the Trinity River downstream to the Klamath River mouth.

Threats—Factors that have contributed to coho salmon declines include the loss of freshwater and estuarine habitat, hydropower development, poor ocean conditions, overfishing, and hatchery practices. As described in the Final Recovery Plan (NMFS, 2014a) and the latest five-year review (NMFS, 2016a), several activities related to human uses of land and water affect the viability of the SONCC ESU. NMFS identified the factors that led to the decline of the species (62 FR 24588) and the stresses and threats associated with those factors. These “listing factors” and current stresses and threats are described in chapter 1 and 3, respectively, of the SONCC ESU Recovery Plan (NMFS, 2014a). The key limiting stresses and threats identified for each of the nine Klamath River Basin coho salmon populations are listed in table 3.6-2.

From 2014 through 2016, SONCC coho salmon in the Klamath River and its tributaries have been adversely affected by drought conditions and resulting low stream flows and increased water temperatures, further exacerbating fish stress and disease. Drought conditions returned to the Klamath River Basin in 2020 (Reclamation, 2020b, as cited in NMFS, 2021b), and the states of California and Oregon declared a state of drought emergency in the Klamath River Basin in early 2021 due to unusually low snowpack and lack of precipitation (State of California, 2021a; Oregon, 2021).

New information since the SONCC ESU was listed suggests that a warming of the earth's climate could significantly affect ocean and freshwater habitat conditions (Intergovernmental Panel on Climate Change, 2014), which affects survival of coho salmon (Moyle et al., 2013) and makes salmon recovery targets more difficult to attain (Battin et al., 2007). Of all the Pacific salmon species, coho salmon are likely one of the most sensitive to climate change because of their extended freshwater rearing. Additionally, the SONCC ESU is near the southern end of the species' distribution, and many populations reside in degraded streams that have water temperatures near the upper limits of thermal tolerance for coho salmon. The threat of climate change to SONCC ESU coho salmon is discussed in detail in the NMFS (2014a) Recovery Plan.

Climate change projections, as described in section 3.2.2.1, are expected to increasingly affect coho salmon via changes in seasonality of runoff, decreased snow water equivalent, decreased snowpack, and warmer air and water temperatures. Effects of climate change in the Klamath River Basin were documented in Hamilton et al. (2010), and as discussed previously in section 3.2.2.1, evidence suggests that water temperatures have been increasing around 0.5°C per decade since the early 1960s (Bartholow, 2005). Reduced flows can cause increases in water temperature, resulting in increased heat stress to coho salmon and thermal barriers to migration. The climate change vulnerability assessment for south-central Oregon (Halofsky et al., 2019) found that the distribution and abundance of cold-water fish species are expected to decrease in response to higher water temperature, although effects will vary as a function of local habitat and competition with non-native fish.

According to NMFS (2019a), projected climate change will cause earlier and declining low flows and earlier and increasing high flows because a greater proportion of winter precipitation is likely to occur as intense rain or rain-on-snow events. Extreme wet and dry periods are also projected. Increased flooding could scour coho salmon eggs from their redds or displace overwintering juveniles, while lower low flows are likely to increase summer water temperatures and decrease available salmon habitat. Increasing freshwater temperatures could have several effects on coho salmon, including reduced thermal refugia in cold-water habitats, increased variability in juvenile rearing habitat quality and quantity in tributaries, altered seasonal migration patterns, accelerated embryo development, premature emergence of fry, increased bio-energetic and disease stresses, and increased competition with other species (NMFS, 2019a). In addition, changing ocean conditions driven by climate change may negatively influence ocean survival of coho salmon (Doney et al., 2012). Increases in ocean water temperature influence most coho salmon life stages via heat stress, changes in growth and development rates, lowering disease resistance, and shifting foraging conditions. Changes in ocean foraging conditions are particularly important because zooplankton communities shift to species that are more tolerant of warm water, which contain less lipid-rich tissue that colder-water species (NMFS, 2016a). Ocean acidification also has the potential to affect the ocean food web, which could negatively affect coho salmon that have to alter their foraging behavior and migration patterns (Crozier, 2016; Halofsky et al., 2019).

3.6.2.2 Southern DPS Green Sturgeon

The Southern DPS of North American green sturgeon was listed as threatened in 2006 (71 FR 17757). This DPS includes all spawning populations south of the Eel River, encompassing coastal or Central Valley populations and with the only known spawning population in the Sacramento Feather Rivers. In 2009, NMFS published a final rule designating critical habitat for Southern DPS green sturgeon that does not include any portion of the Klamath River Basin as critical habitat (74 FR 52300). The coastal marine areas around the Klamath River estuary are designated as critical habitat for Southern DPS green sturgeon. Critical habitat includes the following primary constituent elements in freshwater rivers: abundant prey items for larval, juvenile, sub-adult, and adult life stages; suitable substrates for egg deposition and development, larval development, and sub-adults and adults; a flow regime suitable for normal behavior, growth, and survival of all life stages; and suitable water quality, including temperature, salinity, oxygen content, and other chemical characteristics. In addition to information about the Southern DPS' range, habitat, and life history, the green sturgeon is discussed previously in section 3.4.2.2, *Anadromous Fish Populations*.

Project Occurrence—Green sturgeon in the Klamath River belong to the northern green sturgeon DPS, which is not federally listed, but NMFS has designated as a Species of Concern. Although the presence of Southern DPS green sturgeon has not been documented in the Klamath River, sub-adult and adult Southern DPS green sturgeon enter coastal bays and estuaries north of San Francisco Bay, California, during the summer and fall to forage (Moser and Lindley, 2007; Reclamation, 2010b), and Southern DPS green sturgeon sub-adult and adult life stages could use the Klamath River estuary (NMFS, 2018). However, no Southern DPS green sturgeon tagged in the Sacramento/San Joaquin and/or San Francisco Bay region have ever been detected in the Klamath River despite the presence of functioning acoustic receivers in the Klamath River estuary (McCovey, 2011).

Population estimates for the Southern DPS green sturgeon are not available, but Dual Frequency Identification Sonar surveys in the Sacramento River, which began in 2010, have been used to estimate the abundance of Southern DPS adults at 1,348 ± 524 (NMFS, 2015). Since there are no past survey data or abundance estimates, these recent population estimates do not provide a basis for evaluating trends in the status of the Southern DPS.

Threats—The listing rule for Southern DPS green sturgeon indicates that the principal factor for the decline in the DPS is the reduction of spawning to a limited area in the Sacramento River (71 FR 17757). Other threats include altered hydrologic and thermal regimes in spawning areas, contaminants (e.g., pesticides), bycatch of green sturgeon in fisheries, potential poaching (e.g., for caviar), entrainment and potential stranding of juveniles by water projects, influence of exotic species, small population size, and impassable migration barriers. An emerging threat is the development and operation of offshore and nearshore energy projects (NMFS, 2015).

Predicting climate change effects on green sturgeon is challenging because they occupy numerous marine environments with a wide range of salinities, temperatures, and DO levels (NMFS, 2015). Green sturgeon are vulnerable to climate change if it degrades or destroys spawning habitats (California DFW, 2021), where stable and sufficient flow rates are necessary to maintain water temperatures within the appropriate range for egg, larval, and juvenile survival and development. Increased winter runoff and reduced spring and summer flows over the course of the 21st century may affect the timing and success of Southern DPS green sturgeon spawning (Sardella and Kultz, 2014; NMFS, 2015).

3.6.2.3 Southern DPS Eulachon

The Southern DPS of Pacific eulachon (Southern DPS eulachon), an anadromous smelt in the northeastern Pacific Ocean, was listed as a threatened species in 2010 (75 FR 13012). This DPS encompasses all populations in the states of Washington, Oregon, and California, and extends from the Skeena River in British Columbia (inclusive) south to the Mad River in northern California (inclusive). The DPS is divided into four subareas: Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River (KRRC, 2021f). In 2011, NMFS published a final rule designating critical habitat for Southern DPS eulachon that includes as critical habitat the lowest 10.7 river miles of the Klamath River, from the Klamath River mouth to the Klamath River confluence with Omogar Creek; however, critical habitat does not include any Tribal lands of the Yurok Tribe or the Resighini Rancheria (76 FR 65324).

Project Occurrence—Historically, the Klamath River was described as the southern range limit of eulachon, and large spawning aggregations have historically occurred in the lowermost reaches of the river. Moyle (2002) indicates that eulachon have been scarce in the Klamath River since the 1970s, except for three years: they were plentiful in 1988, and moderately abundant again in 1989 and 1998. After 1998, eulachon were thought to be extinct in the Klamath River Basin, until a small run was observed in the estuary in 2004. Eulachon appear to be more abundant in the Klamath River than at the time of listing in 2010, with adults being documented in the Klamath River in the spawning seasons of 2011 to 2014; however, spawning estimates were not possible to calculate (Gustafson et al., 2016; NMFS, 2017).

Threats—At the time of listing, NMFS concluded that the major threats to eulachon included climate change impacts on ocean conditions and freshwater habitat, bycatch in offshore shrimp trawl fisheries, changes in downstream flow timing and intensity due to dams or water diversions, and predation (75 FR 13012, Gustafson et al., 2010). The NMFS (2017) Recovery Plan for Southern DPS Eulachon performed a threat assessment for subpopulations of the Southern DPS, listing 13 threats to the Klamath subpopulations. The greatest identified threat is climate change impacts on ocean conditions. Five other threats were classified as moderate, including: dams/water diversions, bycatch, climate change impacts on freshwater habitats, predation, and water quality.

Eulachon are a cold-water species; therefore, elevated temperatures in both freshwater and marine habitats are expected to be detrimental to their growth and survival. Projected ocean warming may contribute to a mismatch between eulachon life history and preferred prey species and is likely to result in an altered distribution of both predators on eulachon and competitors for food resources. These conditions would likely have significant negative impacts on marine survival rates of eulachon (NMFS, 2016a).

3.6.2.4 Southern Resident DPS Killer Whale

In the Pacific Northwest, the group of killer whales that feed almost exclusively on salmon are referred to as "residents" because they remain in inland or nearby coastal waters. The Southern Resident killer whale is one of four distinct resident subgroups recognized. It consists of three pods, identified as J, K, and L pods, that reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall (Krahn et al., 2002). The Southern Resident killer whale DPS was listed as endangered under the ESA in 2005 (70 FR 69903). They feed primarily on Chinook salmon. Such prey are a primary constituent element of critical habitat, which was designated in marine habitats off Washington in 2006 (71 FR 69054) and expanded in 2021 to encompass coastal waters farther south in Washington, Oregon, and California (86 FR 41668).

Project Occurrence—The Southern Resident killer whale population in September 2020 was 74 whales. The first complete count of Southern Resident killer whales, in 1974, found 71 whales. The population increased to its peak of 96 to 98 whales in the mid-1990s following the cessation of killings and captures for marine parks. The population has since declined by over 20 percent over the last generation (25 years).

Threats—The limiting factors described in the listing rule and the recovery plan for Southern Resident killer whale DPS include reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS, 2008). A five-year review under the ESA, completed in 2016, concludes that Southern Resident killer whale should remain listed as endangered and provides recent information on the population, threats, and new research results and publications (NMFS, 2016b). Southern Resident killer whale DPS survival and fecundity are correlated with Chinook salmon abundance (Ward et al., 2009; Ford et al., 2006), but many salmon populations are themselves at risk, with nine ESUs of Chinook salmon listed as threatened or endangered under the ESA. Pollutants cause disease and reproduction problems in marine mammals, particularly in young whales, and Southern Resident killer whale are among the most contaminated. Also, vessels may cause whales to hunt less, travel more, and modify their vocalizations (NMFS, 2014b). It is likely that these threats are acting together to threaten the Southern Resident killer whale (Ferrara et al., 2017). Population modeling by Lacy et al. (2017) that considered the sublethal cumulative impacts of the above threats concludes that the effects of prey abundance on fecundity and survival had the largest effect on the population growth rate of Southern Resident killer whale.

The decline of killer whale's most preferred prey, Chinook salmon, is recognized as the primary limiting factor to their immediate survival and future recovery, as increased mortality and decreased fecundity of killer whales is correlated with indices of Chinook salmon abundance (NMFS, 2008; Ward et al., 2009; Ford et al., 2009). The future effects of climate change on declining salmon populations thus poses a main threat for Southern Resident killer whale Southern Resident killer whale (Hilborn et al., 2012; Wasser et al., 2017; Crozier et al., 2021). To meet recovery targets via prey management alone, they suggest that Chinook salmon abundance would have to be sustained at levels not observed since the 1970s (Lacy et al., 2017).

3.6.2.5 Lost River and Shortnose Suckers

Lost River and shortnose suckers are long-lived, lake-obligate fish that are endemic to the Upper Klamath River Basin (Moyle, 2002). FWS designated the Lost River sucker and shortnose sucker as endangered under the ESA in 1988 (53 FR 27130). FWS (1993) published an initial recovery plan for both species in 1993. Both the Lost River and shortnose suckers were petitioned for delisting in 2009, but FWS found that the petition did not present substantial scientific or commercial information indicating that either species warranted delisting (74 FR 30996). FWS published a revised recovery plan (2013a) along with five-year reviews for Lost River suckers (FWS, 2019c) and shortnose suckers (FWS, 2019d), and a species status assessment for both species (FWS, 2019e). Critical habitat for Lost River and shortnose suckers was designated in 2012 (77 FR 73740). Two units were designated for each species, which were occupied at the time of listing and are still occupied: (1) the Upper Klamath Lake Unit, including Upper Klamath Lake and its tributaries as well as the Link River and Keno Reservoir, and (2) the Lost River Basin Unit, including Clear Lake Reservoir and its tributaries. The units are the same for both species, but also include Gerber Reservoir and its principal tributaries for shortnose suckers. The project reservoirs, which are on the Klamath River downstream of Keno Dam, are not designated critical habitat for either sucker species.

Project Occurrence—The FWS (2019e) species status assessment and Reclamation's BA for Klamath Irrigation Project operations (2018) provide up-to-date information on Lost River and shortnose suckers inhabiting the project area. Larval, juvenile, and adult suckers are known to emigrate from Upper Klamath Lake into the Link River, with numbers varying annually, likely based on sucker reproduction and other factors such as water quality and lake level. Downstream waters occupied by suckers in the Lower Klamath Project area include J.C. Boyle Reservoir, Copco No. 1 Reservoir, and Iron Gate Reservoir. Lost River and shortnose suckers inhabiting the project reservoirs are considered “sink” populations[156] because they experience low reproductive success due to limited spawning habitat, abundant non-native predatory fish species, poor water quality, no interaction with fish in Upper Klamath Lake due to steep channel gradients between J.C. Boyle Reservoir and Keno Dam, and poor fish passage conditions at the Keno Dam fish ladder.

KRRC completed four surveys to assess the current abundance, demographics, and genetics of Lost River and shortnose suckers in J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs in fall 2018, spring and fall 2019, and spring 2020. KRRC captured 222 suckers across the three reservoirs over the four sampling periods. Recaptured suckers were used to develop population estimates for the three reservoirs and for the combined reservoirs.

As shown in table 3.6-3, mean population estimates for the listed suckers in the three reservoirs range from 2,201 to 5,540 (with a maximum of 11,531 suckers). The total number of adult suckers in the study area is highest in Copco No. 1 Reservoir, slightly less in J.C. Boyle Reservoir, and lowest in Iron Gate Reservoir. Several thousand adult suckers are present in Copco No. 1 and J.C. Boyle Reservoirs, and several hundred adult suckers are present in Iron Gate Reservoir (see table 3.4-15). The 95 percent confidence intervals suggest that there are several thousand adult suckers in Copco No. 1 and J.C. Boyle Reservoirs, and several hundred adult listed suckers in Iron Gate Reservoir. The estimated total number of listed suckers across the three reservoirs is between 4,500 and 11,500 suckers.

Threats—The reasons for listing the Lost River and shortnose sucker were similar, and many of the same threats continue today. Habitat loss, including restricted access to spawning and rearing habitat, severely impaired water quality, and increased rates of mortality resulting from entrainment in water management structures were cited as causes for declines in populations prior to listing (53 FR 27130). Upper Klamath Lake, which represents the majority of the remaining habitat for both species, has experienced regular fish kills due to blue-green algal blooms and resultant low DO levels (Perkins et al., 2000; Buchanan et al., 2011; Hereford et al., 2019). Decreases in the abundance of spawning adults from mortality have not been offset by recruitment of new individuals, and the main limitation in Upper Klamath Lake is poor survival of age-0 and age-1 suckers. The last time a large cohort of juvenile suckers survived to adulthood in Upper Klamath Lake was during the 1990s (Hewitt et al., 2018). Other threats described in the listing rule include the damming of rivers; instream flow diversions; hybridization, specifically shortnose sucker with the native Klamath largescale sucker; competition and predation by exotic species; dredging and draining of marshes; and water quality

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[156] Sink populations exist in low quality habitat patches that would not be able to support a population in isolation. Without the contribution of individuals from a source population, they would become extinct.

problems associated with timber harvest, the removal of riparian vegetation, livestock grazing, and agricultural practices (53 FR 27130).

Climate trends resulting from anthropogenic causes and natural variation play an important role in Lost River and shortnose sucker survival and reproduction. Drought conditions, as observed in the past several decades, reduce water levels and habitat in Upper Klamath Lake, Clear Lake Reservoir, and Gerber Reservoir. At present, lethal temperatures for suckers are uncommon, but stressful temperatures occur with regularity (FWS, 2019c,d). Climate change will increase the frequency and duration of these stressful temperature events and is likely to make high stress events more common. Changes in precipitation are highly uncertain, but climate models all suggest that a larger proportion of annual precipitation and runoff will occur as rain events in winter, with less snowfall (Barr et al., 2010). Reduced snowmelt runoff and predicted changes to spring flows during the sucker spawning season may restrict access to spawning areas in smaller watersheds, such as those entering Clear Lake and Gerber Reservoir, and reduce reproductive success when spawning is possible because larval production is correlated with the magnitude of spring flows (FWS, 2019e).

3.6.2.6 Bull Trout

The bull trout was listed as threatened in the conterminous United States in 1999 (64 FR 58910). Bull trout are native to the Pacific Northwest and occurred historically throughout much of the Oregon portion of the Klamath River Basin. At the time of their listing, bull trout were still widely distributed but estimated to have been extirpated from approximately 60 percent of their historical range. The Klamath Recovery Unit Implementation Plan (FWS, 2015a) provides an update on the species status and complements the (FWS, 2015b) recovery plan for the species in the coterminous United States. Bull trout in the Klamath Recovery Unit have been isolated from other bull trout populations for the past 10,000 years and are recognized as evolutionarily and genetically distinct (FWS, 2015b). FWS designated critical habitat for the bull trout DPS in the Klamath and Columbia Rivers on October 6, 2004 (69 FR 59996); it was designated for the species in the coterminous U.S. in 2005 (70 FR 56212) and revised in 2010 (75 FR 63898). The Klamath River Basin Critical Habitat Unit is in south-central Oregon and includes three subunits: (1) Upper Klamath Lake, (2) Sycan River, and (3) Upper Sprague River.

Project Occurrence—In the Klamath River Basin, bull trout abundance and distribution have been greatly reduced from historical levels; they are confined to the far upper reaches of the Klamath River watershed. Bull trout are considered extinct in California (Moyle et al., 2008). Although the status of certain local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed (FWS, 2015b).

Threats—Factors responsible for the decline of bull trout include habitat loss and degradation caused by passage barriers including dams, forest management practices, livestock grazing, agricultural practices, transportation networks, mining, residential development and urbanization, and fisheries management activities, as well as natural events (FWS, 2015b). In the Klamath River Basin, forestry practices, agricultural development, and fisheries management practices have greatly reduced bull trout distribution in the watershed. Other factors such as competition and hybridization with non-native brook trout have further affected the three bull trout core areas (Sycan River, Upper Klamath Lake, and Upper Sprague River) in the Klamath Recovery Unit (FWS, 2015a).

The Klamath Recovery Unit is at the southern extent of the bull trout's range and is likely susceptible to climate change effects because thermally suitable habitat may become restricted to smaller, more disjunct habitat patches, or become extirpated as the climate warms (Rieman et al., 2007). Halofsky et al. (2019) report that climate change is expected to reduce optimal habitat for bull trout by 31 percent by the 2040s and 52 percent by the 2080s. As described above for coho salmon, increased frequency and severity of flood flows during winter pose a risk to bull trout by displacing fry during the first month after emergence, dislodging and/or scouring eggs incubating in the streambed, or increasing sediment deposition in redds and suffocating eggs and embryos (Goode et al., 2013). Bull trout eggs are likely at higher risk than spring-spawning fish eggs from winter flood events because they spawn in the fall and their eggs incubate in stream substrates during the winter (Bjornn and Reiser, 1991; Goode et al., 2013).

3.6.2.7 Franklin's Bumble Bee

FWS listed Franklin's bumble bee (*Bombus franklini*) as endangered in August 2021 (86 FR 47221). No critical habitat has been designated for the Franklin's bumble bee.

Population Status and Project Occurrence—The closest historic detections of the Franklin's bumble bee are from 1998, approximately 7.7 miles west of Iron Gate Dam near Hornbrook, California, and 11 miles northwest of Iron Gate Dam near Hilt, California. However, the species has not been observed anywhere since 2006, when it was found at around 7,000 feet elevation on Mt. Ashland in Jackson County, Oregon. Despite focused surveys by species experts from 1998 to 2006, and by the larger entomological community before 1998, no Franklin's bumble bees have been detected near the Lower Klamath Project (KRRC, 2021f). More recent citizen science projects (e.g., Bumble Bee Watch, 2021) have also failed to detect any occurrences of Franklin's bumble bees in the project vicinity.[157]

Threats—Identified threats to the health and survival of Franklin's bumble bee include pathogens spread from commercial bee colonies raised for crop pollination,

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[157] In the context of the *Threatened and Endangered Species* section, project vicinity includes the USGS 7.5-minute quadrangles in which the project area is located and the adjacent quadrangles.

destruction of habitat through agricultural expansion, and the use of pesticides in agricultural and residential settings (Forest Service, 2021). The listing decision did not find habitat loss or modification to be a factor in the species decline; rather Franklin’s bumble bee began disappearing soon after the exposure of native bumble bees to introduced pathogens, and evidence suggests that the interactive effects of pathogens and pesticides are particularly harmful for bumble bees (FWS, 2018a). The reasons for these drastic declines are unknown, but research suggests that a virulent strain of the microsporidian *Nosema bombi* acquired from commercially reared bumble bees as a possible factor (Colla et al., 2006; NRC, 2007; Cameron et al., 2016). However, numerous other bumble bee species persist in many areas that still provide good quality habitat for the Franklin's bumble bee.

Some studies conclude that climate change may affect pollinators directly due to the effects that temperature, precipitation, and extreme weather events would have on survival and reproduction. Changes in temperature can affect Franklin’s bumble bee directly if high temperatures limit foraging activity or if the species’ critical thermal maximum temperature is exceeded, beyond which nearly lethal or lethal injury occurs (Pimsler et al., 2020). Plants are also blooming earlier as a result of climate change, which can lead to a mismatch with the availability of pollinators and nectar-producing flowers (NRC, 2007). However, it is unclear whether this phenological shift will be the primary way in which climate change affects plant–pollinator interactions (Forrest, 2015). Some pollinators may shift their range to find new food sources, but it is unknown if Franklin’s bumble bees will be able to adapt to match their life cycle to phenological shifts of plants. FWS reports no specific information about climate change effects on Franklin’s bumble bee; however, several of the targeted Franklin's bumble bee survey reports between 2015 and 2017 include mention of widespread hot, dry climate affecting timing and abundance of flowers (86 FR 47221).

3.6.2.8 Little Brown Bat

The little brown bat (*Myotis lucifugus*) is currently under review for listing under the ESA and is included here at the request of FWS. Because the species is not listed under the ESA, no critical habitat is designated for the little brown bat.

Population Status and Project Occurrence—Little brown bats are one of the most common bats in Oregon and the United States. They still occur throughout their historic range, albeit at dramatically reduced densities in the eastern U.S. due to WNS.[158] In the Klamath River Basin, the subspecies *M. l. alascensis* is most likely to occur, as it is found along the Pacific Coast and coastal mountain ranges (Vonhof et al., 2015).

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[158] WNS is a fungal infection that agitates hibernating bats, causing them to rouse prematurely and burn fat supplies. Mortality results from starvation or, in some cases, exposure.

KRRC performed bat occupancy surveys from 2017 through 2019 (see section 2.1.2.12, *Terrestrial and Wildlife Management Plan, Bats*). The only species confirmed to be roosting in any project structures was Yuma myotis (*Myotis yumanensis*). However, other bat species are present, and more than 2,000 unidentified *Myotis* spp. were estimated at the Copco No. 1 gatehouse C-12 during summer emergence surveys. This building supports the largest roost found in the project area and is used as a maternity roost and possibly as a hibernaculum. No known little brown bat hibernacula have been documented in the project area, although no targeted surveys have been performed and suitable habitat (e.g., tunnels, cliffs, and talus slopes) exists.

Threats—WNS has caused precipitous declines of little brown bat populations during the past two decades (Kunz and Reichard, 2010; Cheng et al., 2021). Currently, the fungus is currently not present in the Klamath River Basin, but it continues to spread west across the country (WNS Response Team, 2021). Although the fungus is not known to be present in Oregon; it has been detected in California, where it was found in Plumas County in 2019 (National Park Service, 2019) and is presumed present in Shasta County (WNS Response Team, 2021). WNS has caused overwinter mortality rates of 75 to 90 percent, although it appears that some populations of little brown bat are evolving mechanisms to resist its adverse effects (Frank et al., 2019; Gignoux-Wolfsohn et al., 2021). Other threats to little brown bat include pesticide use, the loss of roost sites in snags due to deforestation, and disturbance of individuals during hibernation, but none of these issues pose as significant of a threat to the survival of the species as WNS.

Climate change is considered likely to affect bats because of their sensitivity to roost temperatures and their reliance on abundant insect populations. Bats must drink every night, particularly females when nursing their pups in summer, so projected reductions in late spring and summer moisture could affect little brown bat reproduction. Bats could shift their ranges more rapidly than most mammals in response to climate change, but populations are generally predicted to decline due to effects associated with climate change (National Park Service, 2011).

3.6.2.9 Monarch Butterfly

The monarch butterfly (*Danaus plexippus*) was determined to be a candidate species in December 2020 (85 FR 81813), meaning that there is sufficient information on its biological status and threats to propose it as endangered or threatened under the ESA; however, higher priority actions preclude immediate listing. The monarch is a large, black, orange, and white butterfly that occurs throughout the United States. It is dependent on milkweed plants as a host for the larval stage of its life cycle. Because the monarch butterfly is not listed under the ESA, no critical habitat is designated for the species.

Population Status and Project Occurrence—Populations of western monarch butterflies have declined by approximately 85 percent since 1996, and the California population is close to a quasi-extinction threshold. In some overwintering areas in

California, populations have plummeted over 97 percent since the 1980s, from about 1.2 million in 1997 to fewer than 30,000 in 2019 (Pelton et al., 2016).

KRRC has not performed surveys for monarch butterflies at the Lower Klamath Project, but suitable habitat and host plant species are present, and the species would likely be found during summer and fall either breeding and/or migrating to overwintering and breeding sites on the coast of California. For example, a monarch that hatched in Klamath Falls was tagged by FWS in 2017 and was tracked to approximately 16 miles northeast of J.C. Boyle Dam and 39 miles northeast of Iron Gate Dam. After emerging from pupation on September 3, 2017, the tagged individual was recorded 19 days later ovipositing in Santa Barbara, California, a movement of over 500 miles (FWS, 2018b).

Monarch butterflies are most likely to be found where milkweed plants occur, including purple milkweed, narrow leaf milkweed, showy milkweed, and swamp milkweed. Narrow leaf milkweed and swamp milkweed were detected during a wetland delineation at Raymond Gulch on Copco No. 1 Reservoir and approximately 0.8 miles southeast of Raymond Gulch in a patch of wet meadow at the reservoir's edge. Monarch butterflies are likely to also be found in isolated patches of milkweed associated with landscape plantings at residential structures, open meadows, and forested areas.

Threats—Threats identified in the petition to list monarch butterflies (CBD et al., 2014) include loss and degradation of habitat and loss of milkweed resulting from herbicide application, conversion of grasslands to cropland, loss to development and aggressive roadside management, loss of winter habitats from logging, forest disease, and climate change. The reduced availability, spatial distribution, and quality of milkweed and nectar plants associated with breeding and use of insecticides are most responsible for their decline (85 FR 81813).

There are no studies that show how monarch butterflies, or other butterflies are responding to climate change in the Pacific Northwest. Most scientists believe that the loss of milkweed plants is the primary factor affecting declines of monarch butterflies, but monitoring efforts will be increasingly necessary to understand how climate change is affecting them (Forest Service, 2015).

3.6.2.10 Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) was listed as threatened under the ESA in 1990 (55 FR 26114). KRRC provided a detailed account of the subspecies' habitat, life history, distribution, threats, status, and occurrence in the project area in appendix G of its Lower Klamath Project BA (KRRC, 2021f).

Population Status and Project Occurrence—Northern spotted owl activity centers[159] have been documented in the vicinity of Copco No. 1 and J.C. Boyle Reservoirs. Further details about current northern spotted owl habitat and activity centers in the project vicinity is provided in appendix G (table G-6) of KRRC's Lower Klamath Project BA. One activity center is located approximately 1.3 miles southeast of the eastern end of Copco No. 1 Reservoir. The nearest activity center to J.C. Boyle Reservoir is approximately 4.6 miles southwest of J.C. Boyle Dam. There are no known northern spotted owl activity centers near the Iron Gate Dam.

PacifiCorp (2004a) reported that during surveys in 2002 and 2003, five single sightings of northern spotted owl were recorded during each year, but some sightings were likely the same individuals, pairs or both. Most detections were about 5.5 miles east-southeast of Copco No. 1 Dam. KRRC did not perform surveys for northern spotted owls near Copco No. 1, Copco No. 2, and Iron Gate Dams and Reservoirs because suitable spotted owl habitat was not available (KRRC, 2019).

PacifiCorp (2004a) noted a single detection of a pair of female northern spotted owls within 1-mile southeast of J.C. Boyle Reservoir. At J.C. Boyle Reservoir, KRRC conducted a desktop evaluation and field reconnaissance in 2017, and in coordination with FWS, identified and established 18 calling locations in the vicinity of J.C. Boyle Reservoir, Dam, and Powerhouse where calls were broadcasted to detect northern spotted owls. Surveyors followed FWS (2012) protocol[160] designed for sites that would be disturbed, but habitat would remain intact, to survey for northern spotted owl during the 2018 breeding season (April–August 2018). Beginning in June 2018, surveyors conducted call surveys at an additional location near the J.C. Boyle forebay at the end of the power canal due to the presence of large conifers (KRRC, 2019). No northern spotted owls were reported during KRRC's surveys, but suitable habitat for the species was documented around J.C. Boyle Dam and associated facilities, the disposal site, and haul and access roads. The facilities associated with Copco No. 1, Copco No. 2, and Iron Gate Dams, including their reservoirs had poor habitat for northern spotted owls (KRRC, 2019). Because no northern spotted owls were detected during the 2018 surveys, KRRC does not propose additional surveys for the species.

Threats—Northern spotted owls were listed as a threatened species due to the loss, degradation, and fragmentation of old-growth forest habitat (55 FR 26114). The Northwest Forest Plan focused on northern spotted owl recovery by providing for the

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[159] Northern spotted owl activity centers are locations or points representing detections such as nest stands, stands used by roosting pairs or territorial singles, or concentrated nighttime detections. Activity centers represent central locations within the core use area (FWS, 2012).

[160] For projects that would disturb spotted owls but not result in habitat modification, FWS protocol requires a one-year, six-visit survey that covers all areas within 0.25 miles of the project.

management of older forests on federal lands within the owl's range (Davis et al., 2015). Despite habitat conservation, northern spotted owl populations have continued to decline, largely because of competitive interactions with recently established populations of barred owls, an invasive species native to eastern North America (Dugger et al., 2016). Barred owls have expanded their range west (Livezey et al., 2009a,b) and are now present throughout the range of the northern spotted owl.

There are concerns that climate change may cause warmer, wetter winters and hotter, drier summers, which would likely reduce the survival of northern spotted owls (Lesmeister et al., 2018). Glenn et al. (2010) found that dry summer conditions may cause prey populations of northern spotted owls that include northern flying squirrels, woodrats, and other small mammals to decline, which ultimately affects survival, recruitment, and population dynamics of owls. Climate change can affect the development of understory vegetation by altering temperature and precipitation regimes, and increasing disturbance frequency and intensity (Dale et al., 2001), which could reduce prey availability and affect northern spotted owl fitness (Franklin et al., 2000). Also, increasing wildfire frequency and severity under future climate change scenarios (Mote et al., 2019) could reduce the extent of closed-canopy, old-forest habitat used by northern spotted owls and favor the invasion of aggressive barred owls that can outcompete the smaller northern spotted owls (Halofsky et al., 2019). Lastly, cold, wet conditions in the spring can also have direct effects on the survival of fledgling owls (Glenn, 2010).

3.6.2.11 Oregon Spotted Frog

The Oregon spotted frog (*Rana pretiosa*) was listed as threatened under the ESA in 2014 (79 FR 51658). KRRC provided a full species account for the Oregon spotted frog in appendix G of its Lower Klamath Project BA. *The Conservation Agreement for the Oregon Spotted Frog (Rana pretiosa) in the Klamath Basin of Oregon* (FWS et al., 2010) also provides a description of Oregon spotted frog, habitat, life history, distribution, and status.

Critical habitat for Oregon spotted frog was designated in 2016 and includes three occupied habitat units in the Klamath Basin (81 FR 29335), far upstream of the hydroelectric reach. In Klamath County, Unit 12 (Williamson River) and Unit 13 (Upper Klamath Lake) include several tributary streams to Upper Klamath Lake and adjacent seasonally wetted areas. Closer to the project area, Unit 14 (Upper Klamath) consists of lakes and creeks in Jackson and Klamath Counties, near Buck Lake and Spencer Creek, which drains into J.C. Boyle Reservoir, and Parsnip Lake near Keene Creek, which ultimately drains south to Iron Gate Reservoir via Jenny Creek.

Population Status and Project Occurrence—Within the project vicinity, the Oregon spotted frog is known from only a few sites, the nearest of which is Buck Lake in the Spencer Creek watershed. In Oregon, sites where this species remains extant exceed 3,117 feet elevation and have the least altered hydrology and fewest exotic aquatic predators. There are no sites in California with recent records of this species (Hayes, 1997).

PacifiCorp conducted Oregon spotted frog surveys in 2003 within potentially suitable wetland habitat in the J.C. Boyle and Keno Reservoirs. The Oregon spotted frog was not found within the Lower Klamath Project area (PacifiCorp, 2004a). As such, KRRC has not performed subsequent targeted surveys for the species, and no incidental observations were recorded during general wildlife surveys across the project area. There are no records of the species in the project area in the California Natural Diversity Database, and the species was dismissed from analysis in the California Water Board's EIR (California DFW, 2017b, cited in California Water Board, 2020a).

When the species was listed in 2014, the Oregon spotted frog was known to occupy Buck Lake and suitable reaches of Spencer Creek, which drains into J.C. Boyle Reservoir (79 FR 51658). However, recent surveys indicated that the Buck Lake population may have declined from 1994 to 2010 (Lerum, 2012), although recent trends are unknown. Upstream of the hydroelectric reach, Oregon spotted frogs occur in two watersheds above Upper Klamath Lake.

Threats—Threats to Oregon spotted frogs include loss of wetlands for development, drought, and removal of beavers; changes in water temperature and vegetation structure associated with invasive plants like reed canary grass, predation from non-native species like brook trout and bullfrog, and reductions in habitat connectivity (FWS, 2021e). The presence of bullfrog throughout the project area suggests that predation may have affected Oregon spotted frogs in the project area, as has been demonstrated elsewhere (see Tidwell, 2017). Oregon spotted frog populations are small and isolated, so are thus vulnerable to random, naturally occurring events like as drought, disease, and predation (FWS, 2020a). Many of the Oregon spotted frog breeding locations across the range comprise fewer than 50 adult frogs and have low genetic diversity due to isolation from other breeding locations.

Information regarding the sensitivity of the Oregon spotted frog to climate change is limited. Its shallow pond and wetland habitat could be affected if warmer and drier conditions lead to declines in water levels and changes in vegetation, which could hamper breeding or reduce tadpole survival. Such climate change effects could concentrate predators to a greater extent, including invasive warm-water predators like bullfrogs. Also, bullfrog distribution in the Pacific Northwest is currently limited by temperature, but warmer temperatures would increase the duration of their active season, reducing the time bullfrogs require to mature. An increased bullfrog body size would increase predation risk in post-metamorphic Oregon spotted frogs (Washington DFW, 2021a).

3.6.2.12 Western Bumble Bee

The western bumble bee (*Bombus occidentalis*) is currently under review for listing under the ESA and is included here at the request of FWS. Because the species is not listed under the ESA, no critical habitat is designated.

Population Status and Project Occurrence—The western bumble bee was both common and widespread as recently as 1998 but has experienced drastic decline in California and Oregon, among other states. It remains most abundant in the Rockies and at higher elevation areas in the Cascades (and other western mountain ranges) but is absent in most lower elevation areas and notably scarce west of the Cascades (Pacific Northwest Bumble Bee Atlas, 2021). The International Union for Conservation of Nature Bumble Bee and Wild Bee Specialist Group assessed the status of the western bumble bee and found that it was vulnerable to extinction (Hatfield et al., 2015).

No surveys were conducted for this species, but suitable habitat occurs in the project area and it is assumed present. The Bumble Bee Watch (2021) community science project has documented the species at higher elevations in project vicinity, but no recent occurrences have been found near the hydroelectric reach.

Threats—Threats to the western bumble bee include anthropogenic habitat change, nesting site availability, loss of overwintering habitat, and pesticide use. Non-native parasites transmitted from commercially raised bumble bee pollinators have also been implicated in population decline (Forest Service, 2021). Western bumble bees began declining at the same time as outbreaks of *Nosema bombi* in North American commercially reared bumble bees and are speculated to have inadvertently transported the pathogen into wild bees because they were once reared in the same facilities with other bumble bee species that were infected (Cameron et al., 2016; Graves et al., 2020).

As detailed above for Franklin’s bumble bee, no studies implicate climate change as a causal factor in the decline of western bumble bees. They could be affected by altered vegetation distribution and phenological mismatches between bumble bee emergence and the timing of flowering (NRC, 2007). A warmer climate may also affect the physiology of western bumble bees. For example, Soroye et al. (2020) analyzed a large dataset of bumble bee occurrences in Europe and North America and found that increasing frequency of extremely warm days is increasing local extinction rates, reducing colonization and site occupancy, and decreasing species richness.

3.6.2.13 Western Pond Turtle

The western pond turtle (*Emys marmorata*) is currently under review for listing under the ESA and is included here at the request of FWS. It is listed as a Species of Special Concern in California and is on Oregon’s Sensitive Species List. FWS is performing a pre-listing assessment to evaluate the status and potential threats to western pond turtle populations. Because the species is not listed under the ESA, no critical habitat is designated.

Population Status and Project Occurrence—Western pond turtles are considered common to abundant in many Lower Klamath Project reservoirs and reaches with suitable nesting habitat present. During surveys in 2002 and 2003, PacifiCorp documented 23 turtles on J.C. Boyle Reservoir, 12 at Copco No. 1 Reservoir, 18 in the beaver dam pond/wetland between Fall Creek and Iron Gate Reservoir, and 17 at Iron

Gate Reservoir. Additionally, surveys downstream of the Iron Gate Dam have documented numerous western pond turtles (PacifiCorp, 2004a).

In May 2018, KRRC surveyed suitable open-water habitat including reservoir shorelines and adjacent lands and documented the species at all project reservoirs. In Iron Gate Reservoir, eight of nine observations were along the northern half of the reservoir (Mirror Cove and near Camp and Jenny Creeks), and in Jenny Creek near the Copco Road bridge. Surveyors also found 36 western pond turtles throughout Copco No. 1 Reservoir, with most observations occurring in the northern Beaver Creek and Raymond Gulch coves. More than 40 western pond turtles were observed in J.C. Boyle Reservoir, which also supports a breeding population. In 2019, KRRC conducted a radio-telemetry study on western pond turtles in J.C. Boyle Reservoir to estimate the population and determine the timing and overwintering behavior. While the number of turtles captured and recaptured was insufficient to calculate a population estimate, western pond turtles were considered common, and reproducing as juveniles were observed. All radio-tagged western pond turtles in J.C. Boyle Reservoir overwintered in cavities in the shoreline bank or under trees or root wads along the reservoir shoreline (KRRC, 2020).

Threats—Threats to this species include the loss of aquatic habitats, elevated nest and hatchling predation, reduced availability of nest habitat, and road mortality. Loss and alteration of aquatic habitat has been significant throughout the range of western pond turtles because of human development and agriculture (Rosenberg et al., 2009). Connectivity between aquatic and upland habitats is also a problem for western pond turtles as urban and agricultural development fragments landscapes. Additionally, predation of nests may be above historical levels in human-altered landscapes from the increased abundance of medium-sized predators, including non-native bullfrogs, smallmouth bass, and largemouth bass. Road mortality may be a particularly important threat in urban and recreational areas. Lastly, vegetation management and agricultural activities can result in nest destruction and mortality to adult females (Oregon DFW, 2015).

Little information is available regarding the effects of climate change on western pond turtles, although several factors that have contributed to the species' decline (e.g., habitat destruction and fragmentation by wildfire, drought, and floods) are predicted to increase because of climate change (Washington DFW, 2021b). During the prolonged drought that has affected California, researchers found dried up ponds littered with many western pond turtle shells (Purcell et al., 2017). Warming temperatures (even small increases) also may influence offspring sex ratios, increasing the number of females (Christie and Geist, 2017). On the other hand, warming could benefit western pond turtles by providing more warm days for developing embryos and increasing the availability of habitats that are currently unavailable due to cold water and/or limited basking sites (Washington DFW, 2021b).

3.6.3 Effects of the Proposed Action

SONCC Coho Salmon

Project effects on this federally threatened ESU are discussed in section 3.4.3, under aquatic resources, where they are referred to simply as coho salmon rather than the SONCC ESU. As a result of the effects discussed, the number of SONCC coho salmon produced in the Klamath River Basin is expected to increase compared to existing conditions.

Reservoir drawdown and release of sediment associated with dam removal is likely to have short-term, adverse effects on coho salmon's critical habitat in the mainstem Klamath River, including the spawning sites, food resources, and water quality physical or biological features (PBFs) of (KRRC, 2021f). In the short term, the proposed action is likely to have significant and unavoidable adverse effects on SONCC coho salmon critical habitat. In the long term, the proposed action would result in more natural sediment transport and hydrologic processes downstream of Iron Gate Dam, which would help create more natural substrate characteristics, increase the number and quality of spawning sites, enhance food resources, improve water quality, and reduce disease prevalence. Consequently, the proposed action would have a permanent, significant, beneficial effect on SONCC coho salmon critical habitat.

KRRC (2021f) concludes that the proposed action *may affect and is likely to adversely affect* both the SONCC coho salmon and its critical habitat. The NMFS (2021b) BiOp concurs with this determination and further concludes that the proposed action is not likely to jeopardize the continued existence of the ESU, nor is it likely to destroy or adversely modify the ESUs designated critical habitat.

Southern DPS Green Sturgeon

The green sturgeon found in the Lower Klamath River belong to the northern green sturgeon DPS, which is not listed under the federal ESA; however, NMFS has designated the northern green sturgeon DPS as a Species of Concern. Southern DPS green sturgeon (which are listed under the ESA) have not been documented in the Klamath River Basin or estuary; nevertheless, sub-adult and adult Southern DPS green sturgeon are known to enter coastal bays and estuaries north of San Francisco Bay, California, during the summer and fall to forage (Moser and Lindley, 2007; Reclamation, 2010b). Therefore, any Southern DPS green sturgeon that are present within or near the Klamath River estuary could be exposed to higher-than-normal SSCs during the summer and fall of dam removal year 2 (KRRC, 2021f).

KRRC does not propose any specific measures to minimize potential effects of the proposed action on Southern DPS green sturgeon.

Our Analysis

Southern DPS green sturgeon would not be exposed to elevated SSCs during dam removal because they would likely be well outside of the action area prior to the onset of reservoir drawdown. During the summer foraging period of dam removal year 2, modeled monthly median SSCs in the estuary would range from 20 to 496 mg/l, compared to 1 to 131 mg/l under existing conditions.

While the SSCs in the estuary in dam removal year 2 would be higher than existing conditions, green sturgeon are not sight feeders and typically use their sensitive barbels to feed on benthic organisms in fine sediments. This trait would likely reduce any adverse effects of higher SSCs on feeding ability. Adult sturgeon are also considered to be more tolerant of turbid water conditions than salmonids (Moser and Lindley, 2007) and prefer turbid water for spawning (Gessner and Bartel, 2000). They also require turbid water to prevent egg adhesion and deformation. In addition, only a small proportion, if any, of the total Southern DPS green sturgeon population is expected to use the Klamath River estuary during dam removal year 2, further minimizing the potential for any short-term effects related to the project. Given the above information, we find that the proposed action would have short-term, less than significant, adverse effects on Southern DPS green sturgeon.

In the long term, conditions in the Klamath estuary are not expected to be substantially different than existing condition. The benefits of a more natural water temperature, flow, and sediment transport regime are not expected to extend to the estuary, or they would be greatly diminished due to accretion from the many tributaries entering the Lower Klamath River. Therefore, we find that the proposed action would have long-term, less than significant, beneficial effects on Southern DPS green sturgeon.

Designated critical habitat for Southern DPS green sturgeon is found approximately 1 mile offshore of the mouth of the Klamath River. The Klamath River, the Klamath River estuary, and 1 mile of the coastal marine area adjacent to Yurok Tribal land are excluded from the critical habitat designation.

As stated in 74 FR 52300, the specific PBFs essential for the conservation of the Southern DPS green sturgeon in coastal marine areas include: (1) a migratory pathway necessary for the safe and timely passage of all life stages in marine and between estuarine and marine habitats; (2) nearshore marine waters with adequate dissolved oxygen levels and low enough levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) to allow normal behavior, growth, and viability of sub-adult and adult green sturgeon; and (3) abundant prey items for sub-adults and adults, which may include benthic invertebrates and fish.

The migratory pathway for green sturgeon is in the nearshore and deep offshore ocean environment. Therefore, the proposed action would not hinder the migration of this species; however, sediment release associated with the proposed action have the potential to negatively affect water quality in the coastal marine areas, as organic and inorganic contaminants have been identified in the sediment deposits currently trapped behind the dams (Reclamation, 2011a). As these sediments are mobilized and transported downstream, they would eventually enter the nearshore marine environment.

In 2004, 2005, and 2009, Reclamation and California DFW collected and analyzed reservoir sediment samples from the project's reservoirs. The results of this assessment indicated no positive exceedances of organic and inorganic contaminants (Reclamation and California DFW, 2012), with the exception of a small number of samples from J.C. Boyle Reservoir, which exceeded the applicable marine screening level for Dieldrin and 2,3,4,7,8-PECDF (CDM, 2011). With respect to bioaccumulation potential, there were no exceedances of applicable marine bioaccumulation screening levels (CDM, 2011). The marine screening levels are designed to be protective of direct toxicity to benthic and epibenthic organisms, which corresponds to a no adverse effects level. Because the vast majority of the 2009 and 2010 samples indicated a low risk of toxicity to sediment-dwelling organisms, the effects of the proposed action on the water quality PBF are expected to be insignificant.

Following drawdown and dam removal, a considerable amount of fine sediment would likely be deposited on the seafloor shoreward of the 60-meter isobath, with greater quantities deposited in proximity to the mouth of the Klamath River (Reclamation and California DFW, 2012). However, much of this sediment would eventually be transported farther offshore to the mid-shelf, and into deeper water off-shelf through progressive resuspension and fluid-mud gravity flows. This sediment deposition may affect the benthic food resources used by Southern DPS green sturgeon in the nearshore environment, which include crabs, shrimp, clams, annelid worms, and other invertebrates, as well as small fish like anchovies and sand lances (74 FR 52300). Although many of these food resources are mobile and would not be affected by sediment deposition, some organisms, like clams and annelid worms, may be affected by sediment deposition and resuspension. The area of effect would be relatively small when compared to the expanse of the critical habitat zone, however, and green sturgeon would be able to access other food resources if benthic food organisms become affected by sediment deposition.

Given the above information, KRRC (2021f) concludes that the proposed action *may affect but is not likely to adversely affect* both the Southern DPS green sturgeon and its critical habitat. The NMFS (2021b) BiOp concurs with this determination.

Southern DPS Eulachon

Southern DPS eulachon occupy the Lower Klamath River, Klamath River estuary, and nearshore environment during the winter and spring, and typically use these areas for spawning, egg incubation, and early rearing. Under the proposed action, adult eulachon entering the Klamath River in the late winter and spring, following reservoir drawdown, could be exposed to SSCs that exceed background levels during at least a portion of their migration period.

KRRC does not propose any specific measures to minimize potential effects of the proposed action on Southern DPS eulachon.

Our Analysis

Using available eulachon spawning periodicity information, KRRC calculated the expected seven-day median SSCs, as measured at Klamath Station, between January 1 and May 5 under both the proposed action and existing conditions (for both the median impact year [1974] and severe impact year [1977] scenarios). While suspended sediments released from the reservoir reach would likely decline in concentration with distance downstream due to tributary accretion, it is expected that under the worst-case scenario, short-term SSCs at Klamath Station would range from 30 to 3,477 mg/l in winter and spring of the drawdown year, as shown in figure 3.3-28 (KRRC, 2021f).

Applying the severity of effects approach described in Newcombe and Jensen (1996), KRRC (2021f), predicted that under a most-likely or worst-case scenario, mortality would be higher under the proposed action than under existing conditions. Mortality would also be higher for spawning, incubation, and larval life stages, with no discernable difference in predicted effects between the most-likely and worst-case scenarios. However, eulachon would only be present within the Klamath River for about one month and could potentially migrate and spawn anytime during the winter and early spring. For the severe impact year scenario, seven-day median SSCs under the proposed action in the drawdown year would be substantially higher than existing conditions and are expected to result in up to 20 percent adult eulachon mortality for approximately 10 percent of the migration and spawning period. Effects on eggs and larval eulachon from elevated SSCs are also expected to be higher during the drawdown year when compared to existing conditions. In addition, increased SSCs may temporarily alter the quality of the sand and pea gravel substrate that eulachon rely on for spawning and incubation. Therefore, elevated SSC levels in the Lower Klamath River resulting from the proposed action are likely to have significant and unavoidable adverse effects on Southern DPS eulachon in the short term.

In the long term, conditions in the Lower Klamath River and estuary are not expected to be substantially different than under existing conditions. However, KRRC expects a more natural water temperature, flow, and sediment transport regime would benefit eulachon, but those benefits would not be expected to extend to the Lower Klamath River or estuary; or they would be greatly diminished due to accretion flow from the many tributaries between the Iron Gate Dam site and the estuary. Therefore, we find that the long-term, beneficial effects of the proposed action on Southern DPS eulachon would be less than significant.

In the Klamath River, Southern DPS eulachon critical habitat extends from the mouth of the Klamath River upstream to Omogar Creek, a distance of 10.7 miles, and excludes Tribal lands in the Yurok Reservation and Resighini Rancheria boundaries. As stated in 76 FR 65324, the specific PBFs essential for the conservation of the Southern

DPS eulachon include: (1) freshwater spawning and incubation sites with water flow, quality, and temperature conditions, and substrate supporting spawning and incubation; (2) freshwater and estuarine migration corridors free of obstructions with water flow, quality, and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted; and (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juvenile and adult survival.

Under the proposed action, modeled daily SSCs at Klamath Station for the median impact year would be similar to existing conditions in year 1 and year 2. However, SSCs associated with the severe impact year would be substantially higher than those seen under existing conditions in year 1, and are expected to temporarily degrade available eulachon spawning and incubation habitat. SSCs under both scenarios are predicted to return to within the range of background levels in the Lower Klamath River by the winter following drawdown, and any fine sediment that has settled would likely be resuspended and transported from the Lower Klamath River by fall and winter freshets.

Increased SSCs in the Lower Klamath River and estuary from January 1 through fall of the drawdown year are also likely to cause degradation of water quality conditions for adult Southern DPS eulachon that are migrating to spawning sites in the Lower Klamath River. However, SSCs should return to background levels at Klamath Station prior to the following year's adult and larval eulachon migration periods. KRRC also expects some short-term increases of SSCs in the nearshore and possibly offshore marine environment near the mouth of the Klamath River. However, these temporary increases are not expected to adversely affect Southern DPS eulachon forage species or be of sufficient magnitude to reduce the suitability of the water quality in the nearshore or offshore eulachon foraging.

In summary, the initial drawdown and release of sediment would have unavoidable, short-term, significant, adverse effects on freshwater spawning and incubation sites and adult and larval migration habitat PBFs of Southern DPS eulachon critical habitat in the short term. However, effects would be less than significant on the nearshore and offshore marine foraging habitat PBF.

KRRC (2021f) concludes that, in the short- and long-term, the proposed action *may affect and is likely to adversely affect* both the Southern DPS eulachon and its critical habitat. The NMFS (2021b) BiOp concurs with this determination and further concludes that the proposed action is not likely to jeopardize the continued existence of the DPS, nor is it likely to destroy or adversely modify the DPS' designated critical habitat.

Southern Resident DPS Killer Whale

As discussed throughout section 3.4, *Aquatic Resources*, and above for SONCC C, the proposed action would have short-term, adverse effects on Chinook and coho salmon associated with increases in SSCs, decreases in dissolved oxygen, and increases in bedload deposition in the mainstem Klamath River below Iron Gate. Long-term effects of the proposed action include reduced hatchery production of sub-yearling Chinook salmon associated with the proposed Fall Creek Hatchery and the removal of Iron Gate Hatchery. The proposed action is anticipated to result in long-term benefits for Chinook and coho salmon as the Klamath River's temperature regime, hydrology, and sediment characteristics are restored and salmon regain access to historical habitat upstream of Iron Gate Dam. Because the Klamath River contributes a small number of Chinook salmon to the Southern Resident killer whale prey base (2.2 percent ±2.3 percent) between mid-winter and early spring when killer whales inhabit outer coastal areas (Hanson et al., 2021), project effects on salmon would also affect the Southern Resident DPS killer whale through food resources.

KRRC does not propose any protection or mitigation measures directly related to the Southern Resident killer whale. However, as discussed in section 3.4.3, *Aquatic Resources, Effects of the Proposed Action,* KRRC proposes a variety of measures to reduce short-term effects on salmon.

Our Analysis

The proposed action would affect multiple life stages of Chinook salmon during the pre-drawdown, drawdown and dam removal, and post-drawdown periods due to construction activities, suspended sediment and bedload sediment releases, and dissolved oxygen effects. Aquatic resources measures would be implemented to reduce effects of the proposed action on Chinook salmon. Additionally, because Southern Resident killer whales select larger Chinook salmon as prey items and the proposed action would primarily affect juvenile production in year 1 and year 2, short-term, adverse effects of the proposed action on Southern Resident killer whales would be less than significant.

In the long term, restoration of a free-flowing Klamath River would open habitat upstream of Iron Gate Dam to recolonization by Chinook and coho salmon. Along with increases in available habitat, the proposed action would improve water temperature, dissolved oxygen, and water quality in the main stem of the Klamath River. The proposed action is also expected to reduce prevalence of disease in Klamath River salmon populations. SSCs and DO effects may affect up to 17 percent of fall-run Chinook salmon juvenile production during year 1, and bedload may affect 13 percent of adult escapement in year 2. These effects would be revealed three to four years after reservoir drawdown as three-year-old and four-year-old age class fish would be less abundant in the ocean. Over time, as fall-run Chinook salmon access historical habitat and natural production increases, up to 41,000 additional naturally produced adult Chinook salmon would be present in the ocean (KRRC, 2021f). Therefore, long-term effects of the proposed action on Southern Resident killer whales would be beneficial and significant because, in the long term, the no-action alternative is likely to lead to a severe decline in the abundance of Klamath River salmon.

KRRC (2021f) concludes that, in the short- and long term, the proposed action *may affect but is not likely to adversely affect* both the Southern Resident DPS killer whale and its critical habitat. The NMFS (2021b) BiOp does not concur and concludes that the action *may affect and is likely to adversely affect* the DPS but further concludes that the proposed action is not likely to jeopardize the DPS' continued existence, nor is it likely to destroy or adversely modify the Southern Resident DPS killer whale designated critical habitat.

Lost River and Shortnose Suckers

Dam removal activities associated with the proposed action would eliminate all available rearing habitat for Lost River and shortnose suckers in Iron Gate, Copco No. 1, and J.C. Boyle Reservoirs, and those individuals remaining in the hydroelectric reach would likely be lost because they are not anticipated to migrate upstream to Upper Klamath Lake.

As described in the Aquatic Resources Management Plan, KRRC would focus its sucker salvage and translocation effort in the spring, prior to reservoir drawdown, when shortnose suckers congregate in shallower habitats in advance and during the spring spawning period. FWS (2021a) estimates that approximately 600 suckers can be captured from J.C. Boyle, Copco No. 1 and Iron Gate Reservoirs. Salvaged suckers would then be translocated to either the Klamath National Fish Hatchery, the Klamath Tribes' sucker rearing facility east of Chiloquin, Oregon, or to the Tule Lake Sump 1A, although other translocation sites may be identified based on further planning and agreement between FWS, Oregon DFW, California DFW, and KRRC. These sites would provide FWS with management flexibility concerning Lost River and shortnose suckers.

Our Analysis

Under the proposed action, the short-term effects of dam removal are anticipated to result in mostly sublethal, in some cases lethal, effects on Lost River and shortnose suckers (as well as hybrids of these two species) within the hydroelectric reach (KRRC, 2021f). In its BiOp (FWS, 2021a), FWS estimates that 4,940 adult listed suckers would perish during drawdown and dam removal, based on the total estimate of 5,540 adult listed suckers in the reservoirs minus 600 captured and translocated adults. The loss of the 4,940 adults represents approximately 9 percent of the Lost River and shortnose sucker adult population in the Upper Klamath Lake Recovery Unit. This loss represents approximately 5 percent of the estimated range-wide adult population. However, as noted above, FWS does not consider the Lower Klamath Project reservoir populations and habitat below Keno Dam as contributing significantly to sucker recovery (Hamilton et al., 2011; FWS, 2013c).

Despite these losses, the proposed action would not affect any known spawning habitat for either species. The Lost River and shortnose sucker are not known to spawn in the hydroelectric reach reservoirs, or anywhere downstream of Upper Klamath Lake.

Thus, they provide no contribution to future population growth at the range-wide scale. While their numbers and distribution would be somewhat reduced through the loss of the four dams and reservoirs, the Klamath River downstream of Keno Dam to Iron Gate Dam, including the hydroelectric reach, is considered a sink population,[161] and reproduction by both species would not be affected by the proposed action. Buettner et al. (2006) conclude that, since little or no reproduction occurs downstream from Keno Dam, and there is no potential for interaction with upstream populations, the Lost River and shortnose suckers in the hydroelectric reach are not considered to substantially contribute to the achievement of conservation goals or recovery.

Given the above information, implementation of the proposed action would have a short-term, significant, adverse effect on Lost River and shortnose suckers, but in the long term would not impair or preclude the conservation role the Upper Klamath Lake Recovery Unit provides for the survival and recovery of these two species. In the long term, translocated adult suckers are expected to provide an additional source of genetic broodstock and contribute to the existing populations in Upper Klamath Lake and the Upper Klamath Lake Recovery Unit. They would also improve opportunities for adults to spawn and successfully reproduce in these areas, contributing to increased numbers and reproduction.

KRRC (2021f) concludes that the proposed action *may affect and is likely to adversely affect* both the Lost River and shortnose sucker, and further determined the proposed action *may affect but is not likely to adversely affect* critical habitat for either species. The FWS (2021a) BiOp concurs with these determinations and further concludes that the proposed action is not likely to jeopardize the continued existence of the Lost River and shortnose sucker, nor is it likely to adversely affect designated critical habitat for either species.

Bull Trout

Under existing conditions, bull trout inhabit the cold headwaters of several tributaries to Upper Klamath Lake, and therefore, are located well upstream of the hydroelectric reach. Consequently, they would not be directly affected by reservoir drawdown and dam removal. However, in the long term, anadromous fish recolonization upstream of Iron Gate Dam could affect bull trout through a combination of predation, competition, and disease/pathogen transmission (if reintroduced fish eventually occupy the same cold-water habitats as bull trout).

KRRC does not propose any measures that would affect bull trout, and the proposed action does not contain any conservation measures for this species.

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[161] Sink populations exist in low quality habitat patches that would not be able to support a population in isolation. Without the contribution of individuals from a source population, they would become extinct.

Our Analysis

According to FWS (2021a), Chinook salmon and steelhead are likely to recolonize their historical range and overlap the current distribution of bull trout in all parts of the three core areas with the exception of Threemile Creek and Sun Creek, although they may be able to access these areas over time if Oregon DFW or FWS physically move fish to these areas. For this analysis, we are assuming that Chinook salmon and steelhead may occupy all areas that are occupied by bull trout over time. In addition, one of the recovery goals for bull trout in the Klamath Recovery Unit is to improve fish passage throughout the range to encourage fluvial life histories (FWS, 2015b).

Because adult Chinook salmon and steelhead do not feed during their spawning migrations, we do not expect the adult life stages of these species to affect bull trout. However, juvenile steelhead, which may eventually occupy bull trout habitat, are known to prey on a variety of food resources, including eggs and fry of other fish. Juvenile steelhead may also interact with bull trout, competing for rearing habitat and possibly preying on juvenile bull trout where their rearing habitats overlap.

Anadromous fish recolonization could also lead to the introduction of disease and pathogens from Chinook salmon and steelhead. In its BA, KRRC (2021f) discusses the presence and potential for multiple diseases and pathogens to affect many fish species. A common salmonid parasite, *C. shasta*, is a significant source of salmonid mortality in the Lower Klamath Basin (Stocking et al., 2006). However, the geographic distribution of *C. shasta* in the Klamath Basin already includes the headwaters of the Klamath River and is known to infect native Klamath redband trout (*Oncorhynchus mykiss newberri*) (Stocking et al., 2011; Atkinson and Bartholomew, 2010). Redband trout are known to exist in sympatry with bull trout in the Klamath Basin and bull trout have likely been exposed to *C. shasta*. Based on the presence of the same diseases and pathogens upstream and downstream of Iron Gate Dam, and the evolution of bull trout in the presence of these pathogens, the potential for recolonizing Chinook salmon and steelhead to facilitate the reintroduction of new or unknown diseases and pathogens to bull trout is not meaningfully measurable or detectable and is therefore insignificant.

The recolonization by Chinook salmon and steelhead would increase the prey base for bull trout through salmon eggs, fry, juveniles, and carcasses. Another effect would be increased productivity from marine-derived nutrients. These nutrients would lead to a greater abundance and richness of insects and aquatic macroinvertebrates (Cederholm et al., 1999) that also serve as food for bull trout. These effects would be permanent, significant, and beneficial to bull trout.

In most streams, juvenile bull trout generally do not occupy the same microhabitat as Chinook salmon. For example, in the Yakima River Basin, reintroduced spring Chinook salmon rarely overlapped spatially with bull trout in tributaries (Pearsons and Temple, 2007). Furthermore, the diets of juvenile bull trout and Chinook salmon are not likely to overlap, as seen in the Elwha River Basin in which no piscivorous behavior was documented (Duda et al., 2011). Therefore, the short- and long-term effects of the proposed action on bull trout would be less than significant.

Critical habitat for bull trout is designated in several tributaries to Upper Klamath Lake. Therefore, our effects analysis for bull trout critical habitat focuses on changes in the availability of food resources. Effects on food resources were determined by assuming that Chinook salmon and steelhead would reoccupy historical habitat upstream of Upper Klamath Lake. Our effects analysis also assumes that bull trout, being highly piscivorous, would take advantage of the availability of these increased food resources (anadromous salmonid egg, fry, juveniles, and adult carcasses).

KRRC (2021f) concludes that the proposed action *may affect and is likely to adversely affect* the bull trout, and further determined the proposed action *may affect but is not likely to adversely affect* critical habitat for the species. The FWS (2021a) BiOp concurs with this determination and further concludes that the proposed action is not likely to jeopardize the continued existence of the bull trout, nor is it likely to destroy or adversely modify the species' designated critical habitat.

Franklin's Bumble Bee

Dam and facilities removal and restoration activities would occur within the known range of the Franklin's bumble bee, but the species has not been observed in the wild since 2006. The presence of any extant population is unknown. The proposed action could destroy or disturb potentially suitable habitat for Franklin's bumble bee via vegetation clearing and other ground disturbance for dam removal, structure demolition, and restoration activities. However, restoration of the reservoir footprint with native flowering plants would increase available habitat. Potential drift from herbicide application for invasive plant control could have localized effects on potential Franklin's bumble bee habitat.

KRRC addressed the effects of dam removal to Franklin's bumble bee in appendix B of its BA (KRRC, 2021f) and proposed no specific protective measures. KRRC's proposed RAMP, discussed above in section 2.1.2.11, *Reservoir Area Management Plan*, includes collection of wild seed from several species that would provide potential forage to Franklin's bumble, such as lupine spp., bee balm, penstemon spp., and goldenrod. KRRC would plant these pollen and nectar sources within restoration areas, providing over 2,000 acres of suitable habitat for bumble bee foraging. To avoid effects from herbicides, KRRC would conduct biological resources awareness training and implement herbicide use guidelines that consider environmental conditions to limit drift and runoff. KRRC would identify and avoid areas with important native species such as horse mint, coyote mint, and other genera such as ceanothus, buckwheat, lupine, native clover, and hellebore. KRRC provides a full description of herbicide use including products, formulation, and BMPs to minimize effects on listed species in the RAMP.

Our Analysis

Dam removal and restoration activities would temporarily destroy and disturb a relatively small area of potentially suitable Franklin's bumble bee habitat. Although unquantified, the extent of affected flowering plants would be negligible relative to the availability of Franklin's bumble bee habitat surrounding the project. After reservoir drawdown, the reservoir sediments would remain sparsely vegetated for several months as seeded plants become established. However, following restoration of the reservoir footprint and riparian areas, increased pollen and nectar sources along the hydroelectric reach would have substantial long-term, beneficial effects on Franklin's bumble bee, if present, because pollen availability directly affects bumble bee populations by supporting survival of queens (Burns, 2004).

While Franklin's bumble bees are not known to occur in the project area, KRRC has included measures to avoid effects from herbicide exposure near known nectar and pollen resources. The protective measures that KRRC proposes are taken from BLM and FWS decision documents (BLM, 2010; FWS, 2013d). Based on this information, we conclude that the proposed action could have a short-term, less than significant, adverse effect but a permanent, significant, beneficial effect on Franklin's bumble bee. Furthermore, in its listing rule, FWS concluded that "the present or threatened destruction, modification, or curtailment of habitat is not a threat to Franklin's bumble bee" (86 FR 47221).

KRRC (2021f) considered but excluded the Franklin's bumble bee from further analysis in its BA. The FWS (2021a) BiOp found that the risk of exposure and effects on Franklin's bumble bee from the proposed action is considered discountable and concludes that the project *may affect but is not likely to adversely affect* the species.

Little Brown Bat

Removal of the four dams and structures, and associated construction activity would displace or disturb resident bats and destroy roosting habitat (see section 3.5.3.9, *Sensitive Wildlife Species, Bats*). KRRC's bat surveys did not detect any little brown bats, but the species may occur during the summer in project structures; for example, they could be among the 2,000 to 3,000 *Myotis* species identified at the Copco No. 1 gatehouse C-12, or among 30 *Myotis* species detected at the maintenance building next to the switchyard on Copco Access Road. During winter, little brown bats would be less likely to occur in these structures because they typically hibernate in caves and mines, or in rock roosts on talus slopes and cliffs (Neubaum, 2018).

KRRC has proposed several protective measures for bats that would avoid or limit potential effects on the little brown bat, as detailed in section 3.5.3.9, *Sensitive Wildlife Species, Bats*. Measures include seasonal restrictions on structure removal, visual surveys prior to structure removal, phased removal, and barricading remaining structures to exclude bats. Additionally, the Construction Management Plan provides for an on-site biologist/construction monitor with stop-work authority to be present during construction-related activities. This biologist would conduct daily preconstruction surveys of the areas to be disturbed that day.

FWS recommended KRRC draft conservation measures for potential effects on the little brown bat to minimize possible project delays if the species were listed under the ESA before the proposed action is complete.

Our Analysis

Roosting habitat potentially used by little brown bats could be lost by the demolition of the Copco No. 1 gatehouse C-12, the maintenance building next to the switchyard on Copco Access Road, and likely other structures. KRRC's proposed bat protective measures could avoid or minimize adverse effects on bats in general. As discussed above in section 3.5.4, requiring replacement structures for bat roosting could offset adverse effects. Also, any potential effects would be further minimized by staff modifications to the TWMP, which include imposing additional criteria for potential structure removal during the maternity season (April 16 to August 31); ensuring structure removal would occur when bats are active; using bat gates to close portal outlets, tunnels, and other water conveyance structures; developing and monitoring replacement bat roosting habitat; and implementing decontamination protocols. Therefore, we conclude that the proposed action would have temporary, less than significant, adverse effects on the little brown bat, but that long-term effects would be mitigated by creating or enhancing artificial roosting habitat and using bat gates to continue to provide access to tunnels and conveyances to maternity, roosting, and hibernating sites.

Monarch Butterfly

Potential effects on monarch butterflies could occur during demolition and deconstruction of hydropower facilities by crushing larva (caterpillar) or pupa (chrysalis), if present, and by removing host plants (milkweed) or foraging habitat with nectar plants from landscaped areas near residential buildings. Also, herbicides used to reduce the spread of invasive plants along access roads and within construction areas could inadvertently affect nearby milkweed or nectar plants, although no large populations are reported. On the other hand, removing around 40 structures and human disturbance associated with structure maintenance would reduce herbicide use in those areas. Site restoration of around 2,000 acres of reservoir footprint and areas surrounding project facilities would include several species nectar plants that are important to monarch butterflies.

KRRC addressed the effects of dam removal to the monarch butterfly in appendix B of its BA (KRRC, 2021f), including a list of minimization measures. Prior to and after dam removal, and during restoration of the reservoir footprint and tributaries, KRRC would employ biological monitors to report any observations of status species (including monarch butterflies) in monthly reports and would, to the extent practicable, direct construction activities away from any observed sightings. KRRC proposes to carefully manage the use of herbicides during site restoration by conducting pre-application surveys to identify populations of milkweed and other suitable nectar plants, avoiding those plants, and carefully applying herbicides in limited areas

As discussed above for Franklin's bumble bee, KRRC's RAMP would restore native vegetation, including important flowering species for pollinators. KRRC is collecting and developing sources for locally adapted native seed. KRRC would plant showy milkweed planted as rhizomes but did not specify the quantity/acreage.

Our Analysis

Monarch butterflies are most likely to be found where milkweed plants occur because the availability of milkweed is essential to monarch reproduction and survival. As discussed above for Franklin's bumble bee, KRRC would also implement measures to avoid or minimize risk from herbicide use based on BLM (2010) and FWS (2013) guidance.

The restoration of native plant communities following reservoir drawdown and dam removal would provide a significant opportunity to increase monarch butterfly habitat. The RAMP, however, does not include milkweed in the specified seed mixes, but only provides planting rhizomes. Including planting locations and quantities for milkweed restoration in the final RAMP would ensure FWS has the opportunity to review and comment on the extent to which milkweed is incorporated into the restoration effort for the benefit of monarch butterflies. In conclusion, the proposed action could have minor, short-term, adverse effects on some individual monarch butterflies, but would have substantial, long-term, beneficial effects at the population level. For these reasons, KRRC (2021f) considered but excluded the monarch butterfly from further analysis in its BA and we find that the proposed action would have minor, less than significant, adverse effects on the species. The FWS (2021a) BiOp acknowledged that the project includes appropriate minimization measures to reduce effects on this candidate species.

Northern Spotted Owl

The use of blasting, helicopters, and other heavy equipment for dam and facility removal and restoration activities could disturb any nearby northern spotted owls. However, suitable habitat for the northern spotted owl is limited at the project; the majority of areas that would be affected by dam removal and restoration activities are considered unsuitable. Adjacent to the J.C. Boyle Powerhouse, there are small, isolated stands of trees that may provide roosting and foraging opportunities. Nesting, roosting, or foraging habitat also occurs in the vicinity of a northern spotted owl activity center located 1.3 miles southeast of Copco No. 1 Reservoir, but the habitat around the dam and reservoir are not suitable.

KRRC reviewed information about northern spotted owl occurrences, and after consulting with FWS, determined that surveys were not necessary at Copco No. 1 and

Copco No. 2 Reservoirs and concluded that construction activities associated with the removal of Copco No. 1 Dam and Copco No. 2 Dam would not affect suitable habitat for northern spotted owl southeast of Copco No. 1 Reservoir. Additionally, KRRC found no owls during protocol surveys specifically established for disturbance-only activities (i.e., without affecting northern spotted owl habitat) in suitable dispersal habitat around the J.C. Boyle Dam. Furthermore, KRRC determined the habitat quality to be marginal at best. It consists of younger forest stands with open canopies and only a small number of isolated patches of habitat that may support roosting and/or foraging.

Removal of approximately 0.4 acres of trees and vegetation to realign portions of the J.C. Boyle Powerhouse access road would occur within designated northern spotted owl critical habitat. KRRC reports that this area may provide dispersal habitat but does not have the characteristics of nesting, roosting, or foraging habitat.

Our Analysis

In California, dam removal activities could potentially affect a northern spotted owl activity center located 1.3 miles southeast of Copco No. 1 Reservoir. The nearest construction activity that could affect suitable habitat would entail reservoir restoration, including using helicopters for seeding. The disturbance is greater than 1 mile from the activity center, which exceeds the FWS (2020b) threshold distances for potential effects of auditory and visual disturbance to northern spotted owls and the 1-mile threshold distance necessary to avoid potential effects from blasting (e.g., for dam removal dams), as specified by FWS (2006) guidance. Additionally, KRRC proposes to prevent disturbance by requiring helicopter flight paths to stay at least 1 mile away from a northern spotted owl activity center during all work activities. These measures would avoid disturbance, and proposed project activities would not change the functional characteristics of the habitat for northern spotted owls. In the long term, restoration of the Klamath River to its historic channel and associated riparian forest would result in an increase in dispersal habitat.

In Oregon, it is possible that northern spotted owls may be present in the vicinity of J.C. Boyle Dam, but KRRC's surveys did not detect any nests or activity centers, and habitat to support future nesting pairs is not present within the FWS (2006; 2020b) threshold disturbance distances. No nesting, roosting, or foraging habitat would be affected and direct effects on northern spotted owl are very unlikely. Also, while the J.C. Boyle Dam demolition and disposal sites do not provide suitable dispersal habitat, associated activities like widening existing roads may remove relatively small numbers of trees from approximately 0.4 acre of dispersal habitat. This tree removal would have minimal effect on northern spotted owl habitat because forest conditions at the scale important to northern spotted owls would essentially remain the same. Thus, potential effects on any individuals that may disperse through the J.C. Boyle area are not anticipated to rise to the level of northern spotted owl habitat modification.

Modification of critical habitat during relocation and widening of the J.C. Boyle Powerhouse access road, mainly in the vicinity of the scour hole would be limited to around 0.4 acres of northern spotted owl dispersal habitat. Although KRRC may thus potentially adversely modify or destroy the species' critical habitat, removal of a relatively small number of trees would not influence forest conditions with respect to the species' life history. This small scale of habitat removal would not significantly influence forest stand conditions that support dispersal for the owl, such as contiguous canopy cover, foraging opportunities, protection from avian predators, or roosting sites. The functional characteristics of northern spotted owl nesting, roosting, or foraging habitat would not be degraded or removed, nor would the affected dispersal habitat. The surrounding dispersal habitat would remain intact and available for dispersing owls.

With KRRC's proposed protective measures in place, the proposed action would have a short-term, less than significant, adverse effect on northern spotted owl nesting, roosting, or foraging habitat. While a relatively small amount of dispersal habitat could be temporarily affected, the restoration of the river channel and adjacent riparian forest would increase dispersal habitat over the long term, providing a permanent, less than significant, beneficial effect on northern spotted owls. KRRC (2021f) therefore concludes that the proposed action *may affect but is not likely to adversely affect* the northern spotted owl or its critical habitat. The FWS (2021a) BiOp concurs with this determination.

Oregon Spotted Frog

There is suitable habitat for the Oregon spotted frog within the project boundary, but the species is not believed to inhabit areas in the hydroelectric reach or downstream of Iron Gate Dam. Thus, effects on the species are not expected to occur during reservoir drawdown and dam removal activities. Although no Oregon spotted frogs are believed to occur within the project area, individuals from upstream reaches (e.g., Spencer Creek) could colonize restored reaches following dam removal. Dam removal would restore passage for anadromous salmonids in the Middle and Upper Klamath River Basin that could prey upon the tadpoles or young frogs produced by the small numbers of Oregon spotted frogs that remain in the Klamath River and its tributaries. On the other hand, reservoir drawdown and dam removal would reduce lacustrine habitat that supports non-native American bullfrogs, which are known to prey upon and outcompete Oregon spotted frogs.

The effects analysis in KRRC's (2021f) BA focused on potential effects of restoring anadromous salmonid access to historical habitat in Upper Klamath tributaries after the four dams are removed, which could potentially result in adverse effects on Oregon spotted frog due to predation, competition for resources, and/or disease transmission. KRRC has not proposed any measures to mitigate potential adverse effects on Oregon spotted frogs that may result from salmonid predation because there is limited information available to predict the potential effects; nor have Oregon DFW, or California DFW recommended any measures. However, KRRC has proposed measures in its TWMP that would avoid or minimize effects on suitable Oregon spotted frog habitat, such as buffers around wetlands, biological monitoring, and herbicide use BMPs.

Our Analysis

Given the distribution of recent Oregon spotted frog observations in the region at elevations higher than the hydroelectric reach, reservoir drawdown and dam removal are not expected to affect the Oregon spotted frog. Predation on Oregon spotted frogs by salmonids is difficult to predict. Researchers have minimal understanding of the local distribution of Oregon spotted frogs and of the causative factors affecting their distribution. Given such uncertainty, it is impossible to quantify population-level effects that could result from altered predator populations after dam removal. While there could be additive mortality from increased salmonid predation, the overall effects on Oregon spotted frogs would likely be limited and similar to that caused by existing native and non-native trout. Oregon spotted frogs tend to avoid laying eggs in permanent waterbodies where eggs and hatching tadpoles are most vulnerable to predation (Watson et al., 2003); populations also persist where they co-occur with redband trout and brook trout (W. Tinniswood, pers. comm., February 18, 2021, as cited in KRRC, 2021f).

The lentic habitats of project reservoirs currently serve as breeding grounds for non-native American bullfrogs, which compete with and predate upon Oregon spotted frogs. Dam removal and the resulting Klamath River hydrology would more closely mimic historical patterns and aid in controlling bullfrogs, thus improving conditions for any recolonizing Oregon spotted frogs (Fuller et al., 2010). Still, predatory fishes and bullfrogs would likely persist in most reaches and continue to limit the recovery of Oregon spotted frog.

Designated critical habitat for Oregon spotted frog occurs in the Middle Klamath Basin in upstream reaches of the project, but because there is no designated critical habitat within stream reaches affected by dam removal, there is no potential for the proposed action to adversely modify or destroy the species' critical habitat. KRRC (2021f) determined that the proposed action would have *no effect* on critical habitat for Oregon spotted frog; FWS (2021a) stated that it "makes no response" to that conclusion. Given that KRRC's protective measures have been developed in consultation with the resource agencies, we find that dam removal and associated restoration activities would have a less than significant, adverse effect on Oregon spotted frog. KRRC (2021f) concluded that the proposed action *may affect but is not likely to adversely affect* the Oregon spotted frog. The FWS (2021a) BiOp concurs with this determination.

Western Bumble Bee

The current distribution of the western bumble bee is not known to include the project area, but suitable habitat exists. As discussed above for Franklin's bumble bee, the proposed action could destroy or disturb that habitat via vegetation clearing and ground disturbance for dam removal and restoration activities, or from herbicide use for controlling invasive plants.

KRRC would avoid potential adverse effects on western bumble bee by implementing the avoidance and minimization measures discussed above for Franklin's bumble bee. FWS recommended KRRC draft conservation measures for potential effects on the western bumble bee to minimize possible project delays if the species were listed under the ESA before the proposed action is complete.

Our Analysis

The western bumble bee's range in Oregon has contracted to include high-elevation sites on the east side of the Cascade Range. Based on recent survey data compiled by the Pacific Northwest Bumble Bee Atlas (2021), the species is not likely to be found within areas subject to the effects of dam removal. The proposed action could destroy and disturb small areas containing pollen and nectar plants that are important to the western bumble bee, but the total area would be small and population-level effects would not be expected. As discussed previously, KRRC's proposed RAMP includes site restoration using a variety of native plants, which would have major beneficial effects on the western bumble bee. In conclusion, the proposed action is unlikely to directly affect any western bumble bees. Although there could be minor, indirect, adverse effects on suitable habitat for the species, any effects would be temporary, and site restoration would have long-term, beneficial effects. Thus, we conclude that the proposed action would have a short-term, less than significant, adverse effect but a permanent, significant, beneficial effect on the western bumble bee.

Western Pond Turtle

Western pond turtles occur throughout the project area but are concentrated in areas where basking structures (exposed rocks and occasionally logs) are present near slow-moving water. Any western pond turtles downstream of the project reservoirs may be temporarily disturbed by fluctuating water levels of the river during drawdown. There is potential for stranding, including mortality, to western pond turtle from the effects of drawdown, as well as potential effects from construction and alterations to habitat. Because reservoir drawdown would occur during winter, western pond turtle overwintering along the shoreline of J.C. Boyle Reservoir could be killed by exposure to freezing conditions following drawdown. Turtles could also become buried from sediment slumping or bank failure as the reservoirs are drawn down, and turtles overwintering in shallow, upstream portions of the reservoir may be vulnerable to washing downstream during sediment export. Some turtles may be overwintering on land during the drawdown and not affected by sediment redistribution. However, unless they disperse into nearby tributaries or travel across vegetated lands not affected by reservoir drawdown, western pond turtle returning to aquatic habitats could become entrapped in cracks that develop in the reservoir footprint sediments following drawdown and drying. Adults and juveniles may also be at greater risk of predation as they move from exposed overwintering sites to new locations. Dam removal would affect invertebrate food availability for western pond turtle by temporarily displacing or reducing benthic macroinvertebrate populations (California Water Board, 2020a). Lastly, restoration activities would require ground disturbance that could injure or kill western pond turtles.

KRRC proposes measures to protect the western pond turtle in its TWMPs, which includes preconstruction surveys, drawdown surveys and a rescue and relocation protocol. Specific activities are detailed in section 2.1.2.12, *Terrestrial and Wildlife Management Plan*.

Our Analysis

Short-term, adverse effects on western pond turtles would occur within project reservoirs during reservoir drawdown due to shoreline habitat loss, exposure to stressful temperatures or predation, and sediment redistribution. Downstream of the four dams, short-term, adverse effects on western pond turtle habitat may occur due to changes in sediment distribution and local hydrology, causing turtles to move and thus become more vulnerable to predators or experience diminished foraging opportunities. Reservoir drawdown rates would be within the natural variation for winter seasonal flows; however, and western pond turtles in downstream reaches could escape to adjacent upland habitat if needed. They would also not likely be exposed to the high suspended sediment while within overwintering habitats along the riverbanks or adjacent terrestrial areas.

Following dam removal, approximately 20 miles of mainstem and tributary reaches would be exposed within the reservoir footprints. This restored riverine habitat would replace the existing western pond turtle habitat in the project reservoirs with riverine habitat that would be suitable for the species to survive and reproduce. Once benthic macroinvertebrate populations reestablish after drawdown, western pond turtles would be able to forage within riverine habitat. Although over 90 percent of the existing aquatic surface area would be removed and converted to riverine, riparian, and upland habitat, the effect on western pond turtles would be more directly related to a change in the amount of shoreline habitat. Shoreline habitat would then be present on either side of the newly exposed mainstem channel and tributaries, providing around 40 miles of shoreline habitat. KRRC's proposed habitat restoration would be designed to create shoreline complexity to slow water velocities, including large wood placement that could create basking habitat used by western pond turtles. River restoration would also seek to create connectivity to tributaries and floodplain habitat features that are important to western pond turtles (e.g., wetlands and side channels). While the replacement of lentic reservoir habitat with free-flowing river habitat is anticipated to provide western pond turtles with suitable habitat following dam removal, the extent of future suitable habitat is not quantified. Nevertheless, the California Water Board (2020a) determined that, once the proposed action is complete, riverine habitat within the newly connected Klamath River would continue to support all life stages and functions of the western pond turtle.

It is not possible to predict how many hatchlings, juveniles, or adults would be affected in the short term by dam removal because the number of western pond turtles captured during KRRC's tracking study in J.C. Boyle Reservoir was not enough to provide a population estimate. It is also not known how much of the newly created riverine and floodplain habitat would be suitable for western pond turtles. For example, Reese (1986) showed that modifications of the river channel for fisheries enhancements may be too shallow and exposed to improve conditions for western pond turtles. However, restoration of off-channel wetlands could provide alternative habitats if the riverine habitat is unsuitable. As discussed above for Oregon spotted frog, returning the Klamath River to a more natural hydrologic condition and removing stable, deep, lentic habitats used for breeding should aid in controlling bullfrogs (Fuller et al., 2010) and largemouth bass, reducing the effects of predation on western pond turtles. Restoration efforts should focus on reducing bullfrog reproduction, if possible, by creating ephemeral ponds that dry in late summer or early fall because bullfrog larvae in the Pacific Northwest usually take more than one year to metamorphose, although that may be accelerating due to changing conditions (Wegner et al., 2002).

The free-flowing river would allow western pond turtles to disperse into available habitat upstream or downstream along the Klamath River and upstream into tributaries after reservoir removal, providing for genetic exchange among isolated western pond turtle populations. In the long term, western pond turtles would also benefit from an increase in water quality. Finally, the measures included in KRRC's TWMPs are consistent with California Water Board WQC 16 and Oregon DEQ WQC condition 4c. KRRC's reporting would provide sufficient information for the resource agencies to provide input for limiting effects on western pond turtle before, during, and after dam removal. We conclude that the proposed action would have a temporary, significant, adverse effect but a permanent, significant, beneficial effect on western pond turtles.

3.6.4 Effects of the Proposed Action with Staff Modifications

The effects would be the same as the proposed action.

3.6.5 Effects of the No-action Alternative

Under the no-action alternative, project dams would remain in place and continue to prevent passage of SONCC coho salmon to spawning habitat upstream of the project. Therefore, the no-action alternative would likely have significant, unavoidable, adverse effects on SONCC coho salmon and its critical habitat. Due to the continued effects of the dams on Chinook salmon, the no-action alternative would have significant, adverse effects on Southern Resident killer whale and its critical habitat. The no-action alternative would have less than significant, adverse effects on Southern DPS green sturgeon or its critical habitat, bull trout or its critical habitat, northern spotted owl or its critical habitat, Oregon spotted frog or its critical habitat, and Franklin's bumble bee. The no-action alternative would have no effect on the shortnose sucker or its critical habitat or the Lost River sucker or its critical habitat.

Table 3.6-1. Federally listed species potentially affected by the proposed action (Source: Unless stated otherwise, includes Moyle (2002), ESA listing Rules in the Federal Register, Critical Habitat Designation Rules in the Federal Register Rules, NMFS Species Recovery Plans, NMFS Five-Year Status Reviews, and NMFS Threatened and Endangered Species Directory [online])

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Southern Oregon/Northern California Coastal ESU coho Salmon *Oncorhynchus kisutch* Threatened	Coho salmon are distributed throughout the Klamath River downstream of Iron Gate Dam, and spawn primarily in large tributaries such as the Scott, Shasta, and Trinity Rivers, as well as some higher order tributaries (NRC, 2004). Iron Gate Dam blocks access to approximately 76 miles of spawning, rearing, and migratory habitat (Reclamation and California DFW, 2012). Most spawning takes place in tributaries, but coho salmon have been observed spawning inside channels, tributary mouths, and margins of the mainstem Klamath River between Beaver Creek (RM 161) and Independence Creek (RM 94) (Magneson and Gough, 2006). Typical juvenile habitat consists of pools and runs in forested streams with dense cover in the form of large woody debris. Coho salmon use at least some part of their spawning streams on a year-round basis. The Klamath River estuarine habitat is also used year-round; different sizes of coho salmon use different parts of the estuary in different ways (Hughes et al., 2014; Wallace et al., 2015).	Coho life history throughout their range is summarized in Sandercock (1991) and Baker and Reynolds (1986). Coho salmon have an anadromous life history in which juveniles are born and rear in freshwater, migrate to the ocean, grow to maturity, and return to freshwater as adults to spawn. They generally have a 3-year life history and the vast majority of coho salmon mature in their third year of life after having spent about 3 to 4 months within gravel of their natal stream as eggs and larvae (alevins), up to 15 months rearing in fresh water, followed by a 16-month growing period in the ocean, and returning as adults to spawn and die at age 3. However, juveniles can emigrate from their natal streams as young-of-year, one-year olds, or two-year olds, and adults may spend one to three years in the ocean before migrating into freshwater rivers, indicating some flexibility in life history. Some males return to spawn as two-year-olds (jacks), but virtually all females return after two growing seasons in the ocean (age three). Adults typically start to enter the river in September, peak migration occurs between late October and the middle of November, and a few fish continue to enter the river through the middle of December (NAS, 2004). Fry start emerging approximately 3 to 4 months after spawning, in late February and typically reaching peak abundance in March and April; fry-sized fish appear into June and early July (California Fish & Game, 2002). Fry are not territorial and tend to move around; some fry are captured in outmigrant traps at the mouths of the Shasta and Scott Rivers from March through May (Chesney and Yokel, 2003).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Southern DPS green sturgeon *Acipenser medirostris* Threatened	Green sturgeon is a widely distributed from Baja California to Canada. The Northern DPS and Southern DPS are distinguished based on genetic data and spawning locations, but their distribution outside of natal waters generally overlap with one another. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California (Moser and Lindley, 2007; NMFS, 2015) and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays Southern DPS green sturgeon populations are known to congregate in coastal waters and estuaries during the summer and fall, including non-natal estuaries, such as the Rogue River. The Sacramento River currently contains a spawning population. The spawning population of the Southern DPS in the Sacramento River congregates in a limited area of the river compared to potentially available habitat. As Southern DPS sturgeon spend the majority of their life in the ocean, only a small proportion of the Southern DPS green sturgeon is expected to be present in the Klamath River estuary in any given year. Based on the available evidence, however, it appears unlikely that green sturgeon from the Southern DPS currently occur within the Klamath River or nearshore environment.	Green sturgeon are long-lived (>50 years) anadromous fish that can attain large size and are the most marine-oriented of the various sturgeon species. Southern DPS green sturgeon typically spawn every 3 to 4 years (range 2 to 6 years), primarily in the Sacramento River and in the Feather River. Southern DPS green sturgeon enter San Francisco Bay in late winter through early spring, and spawn from April through early July, with peak activity influenced by factors including water flow and temperature (Poytress et al., 2011). Spawning primarily occurs in cool sections of the upper mainstem river in deep pools containing small- to medium-sized gravel, cobble, or boulder substrate. Post-spawn fish may hold for several months in the Sacramento River and outmigrate in the fall or winter or move out of the river quickly during the spring and summer months, although the holding behavior is most commonly observed (Heublein et al., 2009). Based on the length of juvenile sturgeon captured in the San Francisco Bay Delta, sturgeon migrate downstream toward the estuary between six months and two years of age (Radtke et al., 1966). Juvenile green sturgeon occupy freshwater and estuarine areas for one to four years before dispersing into saltwater. They range widely in the ocean after their outmigration (Moser et al., 2016).

Common Name *Scientific Name* **ESA Status**	**Range and Habitat**	**Life History**
Southern DPS eulachon *Thaleichthys pacificus* Threatened	Eulachon, an anadromous smelt in the northeastern Pacific Ocean, is composed of numerous populations that spawn in rivers from northern California to southwestern Alaska. The Southern DPS includes all eulachon that spawn in the states of Washington, Oregon, and California extending north to the Skeena River in British Columbia. Most eulachon production originates in the Columbia River Basin, including the Columbia River, the Cowlitz River, the Grays River, the Kalama River, the Lewis River, and the Sandy River (Gustafson et al., 2010). Historically, the only other large river basins in the contiguous United States where large, consistent spawning runs of eulachon have been documented are the Klamath River in northern California and the Umpqua River in Oregon. In the Klamath River, adults rarely migrate more than 8 miles inland and spawning grounds may extend up to Omogar Creek (RM 10.7). The PBFs essential for conservation of this species include: (1) freshwater spawning and incubation sites with water flow, quality, and temperature conditions and substrate supporting spawning and incubation; (2) freshwater and estuarine migration corridors free of obstructions with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted; and (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Spawning grounds are typically in the lower reaches of larger snowmelt-fed rivers (76 FR 65324).	Eulachon are semelparous and anadromous smelt, spending three to five years the ocean before returning to freshwater to spawn. Eulachon spawn when water temperatures range from 0 to 10°C, which typically occurs between December and June (Willson et al., 2006). Spawning occurs in January, February, and March in the northern part of the DPS, and later in the spring in the southern parts of the DPS. Adult eulachon have been observed in the Klamath River from January to April (Larson and Belchik, 1998). Spawning occurs over sand or coarse gravel substrates. Eggs are fertilized in the water column, then sink and attach to gravel or sand and incubate for 20 to 40 days (Hay and McCarter, 2000). The larvae are then carried downstream and are dispersed by estuarine and ocean currents shortly after hatching in the spring. Juvenile eulachon move from shallow nearshore areas to mid-depth areas. After three to five years, adults migrate back to natal basins to spawn (NMFS, 2017).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Southern resident DPS killer whale *Orcinus orca* Endangered	Southern Resident killer whales occur primarily in the inland waters of Washington State and southern Vancouver Island, although individuals from this population have been observed off coastal California in Monterey Bay, near the Farallon Islands, and off Point Reyes (NMFS, 2008). Southern Resident killer whales co-occur with Klamath River Chinook salmon in the ocean, although the boundaries around the area of co-occurrence cannot be precisely defined based on current information; however, it includes coastal waters ranging from northern California through central Oregon, up to the Columbia River. Satellite-tagged whales spent time off the northern California coast from January through April (NWFSC unpubl. data, as cited in NMFS, 2019b). The three Southern Resident killer whale pods have different distributions during the year, typically tied to the movements of various runs of Chinook and other salmon. During summer and fall, all three pods have typically been present in Washington and British Columbia inland waters north and west of Puget Sound. From late fall through spring, all three pods apparently spend the bulk of their time on the outer coast, ranging from San Francisco to Southeast Alaska. The K and L pods regularly travel back and forth between Washington and California, presumably to take advantage of concentrations of Chinook salmon returning to the Klamath River, while J Pod remains in Washington and British Columbia year-round. All three pods have been spending less time in the Salish Sea in the last few years than in the preceding 40 years due to decreased salmon abundance (Marine Mammal Commission, 2021).	Killer whales are highly social animals that form long-term associations based on kin called pods. Social organization is based on maternal kinship and may be characteristic of killer whale populations throughout the world (Bigg et al., 1990, Wright et al., 2016). Of the three Southern Resident killer whale pods, J Pod has ranged in size from 15 to 25, K Pod has varied from 14 to 22, and L Pod has ranged up to 59 individuals since the mid-1970s (Reclamation, 2018). Female killer whales give birth to calves about every four years. They are believed to mate in the from May to October, although small numbers of conceptions apparently happen year-round, as evidenced by births of calves in all months. Calves remain close to their mothers during their first year of life and are typically weaned after one or two years. In Southern Resident killer whales, mothers and offspring maintain highly stable social bonds throughout their lives and this natal relationship is the basis for the matrilineal social structure (Bigg et al., 1990).

Lost River and shortnose suckers *Deltistes luxatus* and *Chasmistes brevirostris* Endangered	The historical range of Lost River and shortnose suckers is limited to the Upper Klamath River Basin, including Upper Klamath Lake and tributaries, and the Lost River and its tributaries. Both species persist in Upper Klamath Lake and tributaries, Clear Lake and tributaries, the Lost River, Tule Lake, and in Klamath River impoundments downstream to J.C. Boyle Reservoir. Shortnose sucker populations are also present in Gerber Reservoir, Copco No. 1 Reservoir, and Iron Gate Reservoir. Extirpated populations include populations formerly associated with Lower Klamath Lake (including Sheepy Lake), Lake of the Woods, and at spring systems in Upper Klamath Lake, including Barkley Spring and springs along the northwestern shoreline near Pelican Bay (Reclamation, 2018). Lost River and shortnose suckers are lake-dwelling, but spawn in tributary streams or springs. Spawning habitat includes gravel substrates in streams less than 4 feet deep and over gravel substrates at shoreline springs along the margins of Upper Klamath Lake. Larval habitat is generally along the relatively shallow shoreline where emergent vegetation provides cover and protection. Juvenile suckers use a wide variety of habitat including nearshore areas with or without emergent vegetation and offshore habitat. They increasingly move offshore into the lake as they grow, and adults occupy open-water habitats (Reclamation, 2018). The PBFs of critical habitat include: (1) water of sufficient quantity and suitable quality; (2) sufficient spawning and rearing habitat; and (3) sufficient food resources with an abundant forage base (77 FR 73740).	Lost River and shortnose suckers reside in lakes and spawn in tributaries. On average, Lost River suckers live 20 years, while shortnose suckers live 12 years. Annual survival estimates for adults of both species are typically 90 percent. Reproductive maturity is reached between four and nine years for Lost River suckers, and between four and six years for shortnose suckers (Buettner and Scoppettone, 1990). In Upper Klamath Lake, there are two main spawning aggregations of Lost River suckers, those in the Williamson and Sprague Rivers and those that spawn at springs on the eastern shoreline of Upper Klamath Lake springs. Both populations show a high degree of site fidelity, although a small amount of mixing does occur. Shortnose suckers spawn only in the Williamson and Sprague Rivers (Hewitt et al., 2018). Annual spawning migrations for tributary-spawners in Upper Klamath Lake are triggered by average daily temperatures of 50°F for Lost River suckers and 54°F for shortnose suckers. Suckers begin spawning immediately after migrating up the rivers, and peak egg- drift typically occurs within days of peak adult migration (Hewitt et al., 2018). Spawning typically occurs in shallow water ranging from 0.4 to 2.3 feet deep over mixed gravel or course cobble. Eggs settle in the interstitial space in the substrate and typically develop in 8 days to 3 weeks. Larvae emerge from gravels about 10 days after hatching. Larvae spend relatively little time in the tributaries, and they drift toward the lake shortly after emergence (Buettner and Scoppettone, 1990). Relatively little is known about habitat use, diet, and ecology of age-1 and older juvenile suckers but there is very poor survival of age-0 and age 1 juveniles in Upper Klamath Lake. As summer progresses and water quality conditions decline, suckers congregate in the northern portion of Upper Klamath Lake, seeking refuge in or near Pelican Bay where springs provide cooler water and higher dissolved oxygen concentrations (Banish et al., 2009).
Bull trout	Historically, bull trout occurred throughout the Columbia River Basin; east to Montana, south to the	Bull trout exhibit two basic life-history strategies: resident, and migratory. Migratory bull trout live in larger river (fluvial) and

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Salvelinus confluentus Threatened	Jarbidge River in northern Nevada, the Klamath River Basin in Oregon, and the McCloud River in California; and north to Alberta, British Columbia, and possibly southeastern Alaska. The range of the bull trout has decreased compared with the known historical range. Bull trout are now extirpated in northern California (Moyle et al., 2008), and from other watersheds in Oregon and Washington (FWS, 2015a). In areas where bull trout populations occur, many are reduced in size, fragmented, or have been eliminated from the mainstems of large rivers (FWS, 2015a). Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre, 1993). Habitat components that particularly influence their distribution and abundance include water temperature, cover, channel form and stability, spawning and rearing substrate conditions, and migratory corridors (Fraley and Shepard, 1989). Bull trout require especially clean and cold water with temperatures below 59°F. They live primarily in cold headwater lakes, and streams and rivers that drain high mountainous areas, especially where snowfields and glaciers are present. Like all salmonids, bull trout require diverse, yet well-connected, habitats with structural components that provide good hiding cover (McPhail and Baxter, 1996).	lake systems (adfluvial) where juvenile fish usually rear from one to four years before migrating to either a larger river or lake where they spend their adult life, returning to the tributary stream to spawn (FWS, 2015a). Resident bull trout complete their entire life cycle in the tributary streams where they spawn and rear. Resident and migratory forms may be found together, and interbred at times, which helped maintain viable populations throughout the range (FWS, 2015a).). Bull trout reach sexual maturity in five to seven years, and spawn from the end of August through November (McPhail and Baxter, 1996). Spawning may occur annually for some populations, and every other year for the rest. Migration for spawning is initiated by warming water temperatures in downstream reaches. The distances traveled by migratory bull trout to spawn are on average farther than other non-anadromous salmonids (Fraley and Shepard, 1989). Bull trout require particularly clean gravel substrates to build their redds and increased sediment suffocates eggs by reducing dissolved oxygen (FWS, 2015a). Bull trout eggs incubate over the winter, and hatch in the late winter or early spring. Emergence usually requires an incubation period of 120 to 200 days. Juveniles migrate to areas upstream from spawning beds to grow and take advantage of cool headwater temperatures. Most migratory juvenile bull trout remain in headwater tributaries for one to three years before emigrating downstream to larger stream reaches (Rieman and McIntyre, 1993).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Franklin's bumble bee *Bombus franklini* Endangered	The Franklin's bumble bee occurs within a restricted range in northern California and southern Oregon between the Coast and Sierra-Cascade Ranges, in Douglas, Jackson and Josephine and Siskiyou and Trinity Counties in Oregon and California respectively (Kevan, 2008). It relies on flowering plants like lupine, poppy, hyssop, monardella, and vetch species for nectar and pollen. While the nesting biology of Franklins is unknown, it likely nests underground in abandoned rodent burrows underground, on the ground, and in rock piles (Xerces Society, 2009). The species has also been found nesting in a residential garage in Medford, Oregon (86 FR 47221).	A thorough review of the taxonomy, life history, and ecology of Franklin's bumble bee is presented in the FWS (2018a) Species Status Assessment. Franklin's bumble bee are social insects that lives in colonies consisting of a queen and her immature and adult offspring (sterile female workers and males). Queens are responsible for initiating colonies and laying eggs, workers are responsible for food collection, colony defense, nest construction, and feeding of the young; males' sole function is to mate with new queens at the end of the colony season (86 FR 47221). The active season occurs from mid-May through September. Colonies can contain up to 400 workers. They are generalist foragers and gather nectar and pollen from a wide variety of flowering plants in open meadows and are found in a wide variety of sheltered and exposed habitat types across a broad elevational range. At the end of the active season, new queens are produced, which mate with males prior to hibernating; all the workers and the males die along with the founding queen and only the inseminated hibernating females are left to survive and create new colonies the following year (86 FR 47221).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Little brown bat *Myotis lucifugus* Under Review	Little brown bats ranges across North America, from Alaska south to central Mexico, although its core population is in the northeastern United States. They occupy a wide variety of habitats but tend to prefer areas near open water and wetlands where there they forage over water for aquatic insects. They tend to roost in buildings or similar human-made structures in the spring and summer, but also roost in cavities or under loose bark of trees, under rocks, and occasionally in caves (Humphrey and Cope, 1976; Fenton and Barclay, 1980). In the fall, little brown bats return to hibernacula to overwinter and their distribution may be limited by accessibility to suitable hibernacula. Although little brown bats hibernate almost exclusively in caves and mines in the eastern United States, often in very large groups, it is rarely encountered in these habitats in the western United States (e.g., Neubaum, 2018); most *Myotis* species in the western U.S. do not use caves and mines during winter and rarely aggregate in large groups (Weller et al., 2018).	Little brown bats are active in the late spring and summer. In the fall, little brown bats congregate at “swarming” sites outside of cave or mine entrances to mate. Females store the sperm and delay fertilization until spring. After a 2-month pregnancy that begins in spring at maternal nursery roosts, females give birth to one pup in the early summer. Most little brown bats live just under a decade, but some live up to 20–30 years.

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Monarch butterfly *Danaus plexippus* Warranted but Precluded	The monarch butterfly occurs throughout all parts of the United States and are divided into a western and eastern population. Monarch butterfly habitat is broadly defined by the distribution of its host plant, milkweed. Adults lay eggs on the host plants and the larvae feed on the milkweed and sequester toxic chemicals from the plants to defend against predation (FWS, 2021f). Adults require a diversity of nectar plants during breeding (spring through fall). In arid regions such as the Upper Klamath River Basin, nectar plants and milkweed are often associated with riparian corridors The western population, west of the Rockies, primarily overwinter in eucalyptus, Monterey pine, Monterey cypress, and western sycamore groves along the coast of California and Baja California They migrates as far north as Washington, Idaho, and Oregon in the summer and fall (Xerces Society, 2017). However, some western monarch butterflies may migrate to central Mexico, mixing with the overwintering eastern monarch butterflies, although the rate of exchange is unknown (Pelton et al., 2016).	Monarch butterflies are a multi-generational migratory species. Monarch butterflies leave their overwintering sites along the coast of California and Baja California and migrate north to suitable egg-laying habitat where they mate and deposit their eggs and die. Their offspring typically survive two to five weeks in the adult stage, moving north generation by generation as temperatures warm and pants flower. In three to four generations, the population reaches the northern United States and into Canada and the last final generation in the fall makes the return trip to wintering sites in coastal California and Mexico. Unlike previous generations, these “super generation” monarchs live for six to eight months and begin the multi-generational migration the following spring (Forest Service, 2015).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Northern spotted owl *Strix occidentalis caurina* Threatened	The northern spotted owl's range extends from the San Francisco Bay area in Marin County north through the coast ranges of California, western Oregon, and western Washington, into southwestern British Columbia. It lives in mature forests with a dense, closed canopy and often old-growth trees. Northern spotted owl home ranges require forests that contain nesting, roosting, foraging habitat. Nesting habitat includes forests with moderate to high (60 to 80 percent) canopy closure and multiple layers, having greater than 30-inch-diameter-at-breast-height overstory trees, large trees with cavities, broken tops, or platforms; large snags; accumulations of fallen trees and woody debris on the ground; and sufficient openings below the canopy for flying. Roosting habitat is similar to nesting habitat, except without nesting features (e.g., cavities and platforms). Foraging habitat includes more open and fragmented forest types that support abundant small mammals like northern flying squirrels, woodrats, voles, and mice. Dispersal habitat includes forests as described above, but also younger, less-diverse stands. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796), and revised twice, in 2012 (77 FR 71875) and 2021 (86 FR 38246). The hydroelectric reach traverses through about 10 miles of designated critical habitat, from just below J.C. Boyle Reservoir to nearly the Oregon-California border (Unit 8: East Cascades South, Subunit ECS 2). Another portion of this subunit occurs approximately 0.5 miles southeast of Copco No. 1 Reservoir.	Northern spotted owl pairs occupy the same territories each year, but nesting may not occur every year. They are not migratory, but some individuals will move downslope during winter. Nest trees are often used more than one year; but occasionally, a pair will move to a new nest tree within its territory. Northern spotted owls begin their annual breeding cycle in late February to early March and lay one to three eggs in March or April. After about 30 days, eggs hatch and juvenile owls remain in the nest for three to five weeks. Both parents feed the young until they become independent around September or October and disperse from the parental nest areas (Gutiérrez et al., 1995).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Oregon spotted frog *Rana pretiosa* Threatened	The historic range of the Oregon spotted frog covered much of the Pacific Northwest, from southwestern British Columbia south through the Puget and Willamette Valleys and Columbia River Gorge, and through the Cascade Range as far south as far northeast California (Oregon Conservation Strategy, 2016; FWS, 2014). The species has been extirpated from most of western Washington and Oregon, including the Willamette Valley. It is still found in the Upper Klamath River Basin in Oregon but appears to be extirpated from its range in northeastern California. Most extant populations are in the Deschutes and Klamath basins (Pearl and Adams, 2011). The extant populations are isolated with low connectivity and low genetic diversity (FWS, 2014). Oregon spotted frogs are always found near perennial waterbodies like springs, ponds, lakes, rivers, and irrigation canals. They require shallow (1 to 3 feet) water areas for egg and tadpole development; perennially deep, moderately vegetated pools for adult and juvenile survival in the dry season; and non-freezing perennial water to protect all age classes during cold weather. Adult frogs use emergent or floating aquatic vegetation for basking and escape cover. Populations have been documented in areas having the following characteristics: (1) the presence of high-quality breeding and overwintering sites connected by perennial water; (2) consistent water depth throughout the period between egg-laying and metamorphosis; and (3) the absence of introduced predators, especially bullfrogs and introduced fish such as brook trout and centrarchids (FWS, 2021e).	The Oregon spotted frog typically begins breeding as soon as temperature warms up sufficiently, from March at low elevations to late June at higher elevation locations. Females may deposit egg masses at the same location in successive years in shallow, often temporary, pools no more than 6 inches deep. Eggs usually hatch within three weeks. The tadpoles are grazers, which metamorphose during their first summer. Post-metamorphic Oregon spotted frogs feed on live animals, primarily insects. Oregon spotted frogs require winter habitat that retains oxygenated water with sheltering locations where they are protected from predators and freezing. Overwintering may occur in flowing springs and creeks, or in still-water systems such as beaver complexes, riverine oxbows, lakes and ponds. Oregon spotted frogs are generally inactive during the winter, although some individuals may be active on warmer days at the water surface on under ice (Hayes, 1994; Pearl and Hayes, 2004). In severe cold winter conditions, Oregon spotted frogs are susceptible to mortality from freezing or hypoxia in shallow aquatic habitats that freeze to the substrate (FWS, 2020a). Adults typically use the same general breeding location across years, although actual egg locations shift based on water depth at the time of breeding. Eggs are usually in water less than 1 foot deep 4-5 cm. However, it is not unusual for the tops of egg masses to be exposed above the water surface. Water level fluctuations after oviposition can result in egg masses being stranded or inundated by deeper water (Pearl et al., 2010).

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
Western bumble bee *Bombus occidentalis* Under Review	The western bumble bee has a wide geographic range, broadly disturbed across the western half of the United States and Canada. A range-wide analysis suggests that the species has experienced a 28 percent range decline between recent (2007-2009) and historic (1900-1999) time periods (Cameron et al., 2011). Western bumble bees are generalist foragers and have been reported visiting a wide variety of flowering plants. They typically use shrub, chaparral, and open areas such as urban parks, mountain meadows. Western bumble bee colonies require plants that provide adequate nectar and pollen throughout the colony's life cycle, which is from early February to late November (although dates vary by elevation). Nests are usually in underground cavities such as ground squirrel or other animal burrows, and in wooded areas or edges of meadows over open meadows; a small number of nests have been reported from aboveground locations such as in logs among railroad ties (Hobbs, 1968; Richards, 1978).	Western bumble bees live in colonies with a division of labor as described above for the Franklin's bumble bee. A colony of western bumble bee can have up to around 1,600 workers, which is large compared to that of other bumble bee species (Hatfield et al., 2015). From early February to late November, the colony enters a flight period. Then, around the beginning of the fall, the reproductive individuals of the colony are produced. When winter starts, the old queen, workers, and males all die, leaving the new queens to search for an overwintering site, usually a few centimeters underground.
Western pond turtle *Actinemys marmorata* Under Review	The western pond turtle is the only native freshwater turtle in the Klamath River Basin. It requires both aquatic and terrestrial habitats and uses a wide variety of permanent and seasonal aquatic habitats, including lakes, ponds, rivers, sloughs, canals, and other open water. Western pond turtles forage in aquatic habitat, nest in nearby terrestrial sites, and overwinter either buried in mud on the substrate of aquatic habitats, in undercut banks along shorelines, or under soil and duff on nearby uplands. Nesting typically occurs within 325 feet of aquatic habitat in areas with compact well-	Western pond turtle mating takes place underwater, and females travel into upland environments to nest in mid-summer and may produce more than one clutch of approx. 4-7 eggs. Most mature females nest every other year, but some oviposit in consecutive years (Holland, 1994). Females seem to be able to delay oviposition if disturbed and nesting areas may have several areas where turtles excavate nests and then abandon them without depositing eggs. Survivorship of hatchlings is only 10-15 percent during the first three years of life, beyond which survivorship increases and is relatively high once the carapace length is about 5 inches. Maximum life span in the wild is unknown, but several

Common Name ***Scientific Name*** **ESA Status**	**Range and Habitat**	**Life History**
	drained soil, sparse vegetation, and good solar exposure, and includes open areas along trails, levees, roadbeds, fields, grasslands, stream banks, and utility rights-of-way (Oregon DFW, 2015). Along major rivers in Oregon, western pond turtle are often concentrated in side channels or areas of low current. During periods of high flow, they may move into oxbow or other wetland habitats adjacent to the river and return when flows decrease (Hallock et al., 2017; Holland, 1994). Western pond turtle diets include aquatic insects, amphibians, crustaceans, and fish (Rosenberg et al., 2009). According to PacifiCorp's (2004a) mapping of western pond turtle habitat suitability, a fraction of the project area shoreline is characterized as having suitable nesting and basking habitat, totaling approximately 12.0 miles in J.C. Boyle Reservoir, including the bypassed reach and peaking reach; 2.6 miles in Copco No. 1 Reservoir and none in the Copco No. 2 bypassed reach; and 2.8 miles in Iron Gate Reservoir. The project area also provides around 23 miles of suitable basking habitat (logs, large rocks, or emergent vegetation mats).	records exist for animals probably over 40 years of age and possibly over 50 years of age (Holland, 1994). The relatively low reproductive effort and longevity of western pond turtles means that this species' population recovery time (after disturbances or local extinctions) is relatively slow compared to other species.

Table 3.6-2. Southern Oregon/Northern California Coast (SONCC) ESU coho salmon populations and their key limiting stresses and threats (Source: NMFS, 2014a)

Population	Key Limiting Stresses	Key Limiting Threats		
Upper Klamath River	Altered Hydrologic Function	Barriers	Dams/Diversions	Roads
Shasta River	Altered Hydrologic Function	Impaired Water Quality	Dams/Diversions	Agricultural Practices
Scott River	Altered Hydrologic Function	Degraded Riparian Forest Conditions	Dams/Diversions	Agricultural Practices
Middle Klamath River	Lack of Floodplain and Channel Structure	Impaired Water Quality	Dams/Diversions	High-Severity Fire
Salmon River	Lack of Floodplain and Channel Structure	Degraded Riparian Forest Conditions	High-Severity Fire	Climate Change
Upper Trinity River	Altered Hydrologic Function	Adverse Hatchery Related Effects	Dams/Diversions	Hatcheries
Lower Trinity River	Lack of Floodplain and Channel Structure	Altered Hydrologic Function	Channelization/Diking	Hatcheries
South Fork Trinity River	Altered Hydrologic Function	Impaired Water Quality	Dams/Diversions	Roads
Lower Klamath River	Lack of Floodplain and Channel Structure	Altered Sediment Supply	Channelization/Diking	Agriculture

Table 3.6-3. Population estimates of Lost River and shortnose sucker in project reservoirs (Source: NMFS, 2014a)

Population Estimate Attributes	**J.C. Boyle**	**Copco**	**Iron Gate**	**All Reservoirs Combined**
Total suckers PIT-tagged (fall 2018, spring and fall 2019, and spring 2020)	71	83	27	181
Total maiden suckers captured (fall 2018 through spring 2020)	95	98	29	222
Total tagged suckers recaptured (fall 2018 through spring 2020)	3	3	2	8
Recapture efficiency (# Recaptured/# Tagged)	4.2%	3.6%	7.4%	4.4%
Chapman Method – Population estimate	1,727	2,078	279	4,509
Bootstrap Method – Mean population estimate	2,766	3,371	399	5,540
Bootstrap Method – 95% confidence interval upper limit	6,496	7,879	943	11,531
Bootstrap Method – 95% confidence interval	±3,730	±4,508	±544	±5,991
Jolly-Serber Model – Mean population estimate	864	1,235	102	2,201
Jolly-Serber Model – 95% confidence interval upper limit	1,815	2,609	191	4,615
Jolly-Serber Model – 95% confidence interval	±951	±1,374	±89	±2,414

3.7 RECREATION

3.7.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for recreation includes the Klamath River Basin, with specific focus on the hydroelectric reach. Areas adjacent to the Klamath River Basin or outside the hydroelectric reach, shown in figure 3.7-1, are described to provide an overview of regional recreation alternatives. The temporal extent of our effects analysis ranges from the temporary effects during project deconstruction activities to permanent effects after project removal.

3.7.2 Affected Environment

3.7.2.1 Regional Recreation Resources

The Klamath River Basin and nearby areas provide a range of recreation opportunities on public and private land. The regional recreation setting within the Klamath River Basin includes areas characterized by an expansive rural landscape of rivers, lakes, forested mountains, grasslands, and high plateau shrublands. Nearby public lands that offer recreation opportunities include national forests, parks, monuments, wildlife refuges, and state forests and parks. Recreation opportunities are also available within the region, including parks and other recreation sites developed by PacifiCorp within the hydroelectric reach as required by the project license.

Public Land

The Klamath River Basin is home to four national forests (Klamath, Fremont-Winema, Six Rivers, and Modoc), one joint national and state park (Redwood), one national park (Crater Lake), two national monuments (Lava Beds and Cascade-Siskiyou), and five national wildlife refuges (Klamath Marsh, Tule Lake, Clear Lake, Upper Klamath, and Lower Klamath) (California Water Board, 2020a). The recreation opportunities on public lands include sightseeing, camping, hiking, day use, swimming, fishing, boating, rock climbing, wildlife viewing, and hunting.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act was created to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition. River segments are classified as wild, scenic, or recreational, depending on the degree of development or naturalness at the time of designation.[162] Designated rivers are managed for 0.25-mile on each side of the river for their outstandingly remarkable values (ORVs).

In 1994, the Secretary of the Interior designated approximately 11 miles of the Klamath River from the J.C. Boyle Powerhouse to the California-Oregon border as a National Scenic River (National Wild and Scenic Rivers System [NWSRS], 2021a). The ORVs identified for this stretch of the Klamath River are fisheries; historic uses; Native American traditional use; and recreation use, including whitewater boating, scenic landscape, and diverse wildlife and habitats (NWSRS, 2021a).

The segment from Iron Gate Dam to the Pacific Ocean (approximately 250 miles) is designated as Recreational. This segment was designated in 1981 by the Secretary of the Interior. The ORV identified for this river designation is fisheries; with the river supporting several species of anadromous salmon, resident trout, sturgeon, and Pacific lamprey (NWSRS, 2021b). Various agencies manage the land adjacent to the river and its tributaries, including the Forest Service, BLM, California Resources Agency, Hoopa Valley Indian Reservation, Karuk Tribe of California, Yurok Tribe, and the Resighini Rancheria. These river segments are located downstream from all of the project features.

Another 5.3-mile segment of the Klamath River that begins at the California-Oregon border and continues downstream to the Copco No 1. Reservoir is considered eligible for designation. The ORVs for this segment are fisheries, historic uses, recreation use, scenic landscape, and wildlife resources.

Regional Recreation Opportunities and Demand

Recreation opportunities draw users from throughout a region larger than the adjacent communities. A description of the regional recreation opportunities and demand provide the context in which the project recreation resources are used by people within the region. This is important in assessing the role of the project area recreation resources for meeting a portion of the regional recreation demand. Understanding the opportunities and demand throughout the region provides the context for how changes to the project's recreation resources would affect regional recreation use. Analysis of effects are limited to project actions and their context within the region (figure 3.7-1).

The region includes nine lakes of comparable size to the project reservoirs and three additional reservoirs of much larger size (table 3.7-1) (PacifiCorp, 2004f). Various recreation opportunities are available at these sites, including boating, fishing, swimming, sightseeing, and day use recreation. Approximately 56 developed or improved boat

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[162] Wild Rivers are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. Scenic Rivers are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by road. Recreational Rivers are readily accessible by road or railroad, may have some development along their shorelines, and may have undergone some impoundment or diversion in the past.

launches are at lakes or reservoirs within 100 miles of the Lower Klamath Project (California Water Board, 2020a). There is high to moderate demand for water-based recreation activities, including swimming and beach activities (California Department of Parks and Recreation, 1998; Oregon Parks and Recreation, 2003).

Demand for fishing is high in California and moderate in Oregon (California Department of Parks and Recreation, 1998; Oregon Parks and Recreation, 2003). Fishing at rivers throughout the region is primarily for trout and salmonids (table 3.7-2). Angling at lakes and reservoirs throughout the region is primarily for trout, which are often stocked.

Whitewater boating opportunities occur on many rivers in the region (table 3.7-3). The Rogue River has the highest use because of its ease of access. Factors that contribute to higher levels of whitewater use are proximity to urban areas, year-round suitable flows, and availability of commercial outfitters. Whitewater outfitters service the Rogue, Upper Sacramento, and Klamath Rivers.

Because of the remote nature of the region, both tent and recreational vehicle (RV) camping are popular. Camping season extends from May to September, with the highest use at facilities near Interstate 5. Camping is offered at all Forest Service and National Park Service-managed areas in the region but is not available at FWS-managed refuges (California Water Board, 2020a). Over 2,500 developed campsites are available at lakes or reservoirs within 100 miles of the project (California Water Board, 2020a). Demand for both developed and primitive camping is low in Oregon and high in California (California Department of Parks and Recreation, 1998; Oregon Parks and Recreation, 2003). Aging populations in Oregon are increasing demand for RV and trailer camping as well as day use facilities (Oregon Parks and Recreation, 2019).

Additional recreation facilities, including day use sites, trails, and interpretive centers and displays are available mostly on public lands in the region. Regional supply meets the demand for trail hiking and picnicking, which is high in California and moderate in Oregon (PacifiCorp, 2004f). Demand for additional trails, restrooms, wildlife viewing areas, access to waterways, and play areas were ranked highest in a 2017 Oregon recreation survey according to Oregon's Statewide Comprehensive Outdoor Recreation Plans (Oregon Parks and Recreation, 2019).

3.7.2.2 Project Recreation Resources

Figure 3.7-2 shows the locations of existing project recreation sites.

Reservoir Recreation

J.C. Boyle Reservoir

J.C. Boyle Reservoir is approximately 3.6 miles long and about 350 surface acres (KRRC, 2021a), and is located on land that is primarily owned by PacifiCorp.

Recreational activities at the reservoir include swimming, fishing, boating, day use, overnight camping, target shooting, and off-highway vehicle use (FERC, 2007).

Recreation facilities at J.C. Boyle Reservoir include Sportsman's Park, Pioneer Parks (East and West), and the Topsy Campground (figure 3.7-3). Pioneer Park (East and West sides) and the Topsy Campground provide public access to the reservoir. Pioneer Park consists of two separate areas located on opposite sides of the reservoir adjacent to the Highway 66 Bridge. The park offers picnicking, swimming, boat launches, day use sites, restrooms, and interpretive signs. BLM's Topsy Campground includes a boat launch, day use area, restrooms, and 16 camp sites. Annual use is estimated at 16,700 recreation days[163] for the park and 5,600 recreation days for the campground (Reclamation, 2012).

Sportsman's Park, managed by Klamath County, is within 0.25 miles but does not abut the reservoir; and therefore, provides no public access to the reservoir. The park includes a day use area, shooting and archery ranges, camping, restrooms, and an off-highway vehicle area.

Copco No. 1 Reservoir

Copco No. 1 Reservoir is about 4.5 miles long and covers approximately 972 surface acres, almost entirely on privately owned land. Recreation activities at the reservoir include boating, fishing, day use, and overnight camping (FERC, 2007). In addition to public recreation, dozens of private homes with docks have access to Copco No. 1 Reservoir for recreation.

Two day use areas are available at Copco No. 1 Reservoir: Mallard Cove and Copco Cove (figure 3.7-4). Mallard Cove provides picnic areas, restrooms, a boat launch, and dock. Copco Cove offers picnic areas, restrooms, a boat launch, and dock. Annual use is approximately 7,600 and 1,250 recreation days, respectively, and use is below capacity. Dispersed camping[164] occurs at Mallard Cove. Two dispersed sites are located on Copco No. 1 Reservoir on the north shoreline.

Copco No. 2 Reservoir

Copco No. 2 Reservoir has no recreation facilities or public access. It is a very small, narrow reservoir on five surface acres on PacifiCorp-owned land. PacifiCorp restricts access due to dam operations (FERC, 2007).

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[163] A recreation day is a visit by one person to a recreation area for any portion of a single day. Usage data presented in this section are from FERC (2007), and are somewhat dated.

[164] Dispersed campsites are informal sites created by users and are not developed by the landowner or land manager.

Iron Gate Reservoir

Iron Gate Reservoir is approximately 6.8 miles long and 944 surface acres on PacifiCorp-owned lands (KRRC, 2021a). Recreation opportunities on the lake include sightseeing, swimming, fishing, waterskiing, powerboating, camping, and day use (KRRC, 2021a). Iron Gate Reservoir offers the most recreation opportunities of any reservoir within the project (figure 3.7-5).

Iron Gate Reservoir offers nine-day use sites on PacifiCorp lands (KRRC, 2021a). Fall Creek Day Use Area and Fall Creek Trail average 3,500 annual recreation days of use and have hiking, picnic areas, a boat launch, restrooms, and interpretive signage. Usage of this facility is approaching capacity (FERC, 2007). Overlook Point offers picnic areas, restrooms, and sightseeing opportunities and experiences 1,900 annual recreation days, which approaches capacity (FERC, 2007). Wanaka Springs Day Use Area has a fishing dock, restrooms, hiking trails, interpretive signs, and informal camping areas. Use of this facility is about 4,150 recreation days per year, which exceeds the capacity of the site (FERC, 2007).

The Jenny Creek Day Use Area and Campground usage is approaching capacity at 3,700 annual recreation days (FERC, 2007). The campground offers restrooms and six camping sites that double as day use areas. Camp Creek Day Use Area and Campground provides developed tent campsites, RV camping sites, a boat launch, boarding and fishing docks, swim area, restrooms, and an interpretive display. This site is the most used recreation site on Iron Gate Reservoir at 15,260 annual recreation days, which exceeds its capacity (FERC, 2007). Juniper Point Day Use Area and Campground also exceeds capacity at 4,720 annual recreation days. The campground has developed campsites, a fishing dock, boat launch, restrooms, and interpretive signs. Mirror Cove Day Use Area and Campground has developed campsites, picnic areas, a boat launch, a fishing dock, restrooms, and an interpretive kiosk. Site use exceeds capacity at 11,140 annual recreation days (FERC, 2007). Long Gulch Day Use Area and Campground experiences approximately 5,225 annual recreation days, which is below capacity. The recreation area offers informal camping, a boat launch, restrooms, and picnic areas (FERC, 2007).

Iron Gate Hatchery Day Use Area provides a picnic area, restrooms, hiking, a visitor center, and an undeveloped boat launch. Annual use of the facility is about 2,200 recreation days, which is below capacity (FERC, 2007).

Two dispersed recreation sites at Iron Gate Reservoir are used for fishing access; both experience moderate use (KRRC, 2021a). An additional dispersed recreation site near the Iron Gate Hatchery is used to launch rafts, drift boats, and tubes. This launch site is popular for salmon fishing and drift boat use (PacifiCorp, 2004f).

River Recreation

Downstream of J.C. Boyle Dam

The J.C. Boyle bypassed reach extends approximately 5 miles downstream from J.C. Boyle Dam to the J.C. Boyle Powerhouse. Typical base flows in this reach of 100 to 300 cfs are not suitable for whitewater boating. However, when upstream storage is full and the powerhouse capacity is exceeded, downstream flows provide class III-IV+ rapids (FERC, 2007). River access and parking for recreation use is available at the Spring Island boater access location below the powerhouse. This reach is one of the most popular reaches for trout fishing between Link River and Iron Gate Dams (PacifiCorp, 2004f).

Vehicular access is limited from J.C. Boyle Reservoir downstream to Frain Ranch to the north side of the river. Boat launches, restrooms, day use areas, camping, and fishing access are available downstream of the J.C. Boyle Dam. Vehicular access to the river improves downstream of the state line via a road on the south side of the river. Six designated fishing access sites and one boating access site are available to recreation users downstream of the state line.

The Hell's Corner reach extends about 16.4 miles downstream from the J.C. Boyle Powerhouse to Copco No. 1 Reservoir. BLM manages whitewater outfitters (rafting and kayaking) along this reach through a permit system that limits use to 10 outfitters or 200 clients per day. Private boating use is not restricted in this reach by BLM but is limited by vehicle congestion at the take-out locations near Copco No. 1 Reservoir and the size and number of areas that can be used to scout rapids (FERC, 2007). Summer rafting relies on increased flows through the J.C. Boyle Powerhouse during peak energy production. Flows between 1,500 and 3,000 cfs are considered safe and suitable for whitewater boating (FERC, 2007).

Recreation sites along the Hell's Corner reach are located on lands owned and managed by BLM and PacifiCorp. BLM owns the Spring Island boater access, which is the put-in for both boaters and outfitters. The facility has a boat launch, restrooms, picnic tables, and informational signs. Annual use is estimated at 5,250 recreation days, which is below capacity (FERC, 2007). BLM also owns the Klamath River Campground and Turtle Camp. The Klamath River Campground provides three campsites, restrooms, shoreline fishing, and boating access. Annual use is estimated at 1,000 recreation days, and use is approaching capacity (FERC, 2007). Turtle Camp provides semi-primitive campsites and picnic facilities.

Four dispersed use sites are located along the reach downstream of the J.C. Boyle Powerhouse and upstream of the Stateline Take-out. Primitive camping and dispersed recreation occur at these sites. One of these sites is located at Frain Ranch where outfitters and private boaters use the area for day and overnight boat trips.

The Stateline Take-out is on PacifiCorp land, but BLM manages recreation use and the site's amenities. Recreation opportunities at this site include boating, fishing, and dispersed recreation, and the site provides a boat launch, shoreline fishing access, and restrooms. Below the Stateline Take-out, Fishing Access Sites 1-6 provide shoreline fishing access, parking areas, restrooms, and a boat take-out at Site 1.

The Klamath River from the J.C. Boyle Dam to the state line sees little use by anglers because the north side of the river is difficult to access (FERC, 2007). Access to the river improves downstream of the state line in the 6-mile reach of the Klamath River from the state line to Copco No. 1 Reservoir that is designated as Wild Trout water and managed under the Wild Trout Program (California DFW, 2005). This reach is a popular fishing location.

Downstream of Copco No. 2 Dam

The 1.5-mile reach from Copco No. 2 Dam to the backwater of Iron Gate Reservoir is inaccessible because of the steep, rugged, remote terrain immediately adjacent to the river. Recreation in this area is limited due to access and lack of flows suitable for whitewater boating opportunities. The canyon setting of this reach is called Ward's Canyon, and it has high cultural significance and is used for Tribal traditional cultural practices.

Downstream of Iron Gate Dam

Several outfitters and guide services that focus on salmon, steelhead, and trout fisheries operate in the Lower Klamath River and are heavily dependent upon the size of the annual Chinook salmon fall-run (FERC, 2007). Fishing is open year-round from 3,500 ft. downstream from Iron Gate Dam to the Pacific Ocean.

The Lower Klamath River from Iron Gate Dam to the confluence with the Salmon River offers additional whitewater boating opportunities. This reach offers a diversity of Class II/III whitewater runs that are boatable in rafts, kayaks, and canoes at a wide range of flow levels. Some outfitters advertise this reach as an alternative to the more challenging run on the Hell's Corner reach. The availability of multiple access points along the river allows boaters to create trips of varying lengths and skill requirements (PacifiCorp, 2004f).

3.7.3 Effects of the Proposed Action

3.7.3.1 Reservoir Recreation

The removal of J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs under the proposed action would eliminate existing opportunities for reservoir-based recreation activities, such as power boating, water skiing, lake swimming, and flatwater boat angling. As detailed in its Recreation Facilities Plan, KRRC would entirely remove 11 recreation sites and partially remove a portion of one non-project recreation site that are adjacent to the project reservoirs (KRRC, 2021a) (table 3.7-4). An overview of all recreation sites in the project area is presented in figure 3.7-6, and detailed views for the three main project reservoirs are presented in figures 3.7-3 through 3.7-5. The amenities at these sites include picnic areas, boat launches, restrooms, fishing docks, campsites, interpretive signs, hiking trails, dump stations, and swimming areas. Siskiyou County and Mark Dana stated that a permanent loss of reservoir-based recreation sites and the amenities provided at these sites should be considered a significant, adverse effect requiring mitigation.

In addition to describing the facilities that would be removed or modified, KRRC's Recreation Facilities Plan[165] identifies potential recreation sites, amenities, and river access locations that could provide future recreation benefits (KRRC, 2021a). KRRC states that it would develop these new sites through agreement with the applicable state and would submit specifications for design, construction, operation, and monitoring, for the Commission's approval before development of these sites. The Recreation Facilities Plan does not specify whether KRRC would fund the construction and maintenance of the new potential recreation sites, nor does it identify a timeline for development.

Our Analysis

Under the proposed action, the reservoirs would be permanently drained, recreation facilities that provided access to the reservoirs would be removed, and the recreation sites would be regraded and revegetated. However, numerous lakes and reservoirs in the region provide similar recreation opportunities (table 3.7-5). Many of these lakes and reservoirs have low to moderate recreation use and would be able to accommodate additional recreation users within the capacity of their facilities.

The project recreation sites that would be removed include 44 developed and informal campsites at 5 locations adjacent to Iron Gate Reservoir, and picnic sites, restrooms, and shoreline access at all project recreation sites. The removal of the reservoirs and the adjacent reservoir-based recreation sites (campgrounds and day use areas) would result in a permanent and significant, adverse effect on locally available open-water recreation opportunities and for the recreation users who visit these sites for other uses including shore-based angling, picnicking, and camping.

At Copco No. 1 Reservoir, private landowners of property immediately adjacent to the reservoir, many including docks, have direct access to open-water recreation opportunities. With the removal of the reservoir, these residents would lose direct access to open-water recreation activities. As a result, the proposed action would have a permanent, significant, and unavoidable adverse effect on access to open-water recreation activities for these residents.

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[165] This plan is required by California WQC Condition 19 for California Water Board approval. Consultation on and approval for this plan has not yet been completed.

3.7.3.2 River Recreation

The removal of the reservoirs and the elimination of power production would change the existing flatwater areas to free-flowing reaches and would change the flow regime in the bypassed and power peaking reaches to a more normative flow regime.

American Whitewater, Upper Klamath Outfitters Association (UKOA), James Contos, Michael Parker, Adam Elson, and David Oursler identified safety hazards to boaters at two locations that are the result of project construction or hydropower operations. They requested that these hazards be removed prior to the decommissioning of hydropower facilities to avoid a more complicated and difficult removal after deconstruction and restoration activities have been completed. Sidecast Slide, located approximately 1.4 miles downstream of J.C. Boyle Dam, has a constriction in the river because of debris that fell into the river channel during construction of the J.C. Boyle diversion canal. The bypassed reach below Copco No. 2 Dam has large trees encroaching the active river channel as a result of the long-term flow diversion for hydropower production.

Our Analysis

After removal of the project dams, flatwater reservoir reaches would become free-flowing reaches, and the bypassed and peaking reaches would have a more normative flow regime.

Interior and California DFG (2012) conducted hydrologic modeling to assess changes in the availability of acceptable whitewater boating flows. In the bypassed reaches at J.C. Boyle and Copco No. 2, there would be a substantial increase in the number of days with flows acceptable to whitewater boaters (table 3.7-6). These reaches have historically had minimal or reduced flows during hydropower operations, and a return to more normative flow conditions would create opportunities for whitewater boating. The changes in flow regime in the flow regime in the bypassed reaches would have a permanent, significant, beneficial effect on whitewater recreation.

In the Hell’s Corner reach, the number of days with flows acceptable to whitewater boaters would decrease (table 3.7-6). Flows through this reach are currently sustained by hydropower peaking energy production, allowing whitewater boating from April through October. The greatest demand for recreation boating occurs during the months of July, August, and September; the driest period of the year with low natural stream flows. The Hell’s Corner reach is currently the only Class IV+ rapids in the region with late summer boatable flows. Following dam removal, the number of boatable days between 1,000 and 1,500 cfs would be reduced by an estimated 43 percent, and the number of boatable days with flows between 1,300 and 3,500 cfs would be reduced by 57 percent (table 3.7-6), which would result in a permanent, significant, and unavoidable adverse effect on whitewater river users of the Hell’s Corner reach.

River recreation opportunities are expected to increase substantially in the reservoir and bypassed reaches (table 3.7-7; figure 3.7-7), benefiting regional outfitters and recreation boaters. This would result in a permanent, beneficial effect for whitewater boating in these reaches.

To address previous stakeholder concerns regarding the hazardous conditions at Sidecast Slide, PacifiCorp removed debris in the river at Sidecast Slide in 2012. The recreation flow study in 2020 concluded that boating conditions at Sidecast Slide improved following this work, although the site is still considered hazardous for recreation boaters at lower flows (Confluence Research and Consulting, 2021).

The hazardous boating conditions at the Sidecast Slide location resulted from construction of the project and it would be appropriate to address them during project deconstruction.

KRRC's Recreation Facilities Plan identifies in-channel vegetation removal as a potential recreation enhancement that could be implemented after license surrender is effective. Encroaching vegetation in the river channel is hazardous to whitewater boating and is a direct result of hydroelectric operations of the project and low flows through the bypassed reach. Deferring the removal of encroaching vegetation from the Copco No. 2 bypassed reach would result in additional ground disturbance and have adverse effects on wildlife and recreation users if it were deferred to a later date. Until it is removed, whitewater boaters would be prohibited from this segment of the river to ensure boater safety.

3.7.3.3 River Access

Existing river access sites between J.C. Boyle Dam and the state line are on lands owned and managed by BLM. These sites include Springer Island, Klamath River Campground, Turtle Camp, and one BLM dispersed site. Existing river access sites from the state line to Copco No. 1 Reservoir are on PacifiCorp-owned lands. These sites include the State Line boater access site and Fishing Access Sites 1-6.

As discussed above, KRRC proposes to entirely remove 11 recreation sites and partially remove a portion of one non-project recreation site that are adjacent to the project reservoirs, which would reduce public access to the Klamath River within the hydroelectric reach. To protect public safety during deconstruction and restoration activities at the J.C. Boyle Dam and Powerhouse, public access to existing river access sites immediately adjacent to those locations would be restricted.

The Recreation Facilities Plan identifies new potential recreation sites, amenities, and river access locations that could provide future recreation benefits (KRRC, 2021a). KRRC states that it would develop new river access sites through agreements with the applicable state and would submit specifications for the design, construction, operation, and monitoring for the Commission's approval before development of these locations. The Recreation Facilities Plan does not specify whether KRRC would fund the construction and maintenance of the new potential recreation sites.

UKOA, representing commercial rafters on the Klamath River, are concerned that construction activities in advance of dam removal (such as the realignment of the J.C. Boyle Powerhouse access road at the scour hole) would restrict access to boat launch and take-out sites between J.C. Boyle Dam and Copco No. 1 Reservoir. Restricting access to boat launch and take-out sites prior to reservoir drawdown and dam removal would further restrict the ability of UKOA's members to operate and maintain their businesses. They requested that KRRC maintain public access to the following sites during the years prior to reservoir drawdown and dam removal to minimize the economic effect on outfitters that would occur during the dam removal phase.

- Spring Island Launch Site: from 10 am to noon, May 1 to September 30
- Frain Ranch Left: from 10 am to 1 pm, May 1 to September 30
- Stateline River Access: from 9 am to 4 pm, May 1 to September 30
- Fishing Access Sites 1-6: from 2 pm to 5:30 pm, May 1 to September 30

Our Analysis

KRRC, with the support of American Whitewater, has identified new river access sites designed to support boating on the whitewater reaches that would become available following project decommissioning. Most of these sites are located on lands that are intended to be transferred in ownership from PacifiCorp to the States of Oregon and California after decommissioning is completed. However, KRRC did not indicate in its Recreation Facilities Plan whether any party has committed to construct or operate these access sites. Without such funding, the sites would not be constructed and no benefit would be realized.

KRRC proposes to restrict public access to sites in the year prior to and during reservoir drawdown and dam removal to complete other supporting construction activities. This restriction would result in a temporary, significant, adverse effect on whitewater boaters and outfitters.

3.7.3.4 National Wild and Scenic River System

The proposed action would result in short-term, significant, adverse effects on the scenic landscape, fisheries, and recreation ORVs for which the Scenic River reach was designated (Interior and California DFG, 2012). Downstream water clarity would decrease during decommissioning from the transport of suspended sediments during the reservoir drawdown period. Short-term decreases in water clarity effects would be noticeable by on-river users, but likely not as noticeable from nearby roads or other distant viewpoints. The suspended sediments would also have a short-term, significant, adverse effect on recreational fishing, with reduced water turbidity affecting fishing success during and for approximately six months following the completion of drawdown. Recreational use of the river would be affected during the decommissioning when river access sites immediately adjacent to J.C. Boyle Dam and Powerhouse would be restricted for public safety.

In the long term, the proposed action would provide permanent, significant, beneficial effects on the scenic landscape, fisheries, and recreation ORVs for which the Scenic River reach was designated (Interior and California DFG, 2012). River access sites that were restricted during decommissioning would be accessible again, and river flows throughout the hydroelectric reach would follow a more natural hydrograph. These effects would also occur in the segment below J.C. Boyle that is eligible but not designated as a Wild and Scenic River.

Effects of the proposed action on the Recreational River segment (from Iron Gate Dam to the Pacific Ocean) would be similar to the Scenic River segment. There would be a short-term, adverse effect on fisheries and recreational resources. Sediment mobilized downstream from the project reservoir sites would reduce water clarity, making it more difficult for fish to seek food, reduce recreational fishing success, and be viewed as a non-natural coloration of the water by recreational boaters.

Over the long term for the Recreational River segment, the proposed action would restore normal sediment transport processes; improve water temperatures; reduce multiple factors that contribute to the incidence of fish diseases and fish kills, including reducing food sources for *C. shasta* from the reservoirs; and provide access to upstream habitat for fish. Improved habitat for both resident and anadromous fish would increase harvest opportunities for commercial, recreational, and Tribal fisheries. Restoration of native fish runs would improve the natural character of the landscape, which could lead to increased public appreciation of the river and recreational use of the Recreational River segment.

3.7.4 Effects of the Proposed Action with Staff Modifications

American Whitewater commented that deferring the development of potential river access sites to the States of Oregon and California does not guarantee that any new river access sites would be developed, and if planned, could be delayed a decade or more after completion of project decommissioning. American Whitewater noted that strategically placed river access sites are essential to whitewater recreation in the hydroelectric reach because the reach goes through frequent and significant changes in gradient and difficulty as it cuts through the Cascade Mountains. Staff recommends that KRRC consult with the states to develop a plan for funding the construction and maintenance of the potential access sites. At a minimum, the plan should include a funding commitment to develop identified access sites within the hydroelectric reach. Developing these sites during deconstruction and restoration activities would avoid additional ground disturbance and associated adverse effects that would occur if their development was deferred until after license surrender. Development of new river access sites in the former reservoir reaches would have a permanent, significant, beneficial effect on recreation opportunities (both whitewater and other river-based recreation activities), both regionally and locally.

The hazardous boating conditions at the Sidecast Slide location and the Copco No. 2 bypassed reach resulted from construction of the project and should be resolved during project deconstruction. Staff recommends that KRRC remove the hazardous obstructions in the active river channel during project decommissioning to improve boater safety in the J.C. Boyle and Copco No. 2 bypassed reaches. This would avoid causing additional ground-disturbing activity if the work were performed after restoration activities were completed. These measures would have a permanent, significant, beneficial effect on recreation by enhancing boater safety at these locations and eliminating the need for portages.

Staff also recommends that KRRC consult with UKOA to determine how construction activities prior to reservoir drawdown and dam removal can be planned and scheduled to maintain reasonable access to established boat launch and take-out sites to reduce adverse effects on whitewater boaters and outfitters. KRRC should revise the Construction Management Plan accordingly to document how limitations to public access during the whitewater boating season would be minimized. While construction activities would still have a temporary, significant, adverse effect on recreation access, these effects would be reduced with this consultation.

3.7.5 Effects of the No-action Alternative

Under the no-action alternative, there would be no change in reservoir- and whitewater-based boating opportunities. Operation and maintenance of recreation facilities associated with the project would not change compared to existing conditions. Recreation opportunities provided by the reservoirs would continue, but new opportunities associated with restoration of the river to a more natural state would not be provided.

Over the long term, the ORVs of fisheries for the Recreational River segment would continue to decline as water temperatures continue to increase, leading to reduced habitat quality for both wild and hatchery-produced fish. Declining fish populations in future decades would have a permanent, significant, adverse effect on the fisheries ORV in the Recreational River segment.

Table 3.7-1. Regional lakes and reservoirs providing recreation opportunities other than the project reservoirs (Source: PacifiCorp 2004f)

Lake or Reservoir	Size (Acres)	Managing Agency
Agency Lake	5,500	BLM, Forest Service, and Klamath County
Applegate Reservoir	988	Forest Service
Emigrant Lake	806	Jackson County, OR
Fourmile Lake	740	Forest Service
Howard Prairie Reservoir	2,000	Jackson County, OR
Hyatt Reservoir	1,250	BLM
Lake of the Woods	1,113	Forest Service
Medicine Lake	408	Forest Service
Shasta Lake	29,500	Forest Service
Trinity Lake Unit	16,535	Forest Service
Upper Klamath Lake	85,120	Forest Service, FWS, and Klamath County
Whiskeytown Lake	3,200	Forest Service

Table 3.7-2. Angling opportunities at regional rivers (Source: California Water Board, 2020a)

River	Fish Species Caught[a]	Types of Fishing
Klamath River	Redband trout	Fly fishing; bank fishing; drift boat
McCloud River	Native trout	Fly fishing; bank fishing
Pit River	Native trout; brown trout; smallmouth bass; rough fish	Fly fishing; bank fishing
Rogue River	Chinook salmon; steelhead	Drift boat; powerboat; fly fishing
Salmon River	Chinook salmon; steelhead; resident trout	Fly fishing; bank fishing
Scott River	Chinook salmon; steelhead; resident trout	Fly fishing; bank fishing
Smith River	Chinook salmon; steelhead	Drift boat; powerboat; fly fishing; bank fishing

River	Fish Species Caught[a]	Types of Fishing
Trinity River	Chinook salmon; steelhead; sturgeon; American shad; lamprey	Drift boat; powerboat; fly fishing; bank fishing
Upper Sacramento River	Chinook salmon; native and stocked trout; American shad	Fly fishing; bank fishing

[a] Native trout refers to rainbow trout populations, and resident trout may include populations of brown and brook trout as well as rainbow trout.

Table 3.7-3. Regional whitewater boating opportunities (Source: California Water Board, 2020a)

River	Comparative Level of Use	Boating Class Type[a]	Miles of Boatable Whitewater	Factors Affecting Use Levels
Clear Creek	Low	III-V	7	Difficult access
Upper Klamath River[b]	Moderate	III-IV+	31	Remote, not suited for beginner or intermediate boaters, unless accompanied by a commercial outfitter
Lower Klamath River[c]	Moderate	II-V	122	Most skill levels, easy access, 186 miles support multi-day floats, shoreline camping, scenery, many outfitters, commercial use
North Umpqua River	Moderate	II-IV	32	Easy access, most skill levels, scenery, boatable year-round, shoreline suitable for camping
McCloud (tributary of the Sacramento)	Moderate	II-IV	35	Proximity to I-5, most skill levels, low flows in summer
Pit River (tributary of the Sacramento)	Low	IV-V	34	Fragmented/short runs with long stretches of flatwater between, remote location

River	Comparative Level of Use	Boating Class Type[a]	Miles of Boatable Whitewater	Factors Affecting Use Levels
Rogue River	High	II-V	100+	Easy access, most skill levels, scenery, boatable year-round, shoreline suitable for camping, many commercial outfitters
Salmon River (tributary of the Klamath)	Moderate	II-V	44	Requires advanced/expert boating skills, commercial use
Scott River (tributary of the Klamath)	Low	III-V	20	Recommended for expert boaters only
Smith River	Low	III-V	100+	Requires advanced/expert boating skills, low summer flows
Upper Sacramento River	Low	III-V	36	Proximity to I-5, average solitude
Trinity River (tributary of the Klamath)	Moderate	II-V	100+	Most skill levels, easy access, commercial use

Note: I-5 – Interstate Highway 5

[a] American Whitewater International Scale of Difficulty (American Whitewater, 1998).

[b] Upstream of Iron Gate Reservoir.

[c] Downstream of Iron Gate Dam.

Table 3.7-4. Recreation sites to be removed in the hydroelectric reach (Source: KRRC, 2021a)

Site Name (Landowner)	Project or Non-Project Recreation Site	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition
J.C. Boyle Development				
Pioneer Park East and West (PacifiCorp - Parcel B land)	Project recreation site	Interpretive signs, car-top boat launch, picnic areas, and restrooms	Fishing, boating, and picnicking	Remove except for parking area at Pioneer Park West
Topsy Campground (BLM)	Non-project recreation site	Campsites, RV dump station, day use areas, boat launch with dock, accessible fishing pier, and restrooms	Camping, RV camping, boating, fishing, and picnicking	Remove all permanent water-based improvements. Retain camping and day use facilities for BLM future management
Copco No. 1 and No. 2 Development				
Mallard Cove (PacifiCorp – Parcel B land)	Project recreation site	Picnic area, restrooms, boat launch with boarding dock, and interpretive signs	Picnicking, boating, fishing, and informal camping	Remove
Copco Cove (PacifiCorp – Parcel B land)	Project recreation site	Picnic area, restrooms, boat launch with boarding dock, and interpretive signs	Picnicking, boating, fishing, and informal camping	Remove
Iron Gate Reservoir Recreation				
Overlook Point (PacifiCorp – Parcel B land)	Project recreation site	Restrooms and picnic sites	Picnicking and sightseeing	Remove

Site Name (Landowner)	Project or Non-Project Recreation Site	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition
Wanaka Springs Day Use Area (PacifiCorp – Parcel B land)	Project recreation site	Picnic areas, fishing dock, restrooms, trails, and interpretive signs	Picnicking, fishing, hiking, and informal camping	Remove
Camp Creek Day Use Area and Campground (PacifiCorp – Parcel B land)	Project recreation site	Campsites, boat launch, boarding and fishing docks, swimming area, RV dump station, interpretive display, and restrooms	Developed camping, RV camping, boating, fishing, education, and swimming	Remove
Juniper Point Day Use Area and Campground (PacifiCorp – Parcel B land)	Project recreation site	Campsites, fishing dock, restrooms, and interpretive signs	Developed camping and fishing	Remove
Mirror Cove Day Use Area and Campground (PacifiCorp – Parcel B land)	Project recreation site	Campsites, picnic sites, boat launch, restroom, and fishing dock	Picnicking, developed camping, boating, group camping, waterskiing, and fishing	Remove
Fall Creek Day Use Area (PacifiCorp – Parcel B land)	Project recreation site	Picnic area, boat launch access, and restrooms	Picnicking and boating	Remove

Site Name (Landowner)	Project or Non-Project Recreation Site	Site Amenities	Available Recreation Opportunities	Proposed Site Disposition
Fall Creek Trail (PacifiCorp – Parcel B land)	Non-project recreation site	Hiking trail	Hiking	Remain; transfer to the Fall Creek license
Jenny Creek Day Use Area and Campground (PacifiCorp – Parcel B land)	Non-project recreation site	Campsites, restrooms, and hiking trails	Picnicking, fishing, and developed camping	Remove
Long Gulch Day Use Area and Campground (PacifiCorp – Parcel B land)	Non-project recreation site	Picnic sites, boat launch, and restrooms	Picnicking, boating, and informal camping	Remove

Table 3.7-5. Surface acreage, recreation amenities, and use levels of project reservoirs and other lakes and reservoirs in the region (Source: Interior and California DFG, 2012, as modified by staff)

Lake or Reservoir	Miles from Nearest Project Reservoir	Surface Acres	No. of Developed Campsites	No. of Boat Launches	No. of Picnic Areas	Generalized Use Levels
Project Reservoirs						
J.C. Boyle		420	16	2	4	Low
Copco No. 1		1,000	0	2	2	Low
Copco No. 2		40	0	0	0	Low
Iron Gate		944	37	3	6	Moderate
Other Lakes and Reservoirs in the Region						
Hyatt Reservoir	15	1,250	172	2	1	Moderate

Lake or Reservoir	Miles from Nearest Project Reservoir	Surface Acres	No. of Developed Campsites	No. of Boat Launches	No. of Picnic Areas	Generalized Use Levels
Emigrant Lake	16	806	110	2	2	Moderate
Howard Prairie Reservoir	17	2,000	303	4	1	Moderate
Upper Klamath Lake	20	85,120	269	6	1	Moderate
Lake of the Woods	21	1,113	190	3	1	High
Fourmile Lake	26	740	25	1	0	Low
Agency Lake	28	5,500	43	3	0	Low
Applegate Reservoir	36	988	66	3	1	Low
Medicine Lake	46	408	72	1	1	Low
Gerber Reservoir	62	3,830	50	2	1	Moderate
Trinity Lake Unit	73	16,535	500	7	2	Moderate
Whiskeytown Lake	87	3,200	139	3	1	Moderate
Shasta Lake	87	29,500	320	7	7	High

Table 3.7-6. Estimated number of days meeting the range of acceptable flows for whitewater boating (Source: Interior and California DFG, 2012)

		Total Average Number of Days Annually		
River Reach	**Acceptable Flow Range (cfs)**	**Existing Conditions**	**Post-Dam Removal**	**Percent Change**
J.C. Boyle Bypassed Reach	1,300–1,800	5	41	794%
Hell’s Corner Reach	1,000–3,500	332	189	-43%
Hell’s Corner Reach	1,300–3,500	278	119	-57%
Copco No. 2 Bypassed Reach	600–1,500	10	223	2,084%

Table 3.7-7. Whitewater reaches and identified access sites (listed from upstream to downstream) (Source: KRRC, 2021a)

Reach	**Put-in**	**Take-out**	**Other Access Sites**	**Recreation Plan Recommendation**
Keno	None existing	None existing		Stakeholders recommend access below Keno Dam and near Pioneer Park
Upper Big Bend	None existing	None existing		Stakeholders recommend access near Pioneer Park and Topsy Campground
Big Bend	None existing	Springer Island		Stakeholders recommend below J.C. Boyle Dam and at J.C. Boyle Powerhouse
Upper Hell’s Corner	Springer Island	BLM Dispersed Site 4 / Frain Ranch	Klamath River Campground and Turtle Camp	Retain existing access points
Hell’s Corner	BLM Dispersed Site 4 / Frain Ranch	Stateline		Stakeholders recommend retaining access at Stateline

Reach	Put-in	Take-out	Other Access Sites	Recreation Plan Recommendation
Stateline	Stateline	Fishing access site 1	Fishing Access Sites 2-6	Stakeholders recommend retaining access at Fishing Access Sites 2-6
Copco Valley	Fishing access site 1	None existing		Stakeholders recommend above Copco No. 1 Dam
Ward's Canyon	None existing	None existing		Stakeholders recommend at Copco No. 2 Dam and Copco No. 2 Powerhouse[a]
Iron Gate	None existing	Iron Gate Hatchery Day Use Area		Stakeholders recommend Copco No. 2 Powerhouse

[a] The use of this reach, as well as the location and design of access points, would need to take into account that the Tribes use Ward's Canyon for traditional cultural practices. The canyon is considered a significant spiritual place with visual and auditory religious and ceremonial affiliation.

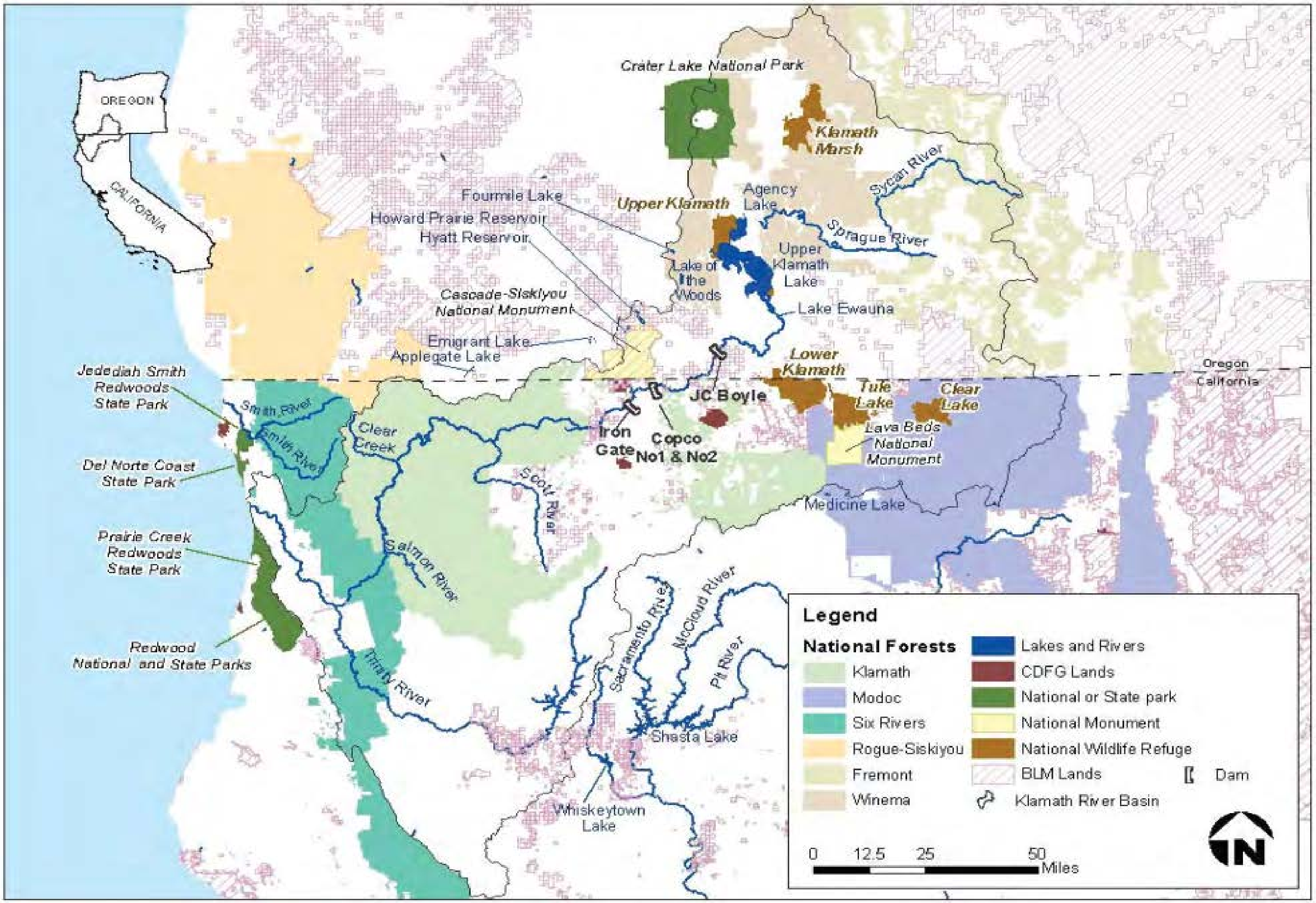


Figure 3.7-1. Regional setting of the project location with California and Oregon (Source: California Water Board, 2020a)

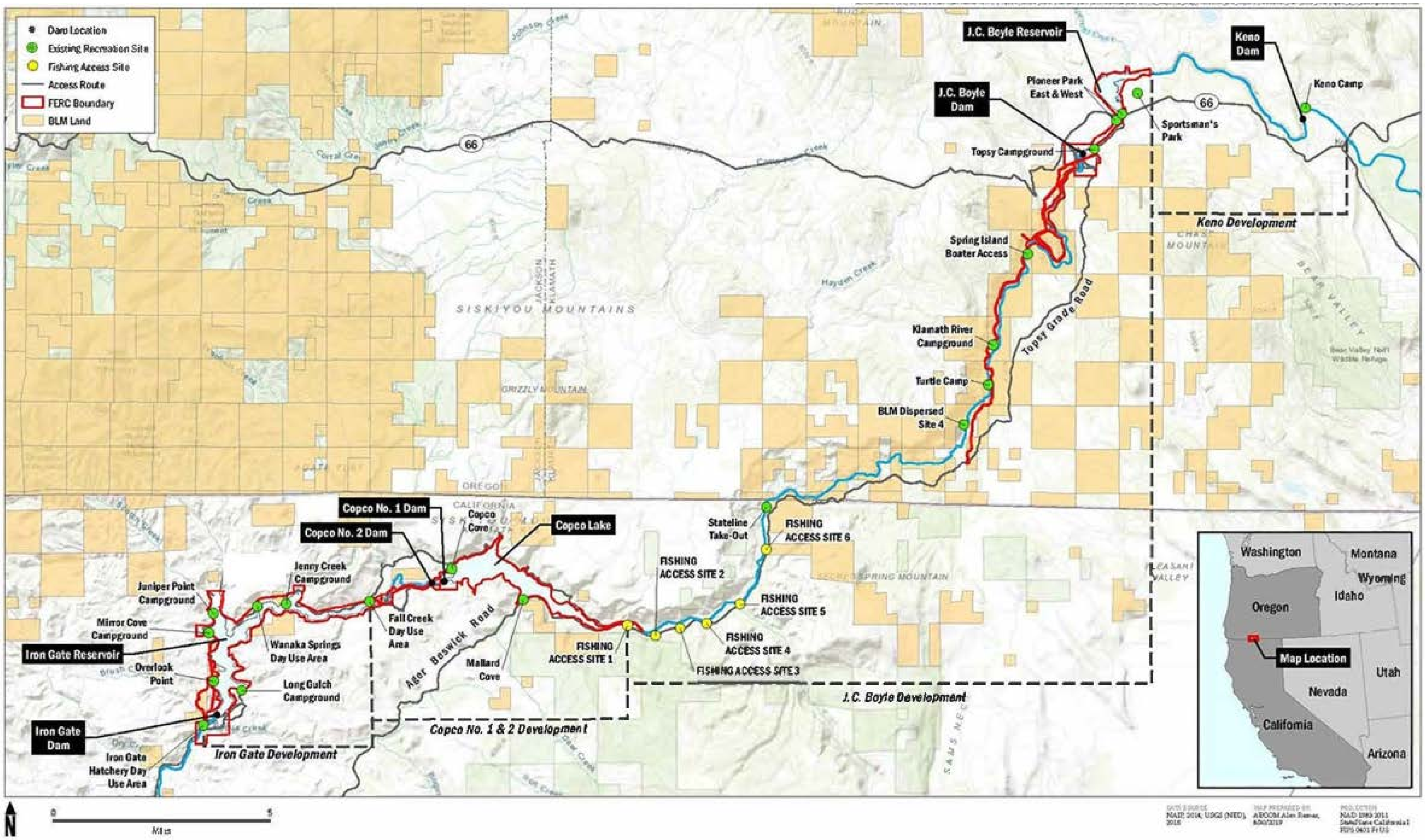
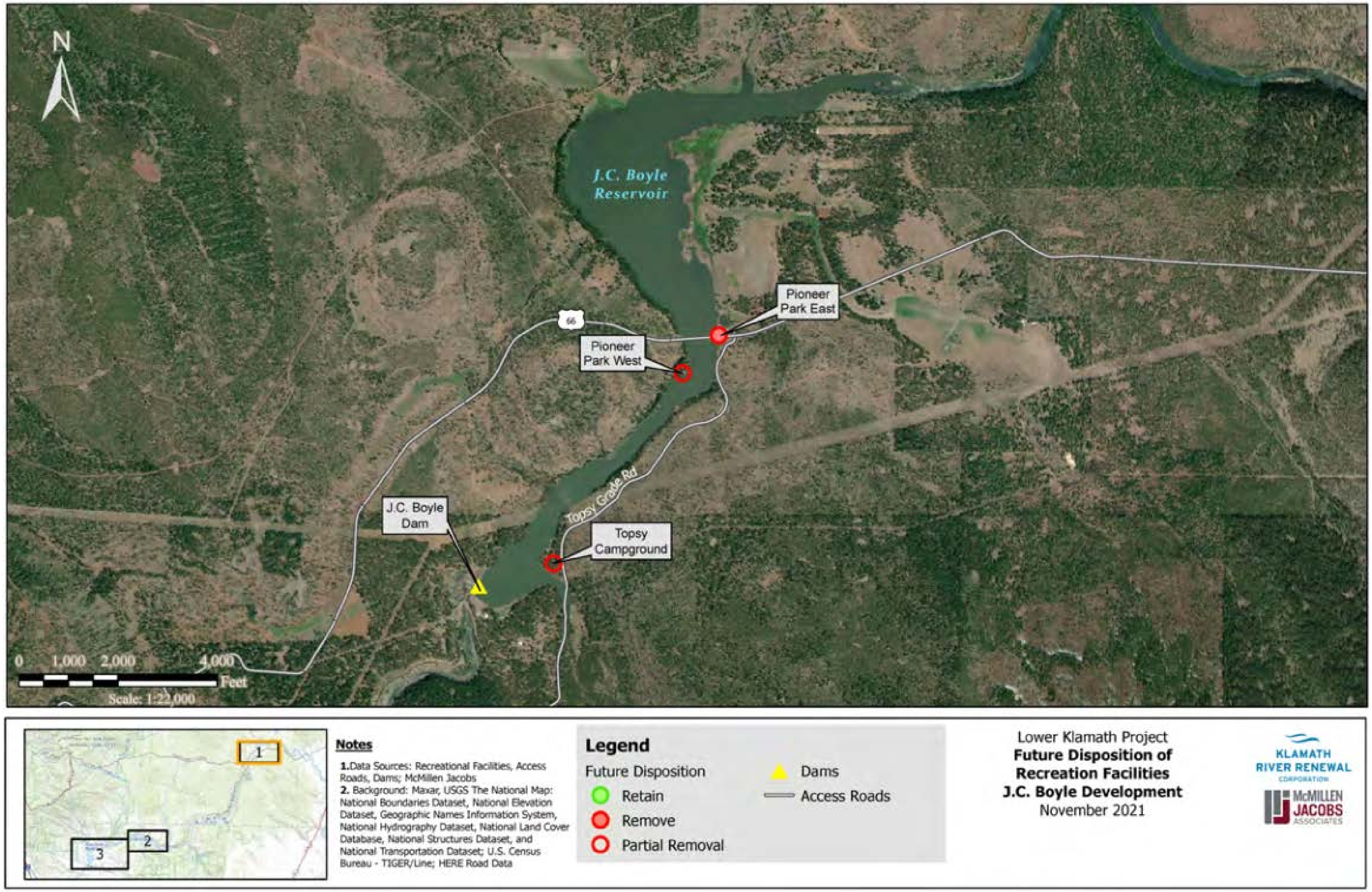


Figure 3.7-2. Existing recreation sites in the project area (Source: KRRC, 2021a)



Notes

1. Data Sources: Recreational Facilities, Access Roads, Dams; McMillen Jacobs

2. Background: Maxar, USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data

1. Pioneer Park West: Above-ground features will be removed. A new recreation enhancement site with the same name is planned for future installation (see Chapter 6).
2. Topsy Campground: Reservoir recreation features (i.e., boat launch and floating dock) to be removed only; other site features to remain.

Figure 3.7-3. Recreation sites proposed to be removed at J.C. Boyle development (Source: KRRC, 2021a)

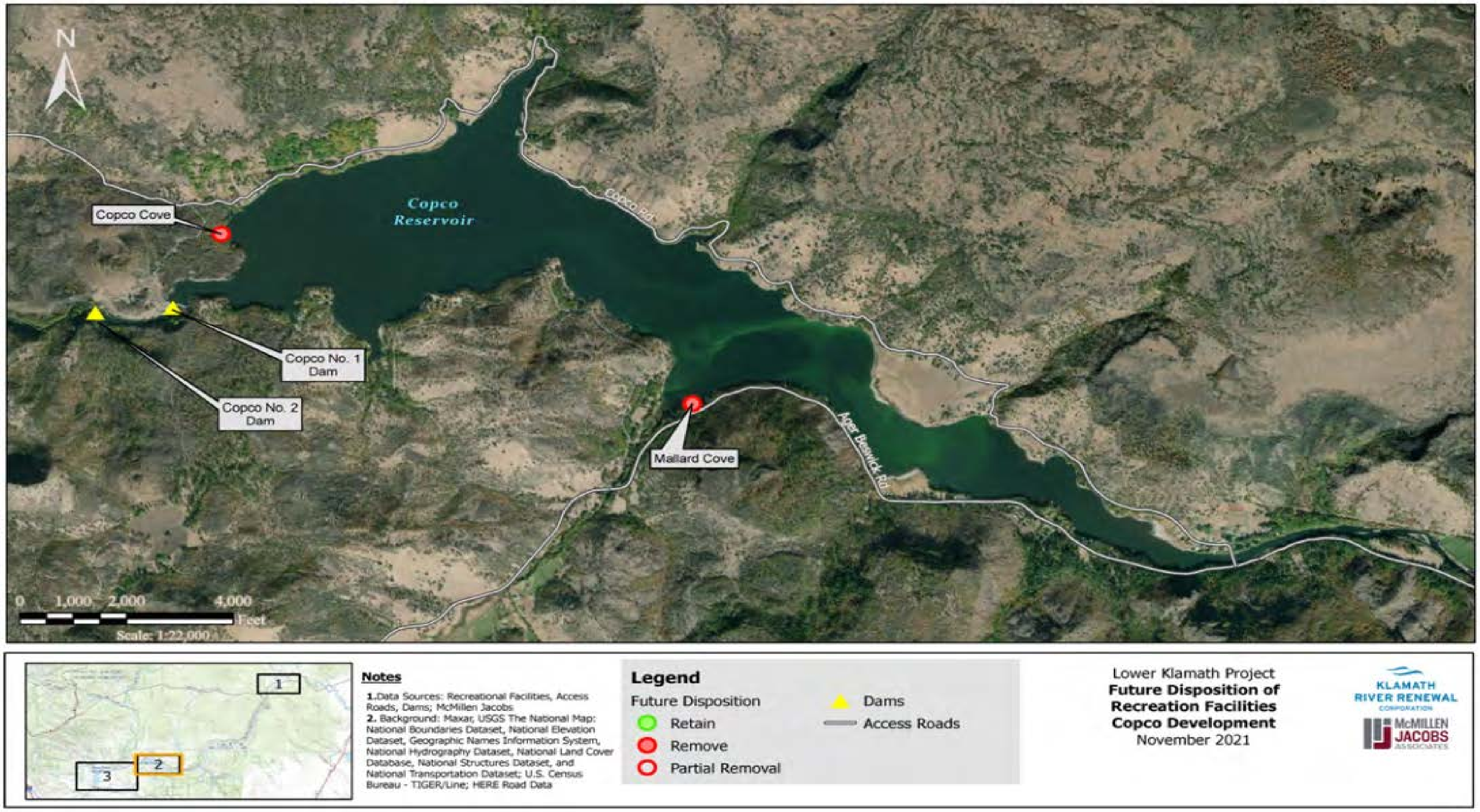
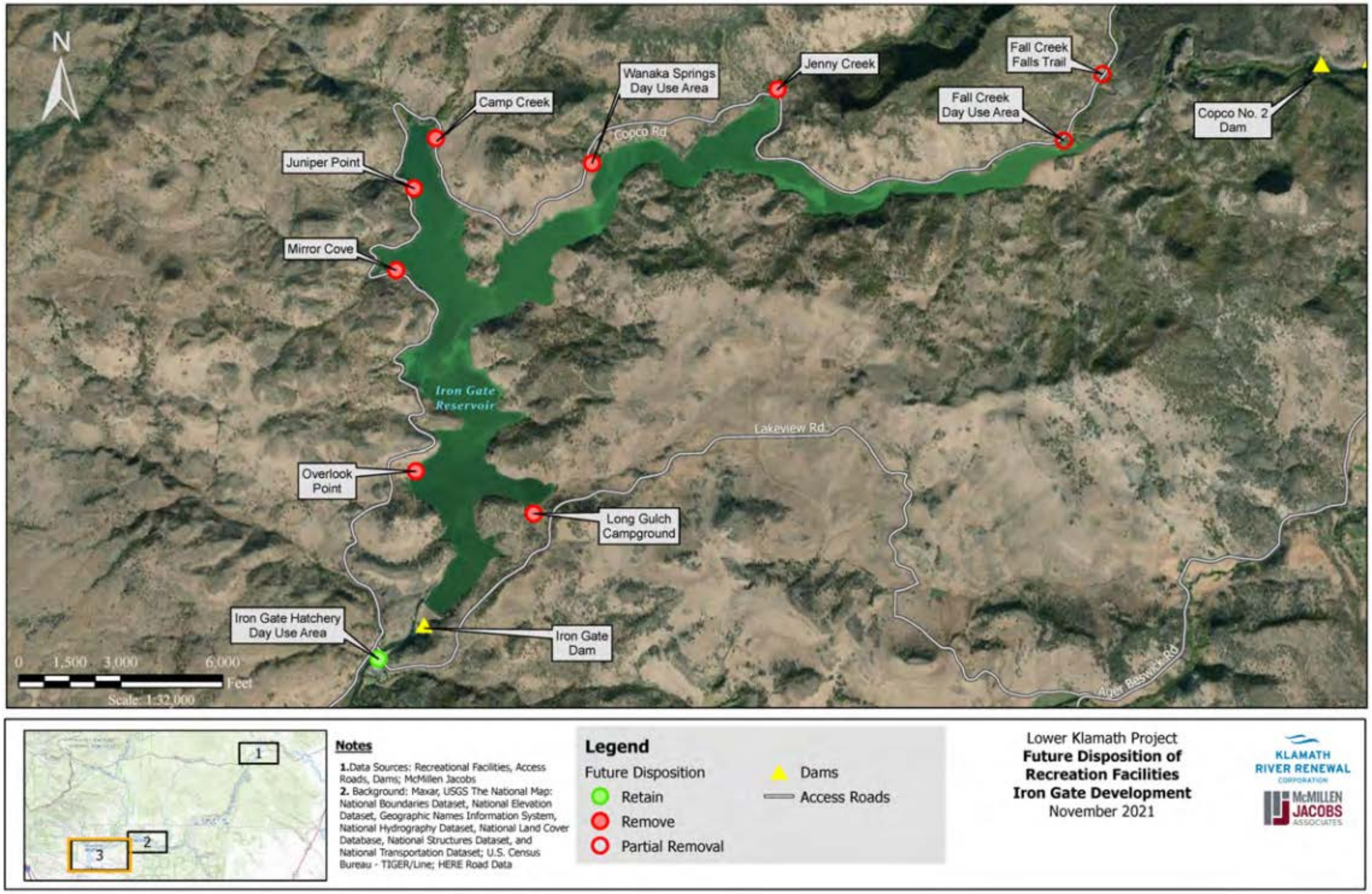


Figure 3.7-4. Recreation sites proposed to be removed at Copco No. 1 development (Source: KRRC, 2021a)



1. Fall Creek Day Use Area: Informal features to be removed; new river access ramp to be installed with other site improvemetns (see Chapter 6).
2. Fall Creek Falls Trail: A portion of the trail will be re-routed as a result of upgrades to the fish hatchery.
3. Iron Gate Hatchery Day Use Area: River access ramp will be improved on north side of river across from existing day use area.

Figure 3.7-5. Recreation sites proposed to be removed at Iron Gate development (Source: KRRC, 2021a)

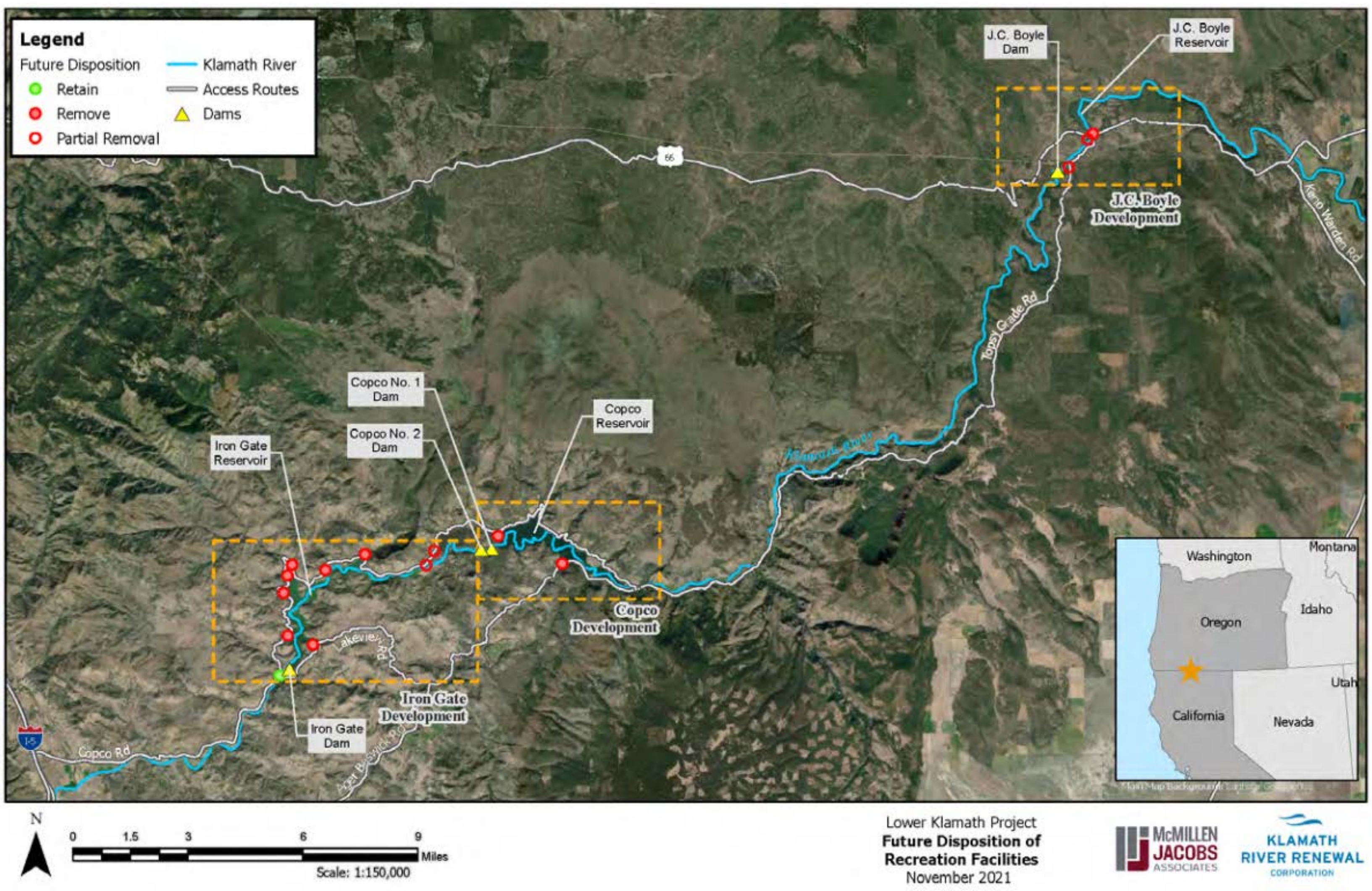


Figure 3.7-6. Recreation sites proposed to be removed in the project area (Source: KRRC, 2021a)

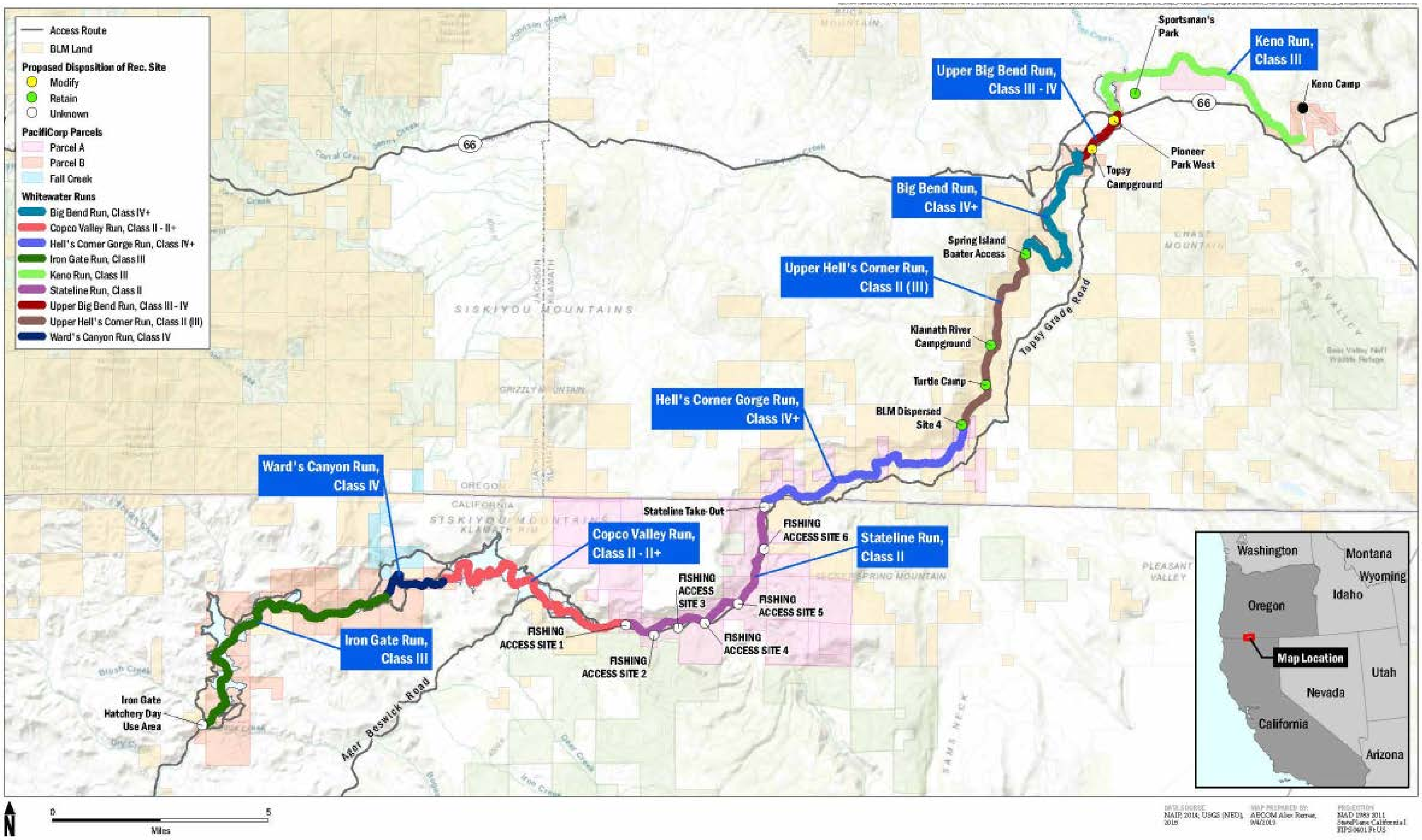


Figure 3.7-7. Expected future whitewater boating reaches between Keno Dam and Iron Gate Hatchery after dam decommissioning (Source: KRRC, 2021a)

3.8 LAND USE

3.8.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for land use includes the footprint of project deconstruction activities, land intended to be transferred to the States of Oregon and California, and land adjacent to the project boundary that would be affected by the removal of the project. The temporal extent of our effects analysis ranges from short-term effects of project deconstruction activities on local land uses, to permanent effects on land currently inundated by the reservoirs, and regional wildfire management.

3.8.2 Affected Environment

3.8.2.1 Land Ownership

Approximately 4,000 acres of land are included within the project boundary, of which PacifiCorp owns approximately 3,500 acres.[166] Once the surrender is effective, PacifiCorp would convey the vast majority of lands that it owns within the project boundary to KRRC, as part of the 2016 amended Klamath Hydropower Settlement Agreement (KHSA). KRRC would then transfer said lands to the respective states, as applicable, or to a designated third-party transferee.

PacifiCorp has two general categories of land ownership in the hydroelectric reach, Parcel A and Parcel B lands (figure 3.8-1). As defined in the amended KHSA, Parcel A lands in Oregon and California "are not directly associated with the Klamath Hydroelectric Project, and generally not included within the existing project boundary." Parcel B lands in Oregon and California are "associated with the Klamath Hydroelectric Project and/or included within the FERC project boundary" (KHSA, 2016). After completion of the proposed action, "ownership of these [Parcel B] lands will be transferred to the respective States, as applicable, or to a designated third-party transferee." The amended KHSA also states that "It is also the intent of the Parties that transferred lands shall thereafter be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access."

3.8.2.2 Land Use and Management

Operation and management of lands around the project are subject to the management plans and policies of federal and state agencies, local municipalities, and FERC requirements.

BLM manages natural resources on its land to provide wildlife habitat, timber, forage, and recreational opportunities. The Klamath Falls and Medford Resource

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[166] The various documents reviewed as part of this proceeding include detailed descriptions of the ownership of project lands but include some discrepancies in acreage.

Management Plans provide guidance on how BLM uses ecological, economic, social, and managerial principles to achieve healthy and sustainable natural systems (BLM, 1995). The ecosystem management strategy outlined in these plans comprises land use allocations that are within or adjacent to the project area. These land use allocations include late-successional reserves; adaptive management areas; general forest management areas; and special purpose management areas such as recreation sites, wild and scenic rivers (section 3.7.2.1, *Regional Recreation Resources*), and visual resource management areas.

The State of Oregon follows the goals of a strategic plan and manages lands for the stewardship of natural resources, recreation, and other values (State of Oregon, 2017). Guidelines of the local county comprehensive plan, land development codes, and zoning ordinances provide a framework for planning and development within unincorporated areas of the county, including private lands and regulate allowable uses, construction, conservation, and preservation of recreational and scenic areas (FERC, 2007).

The State of California follows the goals of a strategic plan and provides stewardship of land, waterways, and resources entrusted to it based on the principles of equality, sustainability, and resiliency, through preservation, restoration, enhancement, responsible economic development, and the promotion of public access (State of California, 2021b).

3.8.2.3 Fire Management

State agencies are responsible for wildfire suppression on non-federal land in Oregon and California, where there are no local fire protection districts. The objectives of the state agencies are to prevent wildfires and reduce the effect of wildfire on the landscape and owned assets; and controlling fires as soon after initiation as possible to keep them small. Resources available to state agencies include trained wildfire fighting personnel, ground-based equipment (water tankers and heavy earth-moving equipment), and aerial-based equipment (airplanes and helicopters). State agencies also assist communities and landowners with wildland fire mitigation strategies to reduce fuels on the landscape and have monitoring equipment and personnel to quickly identify fires initiated in remote locations. During previous wildfires near the project area, state wildfire agencies have used both ground- and aerial-based suppression methods, including sourcing water for aerial drops from the project reservoirs.

CAL FIRE categorizes the fire threat in the project area as high to very high (CAL FIRE, 2007). Klamath County categorizes the Keno wildland urban interface area, which includes J.C. Boyle Dam, with the highest fire hazard damage score in the county (WFT, 2016). Vegetation in the Upper Klamath River Basin is typical of the East Slope Cascades physiographic province and includes forested communities of ponderosa pine, mixed conifer, oak, and juniper. The western portion of the project area and drier sites include sagebrush steppe communities with oak, juniper, and grassland species. The vegetation communities of the Klamath River Basin possess a wide range of fire regimes, from long return interval, high intensity mixed conifer forests to short return interval, low intensity pine forests (Rogers, 2016; Frost and Sweeney, 2000).

Home sites adjacent to Iron Gate Reservoir and Copco No. 1 Reservoir are remote from other communities in the region. Access to home sites adjacent to Iron Gate Reservoir takes approximately 25 to 30 minutes from Interstate 5 via Copco Road. Access to home sites adjacent to Copco No. 1 Reservoir takes approximately 45 to 50 minutes from Interstate 5 via Ager-Beswick Road (Bender Rosenthal, 2012). The remoteness of the location from other developed communities and the low population density, results in limited services for wildfire protection and control.

Oregon and California State forestry and fire prevention agencies (Oregon Department of Forestry and CAL FIRE) are the primary wildfire protection providers on non-federal land in the unincorporated areas of the project. In Oregon, the local wildfire protection resources are managed by the South-Central Oregon Fire Management Partnership, which is a cooperative group of agencies that include Forest Service, BLM, FWS, and Crater Lake National Park. Wildfire dispatching for this partnership is managed by the Lakeview Interagency Fire Center, which coordinates assigning fire suppression resources stationed throughout the region.

In California, the local wildfire protection resources are managed by the CAL FIRE Siskiyou Unit. Wildfire dispatching is managed by the Yreka Station, which coordinates the Shasta Valley Battalion fire suppression resources stationed in Yreka and Hornbrook. In addition to the state fire agencies, there are two rural fire protection districts located near the project area. The Keno Rural Fire Protection District Station 1 is located approximately 6 miles east of J.C. Boyle Dam. The Copco Lake Fire Department Station 210 is located at the upstream end of Copco No. 1 Reservoir.

3.8.2.4 Specially Designated Areas

National Trails System

The Pacific Crest National Scenic Trail stretches for 2,650 miles from Mexico to Canada, passing through California, Oregon, and Washington (PacifiCorp, 2004a). The trail is open to horse and foot traffic only. While portions of the trail are located within 15 miles of the Upper Klamath River, the trail is outside the project boundary (PacifiCorp, 2004a).

The California National Historic Trail stretches over 5,000 miles and covers portions of 10 states, passing from Missouri to California and southern Oregon. The trail marks the route traveled by emigrants in the early 1800s making the overland trek from the central Midwest to the California coast. The segment of the trail passing into southern Oregon is referenced as the Applegate Trail. Historical route locations have been identified crossing the Klamath River near Keno and at the upper portion of J.C. Boyle Reservoir. The route segment crossing the upper portion of J.C. Boyle Reservoir is within the project boundary.

Wilderness Areas

Five Wilderness Areas are located within the Klamath National Forest, including Marble Mountain, Russian, Trinity Alps, Red Buttes, and Siskiyou (PacifiCorp, 2004a). The Soda Mountain Wilderness Area was established in 2009 and is located within the BLM-managed Cascade-Siskiyou National Monument. The Soda Mountain Wilderness Area is the closest Wilderness Area to the project, located in Oregon north of Iron Gate Reservoir. There are no designated Wilderness Areas included in the project boundary.

Scenic Byways/Highways

Three Scenic Byways are located along the Klamath River and within the Klamath and Six Rivers National Forests (California Water Board, 2020a). None of the Scenic Byways are within the project boundary.

- State of Jefferson National Forest Scenic Byway – located primarily on California State Highway 96 between Shasta River and Happy Camp;
- Bigfoot National Forest Scenic Byway – located on Highway 96 between Happy Camp and California State Highway 299; and
- Volcanic Legacy Scenic Byway – located between Lassen National Park in California and Crater Lake National Park in Oregon. The route follows Highways 97, 140, and 62 east of the project area.

3.8.2.5 Road Management and Traffic

There are 50.7 miles of road within the existing project boundary (FERC, 2007). PacifiCorp is solely responsible for the maintenance of 19 miles of road, and jointly responsible for an additional 6.4 miles of road. The KHSA outlines PacifiCorp's responsibilities for funding the development and implementation of a Road Management Plan to determine the priorities for the operation and maintenance of road segments associated with the project until the completion of decommissioning (KHSA, 2016). Upon completion of decommissioning, PacifiCorp would no longer be responsible for roads formerly associated with the operation of the project.

Transportation patterns in the Upper Klamath River Basin are typical of the lightly populated agricultural communities in northern California and south-central Oregon. The volume of traffic is greater near larger communities upstream (east) and downstream (west) of the project area. Predominant use of the rural roads in the area are by residents; recreational users; and agricultural, logging, and commodity freight trucks.

Figure 3.8-2 depicts the transportation network in the area surrounding the project features in the Klamath Basin, and table 3.8-1 lists the regional and local roads that access each site.

Interstate 5 (I-5) is a major north/south Interstate highway that runs through California and Oregon. I-5 has four travel lanes (two each direction) through Siskiyou and Jackson counties, with a posted speed limit of 70 mph in California and 65 mph in Oregon. The average annual daily traffic (AADT) is 15,200 vehicles on I-5 closest to Iron Gate Dam, and 14,300 vehicles near the intersection of Oregon Route 66. The designed vehicle volume to capacity (v/c) ratio for I-5 is 0.85, and the existing v/c ratio for this area of I-5 is 0.24, indicating that existing traffic use is well below the designed capacity (Interior and California DFG, 2012).

Oregon Route 66 (OR66) is a two-lane east/west asphalt paved state highway, with a posted speed limit of 55 mph. OR66 connects I-5 to the J.C. Boyle Dam and to US97 and intersects I-5 approximately 14 miles north of the California border. The AADT is 9,500 vehicles just east of I-5, and 500 vehicles closest to J.C. Boyle Dam. The designed v/c ratio for OR66 is 0.75, and the existing use v/c ratio for this area is 0.01 (Interior and California DFG, 2012).

US97 is a four-lane, north/south, asphalt paved US highway, with a posted speed of 65 mph. The AADT nearest the project is 9,700 vehicles. The designed v/c ratio for US97 is 0.70, and the existing use v/c ratio for this area is 0.19 (Interior and California DFG, 2012). A more recent analysis for US97 near the project area identified an AADT of 6,300 vehicles (KRRC, 2021l).

Copco Road is a minor collector road that leads from I-5 to the Iron Gate, Copco No. 1, and Copco No. 2 Dams on the north side of the river and reservoirs. The road is a paved, two-lane road from I-5 to a point near the Juniper Point Picnic Area, where it turns into a narrow gravel road for the remaining distance to the Copco Dams. The posted speed limit on the paved portion of the road is 55 mph, with speed reduction at sharp curves.

Topsy Grade Road (Oregon) or alternatively Ager-Beswick Road (California) is a minor collector road running along the south side of the river between Copco No. 1 Reservoir and J.C. Boyle Dam. The road running between Copco No. 1 Reservoir and J.C. Boyle Dam is mostly unimproved with gravel surfacing. The Topsy Grade Road continues northward past J.C. Boyle Dam and connects to OR66, providing access to the J.C. Boyle Dam from Klamath Falls and the surrounding communities. Topsy Road Grade is the only local road with a designed v/c ratio identified (0.85), with an existing use v/c ratio for the road of 0.04 (Interior and California DFG, 2012).

Lakeview Road is a narrow gravel road that leads to the top of Iron Gate Dam from Copco Road.

Vehicle-class, based on AADT count information for some roads adjacent to the project area, indicates that passenger cars comprise approximately 60 to 70 percent of the road traffic (except US97), with remaining vehicular traffic composed of medium and heavy trucks. On US97, 34 percent of the traffic is passenger cars, with the remaining traffic composed of medium and heavy trucks (KRRC, 2021l).

3.8.3 Effects of the Proposed Action

3.8.3.1 Land Ownership and Management

Upon license surrender, KRRC would divest ownership of approximately 2,705 acres of Parcel B land and transfer these lands to the respective states (Oregon or California), or to a previously designated third party (KRRC, 2020). No additional changes to land ownership associated with lands currently within the project boundary are expected as a result of the proposed action.

Our Analysis

Parcel B lands that are transferred to the States of Oregon and California would be managed following the strategic plans for the state agencies responsible for the land. Lands transferred to state agencies would be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access (PacifiCorp, 2016b). Third-party entities to which lands would be transferred would be bound by the guidelines and regulations of any state or the local land use agency overseeing private lands.

Management of Parcel B lands following implementation of the proposed action would need to follow all applicable state and local land use guidelines and regulations to ensure that there would be no conflict with existing public agency land use plans, policies, or regulations (California Water Board, 2020a). The proposed action conforms with local land use regulations and complies with the requirements for the Klamath County Comprehensive Plan that implements land use regulations (Oregon DEQ, 2018). Klamath County issued a Land Use Compatibility Statement on April 13, 2018, supporting the proposed action. The proposed action is also consistent with the applicable elements of the Siskiyou County General Plan and relevant land use regulations (KRRC, 2020).

3.8.3.2 Fire Management Plan

The proposed action may increase the risk of wildfire damage to local properties by eliminating reservoirs currently used for both aerial-based and land-based firefighting activities, and by removing fire breaks that the reservoirs provide.

KRRC prepared a Fire Management Plan (FMP) to identify strategies to mitigate for the loss of the project reservoirs and provide long-term local and regional fire suppression resources that do not currently exist in the region (KRRC, 2021i). The FMP describes the following measures KRRC would implement to avoid a net reduction in firefighting resources and to address the loss of the project reservoirs to provide water and firebreaks:

- install monitored fire detection camera technology to improve early detection and location of wildfires in the region,

- install five dry hydrants at road crossings of streams to provide additional water sources,
- construct or improve three boat launches for fire trucks to access the Klamath River,
- construct and maintain aerial river access points (two for each reservoir)[167] that meet criteria for use by Type 1 helicopters with snorkels, and
- provide five portable dip tanks (5,000 to 6,000 gallons) and two helicopter sling dip tanks (360 gallons) with supporting pumps and hoses to local wildfire suppression agencies.

KRRC would also provide a mobile chipper, dump bed trailer, and truck to the Fire Safe Council of Siskiyou County to assist landowners with improving defensible space around home sites to reduce the risk of structure fires. KRRC proposes to enter into cooperative agreements[168] with CAL FIRE, Oregon Department of Forestry, and the Fire Safe Council of Siskiyou County regarding implementation of the measures proposed in the FMP. KRRC would purchase and install the measures as specified in the agreements, but there is no indication in the FMP whether KRRC would provide funding for maintenance and operation of the equipment after license surrender.

Numerous parties comment that the FMP is inadequate to avoid increased risk of damage by wildfires due to reduced access to water for firefighting and the loss of fire breaks that the reservoirs provide. Representative LaMalfa comments that without the reservoir behind Copco No. 1 Dam, planes and helicopters would be required to fly farther for water, increasing the overall resources needed from CAL FIRE or the Forest Service. Several commenters note that loss of the reservoirs would eliminate fire breaks and increase the cost, and reduce the availability, of fire insurance. One commenter noted that some aircraft used for firefighting need a large body of water for refilling. Siskiyou County states that the FMP should be revised to include permanent water sources placed along the Klamath River corridor to support aerial firefighting.

The Copco Lake Fire Protection District identified several issues with the FMP. Many of the same concerns are expressed by local stakeholders Mark Fisher, Loy and John Beardsmore, and Siskiyou County. The specific issues identified are:

- the streams proposed for dry hydrants have insufficient water depth for lifting pumps to operate and to fill fire trucks;

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[167] The FMP does not specify whether KRRC intends to maintain river access points in all four reservoirs. The plan provides maps of potential locations in J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs.

[168] KRRC states it is working to reach such cooperative agreements in the first quarter of 2022.

- the roads at the proposed dry hydrant locations are too narrow, or hydrants would be located on blind corners, which would cause vehicle safety hazards during use;
- roadways are too narrow for a fire truck to turn around at the dry hydrant locations;
- dry hydrant locations do not meet the 14-feet, 6-inch maximum lift for drafting water;
- permission for the use of the private property upon which the dry hydrants would be placed has not been obtained from the landowners;
- deep water pools in the Klamath River may get filled with sediment, limiting their use as helicopter dip sites;
- an entity has not been identified that would be responsible for maintaining the dry hydrants;
- the existing gravity-fed hydrants[169] and supporting groundwater wells would be insufficient to be used for wildfires;
- an entity has not been identified that would be responsible for storing and deploying portable water tanks, and existing ground-based firefighting resources are lacking for tank deployment and refill; and
- no boat ramps are proposed to be installed in the general vicinity of the existing boat ramps on Copco No. 1 Reservoir.

CAL FIRE states that the measures described in the FMP would "not adversely affect CAL FIRE's ability to provide an adequate and effective firefighting capability in Siskiyou County." Oregon Department of Forestry concludes that the FMP "analysis of the incremental risks associated with dam removal project is accurate." The Forest Service concurs with CAL FIRE's assessment "that the FMP is more than adequate" and "do not anticipate this adversely affecting our ability to quickly and effectively respond to fires."

Our Analysis

To address the concern that the proposed action would increase the risk of wildfire damage, the proposed FMP would provide measures for early detection of wildfires,

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[169] The hydrant system at Copco No. 1 Reservoir consists of six hydrants that are the primary water sources for the Copco Lake Fire Department to protect the community and structures at the upstream portion of Copco Lake. These hydrants are gravity-fed from a water storage tank, which is filled from a spring, supplemented by a well, and operated by agreement between Copco Lake Mutual Water Company and Copco Lake Fire Department.

assist property owners with creating defensible space around home sites, and provide additional facilities to access water for ground-based and aerial fire suppression efforts.

The FMP would provide additional early wildfire detection capabilities by installing remote camera monitored detection systems at several sites throughout the region. Monitored detection systems have a greater visible distance than the human eye, and the placement of multiple overlapping systems allow for precise triangulation of fires (KRRC, 2021i). Early detection using monitored detection systems, relative to human observers, can save minutes to hours of time between ignition and the arrival of initial attack resources. Rapid detection allows wildfires to be attacked while still small, minimizing the time and total fire suppression resources needed to contain and control them. This component of the FMP, along with the measures proposed to create defensible space around home sites, would reduce the risk of wildfire damage to properties in the area and compensate for the loss of fire breaks that are currently provided by the reservoirs.

KRRC would construct or improve eight sites to provide access to water to fill water trucks (KRRC, 2021i). Five sites would be dry hydrants located at existing road-stream crossings, and three sites would be at boat launches. The proposed location of these sites would provide an appropriate geographic distribution of water supplies for ground-based fire suppression actions.

Copco Lake Fire Protection District has raised concerns regarding the adequacy of the dry hydrants to provide additional water sources for wildfire control. These issues include insufficient stream depth and excessive lift requirements, unsafe road conditions for fire trucks and other vehicles at some of the proposed locations, and the unapproved use of private property. Their issues are specific to the dry hydrant sites near Copco No. 1 Reservoir but may also be applicable to other sites.

KRRC’s FMP states that dry hydrant sites would be located at bridge crossings over large tributaries with a minimum streamflow of 2.2 cfs (1,000 gallons per minute), a minimum water depth of 1 foot below and 2 feet above the intake, and a vertical lift of less than 10 feet (KRRC, 2021i). There is no site-specific information available to allow staff to determine whether the proposed dry hydrant sites meet the minimum criteria identified in the FMP for installation and use of a dry hydrant. If the dry hydrant sites proposed by KRRC do not meet the minimum requirements, then KRRC should coordinate with local firefighting agencies to identify alternate locations, or other solutions to provide the proposed additional water availability. Changes to the location of dry hydrant sites should be documented in a revised FMP.

KRRC’s FMP does not address road conditions at the proposed dry hydrant sites. Road conditions at the proposed dry hydrant sites should allow for safe travel of other vehicles using the road and have a location nearby for fire trucks to turn around. Details to ensure vehicle safety at each proposed dry hydrant site should be coordinated with the local firefighting agency and community and documented in a revised FMP. These measures may include implementing temporary traffic safety management protocols (e.g., cones, flashing lights, flagging personnel) regularly used by utility and safety personnel working on and adjacent to traveled roadways.

Regarding the Copco Fire Board's comment that landowner permission has not been obtained to install hydrants on their land, KRRC proposes to install the dry hydrants away from the public roadway near existing bridges and stream crossings. The water in a stream is a public resource that is managed and permitted by the California Water Board and California DFW. While private property may be immediately adjacent to the proposed dry hydrant sites, the authority to permit the dry hydrants would be under the jurisdiction of state and local agencies responsible for the roads and streams.

Regarding Siskiyou County's comment on strategic placement of permanent water sources (such as dip tanks) along the Klamath River corridor to support aircraft firefighting activities, KRRC's proposal to identify and maintain two aerial river access points in the reaches currently inundated by the J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs[170] should be sufficient to minimize travel time for helicopters that use water from the river in this reach for firefighting efforts. Although the depth of some pool areas downstream of Iron Gate Dam may be affected by aggradation caused by the downstream transport of bedload sediments, the extent of aggradation is not expected to extend more than 8 miles downstream from the Iron Gate Dam site.

The elimination of Copco No. 1 Reservoir and Iron Gate Reservoir would remove two locations where a specific type of firefighting plane can skim the reservoir surface and refill for aerial wildfire suppression. Removal of the reservoirs would not preclude the use of all planes for wildfire suppression in the area because other types of tanker planes (refilled at air bases) could be used. Water scooping planes could use other lakes and reservoirs in the region (small water scooping planes require a minimum of 0.75-mile of straight water with a minimum depth of 6 feet, with surrounding terrain compatible with aerial decent and ascent trajectory requirements). Other reservoirs approximately 15 to 20 miles from the project area that may meet these requirements include Upper Klamath Lake, Hyatt Reservoir, and Howard Prairie Lake.

Implementing the proposed action, including the measures identified in the FMP, would have a permanent, less than significant, adverse effect on the ability of state and federal wildland firefighting agencies to effectively respond to, and suppress, fires in the region. Access to open waterbodies for water scooping planes would be reduced by two reservoirs, but other bodies of water remain available, and other types of tanker planes and helicopters are also used for aerial firefighting. The construction of new water access sites would mitigate for the loss of existing reservoir boat ramps that are used to refill tanker trucks, resulting in a less than significant effect on fire suppression efforts. The

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[170] The FMP does not include a map showing aerial access points in Copco No. 2 Reservoir, which is relatively small and in proximity to Copco No. 1 Reservoir. We assume that KRRC does not propose to maintain aerial access points in Copco No. 2 Reservoir.

installation of additional monitored detection system wildfire detection sites would have a long-term, significant, beneficial effect on the early detection of new fires in the region.

3.8.3.3 Specially Designated Areas

National Trails, Wilderness Areas, and Scenic Byways

The proposed action would have no effect on the Pacific Crest National Scenic Trail, nearby Wilderness Areas, or Scenic Byways. None of these land use designations are within or adjacent to the project area.

One segment of the California National Historical Trail crosses the Klamath River at the upper portion of J.C. Boyle Reservoir, while another segment crosses the Klamath River a few miles upstream at Keno. The proposed action would return J.C. Boyle Reservoir to a riverine state, a landscape condition that is more similar to when the trail was used in the early to mid-1800s by settlers emigrating from the central Midwest to southern Oregon.

3.8.3.4 Road Management and Traffic

Some stakeholders state that increased numbers of construction traffic and large trucks on the roads adjacent to the project may increase travel times for emergency vehicles to respond to incidents, restrict passage of passenger vehicles, and put excessive wear on rural roads.

Project-related traffic would result from construction workers commuting to and from the project sites daily, the transport of materials and heavy equipment to the sites, and the removal of construction debris for off-site disposal (table 3.8-2).

The average workforce present for construction activities at the J.C. Boyle facilities would be 135 people, with a peak workforce of 165 people. The average workforce present for construction activities at the Copco No. 1, Copco No. 2, and Iron Gate facilities would be 105 people at each site, with a peak workforce of 165 people at each facility (KRRC, 2021l). KRRC proposes to construct temporary housing facilities to provide RV-type housing for employees working in all areas of the project, which would reduce traffic on local roads associated with the project workforce.

KRRC's Oregon and California Traffic Management Plans and Emergency Response Plan (subplans of its Construction Management Plan [KRRC, 2021l]), identify measures to minimize traffic delays, prevent incidents, ensure preparedness, and ensure consistency with all applicable traffic, highway, and roadway regulations in Siskiyou County, California, and Klamath County, Oregon.

KRRC reviewed existing road conditions for segments expected to be used for construction traffic and identified improvements (including bridges and culverts) that would be implemented to address concerns regarding additional traffic, heavy truck weights, and user safety (KRRC, 2021l). The Transportation Management Plan identifies road improvements for specific segments, including widening road segments to allow for safer passing of oncoming vehicles, improved surfacing, replacing culverts, and adding temporary strengthening to existing bridges to support increased truck traffic and weights.

The City of Yreka expressed concerns regarding its water supply diversion on Fall Creek that is integrated with PacifiCorp's Fall Creek hydroelectric facility. The operation of the Fall Creek facility is critical for the continued use of the City's water right. The City requested that all roads required to operate and maintain the Fall Creek facility remain in an operable condition for normal maintenance vehicles.

Our Analysis

Transportation of personnel, supplies, equipment, and the disposal of waste material would result in short-term increases in traffic flow on I-5, OR66, US97, and local access roads. The amount of traffic associated with personnel commuting to and from the site would be minimized by construction of the proposed temporary on-site housing for the project workforce.

Interior and California DFG (2012) evaluated roads near the project to determine if there would be a significant change in traffic volume relative to the capacity of the road to identify if increased use would result in traffic delays. Traffic flow during the peak construction period would be similar to existing conditions with v/c ratios of 0.24 for I-5, 0.01 for OR66, 0.20 for US97, and 0.04 for Topsy Grade Road. Therefore, the short-term increase in traffic during construction would be a less than significant effect for I-5, OR66, US97, and Topsy Grade Road (Interior and California DFG, 2012).

Interior and California DFG (2012) also evaluated temporary traffic flow effects at on-site gravel roads at each dam. The short frequent trips associated with the deconstruction and transport of waste material to on-site disposal locations would cause traffic flow concerns within the construction zone. Increases in construction traffic at these locations would have a short-term, significant, adverse effect, partially mitigated by on-site signage and construction traffic management.

Construction trucks transporting waste material to off-site disposal locations over unpaved roads would create a substantial amount of dust causing a visibility hazard for other vehicles. Roads where this would occur are Copco Road, Lakeview Road, and Topsy Grade/Ager-Beswick Road. Installation of signage, dust abatement and proper construction traffic management would be implemented to reduce the generation of airborne dust. There would be a short-term, less than significant, adverse effect on road visibility due to dust.

Short-term (48-72 hours) road closures would be needed to construct improvements at culvert and bridge crossing sites to support construction vehicles. There are no planned roadway closures during construction at the J.C. Boyle site. Along Copco Road, temporary closures would be implemented at Dry Creek and Fall Creek for strengthening of the bridge structures. Flaggers would be used to manage traffic during short closure periods within the day. If an extended closure is necessary, a detour route via Ager Road and Ager-Beswick would be used to redirect traffic.

At the Scotch Creek and Camp Creek culvert replacement sites along Copco Road, a temporary detour immediately adjacent to the construction site would be constructed to let single lane traffic pass. The detour routes would be managed by flaggers controlling vehicles through the sites. Advanced community warning, and traffic control safety management procedures, would be implemented during all road construction activities. Road construction at bridge and culvert sites would have very short-term, adverse effect on traffic. Overall, increases in traffic by construction personnel, hauling trucks and other heavy machinery during dam removal, and associated activities would have a temporary, significant, adverse effect on congestion, road safety and conditions, and emergency response time in the project area. Once deconstruction is completed, traffic flows would return to current, existing conditions.

KRRC and PacifiCorp have not proposed any changes to the Fall Creek hydroelectric facility. There would be no effect on the water supply diversion structures for the City of Yreka or on the City's continued use of its water right. Existing roads required to operate and maintain the Fall Creek facility that are also used by the City of Yreka to manage its water supply system would not be affected, and the roads would continue to be maintained in an operable condition for maintenance vehicles.

3.8.4 Effects of the Proposed Action with Staff Modifications

The effects on land use in the project area under the proposed action with staff modifications would be the same as discussed for the proposed action, with the exception discussed below regarding the FMP.

As discussed above, the Copco Fire Board and several other commenters expressed concerns about several specific elements in the FMP. Concerns regarding the location of proposed dry fire hydrants include: (1) insufficient stream depth and lift requirements at the proposed locations; (2) location on blind corners; (3) the lack of nearby locations for fire trucks to turn around; and (4) documentation of approval by landowners for any sites located on private property. Other concerns include: (1) the lack of any proposed river access boat ramps within the Copco No. 1 Reservoir area; (2) identification of the entity that would be responsible for storage, deployment and refill of portable water tanks; and (3) the potential need to install permanent water sources (such as dip tanks) strategically placed along the Klamath River corridor to address the potential filling of existing dip sites by gravel transported from the reservoirs.

KRRC proposes to enter into cooperative agreements with CAL FIRE, Oregon Department of Forestry, and the Fire Safe Council of Siskiyou County regarding implementation of the measures proposed in the FMP. Consultation with these parties as the agreements are developed should include the evaluation and identification of specific measures to address the concerns listed above, including whether the proposed dry hydrant sites meet minimum pumping requirements, maintenance responsibility for dry hydrants and other wildfire equipment, and ensuring traffic safety at dry hydrant sites. After this consultation has been completed and any changes to proposed measures or additional measures have been identified, staff recommend that KRRC revise the FMP and Construction Management Plan to incorporate any revisions or additional measures, with an explanation of how each of these concerns have been addressed.

Consultation with these parties to address site-specific concerns about the deployment of water sourcing facilities that would be used during wildfire response would ensure that the proposed action would have a less than significant effect on firefighting capabilities by federal, state, and local wildland firefighting agencies.

3.8.5 Effects of the No-action Alternative

Under the no-action alternative, land ownership and use would remain the same, the risk of wildfire damage to properties in the area would not change, specially designated areas would not change, and traffic levels and use of roadways would be similar to existing conditions.

Table 3.8-1. Regional and local roads that provide access to the project facilities (Source: staff)

Project Facility	Interstate Access	Regional Access	Local Access
J.C. Boyle Dam	I-5 and US97	Oregon Route 66	Topsy Grade Road
Copco No. 1 and No. 2 Dam	I-5	Copco Road	Ager-Beswick Road
Iron Gate Dam	I-5	Copco Road	Lakeview Road

Table 3.8-2. Estimated number of trips and transportation road required to dispose off-site materials (Source: KRRC, 2021l)

Facility	No. of Trips	Roads
J.C. Boyle	102	Highway 66
Copco No. 1	55	Copco Road
Copco No. 2	126	Copco Road and Interstate 5
Iron Gate	60	Copco Road

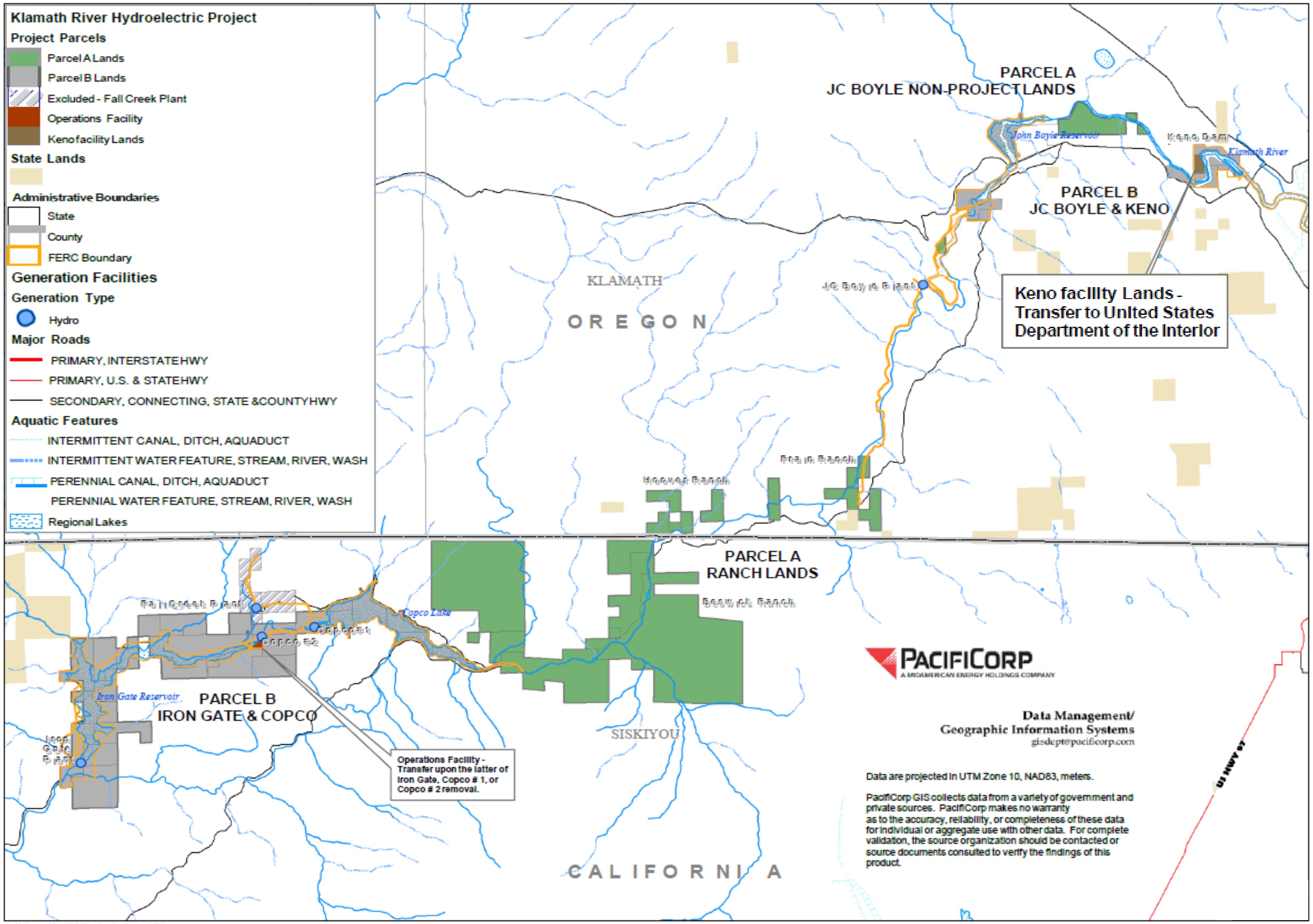

Figure 3.8-1. Map of lands owned by PacifiCorp in the Lower Klamath Project Area, showing existing project boundary, PacifiCorp ownership after license surrender (Parcel A lands), and intended to be transferred to Oregon and California (Parcel B lands) (Source: KHSA, 2016, as modified by staff)

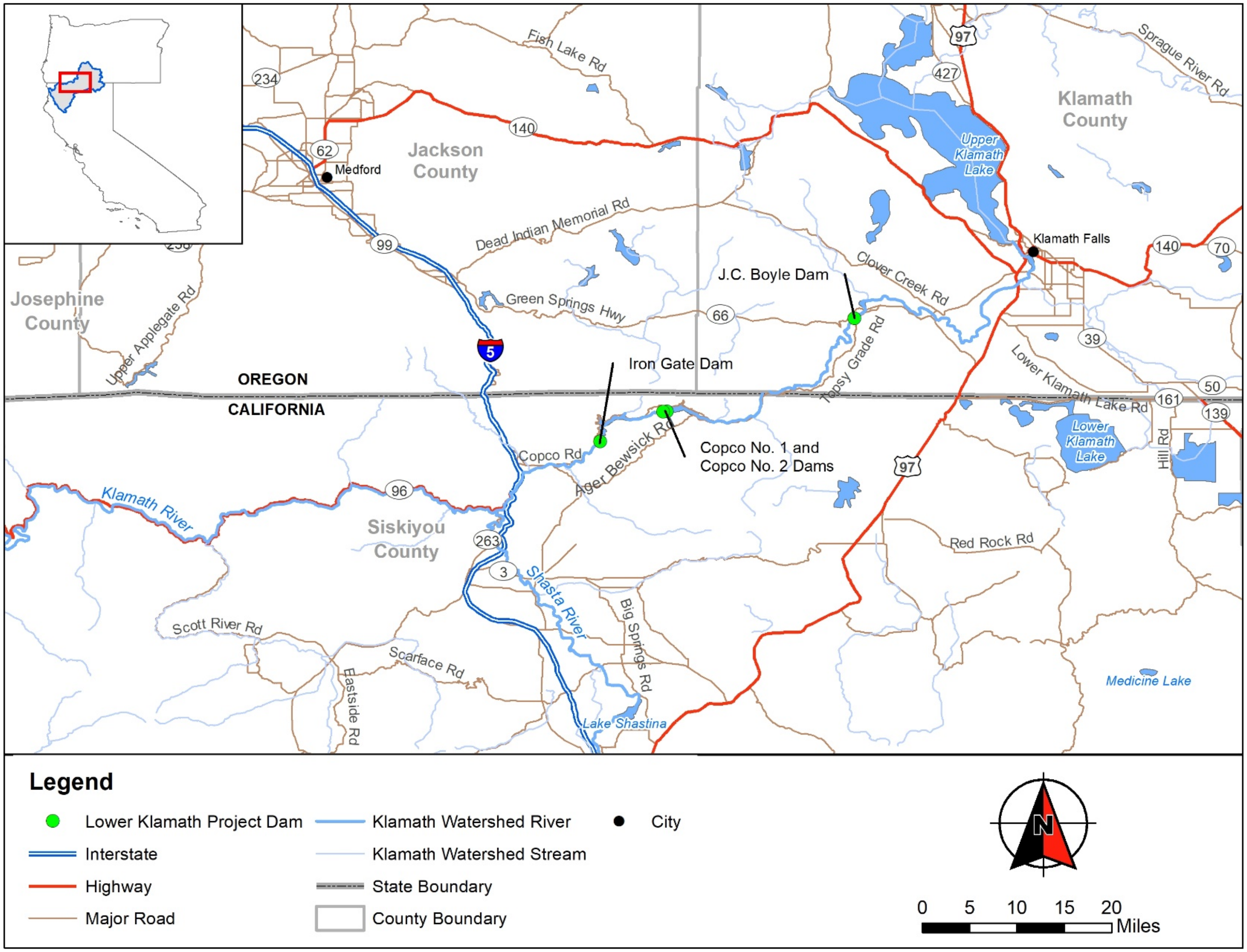

Figure 3.8-2. Regional transportation network (Source: Interior and California DFG, 2012)

3.9 AESTHETICS

3.9.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for aesthetics includes all lands within the viewshed of the project reservoirs and facilities. The temporal extent of our effects analysis ranges from short-term effects during project deconstruction activities to permanent effects after completion of project deconstruction and mitigation activities.

3.9.2 Affected Environment

The Upper Klamath Basin begins at the headwaters of the Klamath River in south-central Oregon and extends downstream into north-central California. Along the northernmost, eastern edge, the Klamath River borders remnants of central Oregon's Modoc Plateau province. The river flows through a broad, flat valley that gradually transitions to a narrow channel as it crosses the low, rolling ridges of the Cascade Mountains (PacifiCorp, 2004g).

The topography of the landscape changes dramatically starting upstream of J.C. Boyle Dam and extending downstream, dropping steeply into the Upper Klamath River canyon. The ruggedness of the terrain exemplifies the surrounding landscape, where nearby mountain peaks often reach 5,000 feet in elevation. As the river passes through the Cascade Mountains, the canyon transitions from a desert landscape in the east to a mountainous landscape in the west. The steep-walled canyon is the predominant visual element in the region. As the river flows through the canyon, it changes from slack, slow-flowing water in the broad, flat valley to a torrent of cascading whitewater. Less than five miles downstream of J.C. Boyle Dam, the canyon and neighboring ridges gradually become flatter and wider as the river flows southwesterly across the state line and into Copco No. 1 Reservoir. Here, along the western edge of the hydroelectric reach, the topography surrounding Copco No. 1 and Iron Gate Reservoirs is open and rolling (PacifiCorp, 2004g).

Key visual elements within the hydroelectric reach include the project reservoirs; the built features of the hydropower project (e.g., dams, powerhouses, water conveyance features, transmission lines, recreation sites); and the natural landscape features of the surrounding area, including the terrain, vegetation, and river flows. The visual character of the project is assessed from key observation points, selected from public access and use areas that reflect typical viewsheds for people recreating on the river, reservoirs, or from developed vistas.

The existing visual character of the project and its immediate surroundings were evaluated and described using the BLM visual resource management (VRM) methodology (PacifiCorp, 2004g). This methodology identifies visual resource management classifications (VRMCs) to describe the level of change allowed to the landscape from the existing conditions. The applicable VRMCs are:

- Class II: Retain the existing character of the landscape. The level of change to the characteristic landscape should be low relative to the existing character of the landscape. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- Class III: Partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate relative to the existing character of the landscape. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

J.C. Boyle Dam, Powerhouse, and associated transmission line are located in areas designated as VRMC Class II. All three facilities attract the attention of the casual observer. The dam is quite visible in the landscape from downstream, although it is much less visible from the upstream side. The powerhouse and penstocks are prominent in the landscape because of their color and strong lines that contrast with the natural setting. The transmission line is noticeable because it continues over a long distance and rises above the other features in the landscape (PacifiCorp, 2004g).

Copco No. 1 Dam and Powerhouse, Copco No. 2 Powerhouse, and the Iron Gate Fish Hatchery and fish ladder are located in areas designated as VRMC Class III. Key observation points are located close to these facilities; therefore, the facilities dominate the view because of the size and prominence relative to the position of the viewer. These facilities also have lines, forms, and colors that contrast with their natural settings (PacifiCorp, 2004g).

Copco No. 2 Dam, Copco transmission line, Iron Gate Dam and Powerhouse, and the Iron Gate transmission line are also located in areas designated as VRMC Class III. Even though the dams are large structures, they sit within the profile of the surrounding landscape, making them appear more like part of the landscape than they would otherwise. These facilities are constructed with colors and lines that blend with their surroundings. Even though the transmission lines rise above other features, they are typically at a distance from the casual viewer and blend into the sky above. From a distance, the lines do not obstruct or overpower other elements in the landscape. In limited instances, the transmission lines or support structures may dominate a view for a short time as the viewer passes by (PacifiCorp, 2004g).

The hydro project features pre-date the development of the VRMCs for the area, and as such are considered consistent with the VRM objectives for the area.

A segment of the Klamath River between J.C. Boyle Powerhouse and the California-Oregon border is designated as Scenic under the Wild and Scenic Rivers Act. The ORVs identified for the designation of this segment of the river include the scenic quality of the river and surrounding area (FERC, 2007). The 5.3-mile segment from the California-Oregon border to Copco No. 1 Reservoir is considered eligible and suitable for designation but not currently protected under the Wild and Scenic Rivers Act. This segment has many of the same ORVs identified for the Scenic-designated segment immediately upstream.

There are three Scenic Byways located along the Klamath River and within the Klamath and Six Rivers National Forests (California Water Board, 2020a). None of the Scenic Byways are within the project boundary, and the project features are not visible from any of the Scenic Byways and have no visual effects.

3.9.3 Effects of the Proposed Action

The BLM VRM methodology is used as guidance to determine the significance of an action on visual resources. Potential changes to the visual landscape are identified by the degree of contrast, relative size or scale, distance, visibility, and magnitude of the change. Contrast elements include changes to the form, line, color, or texture of the features relative to the predominant natural features of the surrounding landscape.

The potential visual changes associated with the project include both long-term and short-term visual effects. Changes to some visual resource elements would be beneficial, while others would be adverse. KRRC has proposed to mitigate visual changes by revegetating all disturbed areas with locally representative native plant communities, thus blending the disturbed areas into the surrounding landscape. The first couple of years following dam removal, vegetation would comprise low-growing grasses, forbs, and small shrubs. Shrubs and trees would increase in number and height in subsequent years as plantings mature and ecological succession progresses. In areas immediately adjacent to the river channel where it is bedrock-controlled, the restored vegetation characteristics are expected to be sparse, which is typical in nearby undisturbed reaches of the river. Over the long term, vegetation and landscape characteristics in revegetated areas are expected to match the surrounding natural landscape conditions (California Water Board, 2020a).

The visual changes expected to occur include:

- loss of long-distance open-water vistas,
- exposure of barren reservoir footprints,
- revegetation of barren reservoir footprints and deconstruction sites,
- changes in river channel flows,
- removal of project facilities (dams, powerhouses, recreation sites), and
- construction activity.

Removal of the project facilities would have a beneficial effect on the existing landscape. The large-scale built features would be removed, eliminating the elements that contrast with the form, line, color, and texture of the surrounding landscape. Sites with built features would be recontoured and graded and revegetated with locally representative native plant communities to blend with the surrounding landscape.

Draining of the project reservoirs would have a short-term, adverse visual effect and a permanent visual effect that may be either adverse or beneficial, depending on the viewer. In the short term, this action would replace the long-distance open-water vistas that have been present for decades with exposed barren reservoir areas. J.C. Boyle Reservoir was established in 1958, Copco No. 1 Reservoir in 1918, and Iron Gate Reservoir in 1962 (PacifiCorp, 2004h). The barren reservoir areas would result in a considerable change and would be highly visible to nearby viewers, contrasting with the form, line, color, and texture of the predominant natural features of the surrounding landscape. Implementing the proposed mitigation measures would revegetate the reservoir area with native plant communities representative of the surrounding area, creating a natural visual element. This would result in a permanent visual effect compared to the existing long, open-water vistas.

Construction activities and restoration efforts at or near the project facilities would also result in short-term, adverse visual effects. The movement of construction equipment, fencing, and fugitive dust all create unnatural contrasting visual elements of form, line, color, and texture relative to the existing built elements and the surrounding natural landscape characteristics (California Water Board, 2018).

Permanent changes in the timing, duration, and magnitude of flows would occur within the hydroelectric reach when reservoir reaches are converted into free-flowing reaches. The flow changes would be a noticeable permanent change as flatwater reservoirs become flowing river reaches. Existing river reaches would show visual change in response to the proposed action and would have similar visual elements of form, line, color, and texture to existing conditions (California Water Board, 2018).

Our Analysis

KRRC’s Reservoir Area Management Plan proposes to revegetate the exposed reservoir shoreline areas, construction sites, disposal areas, and recreation sites with locally representative native plant communities. Over the long term, revegetation efforts would restore the landscape to vegetative conditions similar to the surrounding landscape (KRRC, 2018a). The Reservoir Area Management Plan includes four vegetation characteristics (species richness, tree and shrub density, vegetation cover, and non-native relative frequency) that would be monitored for a minimum of five years until successful targets for revegetation have been achieved.

Short-term, significant, and unavoidable adverse visual effects would occur during deconstruction, as construction equipment moves throughout the area, artificial lighting is used at the construction sites for worker safety and site security, and fugitive dust is generated by the construction equipment (California Water Board, 2018). Long-term, significant, and unavoidable adverse visual effects would continue for approximately three to five years following construction activities until vegetation becomes established at the sites in densities and species compositions similar to the adjacent landscape.

Permanent significant beneficial effects on visual elements would occur at project facilities, built features, and construction and disposal sites, as these sites are revegetated to match the surrounding landscape and minimize their visual contrast with the surrounding area. The result of this action would be consistent with the VRMCs for the area and have a significant, permanent beneficial effect on the visual landscape.

Reservoir areas that are converted to flowing river segments would lose open-water and lake vistas in exchange for more natural river, canyon, and valley vistas. Over the long term, the exposed reservoir footprints would be revegetated to match the surrounding plant communities, resulting in a permanent, significant change from open water to a vegetated landscape. This would be a permanent, significant effect on all viewers. However, viewers may interpret the effect as either beneficial or adverse, depending on their preference. For those who prefer views of a free-flowing river the proposed action would be a permanent, beneficial effect.

Some of the residences abutting Copco No. 1 Reservoir have expressed concerns about the loss of open-water lake views from their property. Those homeowners presumably chose to purchase or build those residences based on their proximity to the reservoir and open-water view. Proposed mitigation to revegetate the exposed reservoir footprint may result in additional adverse changes to the contrast and texture elements of their view. The proposed action would result in a permanent, significant, and unavoidable adverse change of resident’s view, compared to the desired open-water vista.

3.9.4 Effects of the Proposed Action with Staff Modifications

The effects would be the same as the proposed action.

3.9.5 Effects of the No-action Alternative

Under the no-action alternative, the built features of the hydropower project (e.g., dams, powerhouses, water conveyance features, transmission lines, recreation sites) would continue to dominate the viewshed when evaluated from key observation points. However, the features of the hydropower project pre-date the development of VRMCs for the area, and, as such, the project’s features are considered consistent with the VRM objectives. The effects of the built features of the project on the visual resources over the long term would remain unchanged from the existing conditions and would be considered a long-term, significant, adverse effect to a less than significant, adverse effect. The long, open-water vistas across the reservoirs, including from properties abutting Copco No. 1 Reservoir, would also remain unchanged.

3.10 CULTURAL RESOURCES

3.10.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for cultural resources includes a 0.5-mile-wide area on each side of the Klamath River and a 0.5-mile-wide corridor from the high water mark surrounding each of the four reservoirs from the upper reach of J.C. Boyle Reservoir to the river mouth of the Pacific Ocean (the area of potential effect [APE]). The temporal extent of our effects analysis ranges from short-term effects of deconstruction activities, including releases of sediments, to permanent effects in the reservoir footprints, removal of historical structures and other ground-disturbance activities, and the potential removal of historic properties from ongoing federal protection.

3.10.2 Affected Environment

3.10.2.1 Definition of Cultural Resources, Historic Properties, Effects, and Area of Potential Effect

Historic properties are cultural resources listed or eligible for listing in the National Register of Historic Places (National Register). Historic properties can be buildings, structures, objects, districts (a term that includes historical and cultural landscapes), or sites (archaeological sites or locations of important events). Cultural resources must meet at least one the following criteria to be eligible for listing on the National Register:

- Are associated with events that have made significant contributions to the broad pattern of our history (Criterion A); or
- Are associated with the lives of persons significant in our past (Criterion B); or
- Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C); or
- Have yielded, or may be likely to yield, information important in history or prehistory (Criterion D).

Historic properties also may be resources of traditional religious and cultural importance to Native American Tribes that meet the National Register criteria; these properties are known as traditional cultural properties (TCPs). In most cases, cultural resources less than 50 years old are not considered eligible for the National Register. Cultural resources also must have enough internal contextual integrity to be considered historic properties. For example, dilapidated structures or heavily disturbed archaeological sites may not have enough contextual integrity to be considered eligible.

Section 106 of the National Historic Preservation Act (NHPA), as amended (section 106), requires federal agencies including the Commission, to consider the effects of their undertakings on historic properties and to allow the Advisory Council a reasonable opportunity to comment. An undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including, among other things, processes requiring a federal permit, license, or approval. The Advisory Council's regulations implementing section 106 define effects on historic properties as those that change characteristics that qualify those properties for inclusion in the National Register. In this case, the section 106 undertaking is the proposed surrender of the license for the Lower Klamath Project and the removal of project facilities.

Determining effects on historic properties first requires identifying historic properties in the APE of an undertaking. The Advisory Council's regulations define the APE as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.

In addition to proposing an APE, KRRC uses several other terms to describe various areas at the Lower Klamath Project. These include the area of direct impacts (ADI), the Project Limits of Work and Access (LOW), and "Parcel B" lands.[171] The APE proposed by the applicants for the surrender and decommissioning is defined as a 0.5-mile-wide area extending from the shoreline of each side of the Klamath River from the upper reach of J.C. Boyle Reservoir to the mouth of the Pacific Ocean (AECOM, 2021). Where topography is open, the APE extends for at least an additional 0.5 mile to create a minimum 1-mile-wide APE to address potential indirect effects because of altered viewsheds. The ADI is defined as the area within the APE where direct physical effects are anticipated due to license surrender activities, particularly areas that would be subject to ground disturbance (i.e., demotion and removal; restoration). The ADI also includes lands between Iron Gate Dam and Humbug Creek to account for proposed downstream flood control improvements. The ADI also corresponds to the LOW, which refers to the physical extent of construction activities associated with dam decommissioning and removal, reservoir restoration activities, safety zones, the Yreka pipeline crossing, and improvements to Fall Creek Hatchery. All cultural resources within portion of the proposed APE upstream of Humbug Creek, which includes the ADI, LOW, and Parcel B lands, have the potential to be directly or indirectly affected by the proposed action. The reason that the APE extends so far downstream of the ADI and the LOW is to address potential effects on the proposed Klamath Cultural Riverscape, a potential historic property that tentatively extends from "the upstream boundary of Shasta

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[171] Parcel B lands are identified as those that would ultimately be transferred to the State of Oregon, the State of California, or a third-party following completion of license surrender conditions.

territory to the Pacific Ocean" (King, 2004).[172] No direct project-related adverse effects on cultural resources are anticipated downstream and outside of the ADI, and our analysis for effects on archaeological resources and other physical historic properties primarily focuses on the ADI between Humbug Creek upstream to the upper reach of J.C. Boyle Reservoir where direct effects may occur. However, potential effects on the downstream riverscape and the larger APE (although pending completion of the TCP study) are also addressed in our analysis.

In letters filed on June 3, 2018, and June 28, 2018, respectively, the California SHPO and Oregon SHPO provided KRRC with comments on the APE proposed for archaeological resources and TCPs. KRRC revised the APE based on the SHPOs' comments and comments provided by other participants in the Cultural Resources Working Group and filed updated maps with the Commission and the SHPOs on November 15, 2018. The Oregon SHPO also concurred with the APE for aboveground architectural resources in a letter filed on December 12, 2018.

The Advisory Council's regulations require the Commission to seek concurrence from the SHPO on any finding involving effects or no effects on historic properties and allow the Advisory Council an opportunity to comment on any finding of adverse effects. In addition, the regulations require the Commission to consult with interested Native American Tribes that might attach religious or cultural significance to historic properties within the APE.

In its November 10, 2016, Notice of Applications Filed with the Commission, the Commission stated that it had designated KRRC as the non-federal representative for the purpose of informal section 106 consultation. KRRC initiated consultation with the California and Oregon SHPOs in an August 8, 2017, letter, and on September 5, 2017, met with the Forest Service, Corps, California SHPO, and Oregon SHPO for the first of a number of Cultural Resources Working Group meetings. Since that time,[173] KRRC has continued informal section 106 consultation with the following agencies and federally and non-federally recognized Tribes: the Advisory Council, the California SHPO, the Oregon SHPO, the Forest Service (Klamath National Forest and Six Rivers National Forest), BLM (Redding District and Klamath Falls Resource Area, Lakeview District), Reclamation, the Corps, the City of Yreka, Siskiyou County, Klamath County, the Hoopa Valley Tribe, the Karuk Tribe, the Yurok Tribe of the Yurok Reservation, the Klamath Tribes, the Resighini Rancheria, Cher-Ae Heights Indian Community of Trinidad Rancheria, Quartz Valley Indian Community of the Quartz Valley Reservation of California, the Confederated Tribes of Siletz Indians of Oregon, the Shasta Nation

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[172] King (2004) does not define a clear boundary for the proposed Klamath Cultural Riverscape.

[173] See attachment 2 of the KRRC's May 20, 2021, filing (Accession # 20210520-5129).

(Yreka, California), the Shasta Indian Nation (Redding, California), the Modoc Nation (Modoc Tribe of Oklahoma), and other interested parties.

The Commission has also consulted with participating Tribes, beginning with an October 18, 2017, outreach letter and in a number of subsequent consultation meetings, including those held between January 16 and January 19, and on February 5, 2018.[174] Representatives of state and federal agencies were also invited to these meetings. Consulted Tribes included the Hoopa Valley Tribe, Karuk Tribe, Yurok Tribe, Klamath Tribes, Modoc Tribe, Quartz Valley Indian Community of the Quartz Valley Reservation of California, Resighini Rancheria, Confederated Tribes of Siletz Indians of Oregon, Trinidad Rancheria, Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes of the Grand Ronde Community of Oregon, Cow Creek Tribes of the Warm Springs Reservation of Oregon, Elk Valley Rancheria (California), Pit River Tribe (California), and the Tolowa Dee-Ni Nation. In addition, Commission held a teleconference with the Yurok Tribe on July 9, 2019. Commission staff also conducted a government-to-government consultation with the Yurok Tribe on October 11, 2021.

3.10.2.2 Cultural History Overview[175]

The project is located in a region of overlapping cultural traits from the California, Great Basin, and Columbia Plateau culture areas. The earliest human occupation of the area occurred in the Paleoarchaic period (12,000 to 7,000 years before present [B.P.]). These people were hunter-gatherers with a broad-spectrum subsistence economy geared toward large game animals and supplemented by fish, birds, and plants. High seasonal and annual mobility, low population densities, and a technology geared toward maximum flexibility define this period. The Early Archaic period (7,000 to 4,500 B.P.) witnessed the first use of semisubterranean house pits in the Plateau region, suggesting at least some people were living a less mobile lifestyle. During the Middle Archaic period (4,500 to 2,500 B.P.), there was an increased use of riverine and marsh environments (salmon and roots of plant species). The Late Archaic/Late Prehistoric period (2,500 to 200 B.P.) saw numerous changes to the social framework, including the widespread use of pit houses, a heavy reliance on fishing, the use of storage pits for salmon, exploitation of the roots and bulbs of the camas lily, and emergence of seasonal land use patterns. This is the period when bow and arrow technology developed. Extensive trade networks were in place by 1,500 B.P., as evidenced by archaeological sites containing obsidian tools made from material found at sources more than 100 miles away.

At the time of contact with Euroamericans in the early 19th century, several Native American Tribes of various language groups counted lands within the Lower

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[174] The Tribal consultation meetings were held with the Hoopa Valley Tribe, Karuk Tribe, Quartz Valley Indian Community of the Quartz Valley Indian Reservation of California, Klamath Tribes, Yurok Tribe, and Modoc Nation.

[175] Adapted from text in FERC, 2007.

Klamath APE as part of their ancestral territories. The Klamath and Modoc Tribes, as well as some of the Snake peoples, were located in the upper reaches of the drainage. The Shasta people (whose territory primarily consisted of river systems located at an elevation above 2500 feet) were represented along the Klamath River by one of the Tribe's four internal subgroups, the Wairuhikwaiiruka or Kammatwa. The Karuk Tribe was most closely associated with the middle reaches of the Klamath River, while ancestral territory of the Yurok included not only the lowest reach of the river and mouth but also stretches along the Pacific Coast. The Hoopa Valley Tribe were less closely associated with the mainstem of the Klamath River; their ancestral territory focused more on the Trinity River, a main tributary of the Klamath River.

Although the Tribes of the Klamath River are from various language groups and have their own distinct cultural traditions and practices, they derived their cultures and subsistence wholly, or in large part, from the river and its aquatic and terrestrial resources. Salmon, steelhead, and other fish (such as suckers and lampreys) taken with weirs, nets, baskets, harpoons, or spears occupied a central place in the diets of these peoples. As a result, fish (particularly salmon) were at the foundation of the Tribes' settlement and seasonal subsistence patterns and remain at the core of their belief systems.

The salmon runs themselves played an important role for the Tribes, not just for sustenance, but for ceremonies and traditional rituals. The Karuk and Yurok Tribes, for instance, recognized two runs of Chinook salmon, with the First Salmon Ceremony performed at the beginning of the spring run when the fish first breached the sandbar at the mouth of the Klamath (Salter, 2003). Traditionally, salmon could not be eaten until after this ceremony when the medicine man would eat the first salmon. The World Renewal Ceremonies, or Pikiavish Ceremonies, were shared among the Karuk, Yurok, and Hoopa Tribes and were timed to the fall salmon run. The Shasta people recognized three anadromous fisheries, beginning with Chinook salmon in April, steelhead in August, and coho and chum salmon in October, and observed their own version of the First Salmon Ceremony (Daniels, 2006). Farther upriver, many of the largest Klamath and Modoc villages were specifically placed near salmon fishing sites, and multi-village and multitribal gatherings centering on the salmon harvest constituted important social and ceremonial events (Deur, 2003).

Other terrestrial and aquatic species such as crayfish, mussels, otters, deer, and the Pacific giant salamander are integral to the Tribes' food, culture, and religion. Crayfish are included as part of the World Renewal Ceremony. As a prized game species, deer hunting required ritual acts to prepare the hunter. The Karuk Tribe used both deerskins as well as martin and otter skins during various ceremonies. The Pacific giant salamander, or puuf puuf, carries cultural significance in Karuk mythology as the creature responsible for purifying water.

The Tribes of the Klamath River also made extensive use of a variety of plants from riparian and upland environments for food and as raw material for clothing, tools, weapons, domestic items, and medicinal and ceremonial purposes. Although the particular biotic environments each of the Tribes occupied were the primary plant sources for each Tribe, extensive travel and trading up and down the river made plant materials from throughout the Klamath River drainage (and beyond) available to all the Tribes. The Yurok Tribe manufactured canoes from fallen redwood, as did the Klamath Tribes from ponderosa pine. Roots of redwood, pine, spruce, alder, willow, and cottonwood were gathered, most frequently along the riverbanks where they were easily harvested with minimal disruption of the trees themselves. Riparian environments were a rich source of edible fruits (huckleberry, gooseberry, currant, grapes, and sallal), and upslope locations provided filberts and acorns. Other food was derived from wocas (yellow pond lily), cattail, camas bulbs, and a wide variety of seeds and roots. Plant materials such as willow shoots and bark, hazel withes, grapevines, beargrass, ferns, nettle, cattail, tule, and woodwardia found use in the manufacture of nets, baskets, and other items. Even leaves of wild iris, gathered at much higher elevations, were used to make fine mesh nets. Geologic and topographic elements (rocks or landforms along the river, as well as upland locations) were featured prominently in the Tribes' cultural "maps" of their ancestral territories, as places of year-round or seasonal settlement, traditional fishing, hunting and gathering sites, and sites of spiritual and ceremonial significance.

The arrival of Euroamericans in the region greatly affected Tribes along the Klamath River. Native populations suffered from introduced diseases, the dislocation and ultimately forced relocation of survivors, disruption of traditional subsistence patterns and resources, and eventual suppression of native religious practices and language in non-Indian schools. The earliest Euroamericans to appear were trappers, who arrived in the mid-1820s in search of fur-bearing animals. Next to come, during the period of 1841–1855, were scientific expeditions, among them the Klamath Exploring Expedition of 1850 that looked for potential gold mining sites and locations for settlement.

Permanent Euroamerican settlement in the Klamath River watershed began in the 1850s on the heels of gold prospectors. Completion of the Southern Emigrant Road, also known as the Applegate Trail, in 1846 brought prospectors to the region and helped to establish communities such as Henley (Cottonwood), Gottville, Happy Camp, and Somes Bar. Fertile soil, level terrain, and plentiful water sources also made various portions of the area favorable for agriculture and ranching. Large-scale settlement did not occur, however, until after 1875 when the Topsy Grade Road was completed. This road could accommodate wagons and served as the main stage and mail route between Yreka, California, and Linkville (Klamath Falls), Oregon.

Mining proved of limited importance in the Euroamerican development of the region, despite its effect on native inhabitants, and logging did not occur to any substantial degree until railroads reached the area. The Oregon & California Railroad was the first railway through the region (1877), extending from Siskiyou County, California, to Jackson County, Oregon, enroute from Sacramento to Portland. Other local railroads, developed to support logging operations, eventually supplanted the stage lines.

The Southern Pacific Railroad Company acquired the Oregon & California Railroad that same year, and by 1909, the railroad connected the Klamath River area to a nationwide market. Rail connection outside the local area provided relatively inexpensive and efficient transport for agricultural commodities to wider markets.

The local timber industry began in the 1860s with a sawmill constructed by the United States Army along the Wood River near Fort Klamath (1863) and a privately owned sawmill in the Keno, Oregon, area (1869). Sustained logging enterprises first appeared in the mid- to late 1880s. Early companies were small, family-run businesses typically run by ranching families trying to supplement their income. In the early 1890s, larger scale logging companies such as Pokegama Sugar Pine Lumber Company and Klamath River Lumber and Improvement Company were established on the north rim of the Klamath River Canyon. The settlements that grew up around the logging companies provided loggers and businessmen with multiple services, including stores, post offices, and schools. Local ranchers and farmers frequently provided meat and produce to adjacent logging camps.

The acreage available for agriculture was greatly increased following the passage of the Reclamation Act by the United States Congress in 1902. The act allowed for a new round of homesteading as portions of the Klamath River Basin were “reclaimed” from wetlands for agricultural use. Increased demand for arable lands led to initiation of the Klamath Irrigation Project in 1905. Seven dams (including Link River Dam), hundreds of miles of irrigation ditches and canals, and 45 pumping plants were eventually built for the project under Reclamation’s direction. Reclamation homestead allotments took place from 1917 to 1949. In 1964, passage of the Kuchel Act ended homesteading on lands in the area of the Klamath Hydroelectric Project.

Although timber production declined in the early 1900s, the industry began to improve around 1910. In the mid-1920s, the Weyerhaeuser Timber Company built a major mill in Klamath Falls and was a major economic power in the area for decades. Rapid growth in the lumbering business occurred in the 1920s, resulting in construction of numerous spur railroads to support logging efforts and increased use of mechanized equipment. The Depression, however, brought operations to a halt. By 1932, timber production had fallen to 55 percent of the pre-Depression volume, and roughly half of all timber-related jobs were lost. Logging revived during World War II but fell on hard times again in the late 20th century.

The first hydroelectric development in the Klamath River Basin was established in 1891 in the Shasta River Canyon below Yreka Creek to provide electricity to the town of Yreka. Four years later, the Klamath Falls Light & Water Company built a generating facility on the east bank of the Link River (known as East Side) to supply power to the community of Klamath Falls. Both ventures soon attracted competitors: the Siskiyou Electric Power Company’s Fall Creek plant (1903) serving Yreka, and the Klamath Light & Power Company’s West Side plant on the Link River (1908) serving Klamath Falls.

By 1912, these and many other small producers throughout the region were brought together as the California Oregon Power Company. The company subsequently embarked on a period of major expansion, with its Copco No. 1 development (1918, expansion 1921-22) the first on the Klamath mainstem, and Copco No. 2 (1925). After World War II, regional population growth prompted a new round of hydroelectric power expansion with Copco's Big Bend (1958) and Iron Gate (1962) developments. While Iron Gate was still under construction, Copco was merged into Pacific Power & Light (today PacifiCorp). In 1966, a new regulating dam replaced a 1931 dam of equivalent function that had replaced an older dam and powerhouse built by the Keno Power Company in the early years of the 20th century.

3.10.2.3 Tribal Organizations

Of the Native American Tribes in the Klamath River drainage, two (the Hoopa Valley Tribe and the Yurok Tribe) today have their own reservation lands in this area—the Hoopa around the Trinity River and the Yurok on the lower reaches of the Klamath River. Tribes whose ancestral territories lie upriver have experienced different fates, but all retain close traditional and cultural connections to the river and natural resources of the valley.

In the Klamath Treaty of 1864, the federal government set off a large area at the headwaters to which it relocated surviving Klamath, Modoc, and Yahooskin, today together known as "The Klamath Tribes." Ninety years later, however, both their government-recognized Tribal status and their reservation were terminated, resulting not only in loss of the land base but also of much of their Tribal identity. Through lengthy court action, the Klamath Tribes were able to regain their status as a federally recognized Tribe in 1986 but have had to acquire such land as they now hold on their own.

The California Gold Rush and Rogue River Wars (1850–1857) pushed most of the Shasta out of their traditional Oregon and northern California territory. The increasingly marginalized people formed small communities near ranches throughout northwest California and southwestern Oregon, including those at Frain Ranch and Bogus Tom Smith's Rancheria in the Klamath River area. These communities were able to benefit somewhat from a 1910 amendment to the 1887 Dawes Act, that made vacant land available to "landless" Native Americans if properly allotted by an Indian agent, but the Shasta have no official reservation or formal U.S. government recognition. Some Shasta, along with Karuk and Upper Klamath, live at the Quartz Valley Rancheria, established in 1938 as the Shasta and Upper Klamath Indian Reservation. Federal supervision of this Quartz Valley Reservation was terminated in 1967; since then, the Tribe has been gradually reacquiring land.

The Karuk Tribe, today one of the largest Tribes in California, has a very small land base. The federal government did not establish a reservation specifically for the Karuk (although as indicated above some Karuk are members of the Quartz Valley Rancheria). Most Karuk live in Siskiyou County, primarily in the districts of Orleans, Happy Camp, and Yreka, and in the Forks of the Salmon region. The Karuk Tribe gained federal recognition in the 1980s.

The Klamath River Reserve in traditional Yurok territory was created by Executive Order in 1856; it encompassed a mile of land on each side of the Klamath River from the Pacific Coast to Tectah Creek, approximately 20 miles. The U.S. government established the Reserve with the intent of relocating members of the Yurok, Tolowa, and Hoopa Valley Tribes. However, only the Yurok and a few Tolowa moved. As a result of an 1864 treaty (unratified) with the Hoopa and several other Tribes, the Superintendent of Indian Affairs for the State of California that year announced the location of a new Hoopa Valley Reservation, the boundaries of which were formally defined 13 years later in an Executive Order. This reservation, early on known as "the square" for its shape, was established around the Trinity River from its confluence with the Klamath. In 1891, the Hoopa Indian Reservation was enlarged (again by Executive Order) to include the Yurok Tribe's Klamath River Reserve plus an "extension" covering 1 mile on either side of the Klamath River between the two formerly separate reservations. The following year, the entire newly constituted reservation was opened to non-Indian settlement (following government "allotment" of selected land for Tribal use), resulting in substantial displacement, particularly of members of the Yurok Tribe. Some Yurok eventually settled on the Resighini Rancheria near Klamath, California, a tract of land within the Klamath Reserve acquired by the federal government from rancher Augustus Resighini under the Wheeler-Howard Act of 1934.

In l988, the Hoopa Valley Reservation created in 1891 was partitioned into two: the original Hoopa square (for the Hoopa Valley Tribe), and a reservation for the Yurok that included both the original 1855 reservation at the mouth of the Klamath and the later upriver "extension." Within it lies the Resighini Rancheria, which was federally recognized in 1975 as the Coast Indian Community of the Resighini Rancheria.

3.10.2.4 Prehistoric and Historic Archaeological Resources

Studies of prehistoric and historic archaeological resources at the Lower Klamath Project were conducted by as part of PacifiCorp's original Klamath Hydroelectric Project relicensing studies. These studies included background research, pedestrian field surveys, and the development of statements to assist in National Register evaluations of identified archaeological and historic-era resources, both the Klamath Hydroelectric Project and the Lower Klamath Project. The results were presented in PacifiCorp's final cultural resources technical report (2004b) for the Klamath Hydroelectric Project relicensing and were summarized in its proposed HPMP for that project (PacifiCorp, 2006). While recommendations of National Register eligibility for some identified sites were proposed, no final determinations of eligibility were obtained from the California or Oregon SHPOs.

Because more than 10 years had passed since the preparation of these two documents, in 2017, KRRC conducted an updated record search at the California

Historical Resources Information System's Northeast center at Chico State University and additional literature reviews for the area extending 40 miles along the Klamath River from the Oregon-California state line to Humbug Creek. The section of river below Iron Gate Dam and outside the project boundary was included in the records search since this 18-mile-long area lies within the Federal Emergency Management Agency 100-year floodplain where cultural resources have the potential to be affected following dam removal. The records search area also included a 0.5-mile-wide buffer extending on either side of the shorelines of Copco No. 1 Reservoir and Iron Gate Reservoir, and from the center point of the Klamath River in all other areas. A background literature search of libraries, archives, and the Sacred Lands file held by the California Native American Heritage Commission was also conducted.

The record search indicated that 58 previous studies had been conducted in the record search area, 5 of which were conducted specifically for the Klamath Hydroelectric Project relicensing. Additionally, the study found that 80 previously recorded sites are located within the project APE and/or ADI. Subsequent studies of previously unsurveyed areas undertaken by KRRC and PacifiCorp between 2017 and 2020 identified an additional 13 sites at the project. Recorded sites include 43 precontact sites, 18 sites containing both prehistoric and historic components, and 32 historic-era sites. Updated information about each of these sites was provided in an updated site table filed with the Commission in its May 20, 2021 response to the Commission's request for additional information (KRRC, 2021c, Attachment 3).[176] While two of the sites have been recommended as not eligible for listing on the National Register, all 93 sites remain unevaluated on the grounds that further Phase II investigations would be required to confirm their information potential and eligibility.[177] Table 3.10-1 provides a summary of all sites located within the project APE between the upper reach of J.C. Boyle Reservoir and Humbug Creek.

In addition to field surveys, KRRC conducted bathymetric surveys at J.C. Boyle, Copco, and Iron Gate Reservoirs to identify submerged topographic features at the project reservoirs. The resulting data was correlated with historic landscape, archival information, and GIS studies to identify the potential locations of submerged cultural

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[176] The information provided in this updated table is slightly different from the information provided in KRRC's Draft HPMP filed on February 26, 2021. Our analysis focuses uses the updated information.

[177] The 2006 HPMP indicates that 36 of these sites are recommended as eligible for listing on the National Register, 12 are recommended ineligible, 1 multi-component site contains both eligible and ineligible components, and no recommendations of eligibility are provided for 44 sites. However, because these previous recommendations were provided for an undertaking that was not implemented (relicensing), the California and Oregon SHPOs have not made any formal determinations of eligibility, and these sites remain unevaluated.

resources. Based on this information, 15 additional precontact locations were identified that may correlate with Shasta Indian villages. Previous study of these areas conducted between 1907 and 1927 identified cultural materials including flaked and ground stone tools, rock features, midden deposits, and human remains. Potential sites associated with historic period activities included numerous ranching, lumber industry, community, and transportation sites. While known historic period cemeteries were moved prior to inundations, submerged historic cemetery features may also be present.

To determine if any of the archaeological resources would be affected by the proposed action and are eligible for listing on the National Register, KRRC filed an updated Phase II Research and Testing Plan for the project with its May 20, 2021, response to the Commission's request for additional information (KRRC, 2021m). The Phase II plan was developed in consultation with the California SHPO, the Oregon SHPO, and the Advisory Council and was also provided to the participating Tribes and other members of the Cultural Resources Working Group. In its plan, KRRC identifies 57 potentially affected sites that are either located within the ADI or on lands that would ultimately be transferred to other parties (Parcel B lands). Of the 57 sites, 40 sites would be affected and require Phase II testing to determine National Register eligibility, 5 sites would not be affected but testing protocols were developed if National Register eligibility determinations are ultimately needed, and 2 sites have been recommended ineligible for listing on the National Register. The remaining 10 sites are historic-era resources and eligibility recommendations would be developed through archival research unless research determines that testing is needed. KRRC anticipated that Phase II fieldwork would begin in June 2021 and that a final report containing the results of the work, recommendations of National Register eligibility, and assessment of effects would be filed in February 2022.

During the initial relicensing effort for the Klamath Hydroelectric Project, three potential archaeological districts at project reservoirs were also identified: the Spencer Creek District in the vicinity of J.C. Boyle Reservoir, the Shovel Creek District near Copco Reservoir, and the Fall Creek District near Iron Gate Reservoir (KRRC, 2021n). The Spencer Creek District contains eight prehistoric archaeological sites. The Shovel Creek District contains four prehistoric sites (including one site that contains two loci), and the Fall Creek District contains three sites. While KRRC provides recommendations of each site's potential contribution to the National Register eligibility of its associated district (KRRC, 2021n), as mentioned above, the sites remain unevaluated pending completion of formal Phase II studies and consultation.

3.10.2.5 Historic Buildings and Structures

KRRC completed three historic resources studies within the ADI to determine if the proposed project has the potential to affect structures that are eligible for listing on the National Register. These studies included assessment of hydroelectric system structures, transportation structures, and privately held properties.

The Hydroelectric Resource Study identified five hydroelectric districts within the ADI that are eligible for listing on the National Register. The Klamath River Hydroelectric Project Historic District encompasses seven hydroelectric developments, including the three developments within the Klamath Hydroelectric Project (the Link, Keno, and Fall Creek Developments) and the four developments within the Lower Klamath Project. Each of these four developments also constitute individual historic districts: the J.C. Boyle Hydroelectric Development District, the Copco No. 1 Hydroelectric Development District, the Copco No. 2 Hydroelectric Development District, and the Iron Gate Hydroelectric Development District.

KRRC has recommended that each of the four hydroelectric development districts is individually eligible for listing on the National Register under Criterion A and Criterion C and contributes to the larger Klamath River Hydroelectric Project Historic District under the same criteria. KRRC evaluated 54 individual structures associated with the 4 hydroelectric districts for their National Register eligibility and their contribution to the eligibility of the district. Within each development/district, the dams, water conveyance systems, and powerhouses (12 structures) were recommended to be contributors to the National Register eligibility of their respective districts under Criterion A and Criterion C, and 24 other structures were recommended to contribute under Criterion A only. Eighteen structures were recommended as non-contributing elements of the districts because of compromised integrity issues or because they do not yet meet the 50-year age requirement for historic significance. Within the Iron Gate Hydroelectric Development District, the Fall Creek Hatchery was also evaluated as an individual potential historic district but was recommended as not eligible for listing on the National Register because of its lack of historic integrity. However, all 11 of the structures associated with the Fall Creek Fish Hatchery were recommended as contributing structures to the Iron Gate district.

Table 3.10-2 provides a summary of all structures identified and the four hydroelectric development district and KRRC’s National Register recommendations.

While three bridges were evaluated as part KRRC’s Hydroelectric Resource Study (Timber Bridge, Daggett Road Bridge, Lakeview Road Bridge), KRRC’s Transportation Resource Study identified several additional bridges within the ADI and evaluated them for listing on the National Register. This study also documented culverts and road segments, which included 11 additional bridges and 8 culverts. KRRC recommends that the Dry Creek Bridge contributes to the eligibility of the Iron Gate Hydroelectric Development Historic District. The Klamath River Bridge was recommended eligible for listing on the National Register in 2004, but a new evaluation is pending completion of construction activities. KRRC recommends that additional research is required to fully evaluate the cable suspension Pedestrian Bridge 1, the Central Oregon and Pacific Railroad Bridge, and Pedestrian Bridge 2. KRRC does not recommend the Ash Creek Bridge as eligible for listing on the National Register because it was replaced in 2012; KRRC also does not recommend the Fall Creek Bridge as eligible because it was built in 1969 and does not meet the National Register significance criteria. The remaining five bridges are recommended as ineligible for listing on the National Register because they do not yet meet the 50-year age threshold for eligibility.

Finally, in 2019, KRRC conducted a “windshield” (drive-by) private property study of lands within the APE to determine if any privately held structures in this area could be adversely affected by fluctuating river elevations following project decommissioning. Between Iron Gate Dam and Humbug Creek, the study identified four structures in the Hornbrook area that were built between 1937 and 1971. These include a restaurant, two campground facilities, and a residence. Near the Klamath River community (the area west of Interstate 5), 24 structures built between 1925 and 1975 were identified. These include a number of multi-family properties and single-family residences. In the Copco No. 1 Reservoir area, KRRC identified approximately 50 properties, including residences and recreational properties. Many of these structures may date to as early as 1935, but many were constructed in the late 1960s following construction of the Iron Gate Dam. Several other undocumented structures in the vicinity of Copco No. 1 Reservoir were identified in aerial photographs but were not subject to the windshield survey. KRRC states that it would conduct further survey and research to evaluate the National Register eligibility of these private property resources within the California part of the ADI, specifically commercial, residential, and recreational properties in Hornbrook, Yreka, and Montague (KRRC, 2021n).

3.10.2.6 Traditional Cultural Properties

As a result of the Klamath Hydroelectric Project relicensing proceeding (currently in abeyance), PacifiCorp funded Tribal ethnographic studies prepared by the Klamath, Shasta, Karuk, and Yurok Tribes. These studies combined ethnography with extensive oral interviews to describe each Tribe’s culture and relationship to the Klamath River. Although functioning as Tribe-specific documents, they were also intended to be used in a separate, “integration” report on the importance of the river to the area’s Native Americans as a whole. PacifiCorp submitted these reports to both SHPOs, either as part of the relicense application or in subsequent submissions as the reports were completed.

The Karuk and Yurok ethnographies were, in particular, designed as foundations for the “integration” report. The Karuk Tribe’s report (Salter, 2003) presented a broad discussion of the Tribe’s use of natural resources (flora, fauna, and geological resources) within the Klamath River corridor and the traditional centrality of the river and its resources (particularly salmon) to the Tribe’s subsistence, its material and spiritual culture, and identity. The report used ethnographic and other writings to describe the natural setting and early patterns of Karuk habitation in the river basin. Interviews with Tribal members focused on their own and their recalled use of the river and its resources (water, fish, cultural features, and vegetation).

The Yurok Tribe’s report (Sloan, 2003) also drew upon extensive ethnographical literature in its presentation of this Tribe’s historical relationship to the Klamath River, organized around the topics of natural resources (water, fish, landforms, vegetation), cultural features (ceremonial practices, fishing places, geologic features, gathering, and habitation), and other topics such as transportation, communication, language, and relations with neighboring upriver Tribes.

The Klamath River Inter-Tribal Fish and Water Commission incorporated information from these Tribal studies and information provided by the Hoopa Valley Tribe from a previous study unrelated to the relicensing of the Klamath Hydroelectric Project in a report (King, 2004) focusing on the Klamath River as a cultural "riverscape" eligible for the National Register for its association with the broad patterns of Tribal culture, including environmental stewardship, spiritual and ceremonial tradition and practice, and subsistence. This approach was developed through a "regulatory analysis" prepared by the Yurok Tribal Heritage Preservation Office (Gates, 2003) that classified the riverscape as a form of district (a district being one of the five types of historic properties defined in National Register criteria), specifically an ethnographic/cultural landscape with a river as its focus. Elements contributing to the eligible riverscape, as described in the integration report, include the Klamath River and its associated water and landforms; its "living population" of fish, terrestrial fauna and plants; and specific locations associated with cultural beliefs and/or practices, including but not limited to archaeological sites. The Klamath River Inter-Tribal Fish and Water Commission makes the case that more than 200 miles of the Klamath River corridor from above the project area downriver to the Pacific Ocean constitute a National Register-eligible traditional cultural landscape or riverscape.

The Klamath Tribes' report (Deur, 2003), based largely on oral interviews and site visits on the part of the consultant in company with interviewees, identified 11 "riverine and lacustrine" locations (including settlements and fishing stations) associated with the Tribes' historical, cultural, and economic reliance on salmonid fisheries as TCPs meeting National Historic Register eligibility criteria. Link River, Big Bend, and Miller Island Oxbow were locations of major settlements and associated burial and ceremonial sites, as well as numerous encampments and fishing sites. The latter was also an important center for wocas (yellow pond lily) seed collection. The other eight TCPs lie farther upriver on the headwaters: (1) Chiloquin Forks; (2) Braymill/Cave Mountain; (3) Beatty Springs; (4) Knapp's Dam/Williamson River Canyon; (5) the mouth of the Wood River; (6) Klamath March/Wocus Bay; (7) Olene Gap; and (8) Rocky Ford/Jackson Creek. The first five sites were all traditional salmonid fishing sites. The last three locations were of importance to Klamath subsistence and culture, as gathering sites (particularly Klamath Marsh), and camp sites for hunting and trout fishing.

The report from the Shasta Nation (Daniels, 2006)[178] combines ethnographic research, records of interviews with Shasta elders from the 1980s, interviews with Shasta people from 2002-2003, and archaeological data. It describes the role of the Klamath

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[178] This report was filed with the Commission in February 2007, after issuance of the draft EIS.

drainage in Shasta culture and the changes to traditional hunting, fishing, gathering and ceremonial practices that result from Shasta contact with Euroamericans. The report presents a list of Shasta village sites recorded in ethnographic literature, a much larger list of locations (with and without archaeological manifestations) that the Shasta consider TCPs, and a third enumeration drawn from the first two that lists 11 locations eligible for the National Register. Among these locations are village and camp sites, places associated with ceremonial practices, and the Frain Ranch area, where many Shasta gathered in the late 19th century. Nine of the 11 eligible TCPs have archaeological manifestations.

In its May 20, 2021, response to the Commission's request for additional information, KRRC states that while the TCP studies mentioned above were completed as part of PacifiCorp's relicensing effort, some participating Tribes have provided input on the ethnographic summaries, but others have not. Specific details regarding identified TCPs are privileged information and are not provided in this EIS.[179] Additionally, not all the Tribes have agreed that the resulting reports were ready to be submitted to the California SHPO and Oregon SHPO for review. KRRC explained in its response that an additional request for information regarding the ethnographic summaries and the identification of TCPs was being prepared and explained that it would send letters to the Tribes in May 2021 to determine if the Tribes were amenable to SHPO submittal and consultation.

3.10.3 Effects of the Proposed Action

The proposed surrender of the project would end the Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and TCPs that are located within the APE and would remove these resources from the federal protection afforded by NHPA. Historic hydroelectric structures at the J.C. Boyle, Copco Nos. 1 and 2, and Iron Gate Developments would be adversely affected by demolition or by abandonment. Archaeological sites on shorelines may be affected by the removal of project dams and currently inundated sites may be revealed that could be susceptible to damage, both from authorized recreational activities and from illegal "pothunting" (removal of artifacts) along the shorelines. Although many recreation-related effects on archaeological resources may be inadvertent, vandalism and unauthorized artifact collection are also associated with public use. Additionally, archaeological sites are susceptible to disturbance from grazing, excavation of irrigation canals, and construction of agricultural and project-related access roads. TCPs at the project could also be adversely affected for the same reasons; however, dam removal is expected to benefit TCPs and areas of

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[179] As specified in 36 C.F.R. 800.11(c), Section 304 of the NHPA allows the head of a federal agency to withhold from public disclosure information about the location, character, or ownership of a historic property when disclosure may cause a significant invasion of privacy, risk harm to the historic property, or impede the use of a traditional religious site by practitioners.

traditional importance to Tribes through the reintroduction of salmon runs to the Lower Klamath Project area. These potential effects on cultural resources are described in more detail below.

3.10.3.1 Effects of Project Deconstruction Activities on Archaeological Resources

KRRC has indicated that deconstruction of the Lower Klamath Project facilities could affect archaeological resources that are eligible for listing in the National Register in several ways. For many eligible sites within the project APE, these effects would be significant and unavoidable. Other sites would see no significant effects or effects would be less than significant with appropriate mitigation. Under section 106 of the NHPA and its implementing regulations found at 36 C.F.R. 800.5, potential adverse effects include the following (KRRC, 2021n):

- Slope instability related to the reservoir drawdown;
- Burial and/or erosion of sites caused by the reservoir drawdown;
- Disturbance or destruction and removal caused by construction;
- Impacts to inadvertent discoveries that may be encountered as a result of ground-disturbing construction;
- An increase in susceptibility to intentional looting and vandalism or unintentional disturbances as sites may be exposed or areas opened to public access in non-designated areas (i.e., off-road vehicle use, camping, latrines);
- A change in ranching and livestock operations and fences: and
- Visual changes to the setting once the reservoirs are no longer present, which could affect resources for which the reservoir setting has been of cultural significance since they were constructed beginning in the early 1900s.

Additionally, under 36 C.F.R. 800.5(2)(vii), absent agreements in place to ensure their long-term protection, sites located on Parcel B lands would be affected by the transfer of these properties to non-federal entities, resulting in unpredictable disposition, use, and management of these lands. These transfers could result in long-term, significant, adverse effects on sites that are eligible for listing on the National Register.

As noted above, KRRC has identified 93 archaeological sites and 3 potential archaeological districts within the Lower Klamath Project APE. In a table filed in response to the Commission’s request for additional information (KRRC, 2021c), KRRC indicates that 47 of the sites would not be affected by the proposed decommissioning and removal of project facilities (effects would be less than significant), and 46 sites would see a variety of project-related effects, including some sites that would experience multiple kinds of effects. Some of these effects would be adverse (significant and unavoidable). Table 3.10-3 identifies the anticipated project-related effects on these archaeological resources. This table also indicates Commission staff's preliminary opinion regarding whether potential effects could be short term, long term, or permanent. Final determinations of effect would be determined by the Oregon and California SHPOs.

KRRC's pending Phase II archaeological studies would result in additional recommendations of National Register eligibility and assessments of effects on all these potentially affected sites. Under section 106 of the NHPA, no further consideration of effects on sites that are determined to be ineligible for listing on the National Register by the California SHPO, Oregon SHPO, and the Commission would be required.

3.10.3.2 Effects of Project Deconstruction Activities on Historic Buildings and Structures

The J.C. Boyle. Copco No. 1, Copco No. 2, and Iron Gate hydroelectric developments that make up the Lower Klamath Project are components of the Klamath River Hydroelectric Project Historic District, a district that is eligible for listing on the National Register. The decommissioning and removal of the structures associated with the Lower Klamath Project would adversely affect the district's overall integrity of design, setting, materials, workmanship, feeling, and association. Should the California SHPO concur with this recommendation, these effects would be significant and permanent.

Additionally, the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate hydroelectric developments at the Lower Klamath Project have also been recommended as individual historic districts that are eligible for listing on the National Register. KRRC has also recommended that each of these four districts would be adversely affected by the decommissioning and removal of project facilities. These effects would also be significant and permanent.

KRRC's Transportation Resource Study identifies 20 structures located within the Lower Klamath River ADI. Only one of these structures, the Dry Creek Bridge, is located within and contributes to the National Register eligibility of one of the five districts mentioned above. It is also locally significant under Criterion A. Improvements to the Dry Creek Bridge include the installation of a temporary single-span overlay bridge span proposed to meet construction load requirements. This work would result in a direct adverse effect on this historic structure that would be significant and permanent. Additionally, table 4-7 of the draft HPMP also indicates that further research is needed to determine if the Klamath River Bridge, Pedestrian Bridge 1, Pedestrian Bridge 2, and the Central Oregon and Pacific Railroad Bridge are eligible for listing on the National Register and would be affected by the project.

The potential effects of the proposed decommissioning and removal of Lower Klamath River facilities on other potential historic structures, including numerous privately held resources identified during KRRC's "windshield survey," are unknown. KRRC proposes to conduct further assessment of structures identified during the windshield survey, and if project-related effects are identified, KRRC would then develop appropriate mitigation measures in accordance with section 106.

3.10.3.3 Effects of Project Deconstruction Activities on Traditional Cultural Properties

KRRC has not yet completed the identification and evaluation of effects on TCPs located within the Lower Klamath River APE and/or ADI. This evaluation would include potential project-related effects on the Klamath River Cultural Riverscape. Consultation with participating Tribes is pending, including their input and review of the ethnographic reports.

3.10.3.4 Management of Historic Properties

Decommissioning and removing the Lower Klamath Project facilities could adversely affect cultural resources listed or eligible for inclusion in the National Register. KRRC proposes to manage effects on historic properties by implementing a Historic Properties Management Plan (HPMP) for the project. The purpose of the HPMP is to resolve (i.e., avoid, minimize, or mitigate) existing or potential project-related adverse effects on historic properties within the Lower Klamath Project APE. KRRC filed a draft HPMP for the Lower Klamath Project with its amended surrender application on February 26, 2021. The draft HPMP was prepared in accordance with the Advisory Council's and Commission's Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects (Advisory Council and Commission, 2002). The draft HPMP provides a background of the project, identifies potentially affected cultural resources (both archaeological and built environment), discusses the types of adverse effects that might be expected, and includes a discussion of potential measures to address these effects. KRRC provided updated information related to the draft HPMP with its updated site table filed on May 20, 2021.

The draft HPMP also addresses four cultural resources mitigation measures identified by the California Water Board in its April 9, 2020, EIR (California Water Board, 2020a). These mitigation measures include:

- TCR-1 – Develop and Implement HPMP/Tribal Cultural Resources Management Plan
- TCR-2 – Develop and Implement a Looting and Vandalism Prevention Program
- TCR-3 – Develop and Implement an Inadvertent Discovery Plan
- TCR-4 – Provide Endowment for Post-Project Implementation

Management of Archaeological Sites and Districts

In the draft HPMP, KRRC proposes both general and specific management measures for the protection of archaeological resources. General measures include but are not limited to plans for: (1) additional surveys following reservoir drawdown; (2) archaeological monitoring during construction and site condition monitoring; (3) the unanticipated discovery of archaeological materials; (4) the unanticipated discovery of human remains; (5) response to episodes of looting and/or site vandalism; (6) curation of recovered artifacts; (7) coordination with local law enforcement and agency training opportunities; (8) public education; (9) a culturally significant plan enhancement program; (10) and endowments for a Tribal Stewardship Program, a University Study Scholarship Program, and a Recreation Education Program.

Measures for the specific treatment of adversely affected archaeological sites is pending completion of the Phase II studies, National Register evaluations, and determination of effects. However, the HPMP includes a discussion of the kinds of treatment that could be suitable to avoid, minimize, or mitigate various adverse effects. These measures include but are not limited to (1) detailed mapping and photography; (2) additional archival research; (3) public access restrictions; (4) strategic routing of road, recreation sites, and livestock operations; (5) strategic plantings and signage; (6) installation of erosion control materials; (7) capping and armoring of archaeological sites; and (8) data recovery; and other forms of mitigation. Following completion of the Phase II report, specific treatment measures for each site that has been determined to be eligible for listing in the National Register would be developed in consultation with the California and Oregon SHPOs, the Commission, and other appropriate agencies and Tribes.

During scoping for this project, many commenters noted that inundated archaeological resources may be exposed following the drawdown of project reservoirs. In comments filed on August 19, 2021, BLM recommended that electronic surveillance and exclusion barriers might be used in the vicinity of vulnerable resources to curtail vandalism, looting, and off-road vehicle use until vegetative restoration has been completed. Appendix D of the draft HPMP provides a Looting and Vandalism Plan. In this plan, KRRC acknowledges that sites that are exposed during reservoir drawdown would be most susceptible to illicit and unauthorized activities. The plan calls for coordination with local law enforcement for crimes occurring on privately held lands. Additionally, a public education program would be developed that informs visitors of the site protection. While no electronic surveillance as recommended by the BLM is proposed, the plan calls for the restriction of public access during the drawdown and dam removal process. Security measures would also include the on-site presence of security personnel during drawdown and decommissioning. Finally, regular site condition monitoring would be conducted to document instances of looting and vandalism. This monitoring would inform the KRRC regarding appropriate site treatment measures including but not limited to (1) installation of fences, barriers, and gates; (2) strategic routing of access roads; (3) strategic routing of recreation sites; (4) strategic plantings; (5) installation of signage; and (6) capping of resources.

Management of Built Resources

In its draft HPMP, KRRC proposes to prepare Historic American Building Survey/Historic American Engineering Record/Historic American Landscapes Survey documentation to mitigate the adverse effects of the proposed decommissioning on historic hydroelectric structures that are eligible or listed on the National Register. This would include documentation of the five National Register-eligible historic hydroelectric system districts. This documentation would be completed prior to removal of the hydroelectric structures. Additionally, KRRC proposes to prepare a marketing plan for potential adaptive reuse of the historic Copco No. 2 Powerhouse, Fall Creek School, and 12 operator residences. This plan would be developed in consultation with consulting parties and would define KRRC's terms under which these structures would be sold to others. If KRRC does not receive any offers from qualified buyers for adaptive reuse, KRRC would then consider long-term leases or donation of the building. If no such transactions are forthcoming, KRRC would, in consultation with the SHPOs, remove these buildings or transfer them to others without further consideration of historic stewardship. Finally, KRRC proposes to develop and implement an interpretive plan in consultation with the SHPOs, Tribes, local historical societies, museums, preservation organizations, and others that would provide information about the history of hydroelectric power and fish management in the area. The interpretive plan would also evaluate the suitability of the Fall Creek Hatchery as a location for interpretive materials and would include mitigation of effects on the Dry Creek Bridge.

In its draft HPMP, KRRC proposes to conduct further research, survey, and evaluation of privately held structures within the ADI, particularly in the areas of Hornbrook, Yreka, and Montague. However, the draft HPMP acknowledges that as private properties, KRRC does not have control over these resources. Should it be determined that the proposed project would adversely affect any of these resources, KRRC would propose appropriate mitigation measures.

Management of Traditional Cultural Properties

The TCP reports for the Lower Klamath Project have not yet been completed, and specific project-related effects on TCPs within the APE and ADI have not yet been identified. For this reason, KRRC's draft HPMP does not include any proposed treatment measures for these resources. Identification of appropriate measures for eligible TCPs would be developed in consultation with the California SHPO, Oregon SHPO, and participating Tribes following the completion of the TCP report. In its comments filed on August 19, 2021, Interior states that a Tribal perspective on resource effects should also be addressed (see appendix K, *Summary of Tribal Views on Dam Removal*). As mentioned above, in its draft HPMP, KRRC proposes to develop two programs that would benefit the Tribes. Areas used by Tribes over time to gather culturally important plant resources may constitute a form of TCP. KRRC proposes to develop a culturally significant plant enhancement program as part of the Restoration Plan's Vegetation Management Plan. This plan would incorporate significant native plant species in revegetation projects and would provide Tribal members with opportunities to help in maintaining native plants in selected locations. Additionally, a Tribal Stewardship Program may be implemented that would facilitate Tribal access to Parcel B lands for traditional purposes for the duration of KRRC's ownership of these properties. Following the transfer of these lands to other parties, access would be coordinated with the new landowner(s).

Memorandum of Agreement

On March 22, 2021, KRRC filed with the Commission a draft Memorandum of Agreement (MOA) between the Commission, California SHPO, and Oregon SHPO with the Commission. Stipulation I(A) of the MOA calls for KRRC to implement the final HPMP and all its requirements upon the Commission's issuance of a license surrender order. The MOA also provides for coordination with other federal agencies, dispute resolutions, amendments to the agreement, termination of the agreement, and other stipulations.

Commission staff requested the California and Oregon SHPOs provide comments on the draft MOA within 45 days of the date of the December 1, 2021, letter. In addition, Commission staff requested any preliminary comments regarding the draft HPMP, as well as the Historic Built Environment Report. In a letter filed on January 14, 2022, the California SHPO provided comments on the draft MOA and the draft HPMP. In its comments on the MOA, the California SHPO stated that the MOA does not include needed components and that because the identification and evaluation of historic properties and assessment of effects cannot be completed until the removal of project facilities is underway, effects cannot be determined. The California SHPO instead suggested that a programmatic agreement executed under 36 C.F.R. 800.14(b)(1)(ii) would be more appropriate. A programmatic agreement is a type of agreement document that is typically executed when the effects of an activity on historic properties cannot be determined prior to approval of the activity. In correspondence filed on January 24, 2022, the Oregon SHPO provided its comments on the draft MOA and draft HPMP. Commission staff is currently reviewing the California and Oregon SHPO comments. As appropriate, the Commission will respond to the comments or will direct KRRC to address the comments in the updated HPMP.

Our Analysis

KRRC's proposal to remove the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate hydroelectric facilities would result in adverse effects on historic properties. Some of these effects would be significant and permanent. KRRC's draft HPMP to resolve effects provides general measures that are consistent with the Advisory Council and Commission's 2002 guidelines. These measures include, but are not limited to: (a) treatment measures such as documentation of historic structures (Historic American Building Survey/Historic American Engineering Record), public access restrictions, capping/armoring, and data recovery in situations where non-intrusive protective measures cannot be implemented; (b) provisions for additional surveys; (c) implementation of a Monitoring and Inadvertent Discovery Plan (appendix C) that includes the participation of Tribal advisors accompanying cultural resources monitors and archaeological teams during fieldwork; (d) treatment of human remain discoveries; (e) implementation of a Looting and Vandalism Prevention Plan (HPMP appendix D) (f) coordination with law enforcement; (g) curation of recovered artifacts; (h) implementation of a public education program; (i) implementation of a culturally significant plant enhancement program; (j) employee training; and (k) additional reporting and consultation. We agree that for the most part, these measures are adequate to address the adverse effects expected from the decommissioning and removal of Lower Klamath Project on historic properties. However, further revision of the draft HPMP is needed to provide additional clarification and to address several outstanding items.

3.10.4 Effects of the Proposed Action with Staff Modifications

Because this alternative does not deviate from the proposed reservoir drawdown/dam removal associated with the proposed action, project-related effects on cultural resources in the project's APE would be the same as those discussed for the proposed action with the exceptions discussed below for the HPMP. The proposed action is to implement the draft HPMP, and the proposed action with staff modifications is to implement the draft HPMP and address the deficiencies in the draft HPMP identified by Commission staff and discussed below.

Further revision or a supplement to the HPMP is needed to clarify and address several outstanding items. These items include but are not limited to (1) the results of Phase II archaeological studies; (2) the results of additional surveys and pending evaluations of historic structures; (3) the results of the pending TCP studies and Tribal consultation; and (4) the identification of specific effects on all historic properties and resource-specific measures to resolve effects determined to be adverse. The draft HPMP currently contains "placeholders" for this necessary information. As mentioned above, by letter filed on September 28, 2021, the Commission transmitted the draft HPMP to the California and Oregon SHPOs for review and comment. Implementing a revised HPMP that contains all outstanding information, including but not limited to National Register evaluations, identification of specific effects on historic properties, and resource-specific measures to resolve effects determined to be adverse, would ensure that the HPMP contains all appropriate information required under section 106. Final provisions in the revised HPMP for resolving adverse effects on historic properties would be developed in consultation with the California and Oregon SHPOs, participating Tribes, and other appropriate agencies and organizations.

In addition to including the outstanding information in the revised HPMP, Commission staff has identified several other items that require some clarification. These are discussed below.

3.10.4.1 Archaeological Sites and Districts

KRRC's proposal would result in significant effects on archaeological sites within the APE that are eligible for listing on the National Register. Some of these effects would be less than significant and/or short-term and others would be significant and permanent. As discussed above, the KRRC's Phase II Archaeological Research Design and Testing Plan (KRRC, 2021m) identifies 57 potentially affected sites within the ADI or on Parcel B lands. Of these, 40 sites were evaluated in summer 2021 to determine their eligibility for listing on the National Register. However, in a separate table that was filed with the plan and in response to the Commission's request for additional information, seven sites are identified as requiring National Register evaluation that are not included in the Phase II plan (CA-SIS-3917, CA-SIS-3935, CA-SIS-3936, CA-SIS-3943, CA-SIS-3944, LKP-2019-04, LKP-2019-05). Additionally, the response table indicates that four sites (35KL1044, 35KL2397, CA-SIS-1670, CA-SIS-3928) do not require evaluation, but these sites are included in the Phase II plan. Inclusion of the status and rationale behind the selection or lack of selection of these sites in the pending Phase II report or in the revised HPMP would provide clarity.

In section 3.2.1 of the draft HPMP, KRRC states that that there are three potential archaeological districts within the project APE, but only one district, the proposed Fall Creek District at Iron Gate Reservoir (containing three archaeological sites), is located within the ADI (KRRC, 2021n). However, according to the updated site table filed with its May 20, 2021, response to the Commission's request for additional information (KRRC, 2021c, attachment 3), all eight sites within the proposed Spencer Creek District at J.C. Boyle Reservoir are also located within the ADI. Further, none of the five sites identified as within the Shovel Creek District are listed in the updated table, although all four are identified as being in the Copco Reservoir area. Finally, two of the sites identified by KRRC as being associated with the Spencer Creek District (35KL2430, 35KL2397) at J.C. Boyle Reservoir, are identified in the updated site table as located at the Iron Gate and Copco Reservoirs, respectively. Clarification in the HPMP of the locations of all three districts relative to the APE and ADI and the sites that contribute to them would ensure that the HPMP contains accurate information about these resources.

Built Environment Resources

KRRC's proposal would result in significant, permanent, adverse effects on historic structures located in the APE. In comments filed on August 19, 2021, Siskiyou County states that the Commission's analysis of the effects of the decommissioning and removal of project facilities should include a formal determination of National Register eligibility of the proposed Klamath River Hydroelectric Project District. As discussed above, KRRC evaluated this district and four other hydroelectric system historic districts (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) and one potential district associated with the Fall Creek Hatchery. All five hydroelectric districts were recommended as eligible for listing on the National Register, and the Fall Creek Hatchery district was recommended as ineligible for listing. According to the draft HPMP, in

September 2003, PacifiCorp documented the overall Klamath River Hydroelectric Project Historic District (Durio, 2003). This analysis identified the Copco No. 1, Copco No. 2, and J.C. Boyle complexes as contributing to the larger Klamath River Hydroelectric Project District and recommended that the Iron Gate Development and the Iron Gate Fish Hatchery were non-contributing. According to KRRC, the Oregon SHPO concurred with the eligibility determinations related to J.C. Boyle complex, but the California SHPO did not provide concurrence for the eligibility determinations related to Copco No. 1, Copco No. 2, and the Iron Gate complexes, or for the Fall Creek Hatchery. We agree with Siskiyou County and recommend that inclusion in the revised HPMP of the California and Oregon SHPOs' final determinations of eligibility regarding the Klamath River Hydroelectric Project District, as well as for the four Lower Klamath Project hydroelectric system districts and the Fall Creek Hatchery district, would ensure compliance with section 106 and ensure that the HPMP contains updated information.

In section 6.3 of its draft HPMP, KRRC indicates that the only transportation resource that is eligible for listing on the National Register is the Dry Creek Bridge, which is located outside the five historic hydroelectric system districts. However, this information is contradictory to table 4-7 of the draft HPMP that indicates that the Dry Creek Bridge contributes to the eligibility of the proposed Iron Gate Hydroelectric Development Historic District. We recommend including the contributory status of this bridge in the revised HPMP to provide clarification. Additionally, table 4-7 of the draft HPMP also indicates that additional research is needed to determine if the Klamath River Bridge, Pedestrian Bridge 1, the Central Oregon and Pacific Railroad Bridge, and Pedestrian Bridge 2 are eligible for listing on the National Register. The remaining five bridges and eight culverts are recommended as ineligible. We recommend including the final eligibility determinations for all transportation structures in the revised HPMP to ensure that the HPMP contains current information.

Finally, section 6.4 of the draft HPMP indicates that KRRC intends to complete additional research and a field survey of historic structures located on private property within the ADI, but no schedule for completion of this task is provided. We recommend including a plan and schedule to undertake this additional work in the revised HPMP.

Inadvertent Discoveries

KRRC's Reservoir Area Management Plan (RAMP) calls for KRRC to identify areas of cultural sensitivity prior to drawdowns to ensure that machinery does not disturb these areas. Section 5.3.1 of the HPMP (Pre-Drawdown) clarifies that prior to construction, KRRC would visit each historic property to document baseline conditions, establish photographic points, and install survey monuments and/or inclinometers for historic properties subject to potential erosion. Additionally, section 5.3.2, and 8.1 of the HPMP call for additional post-drawdown inspection of at-risk sites and complete systematic surveys of previously inundated areas. However, field conditions during and following drawdown would not likely allow for such surveys to be conducted before grading is conducted in areas that are covered by depositional reservoir sediments.

To ensure that historic properties are properly protected, we recommend that the RAMP be modified to incorporate the pre- and post-drawdown requirements for cultural resources inspections, surveys, evaluations, mitigation, and management as specified in the HPMP. Additionally, should ground conditions permit access for depositional sediment grading during reservoir drawdown, the RAMP should include provisions for a cultural monitor to be present to ensure that if any cultural resources are identified on the historical pre-dam ground surface, grading would stop, and the measures outlined in appendix C, section 7.1 of the HPMP (Monitoring and Inadvertent Discovery Plan, Procedures) are closely followed within 48 hours. These protocols include, but are not limited to: (1) notifying the team supervisor of any discovery of cultural or archaeological resources, (2) suspending work within 100 feet of the find in all non-dewatering situations, (3) completing an initial assessment of the discovery, (4) notifying the Commission, SHPO, and participating Tribes of the find, and (5) consulting with these entities to determine and implement agreed-upon treatment measures for discoveries that are potentially eligible for listing on the National Register.

3.10.4.2 Traditional Cultural Properties

Since consultation with participating Tribes and the TCP studies is not yet complete, Commission staff is not yet able to analyze the effects of the proposed decommissioning and removal of Lower Klamath Project facilities. However, while salmon do not constitute a TCP (i.e., a property that is eligible for listing on the National Register), many scoping comments were received noting that restoration of salmon runs and improvement in water quality are of great cultural importance to the Tribal communities residing along the Lower Klamath River. As summarized in appendix K, *Summary of Tribal Views on Dam Removal*, the Hoopa Valley Tribe, the Karuk Tribe, the Yurok Tribe, Resighini Rancheria, and the Klamath Tribes have expressed support for the decommissioning and removal of the Lower Klamath Project facilities because doing so would improve the health of the river and bring it closer to its pre-project condition.

3.10.4.3 Memorandum of Agreement

Commission staff agrees with the California SHPO that the execution of a programmatic agreement for the Lower Klamath Project under section 106 of the NHPA and its implementing regulations found at 36 C.F.R. 800.14(b)(1)(ii) would be more appropriate than the execution of an MOA. To meet the requirements of section 106, the Commission intends to execute a programmatic agreement between the Commission and the California and Oregon SHPOs for the protection of historic properties from the effects of the decommissioning and removal of Lower Klamath Project facilities. The terms of the agreement would ensure that KRRC addresses and treats all historic properties identified within each project APE by implementing a revised HPMP for the project.

3.10.5 Effects of the No-action Alternative

The current license for the four lower Klamath dams does not contain any specific requirements for the management of historic properties located within the project boundary. Under the no-action alternative, management of cultural resources would not change compared to current conditions. Historical districts would remain intact and cultural resources would not be affected by exposure through reservoir drawdowns, ground-disturbing activities, looting, and vandalism.

Table 3.10-1. Archaeological resources identified within the Lower Klamath Project APE (Source: adapted from KRRC, 2021n)

	Site Type			
Development/Area	**Precontact**	**Multi-component**	**Historic**	**Total**
J.C. Boyle	16	5	2	**23**
Copco Nos. 1 and 2	11	3	11	**25**
Iron Gate	7	7	11	**25**
Iron Gate to Humbug Creek	9	3	8	**20**
Total	**43**	**18**	**32**	**93**

Table 3.10-2. Number of structures within each of the Lower Klamath Project Hydroelectric Development districts and National Register recommendations (Source: adapted from KRRC, 2021n)

	Hydroelectric Development District				
National Register Recommendation	**J.C. Boyle**	**Copco No. 1**	**Copco No. 2**	**Iron Gate**	**Total**
Eligible as Contributor to District under Criteria A and C	3	3	3	3	12
Eligible as Contributor to District under Criterion A	1	3	7	13	24
Non-contributing - Lack of Historic Integrity	2	0	1	0	3
Non-contributing - Outside Period of Significance	6	0	6	3	15
Total Number of Structures	**12**	**6**	**17**	**19**	**54**

Table 3.10-3. Number and type of archaeological sites potentially affected by the proposed project (Source: staff, adapted from KRRC, 2021n)

Project Effects	**Prehistoric**	**Multi-component**	**Historic**	**Total Number of Sites**
None (from current undertaking)	20	5	22	47
Looting (long-term effect)	21	11	0	32
Reservoir drawdown (long-term effect)	19	8	0	27
Increased public access (long-term effect)	13	7	0	20
Access route improvement (short-term effect)	5	5	7	17
Habitat restoration (short-term effect)	6	6	0	12
Transmission line and/or pole removal (short-term effect)	0	2	7	9
Staging or stockpiling (short-term effect)	3	2	1	6
Security and/or silt fence (short-term effect)	2	0	1	3
City of Yreka pipeline relocation (short-term effect)	0	2	0	2
Hatchery improvement (short-term effect)	0	1	1	2
Near recreational use or development (long-term effect)	0	1	0	1
Disposal site (short-term effect)	1	0	0	1
Near facility removal (short-term effect)	1	0	0	1

3.11 TRIBAL TRUST RESPONSIBILITIES

The United States "has charged itself with moral obligations of the highest responsibility and trust" toward Indian Tribes.[180] Federal trust responsibilities include legal requirements to protect Tribal treaty rights, lands, assets, and resources, as well as requirements to implement the mandates of federal law regarding American Indian and Alaska Native Tribes and villages. Tribal trust resources include rights, property, assets, or interests protected by treaties, statutes, and executive orders. Tribes may have reserved rights to use resources, such as water and fish, and those rights are protected. The federal government has a trust responsibility to ensure that Tribal fishing and water rights, as determined by treaties, court actions, or other federal decisions, are not diminished. Other resources may also be equally important to the Tribes for traditional, subsistence, or economic purposes.

The relationship between the federal government and federally recognized Tribes is one between two sovereigns. This "government-to-government" relationship is provided for in the United States Constitution and executive orders, including Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments* (November 6, 2000).[181]

Consistent with the Commission's Policy Statement on Consultation with Indian Tribes in Commission Proceedings (Policy Statement),[182] the Commission has a trust responsibility to Tribes and endeavors to work with Tribes on a government-to-government basis to address the effects of proposed projects on Tribal rights and resources, through consultation pursuant to the statutes it administers and in its environmental and decisional documents. Since October 2017, Commission staff has consulted with participating Tribes regarding their concerns about Indian treaty rights, trust resources, and effects of the proposed action (see sections 1.5, *Tribal Consultation*, and 3.10.2.1, *Definition of Cultural Resources, Historic Properties, Effects, and Area of Potential Effect*).

3.11.1 Affected Environment

3.11.1.1 Tribal Nations

There are no reserved Tribal lands within the project's area of direct impact, which we define as a 5-mile radius around the project boundary, and a linear distance

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[180] *Seminole Nation v. United States*, 316 U.S. 310 (1942).

[181] As an independent regulatory agency, the Commission is encouraged but not required to comply with this Executive Order.

[182] Order No. 635, 104 FERC ¶ 61,108 (2003). The Policy Statement is codified at 18 C.F.R. 2.1c.

downstream from the project facilities to the confluence with Humbug Creek and 1-mile radius buffer zone from the Klamath River's downstream shoreline (see figure 3.11-1).

Three presidential executive orders, issued in 1856, 1876, and 1891, secured the rights of the Hoopa Valley and Yurok Tribes. These rights were confirmed in the 1988 Hoopa-Yurok Settlement Act (25 U.S.C. § 1300i *et seq*.). Consisting of almost 90,000 acres, the Hoopa Valley Reservation is located on the Trinity River at its confluence with the Klamath River. In 1864, the Hoopa Valley Tribe chose the location of the Hoopa Valley Reservation due to its proximity to sufficient resources. This included the ability to maintain a living based on fishing.[183] Fish migrating to the Trinity River must pass through 42 miles of the Lower Klamath River and may be affected by Klamath River conditions. The Hoopa Valley Tribe operates a small commercial fishery program on the Trinity River and has witnessed a decrease in the Chinook salmon, steelhead, and coho salmon runs in the river (Interior and California DFG, 2012).

The Yurok Reservation is located on both sides of the Klamath River from the Hoopa Valley Reservation to the Pacific Ocean. The Yurok Tribe is the largest Tribe in California and its Reservation encompasses approximately 57,000 acres. Like the Hoopa Valley Reservation, the location of the Yurok Reservation was selected to allow the Tribe to continue to rely on fishing as a primary subsistence activity.[184] Federal and state courts have long recognized the rights of the Hoopa Valley and Yurok Tribes to use of the fish and waters of the Klamath River for commercial, subsistence, and ceremonial purposes.[185] As discussed in section 3.4.3.9, *Effects on Commercial, Recreational, and Tribal Fisheries*, in 1993, the Department of the Interior reserved 50 percent of the salmon in the Klamath and Trinity Rivers for the Hoopa Valley and Yurok Tribes.[186] Rights to waters of the Klamath River have also been recognized for both Tribes. Additionally, in 1997, the Department of the Interior's Regional Solicitors for the Pacific Southwest and Pacific Northwest Regions determined that the Tribes "hold adjudicated water right which vested at the latest in 1891 and perhaps as early as 1855."[187]

In 1864, a Treaty with the United States allocated approximately 800,000 acres of reservation lands adjacent to Upper Klamath Lake and its tributaries to the relocated surviving Klamath, Modoc, and Yahooskin, today together known as "The Klamath

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[183] Hoopa Valley Tribe February 26, 2021, Motion to Intervene.

[184] Yurok Tribe February 12, 2021, Motion to Intervene.

[185] *See Baley v. United States*, 134 Fed. Cl. 619 (2017), *aff'd* 942 F.3d 1312 (Fed. Cir. 2019) (Tribes' reserved water rights were senior to those of irrigators, and Reclamation's temporary termination of water deliveries to farmers to preserve fish habitat of ESA-listed fish and comply with federal government's trust obligations to Tribes was not a prohibited Fifth Amendment taking).

[186] *Baley*, 134 Fed. Cl. at 134.

[187] *Id*. at 634.

Tribes." The Treaty guaranteed these Tribes the exclusive right to fish in the streams and lakes included in the reservation. Courts later determined that the Tribes' water rights should be sufficient to support the "populations of fish and wildlife on which those Treaty rights depend" and "necessarily carry a priority date of time immemorial."[188] In 1954, Congress passed the Klamath Termination Act that terminated the reservation and the Tribe's government-recognized status.[189] However, the Act provided that the fishing and water rights of the Tribes would be retained, and the Tribes were later restored as a federally recognized Tribe on August 27, 1986. [190] Additionally, the Klamath Tribes reiterate that they also retain Treaty-reserved hunting, fishing, and gathering rights along the Klamath River.

The Karuk Tribe has one of the largest Tribal memberships in California. However, the 1851 Treaty between the United States and the Karuk Tribe was never ratified by Congress, and no reservation lands were set aside for the Tribe. Nonetheless, the Tribe was federally recognized by the Bureau of Indian Affairs in 1980. Recently, the United States took additional lands into trust for the Tribe in Siskiyou and Humboldt Counties, California. Most of Tribe's aboriginal lands along the Klamath River are part of the Klamath National Forest, and the Tribe's water and fishing rights to the river have not been established.[191]

The members of the Quartz Valley Indian Community of the Quartz Valley Reservation of California, located on the Scott River, a tributary to the Klamath River, do not rely on water from the Klamath River and do not have reserved water rights for the river.[192] Although the Tribe has an interest in the health of the river and in the fish that it provides, the Tribe does not have any current reserved rights to the Klamath River fishery and waters.

The Resighini Rancheria is located in Del Norte County, California. Consisting of approximately 239 acres purchased by the Secretary of the Interior in 1938 under the Wheeler-Howard Act of 1934, the Resighini Rancheria Reservation is situated on the banks of the Klamath River but is surrounded by the Yurok Reservation. Although the

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[188] *Baley*, 134 Fed. Cl. at 633, citing *United States v. Adair*, 723 F.2d 1394, 1414 (9th Cir. 1983).

[189] P.L. 99-398 (1986).

[190] 69 Stat 718 codified at 25 U.S.C. § § 564-564w (1976).

[191] On June 26, 2020, the Karuk Tribe was granted treatment in a manner similar to a state. However, no Karuk Tribe water quality standards are in effect for Clean Water Act purposes.

[192] Decision Document for EPA's Approval of Quartz Valley Indian Community of the Quartz Valley Reservation of CA for Treatment in a Similar Manner as a State Under CWA Section 518 for Purposes of the Water Quality Standards and Certification Programs under CWA Sections 303(c) and 401.

lands were originally intended for agricultural use, today, the Resighini Rancheria Reservation serves numerous purposes for Tribal members. According to Interior and California DFG (2012), the Tribe has reserved groundwater rights for present and future use and rights to real property and to mineral extraction.

3.11.1.2 Tribal Economies

According to recent U.S. Census data (2019), the rates of unemployment for all of the Tribes far exceeded 5.1 percent reported for California, 5.0 percent for Oregon, and 4.5 percent for the general population of the United States in 2019 (Bureau of Labor Statistics, 2019). Lack of employment among the Tribes of the Klamath River has greatly contributed to their poverty rates. Table 3.11-1 provides a summary of population, income, and poverty rates, and table 3.11-2 provides unemployment rates for all six federally recognized Tribes in the project area. According to recent U.S. Census data (2019), the poverty rate for the Tribes far exceeds the 2019 rate of 15.4 percent for California, 11.4 percent for Oregon, and 11.4 percent for the general population of the United States (U.S. Census Bureau, 2019k).

3.11.2 Effects of the Proposed Action

Several Tribes support dam removal, arguing that the dams have had a negative impact. The Klamath Tribes support dam removal so that aquatic species, such as salmon and steelhead, can migrate up the Klamath River and its tributaries.[193] According to the Yurok Tribe, dam removal would be a large-scale restoration effort for the fish resources of the Klamath River. The Yurok Tribe supports dam removal and believes (1) it will open up hundreds of miles of historic habitat to salmon; (2) deleterious downstream water quality impacts will be lessened or eliminated; and (3) geomorphic processes, including sediment movement in the Klamath River, will be more normative.[194] The Hoopa Valley Tribe states the Commission should order the removal of the dams to restore fish habitat, improve water quality, and mitigate the substantial damage to the Klamath River resulting from the project.[195] The Karuk Tribe believes the project has

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[193] Klamath Tribes November 13, 2017, Out-of-Time Motion to Intervene.

[194] Yurok Tribe November 3, 2017, Motion to Intervene and Comments. *See also* Yurok Tribe March 18, 2021, and February 11, 2011, Motions to Intervene; Yurok Tribe August 19, 2021, and August 3, 2019, letters.

[195] *See* Hoopa Valley February 11, 2021, and October 17, 2017, Motions to Intervene.

negative effects on water quality and fisheries[196] and that dam removal would enhance fisheries, dramatically improve water quality, and alleviate toxic algae blooms.[197]

KRRC proposes decommissioning and removing most project facilities and implementing 16 management plans that detail procedures for drawing down the four reservoirs; removing the dams and associated facilities; restoring lands currently occupied by the dams, reservoirs, and other facilities; improving salmon access to historical and existing habitat; and minimizing adverse effects on environmental resources. The environmental effects of KRRC's proposal and associated protection, mitigation, and enhancement measures are described and analyzed in sections 3.1 through 3.15 of this EIS.

In the following section, Commission staff address how those resource impacts would affect Tribal Nations with reserved treaty rights and other interests in the Lower Klamath River.

Our Analysis

As discussed in sections 3.3.3, *Water Quality*, and 3.4.3, *Aquatic Resources*, removal of the Lower Klamath Project facilities would improve water quality; reduce the incidence of fish kills; reduce the foreseeable risk of the demise of salmon and steelhead runs in the Klamath River and its tributaries; and potentially result in a substantial increase in salmon, steelhead, and other aquatic species populations. Increasing the amount of habitat that is accessible to salmon and steelhead would also increase recreational angling opportunities, which would provide economic benefits to Tribal people that live along the Klamath River and its tributaries. The proposed action would result in benefits to water quality, aquatic resources, and terrestrial resources used by all Tribes. These changes could aid in the restoration and continuation of Tribal practices and traditions that have been adversely affected by operation of the project in the past. The proposed action would therefore have a permanent and significant beneficial effect on the Tribes of the Klamath River.

Tribes would also be affected by changes to the socioeconomic characteristics of the project area resulting from the proposed action, including effects on population and housing, employment, community services, tax revenue, social programs, and property values. While the rates of unemployment and poverty cannot be strictly tied to the Lower Klamath Project because other factors contribute to these conditions, an increase in fish populations in the Klamath River and the resumption of strong salmon runs could aid in the resumption of successful Hoopa Valley and Yurok Tribal commercial fishing enterprises. In its February 26, 2021, Notice of Intervention, the Hoopa Valley Tribe commented that a strong Klamath River salmon fishery is economically important to the

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[196] Karuk Tribe March 18, 2021, February 12, 2021, and November 3, 2017, Motions to Intervene. *See also* Karuk Tribe's September 29, 2021, letter.

[197] Karuk Tribe August 2, 2019, letter.

Tribe. Additionally, in its March 18, 2021, Notice of Intervention, the Yurok Tribe reiterated the importance of its own commercial fishery and stated that the removal of the Lower Klamath Project dams would support an improved Tribal economy. Restoration of commercial fishing would have a permanent and significant beneficial effect on these Tribal communities by improving Tribal revenue if commercial fishing activity resumes.

Further, activities associated with dam removal (construction, monitoring, etc.) could provide a limited number of temporary jobs to Tribal members during the years of deconstruction activities or create a multiplier effect in the local economy through spending on construction-related activities, which would have a temporary, beneficial effect on Tribal communities. Over the long term, improvements in the salmon fishery may also increase river-based recreational angling opportunities, which would also provide economic benefits to Tribal people that live along the Klamath River and its tributaries through recreation-based tourism. Overall, the socioeconomic impacts on Tribes are likely to be beneficial and significant. Socioeconomic effects are more fully addressed in section 3.12, *Socioeconomics*.

3.11.3 Effects of the Proposed Action with Staff Modifications

The effects of the proposed action with staff modifications on Tribal trust responsibilities related to water quality and aquatic resources would be essentially the same as the proposed action, except that mortality of mussels caused by in-water construction activities would be reduced by translocating mussels from work areas before work commences. Under the proposed action with staff modifications, the effects on the Tribes, within a 5-mile radius of the project boundary and within a 1-mile buffer of the Klamath River, downstream of the project facilities to the confluence of the Klamath River and Humbug Creek, would be largely similar to the effects under the proposed action.

3.11.4 Effects of the No-action Alternative

The ongoing effects of the Lower Klamath Project dams, in combination with increases in water temperature that have occurred over recent decades, have degraded water quality conditions in the Lower Klamath River. The dams also block access to and inundate upstream habitat, including locations with cooler water that could provide areas of refuge from high water temperatures. The blockage from access to upstream habitat, combined with the large numbers of salmon produced at the Iron Gate Hatchery, results in crowding of juvenile and adult salmon in the remaining accessible habitat. The combination of poor water quality conditions, reduced access to cooler water refuges, crowding of juvenile and adult salmon, and high levels of disease incidence have led to numerous kills of juvenile and adult salmon in the Klamath River in recent years, including a major kill of juvenile salmon in 2021. Salmon produced in the Trinity and Scott Rivers, as well as other tributaries to the Klamath River, are exposed to these adverse conditions as they migrate through the Lower Klamath River on their way to and from the ocean. These effects are addressed more fully in sections 3.3, *Water Quality*, and 3.4, *Aquatic Resources.*

Given these ongoing conditions and the likelihood that water temperatures will continue to increase, it is likely that the Klamath salmon fisheries will become severely diminished within several decades under the no-action alternative. Accordingly, a lack of action would continue to cause negative impacts on several resources, including aquatic species, such as fish habitat, and water quality. These resources are vital to Tribal culture, religion, heritage, and lifestyle. In addition, under the no-action alternative, the continued occurrence of toxic algae blooms would impede the Tribes' ability to safely continue their many rituals that depend on contact with the waters of the Lower Klamath River. Moreover, under the no-action alternative, the continued lack of a healthy fishery would not enable the Tribes to operate successful Tribal commercial fishery endeavors. Without these opportunities for employment and self-sufficiency, Tribal unemployment and the associated Tribal economy would continue to suffer, resulting in a continued, permanent significant adverse effect on Tribal communities.

Table 3.11-1. Tribal income and rates of poverty, 2020 (Source: U.S. Census Bureau, 2020c)

Tribe	**Total Population**	**Median Household Income**	**Families below Poverty Level**		
			All Families	**Families with Children under 18 Years of Age**	**Families with Children under 5 Years of Age**
Hoopa Valley Indian Tribe	3,263	$37,222	26.9%	38.1%	61.0%
Karuk Tribe	554	$24,167	42.7%	53.5%	100%
Quartz Valley Community	170	$39,286	18.8%	20.0%	0.0%
Resighini Rancheria	20	$36,563	0.0%	0.0%	0.0%
Yurok Tribe	836	$32,727	33.9%	41.1%	43.8%
Klamath Tribes[a]	38	$10,000	75%	100%	– [a]

[a] – indicates the number of observations was too low to calculate the statistic.

Table 3.11-2. Tribal unemployment, 2020 (Source: U.S. Census Bureau, 2020c)

Tribe	**Total Population**	**Population 16 Years and Over**	**Available to Work**	**Total Unemployment Rate (Population 16 Years and Over)**	**Unemployment Rate Among Those Available to Work**
Hoopa Valley Indian Tribe	3,263	2,337	1,156	50%	8.8%
Karuk Tribe	554	361	204	43%	16.2%
Klamath Tribes	4,533	3,250	1135	21%	37.5%
Quartz Valley Community	170	135	72	47%	5.6%
Resighini Rancheria	20	16	9	43%	0.0%
Yurok Tribe	836	657	314	52%	16.9%

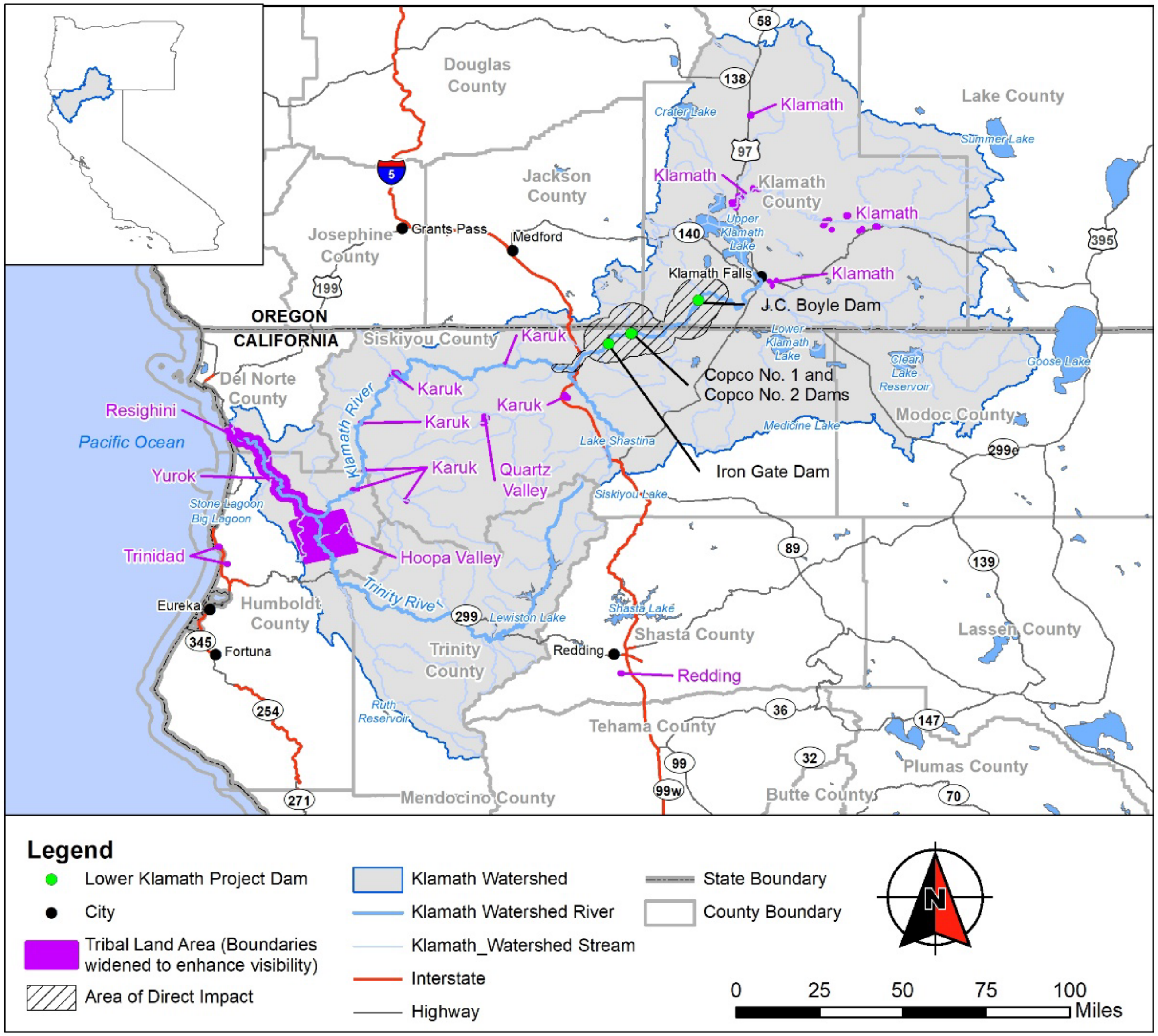

Figure 3.11-1. Tribal lands in the vicinity of the Lower Klamath Project.

3.12 SOCIOECONOMICS

The six-county study area for this analysis includes Klamath, Jackson, and Curry Counties in Oregon and Siskiyou, Humboldt, and Del Norte Counties in California. Klamath County, Oregon, and Siskiyou County, California, encompass the area where project-induced social and economic effects are likely to be highest due to their proximity to deconstruction and restoration activities or their proximity to the Lower Klamath River where downstream effects of the proposed action would occur. The other counties are included because incremental project investments and operational changes could affect their economies, local services, and human resources.

3.12.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for socioeconomics includes Klamath, Jackson, and Curry Counties in Oregon and Siskiyou, Humboldt, and Del Norte Counties in California. Klamath and Siskiyou Counties encompass the area where deconstruction and restoration activities would occur, and they would be the most affected by influx of the workforce involved in those activities, as well as potential changes in land values and tax revenues, while communities in the downstream counties would be affected by changes in the health of salmon fisheries including any future harvest restrictions, which affect communities along the Lower Klamath River as well as coastal areas within the KMZ. The temporal extent of our effects analysis ranges from short-term effects from project deconstruction activities to permanent effects on revenues from fisheries, land valuations, and tax revenues.

3.12.2 Affected Environment

3.12.2.1 Population Characteristics and Housing

The project is in a largely rural area of Klamath County, Oregon, and Siskiyou County, California. According to the 2010 Census, 38 percent of Klamath County’s population and 66 percent of Siskiyou County’s population lived in rural areas (non-Census designated places). Between 2010 and 2020, the total population of Klamath County increased by 5 percent, and the population of Siskiyou County decreased by 2 percent (table 3.12-1). The total population within the six-county study area increased by 5 percent between 2010 and 2020. Jackson County had the highest increase in population (10 percent) during the same period, while Del Norte County experienced the highest decrease (3 percent) (U.S. Census Bureau, 2010a; 2020a).

The largest racial group in the study area is white, representing more than three-fourths of the study area’s population (table 3.12-2). The American Indian and Alaska Native population is approximately 4 percent of the study area’s population. Del Norte County, California, has the largest share of American Indian and Alaska Native residents out of the six-county study area, while Jackson County, Oregon, has the lowest percentage of American Indian and Alaska Native residents. Nearly 1 percent of the population of Klamath County is non-white, while 24 percent of Siskiyou County is non-white.

Between 2015 and 2019, the average household size was 2.39 persons per owner-occupied household in Klamath County and 2.18 persons per owner-occupied household in Siskiyou County. There was a total of 57,673 housing units located in Klamath and Siskiyou Counties. The rental vacancy rate for Siskiyou County, California, was 3.8 percent, and the rental vacancy rate for Klamath County, Oregon, was 4.1 percent (table 3.12-3). Within the six-county study area, there were 240,520 housing units.

3.12.2.2 Employment and Income

Between 2010 and 2020, unemployment rates declined in all of the counties (table 3.12-4). The unemployment rates in Curry County (8.7 percent), Jackson County (7.8 percent), and Klamath County (8.7 percent) in Oregon are higher than the state's average unemployment rate (7.6 percent). In contrast, Del Norte County (9.5 percent), Humboldt County (8.4 percent), and Siskiyou County (9.7 percent) in California have lower unemployment rates than the State of California (10.1 percent). Within the six-county study area, Siskiyou County has the highest unemployment rate (9.7 percent).

Median household income increased in all the geographies presented in table 3.12-5 between 2010 and 2019. In the six-county study area, Curry County, Oregon, had the largest increase (29.3 percent) in median household income during the same period. All the counties have median household incomes below their respective state median household incomes (U.S. Census Bureau, 2010b; 2019b). Klamath County, Oregon, and Siskiyou and Del Norte Counties, California, have the lowest household median incomes in the study area.

3.12.2.3 Local Industry (Agriculture and Recreation)

Throughout the study region, the three industries with the greatest percentage of total county employment are educational services, health care, and social assistance; arts, entertainment, recreation, and accommodation and food services; and retail trade (table 3.12-6). Employment in educational services, health care, and social assistance ranges from 21 percent in Curry County to 30 percent in Del Norte County. Arts, entertainment, recreation, accommodation and food services employment ranges from 11 percent in Jackson, Klamath, and Siskiyou Counties to 15 percent in Curry County. Employment in retail trade ranges from 10 percent in Siskiyou and Curry Counties to 14 percent in Jackson and Humboldt Counties. Within the six-county study area, Siskiyou County has the largest percentage of employment in the agriculture, forestry, fishing and hunting, and mining industry (11 percent), followed by Klamath County (7 percent).

Between 2012 and 2017, the number of farms in the study area decreased by 3.5 percent (4,854 to 5,025). The number of farms in Del Norte County decreased from 121 farms to 90 farms, a loss of 25.6 percent. The number of farms in Siskiyou County decreased from 929 farms to 745 farms, a loss of 19.8 percent; these were the only two counties in the study area that saw a decrease in the number of farms. During the same period, the total market value of study area agricultural products (which includes both crops and livestock, poultry, and their products) increased by 7 percent, after adjusting for inflation (from $6.7 billion to $7.4 billion) (USDA-NASS, 2012, 2017). In 2017, there were 351,479 acres of irrigated agricultural crops in the study area, a decrease of 8.9 percent from 2012. Del Norte and Siskiyou Counties saw a 1.7 and 27.8 percent decrease, respectively. In 2012, the agricultural land values in the study area averaged $7.4 million per farm and increased by 34 percent to 9.9 million in 2017.

3.12.2.4 Tax Base and Revenue

Table 3.12-7 shows the total tax revenues for the past two fiscal years[198] for the six-county study area.

3.12.2.5 Property Values

The Klamath River flows over 250 miles from its headwaters in southern Oregon through northern California to the coast, where it drains into the Pacific Ocean. It is the second largest river in California. The upper portion of the basin has been heavily developed for agricultural production, while much of the Lower Klamath runs through the Klamath National Forest. The river and its fish, particularly salmon, are considered sacred by several Tribes that live nearby, including the Yurok, Hoopa, Karuk, and Klamath Tribes. Three of the four project dams (i.e., Copco No. 1, Copco No. 2, and Iron Gate) are in Siskiyou County, California. Development in the area is focused around the Klamath River and the Copco No. 1 and Iron Gate Reservoirs. While PacifiCorp owns the reservoirs, the southern and eastern shores of Copco No. 1 Reservoir and some of the areas near Iron Gate Reservoir include residential development.

Most waterfront properties are located around Copco No. 1 Reservoir, and most parcels that have views of the reservoir are along the southern shore on Patricia Avenue and Ager-Beswick Road. The properties that front the reservoir have a relatively level site; however, most of the properties are elevated from the lakeshore water level and have steep terrain to access the reservoir. The properties across the road from the reservoir have obstructed views due to geography and heavy tree cover. Where the Klamath River enters Copco No. 1 Reservoir, some parcels front the river along Copco Road and have views of the river (Interior and California DFG, 2012).

The Iron Gate Lake Estates is a residential resort community located on Iron Gate Reservoir. While the area is zoned for residential, few homes are in the area.

Table 3.12-8 represents the estimate of how much the property (house and lot) in each county would sell for if it were for sale. Between 2015 and 2019, the median value for owner-occupied homes in Oregon was $312,200. Curry, Jackson, and Klamath Counties in Oregon have lower median values for owner-occupied homes than the State

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[198] The fiscal year for each of the counties is July 1 to June 30.

of Oregon. Klamath County has the lowest median value ($170,600) of these three counties, while Jackson County has the highest for owner-occupied homes ($280,300). In California, the median value for owner-occupied homes was $505,000. Del Norte, Humboldt, and Siskiyou Counties have lower median values for owner-occupied homes than the State of California. Of the three counties in California, Siskiyou County has the lowest median value for owner-occupied homes ($198,900), while Humboldt County has the highest for owner-occupied homes ($313,200).

Table 3.12-9 presents the value of owner-occupied housing units in the study area. Between 2015 and 2019, 67 percent of Curry County's residential properties (house and lot), 72 percent of Jackson County's residential properties, and 39 percent of Klamath County's residential properties were valued at $200,000 or greater. During the same period, 55 percent of Del Norte County's residential properties were valued at $200,000 or greater, while 82 percent of Humboldt County's residential properties and 50 percent of Siskiyou County's residential properties were valued at $200,000 or greater.

3.12.3 Effects of the Proposed Action

Under the proposed action, the regional economy would be affected in the short term by construction activities associated with dam removal and restoration actions, and in the long term by effects on property values, tax revenue, electric rates, commercial fishing, subsistence fishing, ocean and in-river sport fishing, reservoir and riverine recreation, and tourism. Property owners near the reservoirs could also be affected economically by effects on wells, slope instability, and susceptibility to damage from wildfires, and KRRC proposes several measures to address these potential effects.

Dam removal would create temporary full and part-time jobs for workers directly engaged in deconstruction and restoration activities, and related administrative staff. The estimated size of the workforce is provided in table 3.12-10. After the completion of construction and mitigation activities, any employment and labor incomes within the region would return to prior construction levels. The Construction Camp Plan, a subplan of the Construction Management Plan, provide details on camp locations for temporary offices, housing, laydown areas, storage facilities. The Copco No. 2 Construction Camp (Copco Village) is the only site that would house construction crews. The proposed action would not require long-term annual operations and maintenance expenditures for operation of the hydroelectric facilities. As a result, the regional economy would lose approximately 49 jobs relative to existing conditions.

Our Analysis

The analysis conducted by Interior and NMFS (2013) used the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983) to evaluate both regional and national economic effects of decommissioning the Lower Klamath Project. Our analysis focuses on Interior's regional analysis because nearly all the adverse effects associated with the proposed action are local. Interior also evaluated non-use values associated with river restoration based on a survey of households in three strata: the 12-county Klamath area; the rest of Oregon and California; and the rest of the nation.

Interior's regional analysis indicated that there would be positive economic effects related to short-term employment during dam deconstruction and restoration activities, and long-term benefits to commercial and recreational fisheries (table 3.12-11). Negative economic benefits were predicted due to loss of employment associated with operation and maintenance of the hydropower facilities and adverse effects on whitewater boating, increased power costs, and reduced property values and tax revenues. Excluding the effects of the KBRA, Interior's analysis indicated a net benefit (low estimate) of $14,052.5 million and a high estimate of $82,663.2 million[199] over 50 years associated with the current proposed action.

Interior's analysis did not include analysis of any benefits that would accrue from increases in recreational use and tourism due to restoration of the Klamath as an unimpounded, free-flowing river. Several commenters expressed interest in the whitewater boating opportunities that dam removal would afford (including Ward's Canyon), and others noted that restoration of the river would result in increased tourism due to the scenic nature of the river and to view the results of restoration. Others also noted that river restoration, the development of trails within the restored areas, and the reestablishment of salmon runs through the hydroelectric reach would improve property values. We believe that these are valid considerations but were not able to quantify them.

Interior's analysis also indicated that the magnitude of non-use values would be substantial. Through their stated willingness to pay for specific scenarios for ecosystem restoration within the Klamath River Basin, survey respondents[200] indicated they placed significant value on the restoration of Klamath Basin resources. Overall, the study results indicated that the majority of respondents in all three strata are concerned about declines of Chinook salmon and steelhead trout that return to the Klamath River and the extinction

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[199] 2012 dollars.

[200] The survey was a nationwide survey and was mailed to a random sample of U.S. households. To capture potential differences among respondents based on proximity to the Klamath River, the overall target population sampled was divided into three geographic strata: the 12-county area around the Klamath River, the rest of Oregon and California, and the rest of the United States. The 12-county Klamath area is defined as: Lake, Klamath, Douglas, Jackson, and Josephine Counties in southern Oregon and Modoc, Siskiyou, Del Norte, Humboldt, Trinity, Shasta, and Tehama Counties in northern California. The survey included the following response rates: 12-county Klamath area (1,027 total responses, 41.1 percent response rate), California and Oregon excluding the 12-county Klamath area (1,181 total responses, 30.0 percent response rate), rest of the U.S. excluding California and Oregon (1,164 total responses, 30.2 percent response rate) (Interior and NMFS, 2013).

of fish species in the Klamath Basin; and they agree that restoration should be guided by an action plan that includes Klamath dam removal, water sharing agreements, and basin fish habitat restoration. The estimated non-use values were $67 million[201] for the 12-county area, $2,091 million[202] for the States of Oregon and California, and $1,3487[203] million at a national level.

Because the workforce required for deconstruction and restoration activities would be housed in the Copco Village work camp, the proposed action would have no effect on the availability of local housing or the cost of public services.

For our analysis of potential effects on wells, slope instability, and susceptibility to damage from wildfires, and KRRC's proposed measures to address these effects, sections 3.1.2, 3.2.2, and 3.8.2, *Geology and Soils*, *Water Quantity*, and *Land Use*, respectively.

3.12.4 Effects of the Proposed Action with Staff Modifications

The effects would be the same as the proposed action.

3.12.5 Effects of the No-action Alternative

Under the no-action alternative, operation and maintenance of facilities would not change and would continue to create labor income, tax revenue, and Tribal income. The risk of diminishing salmon runs adversely affecting commercial and subsistence fishing and ocean and in-river sport fishing in the future would remain.

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[201] 2012 dollars.

[202] 2012 dollars.

[203] 2012 dollars.

Table 3.12-1. Oregon and California county populations in the vicinity of the project, census years 2000, 2010, and 2020 (Source: U.S. Census Bureau, 2000, 2010a, 2020b)

Geography	**Population (2000)**	**Population (2010)**	**Population (2020)**	**Percent Change 2010–2020**
Curry County, OR	21,137	22,364	23,446	4.6
Jackson County, OR	181,269	203,206	223,259	8.9
Klamath County, OR	63,775	66,380	69,413	4.4
Del Norte County, CA	27,507	28,610	27,743	-3.7
Humboldt County, CA	126,518	134,623	136,463	1.3
Siskiyou County, CA	44,301	44,900	44,076	-1.8

Table 3.12-2. Population, race, and ethnicity in Oregon and California counties in the vicinity of the project, census year 2020 (Source: U.S. Census Bureau, 2020b)

Race and Ethnicity	**Curry County, OR**	**Jackson County, OR**	**Klamath County, OR**	**Del Norte County, CA**	**Humboldt County, CA**	**Siskiyou County, CA**
Total Population	23,446	223,259	69,413	27,743	136,463	44,076
White only	85%	80%	79%	62%	72%	76%
Black or African American alone	0%	1%	1%	3%	1%	1%
American Indian and Alaska Native alone	2%	1%	4%	9%	6%	5%
Asian alone	1%	2%	1%	3%	3%	2%

Race and Ethnicity	Curry County, OR	Jackson County, OR	Klamath County, OR	Del Norte County, CA	Humboldt County, CA	Siskiyou County, CA
Native Hawaiian and Other Pacific Islander alone	0%	0%	0%	0%	0%	0%
Some Other Race alone	2%	5%	5%	11%	6%	5%
Two or more races	9%	11%	10%	12%	12%	11%
Hispanic	7%	14%	13%	19%	14%	13%

Table 3.12-3. Housing Characteristics in Oregon and California counties in the vicinity of the project, 2015–2019 (Source: U.S. Census Bureau, 2019g)

Geography	Total Housing Units (2015-2019)	Housing Occupancy (2015-2019)	Rental Vacancy Rate (2015-2019)
Curry County, OR	12,948	81.4%	8.4
Jackson County, OR	95,431	92.5%	2.1
Klamath County, OR	33,555	83.1%	4.1
Del Norte County, CA	11,379	87.4%	0.1
Humboldt County, CA	63,089	86.7%	2.9
Siskiyou County, CA	24,118	79.8%	3.8

Note: Statistics for 2015–2019 are five-year annual averages.

Table 3.12-4. Labor force, employment, and unemployment in Oregon and California counties in the project vicinity, census years 2010 and 2020 (Source: U.S. Department of Labor, 2020)

Geography	2010				2020			
	Labor Force	**Employed Persons**	**Unemployed Persons**	**Unemployment Rate**	**Labor Force**	**Employed Persons**	**Unemployed Persons**	**Unemployment Rate**
State of Oregon	1,991,749	1,778,034	213,715	10.7%	2,104,657	1,945,212	159,445	7.6%
Curry County, OR	9,432	8,232	1,200	12.7%	8,944	8,170	774	8.7%
Jackson County, OR	101,368	88,638	12,730	12.6%	105,147	96,937	8,210	7.8%
Klamath County, OR	31,342	27,262	4,083	13.0%	29,511	26,957	2,554	8.7%
State of California	18,370,536	16,078,454	2,292,082	12.5%	18,821,167	16,913,078	1,908,089	10.1%
Del Norte County, CA	10,944	9,465	1,479	13.5%	9,350	8,466	884	9.5%
Humboldt County, CA	66,064	58,933	7,131	10.8%	59,411	54,446	4,965	8.4%
Siskiyou County, CA	19,672	16,283	3,389	17.2%	16,923	15,286	1,637	9.7%

Table 3.12-5. Median household income in Oregon and California counties in the vicinity of the project, 2010, and 2019 (inflation adjusted) (Source: U.S. Census Bureau, 2010b, 2019b)

Geography	2010	2019	Percent Change 2010–2019
State of Oregon	$49,260	$62,818	27.50%
Curry County, OR	$37,469	$48,440	29.30%
Jackson County, OR	$44,142	$53,412	21.00%
Klamath County, OR	$41,818	$46,491	11.20%
State of California	$60,883	$75,235	23.60%
Del Norte County, CA	$36,118	$45,283	25.40%
Humboldt County, CA	$40,089	$48,041	19.80%
Siskiyou County, CA	$36,981	$45,241	22.30%

Note: Statistics for the years 2010 and 2019 are five-year annual average statistics.

Table 3.12-6. Total full-time jobs by industry, Jackson, Klamath, Curry Counties, Oregon and Siskiyou, Del Norte, and Humboldt Counties, California (Source: U.S. Census Bureau, 2019c)

Industry	Jackson County, OR	Klamath County, OR	Siskiyou County, CA	Curry County, OR	Del Norte County, CA	Humboldt County, CA
Total all industries	95,367	26,347	16,538	7,617	9,015	62,030
Agriculture, forestry, fishing and hunting, and mining:	4%	7%	11%	5%	4%	5%
• Agriculture, forestry, fishing and hunting	3%	7%	11%	5%	4%	5%
• Mining, quarrying, and oil and gas extraction	0%	0%	0%	0%	0%	0%
Construction	6%	5%	6%	8%	5%	7%
Manufacturing	9%	10%	5%	3%	4%	4%
Wholesale trade	2%	2%	2%	0%	1%	3%
Retail trade	14%	12%	10%	10%	11%	14%
Transportation and warehousing, and utilities:	5%	5%	4%	7%	2%	3%
• Transportation and warehousing	4%	4%	4%	4%	1%	3%
• Utilities	1%	1%	0%	3%	0%	1%
Information	2%	1%	1%	2%	1%	1%
Finance and insurance, and real estate and rental and leasing:	5%	4%	3%	5%	3%	4%
• Finance and insurance	3%	2%	1%	2%	1%	2%

Industry	Jackson County, OR	Klamath County, OR	Siskiyou County, CA	Curry County, OR	Del Norte County, CA	Humboldt County, CA
• Real estate and rental and leasing	2%	2%	2%	2%	2%	2%
Professional, scientific, and management, and administrative and waste management services:	8%	8%	7%	5%	5%	9%
• Professional, scientific, and technical services	4%	4%	4%	1%	3%	5%
• Management of companies and enterprises	0%	0%	0%	0%	0%	0%
• Administrative and support and waste management services	4%	4%	3%	3%	2%	4%
Educational services, and health care and social assistance:	25%	25%	26%	21%	30%	25%
• Educational services	7%	10%	10%	8%	11%	9%
• Health care and social assistance	18%	15%	15%	13%	19%	16%
Arts, entertainment, and recreation, and accommodation and food services:	11%	11%	11%	15%	12%	13%
• Arts, entertainment, and recreation	2%	3%	1%	2%	4%	4%
• Accommodation and food services	9%	8%	9%	12%	8%	8%
Other services, except public administration	5%	5%	5%	5%	5%	5%
Public administration	4%	6%	8%	14%	17%	7%

Table 3.12-7. Property and sales tax revenues[a] in Oregon and California counties in the vicinity of the project, 2019–2020 (Source: State of Oregon, 2020a,b,c; State of California, 2020, 2020,b,d)

	Fiscal Year 2019	**Fiscal Year 2020**	**Percent Change 2019–2020**
Curry County, OR			
Property tax revenues	$1,801,763	$1,856,408	3%
Sales and use tax revenues	N/A	N/A	
Jackson County, OR			
Property tax revenues	$45,859,743	$46,872,610	2%
Sales and use tax revenues	N/A	N/A	
Klamath County, OR			
Property tax revenues	$15,108,724	$15,705,228	4%
Sales and use tax revenues	N/A	N/A	
Del Norte County, CA			
Property tax revenues	$9,032,918	$7,528,158	-17%
Sales and use tax revenues	$6,139,728	$6,470,114	5%
Humboldt County, CA			
Property tax revenues	$30,894,382	N/A[b]	N/A
Sales and use tax revenues	$17,517,796	N/A	N/A
Siskiyou County, CA			
Property tax revenues	$12,498,668	$13,261,788	6%
Sales and use tax revenues	$5,974,884	$6,400,084	7%

[a] Oregon does not have a sales tax.

[b] Humboldt County 2020 Financial Report not available.

Table 3.12-8. Median value of owner-occupied housing units, in Oregon and California counties in the vicinity of the project, census year 2020 (Source: U.S. Census Bureau, 2019d)

State/County	Median Value (Dollars)
Oregon	$312,200
Curry, OR	$265,400
Jackson, OR	$280,300
Klamath, OR	$170,600
California	$505,000
Del Norte, CA	$218,800
Humboldt, CA	$313,200
Siskiyou, CA	$198,900

Table 3.12-9. Value of owner-occupied housing units in Oregon and California counties in the vicinity of the project, census year 2020 (Source: U.S. Census Bureau, 2019e)

	Curry County, Oregon		**Jackson County, OR**		**Klamath County, OR**		**Del Norte County, CA**		**Humboldt County, CA**		**Siskiyou County, CA**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**P%**	**Number**	**%**	**Number**	**%**
Total	7,526	-	55,792	-	17,924	-	6,273	-	31,078	-	12,509	-
Less than $10,000	277	4%	1,386	2%	380	2%	125	2%	475	2%	223	2%
$10,000 to 14,999	58	1%	942	2%	133	1%	104	2%	292	1%	107	1%
$15,000 to 19,999	40	1%	587	1%	121	1%	182	3%	161	1%	86	1%
$20,000 to $24,999	43	1%	701	1%	281	2%	219	3%	141	0%	115	1%
$25,000 to $29,999	48	1%	382	1%	144	1%	83	1%	194	1%	55	0%
$30,000 to $34,999	56	1%	316	1%	267	1%	120	2%	87	0%	77	1%
$35,000 to $39,999	83	1%	368	1%	175	1%	30	0%	176	1%	31	0%
$40,000 to $49,999	147	2%	630	1%	342	2%	63	1%	194	1%	166	1%
$50,000 to $59,999	50	1%	607	1%	214	1%	96	2%	312	1%	162	1%
$60,000 to $69,999	108	1%	242	0%	475	3%	145	2%	308	1%	196	2%

	Curry County, Oregon		**Jackson County, OR**		**Klamath County, OR**		**Del Norte County, CA**		**Humboldt County, CA**		**Siskiyou County, CA**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**P%**	**Number**	**%**	**Number**	**%**
$70,000 to $79,999	95	1%	474	1%	363	2%	140	2%	135	0%	161	1%
$80,000 to $89,999	77	1%	346	1%	769	4%	108	2%	249	1%	435	3%
$90,000 to $99,999	158	2%	454	1%	492	3%	40	1%	89	0%	250	2%
$100,000 to $124,999	191	3%	1,205	2%	1,787	10%	269	4%	483	2%	1,186	9%
$125,000 to $149,999	343	5%	1,111	2%	1,524	9%	273	4%	320	1%	684	5%
$150,000 to $174,999	317	4%	3,042	5%	1,814	10%	417	7%	919	3%	1,472	12%
$175,000 to $199,999	421	6%	2,835	5%	1,604	9%	414	7%	1,078	3%	886	7%
$200,000 to $249,999	944	13%	7,737	14%	2,172	12%	820	13%	3,789	12%	1,597	13%
$250,000 to $299,999	999	13%	7,466	13%	1,739	10%	684	11%	5,090	16%	1,356	11%
$300,000 to $399,999	1,501	20%	10,753	19%	1,585	9%	909	14%	7,931	26%	1,609	13%
$400,000 to $499,999	569	8%	5,858	10%	738	4%	433	7%	3,487	11%	678	5%
$500,000 to $749,999	535	7%	5,519	10%	503	3%	445	7%	3,684	12%	639	5%

	Curry County, Oregon		**Jackson County, OR**		**Klamath County, OR**		**Del Norte County, CA**		**Humboldt County, CA**		**Siskiyou County, CA**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**P%**	**Number**	**%**	**Number**	**%**
$750,000 to $999,999	234	3%	1,476	3%	85	0%	94	1%	830	3%	205	2%
$1,000,000 to $1,499,999	197	3%	837	2%	82	0%	35	1%	300	1%	96	1%
$1,500,000 to $1,999,999	7	0%	129	0%	39	0%	-	0%	154	0%	12	0%
$2,000,000 or more	18	0%	389	1%	96	1%	25	0%	200	1%	25	0%

Table 3.12-10. Workforce projections for the proposed action (Source: Interior and California DFG, 20212)

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce
J.C. Boyle	25 to 30 people	10 months	40–45
Copco No. 1	30 to 35 people	12 months	50–55
Copco No. 2	25 to 30 people	7 months	35–40
Iron Gate	35 to 40 people	18 months	70–80

Table 3.12-11. Regional economic development impact analysis summary for dams in and dam removal scenarios (Source: Interior and NMFS, 2013)

Category	**Dams In (No-action)**	**Full Facilities Removal (Incremental changes from Dams in) (2012 dollars)**
Dam Decommissioning **Economic Region:** Klamath County, OR, Siskiyou County, CA	None	Short-term impacts during the one-year decommissioning. Approximately 1,400 jobs, $60 million in labor income, and $163 million in output estimated to stem from in-region decommissioning expenditures.
Operation and Maintenance (O&M) **Economic Region:** Klamath County, OR, Siskiyou County, CA	Regional economic impacts stemming from existing in-region O&M expenditures were estimated to generate approximately 49 jobs and labor income and output of $2 million and $5 million, respectively.	No long-term annual O&M expenditures; therefore, the regional economy would lose the 49 jobs, $2 million of labor income, and $5 million output associated with the in-region O&M expenditures for dams in.
Mitigation **Economic Region** Klamath County, OR, Siskiyou County, CA	None	These would be temporary, short-term impacts and vary year by year during 2018–2025 proportionate to actual in-region expenditures. A total of approximately 220 jobs, $10 million in labor income, and $31 million in output during the years 2018–2025 were estimated to stem from the total in-region mitigation expenditures.

Category	Dams In (No-action)	Full Facilities Removal (Incremental changes from Dams in) (2012 dollars)
Commercial Fishing **Economic Regions and Regional Economies:** San Francisco Management Area (San Mateo, San Francisco, Marin and Sonoma Counties, CA)	Estimated regional economic impacts stemming from ocean commercial fishing: San Francisco Management Area Jobs: 510 Labor Income: $6.10 million Output: $15.52 million	Estimated regional economic impacts stemming from the change in ocean commercial fishing between dams in versus full facilities removal. San Francisco Management Area Jobs: 218 Labor Income: $2.56 million Output: $6.6 million
Fort Bragg Management Area (Mendocino County, CA)	**Fort Bragg Management Area** Jobs: 162 Labor Income: $2.45 million Output: $5.62 million	**Fort Bragg Management Area** Jobs: 69 Labor Income: $1.05 million Output: $2.41 million
KMZ-CA (Humboldt and Del Norte Counties, CA)	**KMZ-CA** Jobs: 44 Labor Income: $0.19 million Output: $0.45 million	**KMZ-CA** Jobs: 19 Labor Income: $0.07 million Output: $0.19 million
KMZ-OR (Curry County, OR)	**KMZ-OR** Jobs: 26 Labor Income: $0.15 million Output: $0.33 million	**KMZ-OR** Jobs: 11 Labor Income: $0.06 million Output: $0.13 million

Category	Dams In (No-action)	Full Facilities Removal (Incremental changes from Dams in) (2012 dollars)
Central Oregon Management Area (Coos, Douglas and Lane Counties, OR)	**Central Oregon Management Area** Jobs: 319 Labor Income: $4.15 million Output: $9.55 million	**Central Oregon Management Area** Jobs: 136 Labor Income: $1.74 million Output: $4.07 million
In-River Sport Fishing **Economic Region:** Klamath County, OR, Del Norte, Humboldt, and Siskiyou Counties, CA	**Recreational Salmon Fishery** Regional economic impacts stemming from in-river salmon fishing trip expenditures were estimated to create approximately 34 jobs and stimulate about $0.93 million of labor income and $2.01 million of output.	**Recreational Salmon Fishery** Regional economic impacts stemming from the change in-river salmon fishing trip expenditures were estimated to create approximately three more jobs and stimulate increases of about $0.07 million of labor income and $0.15 million of output compared to dams in.
	Recreational Steelhead Fishery Regional economic impacts stemming from in-river steelhead fishing trip expenditures were estimated to create approximately 20 jobs and stimulate about $0.62 million of labor income and $1.31 million of output.	**Recreational Steelhead Fishery** The Coho/Steelhead Expert Panel Report and previous studies were generally positive regarding the potential for increased distribution and abundance of steelhead. However, insufficient data precluded estimating potential regional economic impacts related to steelhead fishing trip expenditures compared to dams in.

Category	Dams In (No-action)	Full Facilities Removal (Incremental changes from Dams in) (2012 dollars)
	Recreational Redband Trout Fishery A popular guide fishery occurs on the lower Williamson River. Given demand for guide trips is generally higher among non-resident than resident anglers, the proportion of trips by non-resident anglers is likely higher; however, data are lacking to verify this or quantify regional economic impacts associated with in-region guide fishing expenditures.	**Recreational Redband Trout Fishery** The Resident Fish Expert Panel concluded that dam removal would result in increased abundance and distribution of redband trout in Upper Klamath Lake and its tributaries and a potential seven-fold increase in the trophy fishery in the Keno reach. However, the potential regional economic impacts of this notable increase could not be quantified with available data.
Ocean Sport Fishing **Economic Regions and Regional Economies:** **KMZ-OR-Curry County OR**	**KMZ-OR – Curry County, OR** An estimated three jobs, $0.08 million of labor income, and $0.21 million in output were estimated to stem from in-region ocean sport salmon fishing related expenditures.	**KMZ-OR – Curry County, OR** Regional economic impacts stemming from the change in in-region ocean sport salmon fishing trip expenditures were estimated to be increases of approximately one job, $0.02 million in labor income, and $0.09 million in output compared to dams in.

Category	Dams In (No-action)	Full Facilities Removal (Incremental changes from Dams in) (2012 dollars)
KMZ-CA – Humboldt and Del Norte Counties, CA	**KMZ-CA** – Humboldt and Del Norte Counties, CA Approximately 13 jobs, $0.42 million of labor income, and $1.12 million of output were estimated to stem from in-region ocean sport salmon fishing related expenditures.	**KMZ-CA** – Humboldt and Del Norte Counties, CA Regional economic impacts stemming from the change in in-region ocean sport salmon fishing trip expenditures between the dams in and full facilities removal were estimated to be approximately five more jobs, $0.18 million of labor income, and $0.48 million of output.
Fisheries Program **Economic Region:** Klamath County, OR, Del Norte, Humboldt, and Siskiyou Counties, CA	Fishery restoration, reintroduction and monitoring expenditures support 2,015 jobs, $95 million in labor income and $203 million in output.	Increase of approximately 3,917 jobs (average annual of 261), $186.8 million in labor income and $380 million in output.

3.13 ENVIRONMENTAL JUSTICE

According to EPA, "environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." Fair treatment means that no group of people should bear a disproportionate share of the adverse environmental effects resulting from industrial, governmental, and commercial operations or policies (EPA, 2021d). Meaningful involvement means:

1. potentially affected community residents have an opportunity to participate in decisions about activities that may affect their environment and/or health;
2. the public's contributions can influence the regulatory agency's decision;
3. community concerns will be considered in the decision-making process; and
4. decision-makers seek out and facilitate the involvement of those potentially affected (EPA, 2021e).

Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad,* and Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, as amended, requires federal agencies to consider if adverse effects on human health or the environment would be disproportionately high and adverse for environmental justice communities resulting from the programs, policies, or activities of federal agencies. The term "environmental justice community" could encompass (a) populations of color; (b) communities of color; (c) Native communities[204]; and (d) low-income, rural and urban communities who are exposed to a disproportionate burden of the adverse human health and environmental effects of pollution or other environmental hazards.

Commission staff used EPA's Federal Interagency Working Group on Environmental Justice and NEPA Committee's publication, *Promising Practices for Environmental Justice Methodologies in NEPA Reviews* (*Promising Practices*) (EPA, 2016a), which provides methodologies for identifying environmental justice communities within the project's area of review and conducting environmental justice analyses throughout the NEPA process for this project. Commission staff's use of these methodologies is described throughout this section.

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[204] Although Executive Order 14008 specifies Native communities as part of its definition of "environmental justice" communities, Commission staff considers the effects of the project on federally recognized Tribal nations in section 3.11, *Tribal Trust Responsibilities.* Tribal cultural resources are also discussed in section 3.10, *Cultural Resources.*

EPA encouraged the Commission to use EJSCREEN, which is EPA's environmental justice mapping and screening tool, and/or the most recent American Community Survey from the U.S. Census Bureau (i.e., 2015–2019) to determine the presence of minority and low-income populations (EPA, 2021g). Commission staff used EJSCREEN as an initial step to gather information regarding minority and/or low-income populations; potential environmental quality issues; environmental and demographic indicators; and other important factors.

3.13.1 Meaningful Engagement and Public Involvement

The Council on Environmental Quality's (CEQ) environmental justice guidance under NEPA (CEQ, 1997) and *Promising Practices* recommend that federal agencies provide opportunities for effective community participation in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of public meetings, crucial documents, and notices.[205] They also recommend using adaptive approaches to overcome linguistic, institutional, cultural, economic, historical, or other potential barriers to effective participation in the decision-making processes of federal agencies. In addition, Section 8 of Executive Order 13985, *Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*, strongly encourages independent agencies to "consult with members of communities that have been historically underrepresented in the federal government and underserved by, or subject to discrimination in, federal policies and programs."

In its August 19, 2021, scoping comments, EPA stated that the EIS should describe actions taken to inform and involve environmental justice communities in the proceeding (EPA, 2021f). On June 17, 2021, the Commission issued a notice of intent to prepare an EIS for the proposed Lower Klamath Project surrender and removal, request for comments on environmental issues, schedule for environmental review, and notice of public virtual scoping sessions. The notice was published in the *Klamath Falls Herald and News* on July 2, 2021, and the *Siskiyou Daily News* on July 7, 2021, and was sent electronically or via the U.S. Postal Service to both the Commission's official mailing list and KRRC's distribution list for the project.

A scoping document (SD1) for the Lower Klamath Project license surrender application was issued by the Commission on the same date as the notice. The scoping document contained information about four virtual scoping meetings, which were held on July 20 (two meetings), July 21, and July 22, 2021, where Commission staff sought oral comments on the project. Any person who was unable to attend a scoping meeting, or desired to provide further comment, was encouraged to submit written comments and information to the Commission by August 19, 2021. All comments, whether spoken or

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[205] 1997 CEQ Guidance at 4.

delivered in person at meetings, mailed in, or submitted electronically, were considered in the preparation of this EIS.

Furthermore, in 2021, the Commission established the Office of Public Participation to support meaningful public engagement and participation in Commission proceedings. The Office of Public Participation provides members of the public, including environmental justice communities, with assistance in Commission proceedings—including navigating Commission processes and activities relating to the project. For assistance with interventions comments, requests for rehearing or other filings, and for information about any applicable deadlines for such filings, members of the public are encouraged to contact the Office of Public Participation directly at 202-502-6592 or OPP@ferc.gov for further information.

3.13.2 Geographic and Temporal Scope of Analysis

EPA's *Promising Practices* provides that "[o]ne of the important functions of defining the affected environment is to help agencies determine the outer boundaries (i.e., footprint) of each potentially impacted resource topic analyzed in the NEPA document. These boundaries help define the affected area within which potentially impacted minority populations and low-income populations will be considered during the NEPA review. The geographic scope of the affected environment may vary for each resource topic analyzed in the NEPA document"[206] *Promising Practices* also provides that "[a]gencies can be informed by an understanding that minority populations and low-income populations may have increased or unique vulnerabilities from multiple impacts in one or more environmental resource topics or from cumulative impacts, and that the extent of the affected environment may vary for each resource topic addressed in the NEPA document."[207] As a result, Commission staff uses guidance provided by *Promising Practices* to conclude that the analysis of human health and environmental effects of each resource may require varying units of geographic analysis. For this analysis, Commission staff has selected U.S. Census block groups (block groups) located within a 5-mile radius of the project boundary for identification of environmental justice communities and analysis of the localized effects related to the project's decommissioning. For most resources, a 5-mile radius is sufficiently broad and allows for a thorough analysis of the direct effects of the removal of project dams and facilities and restoration activities in the surrounding project area.

Where the proposed action may result in downstream direct effects on a resource, Commission staff considered a broader geographic scope beyond the 5-mile radius around the project boundary. To address downstream effects, we selected a geographic

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[206] EPA, 2016, page 15, *citing* US EPA, *Factors for Identifying and Addressing Disproportionate Environmental Health Impacts* (2007); Supplement to American Journal of Public Health, Vol. 101, No. S1 (Dec 2011).

[207] *Id.* at 12.

scope that includes all block groups within a 1-mile radius buffer along the Klamath River from J.C. Boyle Dam to the confluence of the Klamath River and Humbug Creek. This geographic scope allows consideration of a multitude of factors that can change within the affected area and by resource topic. The geographic scope includes 11 block groups (1 in Jackson County and 5 in Klamath County, Oregon; and 5 in Siskiyou County, California). The demographic characteristics of these block groups are discussed in section 3.13.3.

The temporal extent of the effects analysis ranges from the temporary effects of deconstruction activities to the long-term protection and restoration of anadromous fish runs and the permanent loss of benefits associated with the reservoirs.

3.13.3 Affected Environment

3.13.3.1 Identification of Environmental Justice Communities

Following EPA and CEQ guidance, Commission staff used the provided methodologies and thresholds for minority and low-income populations to identify environmental justice communities within the project's area of review. Block groups that meet the provided thresholds for minority and low-income populations are considered environmental justice communities for purposes of Commission staff's analyses. According to CEQ's guidance, minority populations are those groups that identify as American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. Following the recommendations set forth in *Promising Practices*, minority populations are defined in this EIS where either: (a) the minority population of the affected area exceeds 50 percent; or (b) the aggregate minority population of the affected area is meaningfully greater (10 percent greater) than the aggregate minority population percentage in the general population or other appropriate unit of geographic analysis. The reference population for comparison in this EIS is either Oregon or California, depending on the state in which a block group is located.

Promising Practices indicates that low-income populations may be identified based on the annual statistical and geographical poverty thresholds from the U.S. Census Bureau, the poverty guidelines defined by the Department of Health and Human Services, or other appropriate sources. As recommended by EPA in its August 19, 2021, scoping comments, our analysis uses the California Department of Public Health's threshold of 200 percent of the federal poverty level to define low-income households. Because of California's high cost of living, this threshold provides a more accurate measure of financial hardship than the federal poverty level identified by the U.S. Census Bureau. We then compare the percent of low-income households in each block group to the reference population. *Promising Practices* also indicates that the chosen reference community should accurately capture low-income population percentages within a project's selected area of analysis. Because low-income populations may have varying disbursements within a state and its counties, we use the lesser of the state and county low-income levels to accurately identify all potential low-income communities. In this case, the state is used as the reference population because, in all cases, the state's percent of low-income households is lower than the counties in which the block groups are located.

Table 3.13-1 identifies the minority populations (by race and ethnicity) and low-income populations within Oregon and California, the counties that would be the most affected by the proposed action (Jackson and Klamath Counties in Oregon and Siskiyou County in California), and the block groups within the geographic scope of analysis (as defined in section 3.13.2). To ensure we are using the most recent available data, we use the 2019 American Community Survey data from File# C17002 and File# B03002 as the source for poverty data, as well as race and ethnicity data at the census block group level. According to the current U.S. Census Bureau information, 11 block groups exist within the project area. Figure 3.13-1 provides a geographic representation of these communities relative to the project facilities.

Of the 11 block groups within the geographic scope of analysis, 4 are considered environmental justice communities. Based on our thresholds, one block group is an environmental justice community with both a minority and a low-income population (Census Tract 2, Block Group 1 in Siskiyou County, California). The remaining three block groups are identified as environmental justice communities with low-income populations (Census Tract 3, Block Group 1 and Census Tract 4, Block Group 1 in Siskiyou County, California, and Census Tract 25, Block Group 2 in Jackson County, Oregon). All project facilities, with the exception of the J.C. Boyle Dam and Reservoir, are located within environmental justice communities.

3.13.4 Effects of the Proposed Action

When a project could adversely affect environmental justice communities, *Promising Practices* provides guidance for evaluating potential disproportionately high and adverse effects on minority and low-income populations. Issues considered in the evaluation of environmental justice include human health or environmental hazards; the natural physical environment; and associated social, economic, and cultural factors. A disproportionately high and adverse effect on an environmental justice community means the adverse effect is predominantly borne by such population or is appreciably more severe or greater in magnitude on the minority or low-income population than the adverse effect suffered by the non-minority or non-low-income population. Consistent with *Promising Practices* and Executive Order 12898, we reviewed the proposed action, the proposed action with staff modifications, and the no-action alternative to determine if the resulting effects would be disproportionately high and adverse on minority and low-income populations.

KRRC proposes to decommission and remove most of the project facilities and implement 16 management plans that detail procedures for drawing down the 4 reservoirs; removing the dams and associated facilities; restoring lands currently occupied by the dams, reservoirs, and other facilities; improving salmon access to historical and existing habitat; and minimizing adverse effects on environmental resources.

The environmental effects of the proposed action and associated protection, mitigation, and enhancement measures are described and analyzed in other subsections within section 3 of this EIS. In the text that follows, Commission staff addresses how those resource effects would affect the identified environmental justice communities described previously in section 3.13.3 and the extent to which environmental justice communities are subject to disproportionately high and adverse effects.

3.13.4.1 Geology and Soils (Slope Stability and Sediment Release)

Adverse effects of the proposed action include effects on slope stability, which could affect environmental justice communities. Reservoir removal-related effects on slope stability would generally be localized to the immediate area surrounding project reservoirs and facilities. Draining of project reservoirs, other than Copco No. 1, is expected to have minimal effect on bank stability and would be monitored by KRRC. Draining the Copco No. 1 Reservoir could cause bank instability at some private properties along the reservoir. Effects on slope stability are more fully addressed in section 3.1, *Geology and Soils*.

The proposed action would affect sediment release. The County of Siskiyou commented that the release of sediment from reservoirs could have effects on environmental justice communities. EPA requested that the EIS discuss potential project effects associated with exposure to toxins. Under the proposed action, sediment would be released into the Klamath River during dam removal. Drawdown of the four reservoirs would release an estimated total of 1.5 to 2.4 million tons of sediment (see table 3.1-3 in section 3.1, *Geology and Soils*). Effects related to sediment release are addressed further in sections 3.1, *Geology and Soils,* and 3.4, *Aquatic Resources*.

Sediment deposition may also result in streambed aggradation that would result in changes to the 100-year floodplain in the first 8 miles downstream from the Iron Gate Dam site. These changes in the 100-year floodplain would occur in environmental justice communities (see figure 3.13-1). The ability of available reservoir storage to decrease minor floods would be lost. Flood-related effects are discussed further in section 3.2, *Water Quantity*.

Our Analysis

The effects of reservoir drawdown on slope stability, particularly around Copco No. 1 Reservoir, would be short term, significant, and adverse, but KRRC proposes to mitigate the effects through communication with landowners and establishment of a mitigation fund to remediate effects on private property. With the implementation of KRRC’s monitoring and mitigation measures (including the local impacts mitigation fund) as part of the Reservoir Drawdown and Diversion Plan (KRRC, 2021e), potential effects of slope instability for landowners would be minimized or mitigated. The efficacy of this proposal relies on appropriate communication with the affected landowners, including environmental justice communities.

Sediment released from the reservoirs could be deposited on agricultural or residential lands downstream from the dam removal locations, which would be located in environmental justice communities (see figure 3.13-1). These environmental justice communities are located in Census Tract 2, Block Group 1; Census Tract 3, Block Group 1; and Census Tract 4, Block Group 1 in Siskiyou County, California. The deposition of reservoir sediment may result in changes in the character of soil along streambanks for up to 8 miles below Iron Gate Dam and could cause arsenic contamination, depending on the type of soil deposition that occurs. To mitigate for sediment deposits on private land related to drawdown activities, KRRC would assess sediment deposits on parcels with a residential or agricultural land use for which the property owner has notified KRRC of a potential sediment deposit that may be associated with reservoir drawdown activities. If the deposit appears to be consistent with the physical sediment properties of project reservoirs, KRRC would test the sediment for arsenic. If the concentration of arsenic in the deposited sediments exceeds local background levels and human health residential screening levels established by EPA or the California EPA, KRRC would remediate the deposited sediments to local background levels through removal of the deposited sediments or soil capping, if sediment removal is infeasible or poses a greater risk than soil capping. Therefore, with implementation of mitigation measures, effects on environmental justice communities associated with contaminated sediment would be short term and less than significant.

Flooding in the first 8 miles downstream of Iron Gate Dam (within environmental justice communities located in Census Tract 3, Block Group 1 and Census Tract 4, Block Group 1 in Siskiyou County, California), resulting from sediment deposition after dam removal, would have little effect on existing structures with implementation of mitigation measures, including working with owners to elevate structures above the floodplain and coordinating with the National Weather Service and Federal Emergency Management Agency to issue flooding alerts within the altered 100-year floodplain. Therefore, effects on environmental justice communities associated with changes in the 100-year floodplain would be less than significant.

Much of the sediment released after dam removal would remain in suspension and not be deposited in the river. This release of sediment could adversely affect fish populations in the short term. Effects related to aquatic resources, including fisheries, on environmental justice communities are more fully discussed below.

3.13.4.2 Water Supply

Removal of the project could affect water supply through the drawdown and removal of the J.C. Boyle, Copco No. 1, and Iron Gate Reservoirs. Effects on municipal and agricultural water supply, including those located outside the geographic scope of analysis for environmental justice, are described more fully in section 3.2, *Water Quantity.*

Regarding specific effects on environmental justice communities near the project, several individuals commented that the residential community along the shoreline of Copco No. 1 Reservoir includes many elderly people on fixed incomes who may experience adverse effects if reservoir drawdowns and dam removal affect their existing groundwater wells.

Our Analysis

Reservoir drawdown and dam removal could lower groundwater levels in the aquifer adjacent to the reservoirs, which could affect existing wells. Analysis of well depth, location relative to the reservoir, and underlying geology indicate that the largest potential effect on groundwater wells would be around Copco No. 1 Reservoir, which may affect an environmental justice community. KRRC proposes payments to mitigate effects on groundwater wells that are affected by the drawdown of J.C. Boyle Reservoir or that are within 1,000 feet of Copco No. 1 Reservoir, if residents agree to KRRC's well monitoring program. KRRC would conduct outreach to ensure that residents are aware of the well monitoring program. Given sufficient participation in the well monitoring program, adverse effects on environmental justice communities would be less than significant.

3.13.4.3 Aquatic Resources

Dam removal and restoration of the Klamath River could significantly affect aquatic habitat and fisheries. These effects are described more fully in section 3.4, *Aquatic Resources.* The relationship between Tribal Nations and the salmon fishery in the Klamath River is discussed in greater detail in section 3.11, *Tribal Trust Responsibilities*.

In addition to the numerous comments describing the potential benefits to members of Tribal communities resulting from dam removal and associated improvements to salmon populations, one individual raised concerns about the potential effects of dam removal on the existing reservoir fisheries and the communities that rely on those fisheries for sustenance. Specifically, the commenter described that the project's reservoirs experience heavy use for the purpose of fish gathering as a reliable source of food by the Hmong community and other potentially economically disadvantaged groups within Siskiyou County. The commenter stated that removal of this food source in favor of a different species (i.e., salmon), which is more expensive and difficult to catch, could have adverse effects on local environmental justice communities.

Our Analysis

The proposed action, including removal of project facilities and restoration of natural river flow, would improve water quality and remove barriers to spawning habitat for anadromous fish while simultaneously reducing the availability of habitat for flatwater panfish (perch, bass, and stocked rainbow trout). These changes would affect local anglers who supplement their diet with fish from the project reservoirs. While salmon and steelhead returns would provide angling opportunities to offset the loss of reservoir-based angling, these opportunities would be more seasonally limited and could require investment in heavier rods and reels suitable for catching larger fish. While other lakes are present in the surrounding area that would continue to provide opportunities for panfish angling, they may require additional driving time and be less accessible to local residents. This change in the availability of certain fish species may have a significant, long-term, adverse effect on environmental justice communities, particularly for individuals who predominantly use reservoirs for fishing.

3.13.4.4 Recreation

The removal of Copco No. 1 and Iron Gate Reservoirs under the proposed action would eliminate existing opportunities for reservoir-based recreation activities within environmental justice communities (Census Tract 3, Block Group 1 and Census Tract 4, Block Group 1 in Siskiyou County, California). Under the proposed action, the reservoirs would be permanently drained. Project recreation sites that would be removed include 44 developed and informal campsites at 5 different locations adjacent to Iron Gate Reservoir, picnic sites, restrooms, and shoreline access at all project recreation sites. After removal of the project dams, flatwater reservoir reaches would become free-flowing river reaches, and the bypassed and peaking reaches would have a more normative flow regime. Effects on recreation are more fully addressed in section 3.7, *Recreation*.

Our Analysis

Local recreational users of the reservoirs, recreation sites, and the Klamath River may include individuals from environmental justice communities. Drawdown and removal of the project's reservoirs would have an adverse effect on users who may be unable to travel extensively for their recreation use, including private property owners with docks and direct reservoir access adjacent to Copco No. 1 Reservoir. These effects would be significant, adverse, and permanent.

River recreation opportunities would increase at some locations and decrease at others. In particular, whitewater boating opportunities would improve in most reaches, but would be adversely affected in the Hell's Corner reach, where hydropower operations currently provide flows suitable for whitewater boating on a daily basis. There would be a permanent, significant, adverse effect on whitewater boating in the Hell's Corner reach from the reduction in the number of days with acceptable boating flows. Individuals from environmental justice communities may benefit or be adversely affected by these changes in whitewater boating opportunities, although it is unclear the extent to which local community members desire or engage in whitewater boating as a primary form of recreation.

In general, changes in the availability of recreation opportunities would affect both local and out-of-region visitors in similar ways, with the greatest adverse effects on individuals with shoreline access and those who primarily rely on the reservoirs for recreation, including members of environmental justice communities.

3.13.4.5 Fire Management

The proposed action would eliminate reservoirs currently used for both aerial-based and land-based firefighting activities and remove fire breaks that the reservoirs provide. KRRC proposes to implement an FMP that would provide measures for early detection of wildfires, assist property owners with creating defensible space around home sites, and provide additional facilities to access water for ground-based and aerial fire suppression efforts. CAL FIRE states that the measures described in the FMP would “not adversely affect CAL FIRE’s ability to provide an adequate and effective firefighting capability in Siskiyou County.” Oregon Department of Forestry concludes that the FMP “analysis of the incremental risks associated with dam removal project is accurate.” The Forest Service concurs with CAL FIRE’s assessment “that the FMP is more than adequate” and does “not anticipate this adversely affecting our ability to quickly and effectively respond to fires.” Fire management effects are more fully addressed in section 3.8.3.2, *Fire Management Plan.*

Our Analysis

Implementing the proposed action, including the measures identified in the FMP, would have a permanent, less than significant, adverse effect on the ability of state and federal wildland firefighting agencies to effectively respond to and suppress fires in the region. Access to open waterbodies for water scooping planes would be reduced by two reservoirs, but other bodies of water would remain available, and other types of tanker planes and helicopters are also used for aerial firefighting. The construction of new water access sites for refilling tanker trucks would compensate for the loss of boat ramps on the reservoirs to support ground-based wildfire suppression efforts, resulting in a less than significant effect on fire suppression efforts. The installation of additional monitored wildfire detection sites would have a long-term, significant, beneficial effect on the early detection of new fires in the region.

The removal of the project reservoirs would change the existing practices used by state and federal wildland firefighting agencies to respond to and suppress fires in the region. These changes may adversely affect communities in the project area, including environmental justice communities; however, these adverse effects on environmental justice communities would be mitigated through implementation of the FMP and would not be disproportionately borne by the environmental justice communities.

3.13.4.6 Traffic

Transportation of personnel, supplies, equipment, and the disposal of waste material would result in short-term increases in traffic on I-5, OR66, US97, and local access roads. The County of Siskiyou commented that potential effects on environmental justice communities could include increased traffic. Traffic effects are more fully addressed in section 3.8.3.4, *Road Management and Traffic*.

Our Analysis

The short frequent trips associated with the deconstruction and transport of waste material to on-site disposal locations would cause traffic flow concerns within the construction zone. Increases in construction traffic at these locations would have a temporary, significant, adverse effect, partially mitigated by on-site signage and construction traffic management.

Construction trucks transporting waste material to off-site disposal locations over unpaved roads would create a substantial amount of dust causing a visibility hazard for other vehicles. Installation of signage, dust abatement measures, and proper construction traffic management would be implemented to reduce the generation of airborne dust. There would be a short-term, less than significant, adverse effect on road visibility because of dust.

Temporary (48 to 72 hours) road closures would be needed to construct improvements at culvert and bridge crossing sites to support construction vehicles. Advanced community warning and traffic control safety management procedures would be implemented during all road construction activities. Road construction at bridge and culvert sites would have temporary, adverse effects on traffic. Overall, increases in traffic by construction personnel, hauling trucks and other heavy machinery during dam removal, and associated activities would have a temporary, significant, and adverse effect on congestion, road safety and conditions, and emergency response time in the project area. Once deconstruction is completed, traffic flows would return to current, existing conditions.

Local residents, including environmental justice communities identified within 5 miles of the project's boundary, would experience adverse effects. However, these effects would be limited to periods of deconstruction over the course of a two-year period, and the effects on environmental justice communities would be temporary, significant, and adverse.

3.13.4.7 Aesthetics

Dam removal would include both long- and short-term visual effects. During the first two years following dam removal, vegetation in the formerly inundated areas would comprise low-growing grasses, forbs, and small shrubs. Shrubs and trees would increase in number and height in subsequent years as plantings mature and ecological succession progresses. In areas immediately adjacent to the river channel that are bedrock-controlled, the restored vegetation characteristics are expected to be sparse, as is typical in nearby undisturbed reaches of the river. Over the long term, vegetation and landscape characteristics in revegetated areas are expected to match the surrounding natural landscape conditions. KRRC has proposed to mitigate visual changes by revegetating all disturbed areas with locally representative native plant communities, thus blending the disturbed areas into the surrounding landscape. Other visual changes expected to occur include loss of long-distance, open-water vistas; exposure of barren reservoir footprints; revegetation of barren reservoir footprints and deconstruction sites; changes in river channel flows; removal of project facilities (dams, powerhouses, recreation sites); and construction activity. Visual effects are more fully addressed in section 3.9, *Aesthetics*.

Our Analysis

Draining of the project reservoirs would have a short-term, adverse visual effect and a permanent visual effect that may be either adverse or beneficial, depending on the viewer. As previously described, over the long term, vegetation and landscape characteristics in revegetated areas are expected to match the surrounding natural landscape conditions. KRRC has proposed to mitigate visual changes by revegetating all disturbed areas with locally representative native plant communities. Viewers include both local users of the reservoirs and river, users of local roads, and individuals living adjacent to the reservoirs. Given the presence of environmental justice communities in the project area, these viewers would also include residents of environmental justice communities.

3.13.4.8 Socioeconomics

The proposed action may affect socioeconomic factors, including population and housing, employment, community services, tax revenue, social programs, and property values.

The County of Siskiyou commented that potential effects on environmental justice communities could include changes in property values, which, in turn, would affect county revenues. The County of Siskiyou states that these changes in revenues may result in decreases in county funding of social programs, which may affect environmental justice communities.

In addition, several individuals commented that the residential community along the shoreline of Copco No. 1 Reservoir includes many elderly people on fixed incomes. Commenters noted that project effects on response times for emergency response vehicles would affect this community. Further, commenters expressed concern that removal of the project’s reservoirs would result in adverse effects on property values along the reservoirs’ shorelines.

Our Analysis

Deconstruction of the project and associated restoration activities would result in short-term changes in local employment and population. A population increase of a maximum of 80 workers during peak construction would have a negligible effect on the populations of the two counties in which the project facilities are located. The Copco No. 2 Construction Camp (Copco Village) is the only site that would house construction crews, so no additional burden on housing would occur. Effects on population and housing within environmental justice communities would be negligible.

Dam removal would create temporary full- and part-time jobs for workers directly engaged in deconstruction and restoration activities, and related administrative staff. The peak dam removal period would require 35 to 80 workers depending on the dam. Removing the four dams in Siskiyou and Klamath Counties would result in long-term job losses (approximately 49 jobs) associated with project operations and maintenance. This loss would represent a 0.6 percent increase in unemployment in the two counties. However, it is likely that additional jobs would be created from new recreational opportunities on the river for fishing and whitewater boating, which would have a beneficial effect on job creation. The loss and addition of jobs may affect individuals from environmental justice communities; however, adverse effects due to changes in employment status would be less than significant.

The temporary influx of workers into environmental justice communities could increase the demand for community services, such as law enforcement and emergency medical services. However, adequate capacity exists to address the increased demand associated with the temporary increase of 35 to 80 workers in the project area. The effect on residents in the project area would be temporary, and the effect on environmental justice communities would be negligible.

The proposed action could result in a short- and long-term decrease in tax revenue for the counties due to the loss of tax revenue from PacifiCorp and a possible drop in property taxes due to a drop in property values near the reservoirs. However, increased property values near and adjacent to the Klamath River may result in an additional long-term increase in property tax revenues associated with improved water quality and restoration of fisheries and a more natural landscape. As indicated in the comments of the County of Siskiyou, counties use tax revenue to fund programs such as public health, welfare, education, and a variety of other services. Tax revenue declines, estimated to be between $600,000 and $800,000 per year in Siskiyou County (comment letter from Representative LaMalfa, filed on August 20, 2021), could reduce funding for these programs, which could have a long-term, significant, adverse effect for people in Siskiyou and Klamath Counties who rely on government assistance; however, the relationship between changes in property values, tax revenue, and county services is unclear. For example, Interior and NMFS (2013) found net positive economic effects of dam removal and river restoration ranging from $14,052.5 million to $82,663.2 million over 50 years. In fiscal year 2020, Siskiyou County received $19.7 million in property tax and sales and use taxes. Based on estimates provided by commenters, a $800,000 reduction in tax revenue would constitute a 4 percent reduction in tax revenue for the county.

In terms of the direct effects on private property values, some studies reported increases in value following dam removal (Interior and California DFG, 2012). Increases in value were generally related to improvements in water quality, removal of dam structures, and the enhancement of the natural riparian environment. Other studies described private property values decreasing briefly and regaining value by the end of two years (Kruse and Scholz, 2006). Another study concludes that lake adjacency does have a positive and significant effect on residential property values and that, all things being equal, properties on a lake, with lake proximity or a lake view are worth more than properties without these characteristics (Kruse and Ahman, 2009). Dam removal could influence a potential buyer's decision to purchase a property, depending on the buyer's preference for lakefront or river-front property as well as a host of other property-specific preferences. Any changes in property value resulting from the proposed action are likely to affect environmental justice communities around Copco No. 1 and Iron Gate Reservoirs because the block groups that border those reservoirs are considered environmental justice communities; however, the direction or significance of the effect on property values is unclear.

3.13.4.9 Air Quality and Noise

Temporary effects on air quality and noise may occur as a result of the proposed action. Construction activities would result in emissions of criteria pollutants through fugitive dust and vehicle exhaust. Construction air emissions from the removal of the four dams and associated infrastructure would occur over a 20-month period. In addition to all applicable local, state, or federal requirements, KRRC proposes to implement air quality control measures to reduce effects associated with emissions of particulate matter and other toxics from construction-related activities. Air quality effects are more fully addressed in section 3.15, *Air Quality and Noise*.

The effects of the proposed action on environmental justice populations would also include noise associated with construction-related activities. There would be no long-term, significant effects on noise from the proposed action because the Lower Klamath Project facilities would be removed. The worst-case noise levels were calculated to be momentary instances where noise levels may reach 94 A-weighted decibels (dBA) at 50 feet from the source during blasting, and between 88 and 91 dBA at 50 feet from the dam removal sites during both daytime and nighttime shifts. For comparison, a power lawnmower is 90 dBA at the operator's ear (OSHA, 2011). Noise levels would vary over the course of the work shift and over the course of dam removal as tasks and associated noise levels change. Noise effects are more fully addressed in section 3.15, *Air Quality and Noise*.

The County of Siskiyou commented that potential effects on environmental justice communities could include emissions affecting air quality and noise associated with construction activities.

Our Analysis

KRRC's proposed air quality control measures are standard mitigation measures that would minimize adverse effects on populations near the construction zone. Installation of signage, dust abatement, and proper construction traffic management would help to reduce the generation of airborne dust. With the implementation of mitigation measures, construction emissions from the proposed project would still result in short-term, significant, and unavoidable adverse effects from NOx emissions. These temporary, significant, and unavoidable adverse air quality effects would be experienced by environmental justice communities within the project area.

With regard to the effects of construction on noise, receptors near Iron Gate Dam, Copco No. 1 Dam, Copco No. 2 Dam, and J. C. Boyle Dam would experience significant noise level increases during the daytime construction shift. Receptors near the Copco No. 1 Dam, which is surrounded by environmental justice communities, would experience short-term and significant noise levels increases during both daytime and nighttime. The threshold of significance for this effect is "a greater than 10 dBA increase in the daytime or nighttime outdoor one-hour Leq at the receptor from on-site construction operations" (see section 3.15). To be conservative, an increase of 9 dBA during the night shift (6:00 pm to 4:00 am) at Copco No. 1 Dam was also identified as significant. The proposed noise and vibration control plan (NVCP) (described further in section 3.15, *Air Quality and Noise*) would minimize short-term outdoor noise effects and would require a final NVCP from the construction contractor. However, the effects on receptors, including individuals living in environmental justice communities, would be short term and significant.

3.13.4.10 Cumulative Effects

EPA also requested that the EIS discuss cumulative or multiple adverse exposures from environmental hazards and their effect on environmental justice communities. Within the next 25 years, the reasonably foreseeable trends or planned actions in the project area include other restoration activities such as fish passage and habitat enhancement; implementation of TMDLs for Oregon and California; Klamath River flows required by the FWS and NMFS Biological Opinions and required by court order (U.S. District Court 2017); forestry practices and increasing wildfires; and expanding agriculture in the region. With the notable exception of the potential for increased wildfire, overall, cumulative effects on environmental justice communities would be long term and beneficial and would include improvements in water quality and aquatic resources from the conversion of the impounded reaches into a free-flowing river and the restoration of access for salmon and steelhead to historical habitat.

3.13.4.11 Determination of Disproportionately High and Adverse Effects for the Proposed Action

The proposed action would have both beneficial and adverse effects on the four identified environmental justice communities within a 5-mile radius of the project boundary and within a 1-mile buffer of the Klamath River, downstream of the project facilities to the confluence of the Klamath River and Humbug Creek. We compare the effects on these communities to the effects on the general population within the geographic scope.

Effects on the natural and human environment from the proposed action include effects related to slope stability and sediment release; flooding; water supply including groundwater wells; water quality and aquatic resources, particularly fisheries; recreation; fire protection; traffic; aesthetics; socioeconomics; and air quality and noise. Effects on environmental justice communities related to these topics are discussed throughout this section and in greater detail in the associated sections of this EIS. Effects on Tribes are addressed in sections 3.10, *Cultural Resources*, and 3.11, *Tribal Trust Responsibilities*. This discussion pertains to effects on environmental justice communities as a whole.

In general, the magnitude and intensity of the aforementioned effects would be greater for individuals and residences closest to the project reservoirs and facilities and would diminish with distance. Environmental justice concerns are not present for other resource areas, such as terrestrial resources and threatened and endangered species, because of the minimal overall effect that the proposed action would have on these resources and/or the absence of a clear connection between such resources and effects on environmental justice communities.

As highlighted in table 3.13-1, 4 of 11 census block groups in the project area are environmental justice communities. These block groups border the Copco No. 1 and Iron Gate Reservoirs and the Klamath River below Iron Gate Dam. Both the beneficial and adverse effects associated with removal of the project dams and restoration activities would be predominantly borne by environmental justice communities.

Temporary, adverse effects on environmental justice communities associated with dam removal activities include effects on slope stability, sediment deposition, air quality, noise, and traffic. Many of these effects would be significant. However, KRRC proposes mitigation associated with these resources as discussed throughout this section. Implementation of mitigation measures during project deconstruction could reduce the temporary effects on environmental justice communities, but these measures rely on the quality of communication between KRRC and the environmental justice communities to be effective. Thus, we strongly recommend that KRRC communicate with the identified communities. When not mitigated, these temporary effects would disproportionately affect environmental justice communities because of their localized nature and because most project facilities (especially those associated with Copco No. 1 Reservoir) are located in environmental justice communities.

Long-term, potential adverse effects on environmental justice communities would be related to groundwater wells, fire management, reservoir angling, changes in access to and type of recreation opportunities, and changes in county tax revenues. More subjective, long-term, adverse effects on environmental justice communities include changes in aesthetics. Removal of the project reservoirs could affect the use of existing groundwater wells by environmental justice communities, particularly around Copco No. 1 Reservoir. Implementation of KRRC's mitigation measures would reduce the significance of these effects. Additionally, KRRC intends to enhance its outreach regarding the proposed well monitoring program. Removal of the reservoirs would also result in adverse effects associated with state and local fire management. These effects would be borne by both environmental justice communities and the surrounding project area and would be mitigated through the proposed FMP.

Changes in fishing opportunities as the aquatic species in the project area move from lake-dwelling panfish to riverine species, like salmon and steelhead, would affect environmental justice communities that use the reservoirs for subsistence, including the Hmong community in Siskiyou County, California. Environmental justice communities may not have the same ability to easily switch to alternative fishing locations as reference populations. While fishing access may improve overall, the effect on communities that rely on the lakes for subsistence fishing would be permanent and could disproportionately affect environmental justice communities.

Individuals from environmental justice communities would similarly experience changes to recreational activities away from reservoir-based recreation and to river-based recreation. The adverse effects of the loss of reservoir-based recreation would be borne primarily by residents adjacent to the existing project reservoirs with direct reservoir access. All reservoirs, except J.C. Boyle Reservoir, are located within environmental justice communities. The loss of access to reservoir-based recreation opportunities would affect shoreline residents, including those in both environmental justice and non-environmental justice communities, as well as out-of-region visitors. If a majority of users of the reservoir are low-income or minority individuals, the effect on environmental justice communities may be disproportionate.

Potential reductions in county tax revenue would predominantly be associated with the loss of tax revenue from PacifiCorp and potential changes in property values associated with lakefront properties. The extent and direction of effects on tax revenue are unclear given existing information. Any adverse effects would occur in Klamath County, Oregon, and Siskiyou County, California. Klamath County, Oregon, has no environmental justice communities within the project's geographic scope of analysis, whereas Siskiyou County, California, includes three of the four identified environmental justice communities. Therefore, effects on county tax revenue would occur in both environmental justice and other communities within the geographic scope. When these reductions in tax revenues are applied to county-level services, such as law enforcement or emergency medical services, county residents would be affected equally. If reductions in tax revenues affect programs that benefit low-income individuals, adverse effects on environmental justice populations may be disproportionate.

Long-term, beneficial effects would also occur as a result of the proposed action, including increased river recreation opportunities, restoration of the natural geomorphology in the hydroelectric reach, long-term improvements in aquatic habitat, and restoration of the salmon and steelhead fisheries.

Based on our analysis, we conclude that the proposed action would have a disproportionately high and adverse effect on environmental justice populations. However, the effects associated with the proposed action would mostly be mitigated, and beneficial effects associated with dam removal would outweigh the long-term, adverse effects associated with the proposed action.

3.13.5 Effects of the Proposed Action with Staff Modifications

3.13.5.1 Slope Stability, Sedimentation, and Groundwater Wells

KRRC proposes several mitigation measures to address sediment deposits on private land, private groundwater well production, and slope stability on private lands that require landowners to notify KRRC if the landowner is concerned about potential project effects on property following dam removal. However, the Sediment Deposit Remediation Plan, California Slope Stability Monitoring Plan, and Water Supply Management Plan do not include a public outreach component to ensure property owners are aware of resources available to private landowners that are provided in the plans. KRRC committed to conducting additional outreach regarding well monitoring, but that commitment is not captured in the Water Supply Management Plan. Of the seven census block groups that may experience effects of sediment deposits (between J.C. Boyle Dam and Humbug Creek), four are environmental justice communities. In the Water Supply Management Plan, KRRC notes that it sent mailings to identify groundwater well owners to help collect pre-dam removal data on water wells, but only received responses from four landowners agreeing to participate in the program. Development of a public outreach campaign that specifically addresses these challenges would ensure all property owners are aware that assistance and remediation programs exist and would increase potential for enrollment in such programs. Because the proposed sediment deposit remediation measures are predicated on landowners informing KRRC that remediation may be needed, successful communication with the affected communities would be imperative to ensuring the proposed remediation is successful in minimizing effects of sediment deposits, as is the case for effects on private well production, and slope stability. Therefore, staff recommends KRRC revise the Sediment Deposit Remediation Plan, Water Supply Management Plan, Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services, to include a required public outreach component that specifically addresses communication with environmental justice communities, with consideration that public outreach to environmental justice communities can be complicated by limited access to online resources, language barriers, and potential distrust of government or corporate entities.

3.13.5.2 Recreation

KRRC proposes to place signage at existing recreations sites to inform users of closure dates and potential dangers associated with the altered reservoir landscape following reservoir drawdown. However, the Recreation Facilities Plan does not indicate whether these signs would include any languages other than English. Including signs in Spanish and Hmong would increase potential for non-English speakers to access the information and improve communication with environmental justice communities.

3.13.5.3 Determination of Disproportionately High and Adverse Effects for the Proposed Action with Staff Modifications

Under the proposed action with staff modifications, effects on the four identified environmental justice communities within a 5-mile radius of the project boundary and within a 1-mile buffer of the Klamath River downstream of the project facilities to the confluence of the Klamath River and Humbug Creek, would be largely similar to the effects under the proposed action. However, in addition to implementation of KRRC's mitigation plans, plans would be required to include specific measures for conducting outreach to environmental justice communities regarding mitigation of effects related to slope stabilization, sediment releases from the reservoirs, and groundwater well monitoring. Further, KRRC would be required to include signage at recreation areas in languages other than English to improve language accessibility for environmental justice communities. These measures would reduce the significance of short- and long-term, adverse effects on environmental justice communities. Although the overall effects of the proposed action with staff modifications would continue to be disproportionately high and adverse, the additional mitigation recommended by staff would improve conditions for environmental justice communities over the proposed action. Importantly, the beneficial effects associated with dam removal would outweigh the long-term, adverse effects associated with the proposed action with staff modifications.

3.13.6 Effects of the No-action Alternative

Under the no-action alternative, there would be no change in geology and soils, water quantity, land use, aesthetics, socioeconomics, or air quality and noise compared to existing conditions. Therefore, there would be no effects on environmental justice communities related to these resources. These topics are not discussed further in this section.

3.13.6.1 Water Quality and Aquatic Resources

Under the no-action alternative, there would be no changes in the mobilization of suspended sediments within and below the project area compared to current conditions. Any contaminated sediments held behind the project dams would remain in place and continue to exceed human health screening levels for fish consumption in the reservoirs. The reservoirs would continue to adversely affect water temperature, nutrients, DO, pH, algal toxins, inorganic and organic contaminants, and fish pathogen abundance within and downstream of the hydroelectric reach. Adverse effects on salmon and steelhead from poor water quality and disease outbreaks are expected to worsen if the trend of increasing water temperatures observed over recent decades continues. Upstream passage would remain blocked to salmonids at Iron Gate Dam, and Chinook salmon returns to the Klamath River would continue to depend on hatchery production, likely continuing to decline. Ongoing, periodic restrictions and low harvest rates would continue to adversely affect commercial and recreational salmon fisheries. These effects would, in turn, have adverse effects on environmental justice communities, particularly for individuals who use the river for fishing (including recreationally, commercially, and for subsistence). These effects are more fully addressed in section 3.3, *Water Quality*, and 3.4, *Aquatic Resources*. The relationship between Tribal Nations and the salmon fishery in the Klamath River is discussed in greater depth in section 3.11, *Tribal Trust Responsibilities*.

3.13.6.2 Recreation

Under the no-action alternative, O&M of recreation facilities associated with the project would not change compared to existing conditions. Recreation opportunities provided by the reservoirs would continue, but new opportunities associated with restoration of the river to a more natural state would not be provided. Poor conditions in the reservoirs resulting from algae blooms are likely to continue, which would limit contact recreation in the summer. The effects of continued operation of existing recreation facilities, and effects on those facilities by the project, would be borne by all recreation users. However, if a majority of users of the reservoirs are low-income or minority individuals, a disproportionate adverse effect on environmental justice communities could occur. Recreational effects are more fully addressed in section 3.7, *Recreation*.

3.13.6.3 Determination of Disproportionately High and Adverse Effects for the No-action Alternative

As highlighted in table 3.13-1, 4 of 11 census block groups in the project area are considered environmental justice communities. As described throughout this EIS and in detail throughout this section, the no-action alternative would have a range of effects on individuals living in the vicinity of the project facilities, including individuals from environmental justice communities. Effects on Tribes are specifically addressed in sections 3.10, *Cultural Resources*, and 3.11, *Tribal Trust Responsibilities*.

The dams would continue to adversely affect environmental justice communities by changing water quality and decreasing the quality of the salmon fishery. The salmon population would likely be severely diminished within several decades due to deteriorating water quality and increased disease incidence. Effects associated with the no-action alternative on environmental justice communities would remain unmitigated; long-term, adverse effects on environmental justice communities would continue, particularly among communities that rely on the river for fishing and recreation. Based on our analysis, we conclude that the no-action alternative would have a disproportionately high and adverse effect on environmental justice populations that would remain unmitigated.

Table 3.13-1. Minority populations by race and ethnicity and low-income populations in the project area (Source: U.S. Census Bureau, 2019i,j, as modified by staff)

		Race and Ethnicity									**Low-Income**
State/County/ Tract/Block Group	**Total Population**	**White (Not Hispanic)**	**Black or African American**	**Asian**	**American Indian and Alaskan Native**	**Native Hawaiian and Other Pacific Islander**	**Some Other Race**	**Two or More Races**	**Hispanic or Latino**	**Total Minority**	**Incomes Below 200% Poverty Level**
California	**39,512,223**	**59.4%**	**5.8%**	**14.8%**	**0.8%**	**0.4%**	**13.7%**	**5.0%**	**39.4%**	**40.6%**	**31.0%**
Siskiyou County	**43,468**	**76.1%**	**1.6%**	**1.6%**	**3.2%**	**0.3%**	**0.1%**	**4.5%**	**12.6%**	**23.9%**	**41.3%**
Census Tract 2, Block Group 1[a]	1,711	57.1%	0.8%	0.5%	2.7%	0.0%	0.0%	0.9%	38.0%	**42.9%**	**53.8%**
Census Tract 3, Block Group 1[a,b,c,d]	1,831	79.2%	0.1%	0.4%	5.1%	0.3%	0.0%	3.8%	11.2%	20.8%	**38.1%**
Census Tract 3, Block Group 2[a,b]	1,028	82.5%	0.0%	0.0%	3.6%	0.0%	0.0%	5.8%	8.1%	17.5%	27.9%
Census Tract 4, Block Group 1[a,b,c]	656	88.4%	0.0%	0.0%	2.3%	0.0%	0.0%	3.4%	5.9%	11.6%	**47.0%**
Census Tract 7.01, Block Group 2[b]	891	88.7%	0.4%	4.5%	0.9%	0.4%	0.0%	2.9%	2.1%	11.3%	26.3%
Oregon	**4,217,737**	**83.5%**	**1.8%**	**4.6%**	**1.2%**	**0.3%**	**3.5%**	**4.9%**	**13.4%**	**16.5%**	**30.8%**
Jackson County	**216,574**	**80.8%**	**0.7%**	**1.3%**	**1.1%**	**0.3%**	**0.2%**	**2.8%**	**12.8%**	**19.2%**	**36.3%**

		Race and Ethnicity									Low-Income
State/County/ Tract/Block Group	**Total Population**	**White (Not Hispanic)**	**Black or African American**	**Asian**	**American Indian and Alaskan Native**	**Native Hawaiian and Other Pacific Islander**	**Some Other Race**	**Two or More Races**	**Hispanic or Latino**	**Total Minority**	**Incomes Below 200% Poverty Level**
Census Tract 25, Block Group 2[a]	695	95.8%	1.7%	0.0%	0.0%	0.0%	0.0%	2.0%	0.4%	4.2%	**36.0%**
Klamath County	**66,921**	**77.9%**	**0.7%**	**1.0%**	**3.9%**	**0.1%**	**0.0%**	**3.4%**	**13.1%**	**22.1%**	**44.3%**
Census Tract 9703, Block Group 1[a,e]	543	93.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.0%	0.0%	7.0%	29.7%
Census Tract 9703, Block Group 2[a]	476	97.3%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%	2.7%	12.0%
Census Tract 9703, Block Group 3[a]	840	92.7%	0.0%	0.0%	0.8%	0.0%	0.0%	5.0%	1.4%	7.3%	12.1%
Census Tract 9703, Block Group 4[a]	939	94.4%	0.0%	0.0%	0.0%	0.0%	0.0%	4.6%	1.1%	5.6%	21.4%
Census Tract 9709, Block Group 1[a]	2,149	82.1%	0.7%	0.7%	4.1%	0.3%	0.0%	1.4%	10.5%	17.9%	13.8%

Notes:

[a] Census block group within a 5-mile radius of project facilities.

[b] Census block group within a 1-mile buffer of Klamath River, approximately 18 miles downstream to Humbug Creek.

[c] Iron Gate Dam and Reservoir are in this block group.

[d] Copco No. 1 Dam and Reservoir and Copco No. 2 Dam are in this block group.

[e] J.C. Boyle Dam and Reservoir are in this block group.

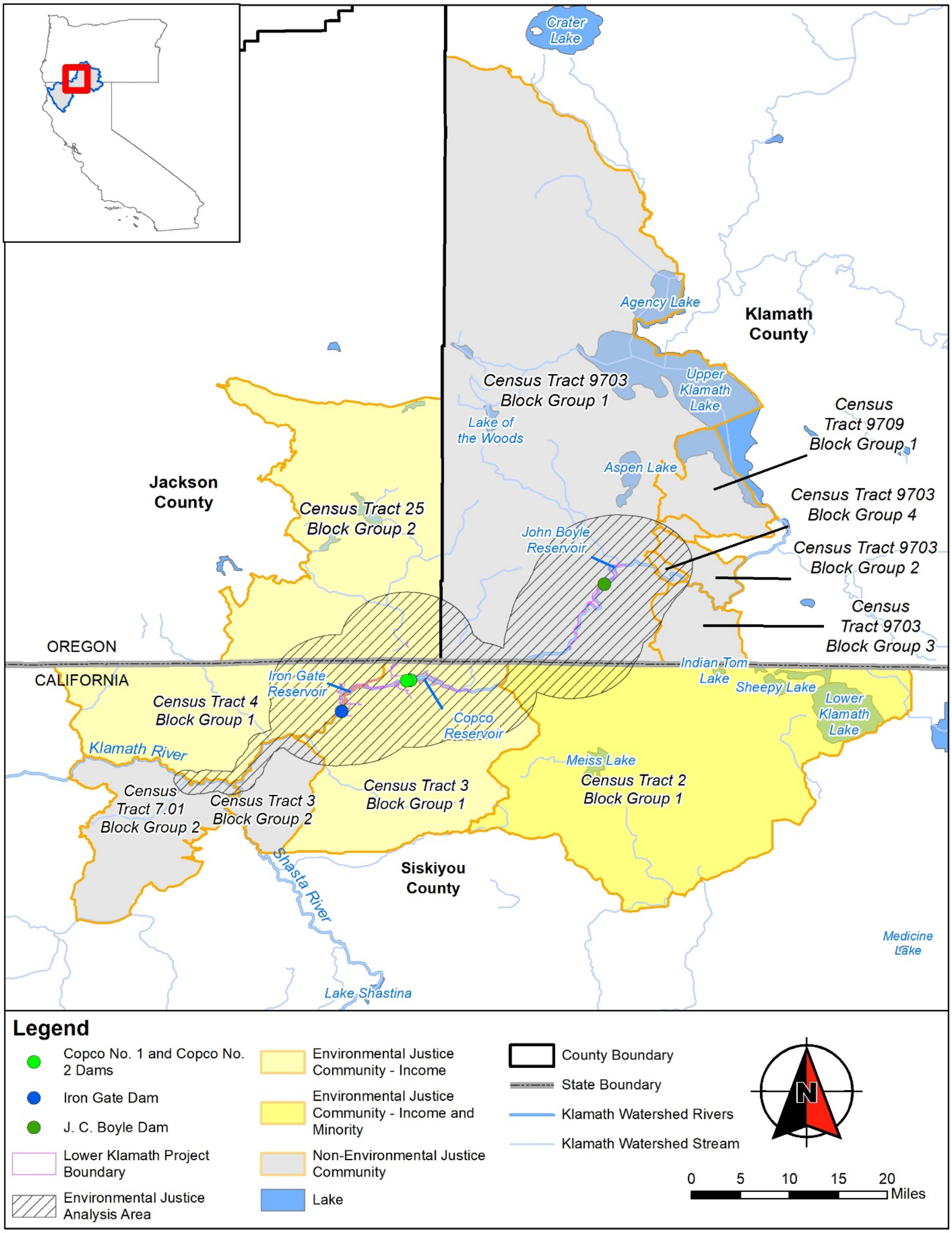

Figure 3.13-1. Environmental justice communities located in proximity to the proposed action (Source: staff)

3.14 PUBLIC SAFETY

3.14.1 Geographic and Temporal Scope of Analysis

The geographic area for public safety includes areas in the vicinity of hydroelectric project and associated facilities. The temporal extent of our effects analysis is limited to temporary effects during deconstruction and restoration activities.

3.14.2 Affected Environment

PacifiCorp operates and maintains multiple project recreational facilities along the Klamath River from the head of J.C. Boyle Reservoir to Iron Gate Dam, as well as other non-project recreational facilities. Project recreational facilities provide access for recreational uses including swimming, fishing, boating (flatwater and whitewater), picnicking, camping, day and overnight uses, off-highway vehicles, and target shooting; some of the facilities provide restrooms.

All of PacifiCorp's facilities are open to the public. PacifiCorp maintains public safety and informational signage at these sites and installs and maintains boat barriers upstream of each project dam, even at facilities where public access to the reservoirs is not allowed.

PacifiCorp restricts access to the power canal and forebay area at the J.C. Boyle development through the installation of signage and fencing. It does not allow public access to Copco No. 2 Reservoir because of the steep topography surrounding the reservoir, its small size, its narrow configuration, and difficult access.

3.14.3 Effects of the Proposed Action

Public safety concerns related to project decommissioning include making sure that there would be no people in the river valley below the dams or on the reservoirs when the reservoirs are drained and guarding against construction/demolition site hazards during project removal. Other concerns include increased traffic safety hazards and the potential for increased emergency response times due to truck and heavy equipment use of local roads and potential instability of exposed reservoir sediments when the reservoirs are dewatered. Effects of the proposed action on water quality, which can affect public safety due to changes in exposure to microcystin from water-based recreation, is discussed in section 3.3, *Water Quality*.

KRRC proposes measures in its Health and Safety Plan, as well as in its Oregon and California Traffic Management Plans and Emergency Response Plan (included as subplans within the proposed Construction Management Plan). KRRC would establish a safety committee to: (1) review and implement the safety policy; (2) develop work practices and procedures that comply with the KRRC's safety policy, applicable laws and regulations, and jobsite plans; (3) review new health and safety standards and regulations for applicability to work environment; (4) identify any deficiencies and establish procedures to eliminate those deficiencies, including on-site inspection programs;

(5) inform employees of any changes to work practices and procedures that are required to maintain compliance; and (6) review and make recommendations to management regarding safety suggestions and/or recommendations from individual employees. The Health and Safety Plan identifies safety-related responsibilities for the safety committee, corporate management, the environmental and health safety director, construction project superintendents, forepersons and field crews, subcontractors, owner's representative, and KRRC employees.

Under the proposed Health and Safety Plan, KRRC would:

(1) Provide employees and contractors with guidelines for working safely and identify laws that apply to the work; provide necessary resources, PPE, and maintain safe work environments; and provide safety training to promote safe work practices.

(2) Conduct general and detailed weekly inspections of the jobsite.

(3) Develop a site-specific emergency plan that describes the procedures to be followed in the event of an emergency.

(4) Report and investigate accidents.

(5) Prepare an operation-specific hazard analysis for each work activity, including assessment of risks to employees, contractors, and the public.

(6) Prepare a traffic management plan to provide for safe and orderly vehicular movements to include: (a) descriptions of planned traffic phasing; (b) procedures for coordinating with jurisdictions and stakeholders; (c) methods and frequency of inspection for traffic control; (d) response times and methods to maintain traffic control devices; (e) procedures to obtain approval from applicable jurisdictions; (f) procedures for public communications; (g) identification of the traffic control supervisor and traffic control manager; (h) identification of personnel responsible for establishing and maintaining traffic control devices; and (i) procedures for inspection and documentation when traffic control devices are in place.

(7) Prepare a public safety plan that describes the types of hazards and the measures KRRC would implement to reduce the risk of injury to the public as a result of the proposed action. Under this plan, KRRC would perform a public safety risk assessment that identifies public access points, likely public activities (river rafters, fishing, scavenging, residential living, sightseeing, camping), identifying associated risk for these activities (stranding, drowning, falling, electrocution), risk reduction barriers (gates, signage, direct outreach, social media, law enforcement), and land control limits. The plan would take into consideration the outcomes from the Emergency Action Plan exercises and Potential Failure Modes Assessment, to fully characterize the public safety risk.

The proposed Oregon and California Traffic Management Plans describe the measures KRRC would implement to maintain efficient and safe movement of vehicles throughout the construction zones and construction activities at each of the four developments. The plans are designed to prevent unreasonable traffic delays and maintain acceptable levels of service; traffic circulation; and safety on state, county, and private roadways used during deconstruction and restoration activities. KRRC is consulting with the County of Siskiyou to develop a final MOA that addresses the County's regulatory interests with respect to traffic control, roadway alignment and maintenance, and related topics.

The proposed Emergency Response Plan defines the roles, responsibilities, and procedures to be followed in the event of an emergency during implementation of the proposed action. The plan is designed to minimize hazards to employees, the public, or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous materials, hazardous waste, or hazardous constituents to air, soil, surface water or groundwater.

Our Analysis

Based on our review of the proposed Health and Safety Plan, Oregon and California Traffic Management Plans, and Emergency Response Plan, we conclude that these plans would effectively minimize risks to public safety and traffic delays caused by deconstruction and restoration activities. Effects of the proposed action on safety issues related to fire suppression are addressed in section 3.8, *Land Use*.

3.14.4 Effects of the Proposed Action with Staff Modifications

The effects would be the same as the proposed action.

3.14.5 Effects of the No-action Alternative

Under the no-action alternative, there would be no change in public safety from current conditions.

3.15 AIR QUALITY AND NOISE

3.15.1 Geographic and Temporal Scope of Analysis

Our geographic scope of analysis for air quality includes areas within the counties of Siskiyou (California) and Klamath (Oregon) for potential effects on measures needed to meet renewable energy standards. The temporal extent of our effects analysis ranges from short-term effects of deconstruction activities to permanent effects on GHG emissions. The geographic area for noise includes areas in the vicinity of the project dams, powerhouses, canals, and associated facilities and the haul routes to and from these facilities. The temporal extent of our effects analysis is limited to temporary effects during deconstruction and restoration activities.

3.15.2 Affected Environment

3.15.2.1 Air Quality

The air quality of an area reflects the existing emission sources combined with the meteorology, climate, and topography of the area. Air pollution is harmful to health (e.g., respiratory distress, premature death), reduces visibility, and damages vegetation (e.g., agricultural crops, forests) (CARB, 2020a). The affected environment for the proposed project includes the counties in which the Lower Klamath Project is located or where construction vehicles or workers may travel. In California, the Lower Klamath Project and all associated construction and decommissioning activities are within the Siskiyou County Air Pollution Control District, with activity at J.C. Boyle located in Klamath County, Oregon. Emissions estimated were conducted in accordance with Siskiyou County Air Pollution Control District guidance and approved methods. Similar guidance for Klamath County was not identified.

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM), and lead (EPA, 2018). (For more information regarding national and state ambient air quality standards see appendix J, *Air Quality Analysis*.) Particulate matter is further designated into two different size classes: PM_{10} (particle size less than 10 microns) and $PM_{2.5}$ (particle size less than 2.5 microns). In addition, the State of California has developed California Ambient Air Quality Standards for 10 pollutants.

The status of criteria pollutants in an area is described by three categories: attainment, non-attainment, and unclassified (EPA, 2020a). According to EPA's definition, an area that meets or exceeds the standard is designated as in attainment/unclassifiable. Areas that do not meet air quality standards are in non-attainment. Areas are designated as unclassifiable if EPA is unable to determine the status based on the available information (EPA, 2020a). Maintenance areas are areas that were previously a non-attainment area but are now consistently meeting the NAAQS.

Siskiyou County is in attainment or unclassified for all criteria pollutants (CARB, 2020b) (table 3.15-1). The portion of the proposed project in the State of Oregon is within an area that is designated as in attainment for all criteria air pollutants. There are areas surrounding the proposed project where construction vehicles or workers may travel that are in maintenance or non-attainment areas; these areas include the Klamath Falls Urban Growth Boundary, the Klamath Falls non-attainment area, and the Medford-Ashland Air Quality Maintenance Area (Oregon DEQ, 2020b). Additional data regarding ambient air quality and attainment area designations are provided in the California Water Board's EIR (California Water Board, 2020a). Appendix N of the California Water Board's EIR, *Air Emissions Modeling for the Lower Klamath Project,* provides a summary of the existing emission sources and monitoring data, detailed emission calculation methodologies, and detailed emission inventories.

Section 176(c) of the Clean Air Act, 42 U.S.C § 7506, prohibits federal agencies from taking actions that do not conform to the State Implementation Plan for the attainment and maintenance of the NAAQS. The purposes of conformity are to ensure that (1) federal activities do not interfere with the emissions budgets in the State Implementation Plans, (2) actions do not cause or contribute to new violations, and (3) NAAQS are attained and maintained. General conformity applies only in areas that are designated as NAAQS non-attainment areas or maintenance areas. A conformity review is required only for those pollutants designated as non-attainment or maintenance pollutants.

The proposed project would occur within 100 kilometers of several Federal Class I areas, which are areas in which visibility was declared by Congress to be an important value (Clean Air Act, Section 169A). The following Class I areas could be affected by the proposed project.

- Crater Lake National Park (Oregon)
- Gearhart Mountain Wilderness (Oregon)
- Lava Beds National Monument (California)
- Marble Mountain Wilderness (California)
- Mountain Lakes Wilderness (part of the Soda Mountain Wilderness, Oregon)

In 1999, EPA adopted the Regional Haze Rule, which requires states to establish a series of interim goals to ensure continued progress toward improving visibility in Class 1 federal lands (e.g., national parks and other scenic areas). To comply with the Regional Haze Rule, CARB and Oregon DEQ have developed a Regional Haze Plan.

3.15.2.2 Noise

Noise is defined as unwanted sound resulting from vibrations in the air (EPA, 1974). Most sounds are composed of a combination of frequencies. The normal human ear can usually distinguish frequencies from 20 hertz (Hz) (low frequency) to about

20,000 Hz (high frequency), although people are most sensitive to frequencies between 500 and 4,000 Hz. The individual frequency bands can be combined into one overall sound pressure level. This sound pressure level is measured in decibels (dB). Noise levels relate the magnitude of the sound pressure to a standard reference value. Although the noise values of certain activities can approach 135 dB, sounds typically encountered in the environment range from 40 to 120 dB. The faintest sound that can be heard by a healthy ear is about 0 dBA, while an uncomfortably loud sound is about 120 dBA.

The perception of loudness is generally predictable and can be approximated through frequency filtering, using the standardized A-weighting network, or A-scale (expressed as dBA). The A-weighting approximates the frequency response of the average young ear when listening to most everyday sounds. When people make relative judgments of the loudness or annoyance of a sound, their judgments correlate well with the A-weighting sound levels of those sounds (Caltrans, 2013). Noise levels reported here are in units of A-weighted decibels. Typical noise levels of familiar noise generators are illustrated in figure 3.15-1.

The following are the sound level descriptors commonly used and incorporated into this environmental noise analysis:

- Equivalent sound level (Leq): An average of the sound energy occurring over a specified time period.
- Peak hour Leq: The Leq during the hour with the highest Leq.
- Maximum sound level (Lmax): The highest instantaneous sound level measured during a specified period.

Sound from a localized source (i.e., point source) propagates uniformly outward from the source in a spherical pattern. The sound level attenuates due to the following factors (Caltrans, 2013):

- Distance between the source and the receptor;
- Atmospheric effects and refraction;
- Ground absorption; and
- Terrain (shielding by natural and human-made features, noise barriers, diffraction, and reflection).

Generally, sound levels attenuate at a rate of 6 dB for each doubling of distance from a point source (FHWA, 2011). Sound from nonpoint “line” sources (roadways and highways) attenuates at a rate of 3 dB for each doubling of distance from the linear source. Due to the nature of the decibel scale, a doubling of traffic will result in a 3-dB increase in noise levels, which in and of itself would not normally be a perceptible noise increase. Traffic would need to increase at least three times to result in a readily perceptible (5 dB) increase in noise.

Noise-sensitive receptor locations (e.g., rural residences, schools, hospitals, rest homes, churches, long-term care facilities, mental care facilities, residences, convalescent nursing homes, hotels, certain parks) were identified in the vicinity of each dam and associated facilities. Land use and terrain features are based on a review of current topographic, aerial, and land use maps.

J.C. Boyle Dam and Associated Facilities

The land surrounding the J.C. Boyle Dam is primarily undeveloped, and land use is primarily recreational. Recreational sites would be closed to visitors during construction and demolition activities; therefore, no impact analysis was conducted for campgrounds. The nearest residence is more than 0.5-mile west of the dam, and the line of sight is blocked by terrain and the land between is vegetated. Table 3.15-2 provides information regarding the existing noise environment.

Existing roadway traffic noise is present along Oregon State Route 66, which is the proposed main off-site haul route from the J.C. Boyle Dam and Powerhouse construction site. The existing peak hour Leq for the proposed project haul routes at 50 feet and 500 feet from the edge of the roadway is summarized in table 3.15-3.

Copco No. 1 Dam and Associated Facilities

The closest noise-sensitive receptor to Copco No. 1 Dam and Powerhouse is the Janice Avenue rural residential area, located approximately 2,200 feet east of Copco No. 1 Dam (table 3.15-2). The estimated existing daytime and nighttime outdoor Leq at the Janice Avenue rural residential area are 40 and 30 dBA, respectively (EPA, 1974).

Existing roadway traffic noise is present along Copco Road and Ager-Beswick Road, which are the proposed main off-site haul routes from the Copco No. 1 Dam and Powerhouse construction site (table 3.15-3).

Copco No. 2 Dam and Associated Facilities

The closest sensitive receptor to Copco No. 2 Dam is the residential area on Janice Avenue described above for Copco No. 1 Dam. The receptor is approximately 3,700 feet to the east of Copco No. 2 Dam. The estimated existing daytime and nighttime outdoor Leq at the residences on Janice Avenue, based on EPA information, are 40 and 30 dBA, respectively (EPA, 1974) (table 3.15-2).

Copco Road and Ager-Beswick Road are the proposed main off-site haul routes from the Copco No. 2 Dam construction site. The existing peak hour Leq for the proposed project haul routes at 50 feet and 500 feet from the edge of the roadway is summarized in table 3.15-3. The existing roadway traffic noise is based on the same information as described for Copco No. 1 Dam facilities.

Iron Gate Dam and Associated Facilities

The closest sensitive receptor to Iron Gate Dam is the fish hatchery complex (which includes staff residences, egg incubation, rearing, maintenance, and administration facilities), approximately 1,200 feet downstream. However, PacifiCorp's residential properties, including the staff residences at the hatchery complex, would be unoccupied during proposed project construction activities and thus are not considered as a sensitive receptor for the purposes of this analysis. The next closest sensitive receptor to Iron Gate Dam is the rural residential land on Tarpon Drive, approximately 4,500 feet southwest of the dam. Based on the rural residential land use category, the existing daytime outdoor Leq on Tarpon Drive likely is 40 dBA, and the existing nighttime outdoor Leq at this receptor is approximately 30 dBA (EPA, 1974) (table 3.15-2).

Existing traffic noise was assessed along Copco Road, located approximately 1,100 feet from Iron Gate Dam, because it would be the main off-site haul route from the Iron Gate Dam and Powerhouse construction site. The existing peak hour Leq for the proposed project haul routes at 50 feet and 500 feet from the edge of the roadway is summarized in table 3.15-3. The existing roadway traffic noise is based on the same information as described for Copco No. 1 Dam facilities.

3.15.3 Effects of the Proposed Action

3.15.3.1 Air Quality

Construction activities would result in emissions of criteria pollutants through fugitive dust and vehicle exhaust. Construction air emissions from the removal of the four dams and associated infrastructure would occur over a two-year period. Although estimates for type, number, duration, and location of heavy equipment are preliminary, equipment requirements and construction activities can be estimated based on similar construction projects and activities. Construction activities would involve deconstruction of powerhouse intake structures, dam embankments, sidewalls, penstocks and supports, decks, piers, gatehouses, fish ladders and holding facilities, diversion control structures, and other infrastructure. In some instances, blasting would be used to demolish concrete structures. Dozers, excavators, dump trucks, and other diesel-powered construction equipment would be used to load and remove deconstructed and excavated material. Additional equipment required for construction would include backhoes, loaders, and water trucks for dust suppression. Barges, trucks, helicopters, and other equipment would be used to restore land exposed due to reservoir draining.

In addition to all applicable local, state, or federal requirements, KRRC proposes to implement the following air quality (AQ) control measures[208] to reduce effects associated with emissions of PM and other toxics from construction-related activities. These proposed measures are standard mitigation measures and would minimize adverse effects. Staff recommend incorporating them in any Commission order.

AQ-1 Off-Road Construction Equipment Engine Tier

For the construction activities occurring within California, any off-road construction equipment (e.g., loaders, excavators) that are 50 horsepower or greater must be equipped with engines that meet the EPA Tier 4 Final emissions standards for off-road compression-ignition (diesel) engines, unless such an engine is not available for a particular item of equipment. To the extent allowed by the California Air Resources Board (CARB) Off-Road Diesel Fueled Fleets regulations, Tier 3 and Tier 4 interim engines would be allowed when the contractor has documented, with appropriate evidence, that no Tier 4 Final equipment or emissions equivalent retrofit equipment is available or feasible (CARB, 2016). Documentation may consist of signed statements from at least two construction equipment rental firms.

AQ-2 On-Road Construction Equipment Engine Model Year

Any heavy-duty on-road construction equipment must be equipped with engines that meet the model year 2010 or newer on-road emission standards.

AQ-3 Heavy-Duty Trucks Engine Model Year

Any heavy-duty trucks used to transport materials to or from the construction sites must be equipped with engines that meet the model year 2010 or later emission standards for on-road heavy-duty engines and vehicles. Older model engines may also be used if they are retrofitted with control devices to reduce emissions to the applicable emission standards.

AQ-4 Blasting-Related Dust Control Measures

Dust control measures would be incorporated to the maximum extent feasible during blasting operations at Copco No. 1 Dam. The following control measures would be used during blasting activities as applicable: Conduct blasting on calm days to the extent feasible. Wind direction with respect to nearby residences must be considered. Design blast stemming to minimize dust and to control fly rock.

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[208] The California Water Board EIR (California Water Board, 2020a) states that KRRC has agreed to implement these measures. Although these measures are not listed in KRRC’s amended license surrender application or final management plans, this was likely an oversight and consider them to be part of KRRC’s proposal. We recommend revising the Construction Management Plan to include these measures.

AQ-5 General Construction Dust Control Measures

To reduce fugitive dust emissions, the following additional measures would be implemented:

- Water all exposed surfaces as appropriate to control fugitive dust through sufficient soil moisture. Under normal dry-season conditions this is generally a minimum of two times daily. Watering of exposed surfaces is not necessary when soils are already sufficiently wetted (e.g., during rain). Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.
- Install stabilized construction entrances where appropriate, to include geotextile fabric and/or coarse rock to manage the amount of soil tracked onto paved roadways by motor vehicle equipment, and suspended in runoff, from the active construction sites.

EPA recommends a series of mitigation measures contained in an August 19, 2021, letter communicating scoping comments for the notice of intent to prepare an environmental impact statement for the Lower Klamath Project surrender and removal (FERC Project No. 14803-001), Siskiyou County, California and Klamath County, Oregon (EPA, 2021g). Mitigation measures AQ-1 through AQ-5 are consistent with EPA's recommendations.

Additional mitigation measures may reduce NOx emissions further. These include:

- Configure construction scheduling in order to reduce the concurrent operation of construction equipment.
- Minimize the idling time of diesel-powered construction equipment to two minutes.
- Require that all construction equipment, diesel trucks, and generators be equipped with Best Available Control Technology for emission reductions of NOx and PM.
- Require all contractors use equipment that meets CARB's most recent certification standard for off-road heavy-duty diesel engines.

Our Analysis

Uncontrolled emissions of PM10 and NOx are estimated to exceed the Siskiyou County Air Pollution Control District emissions thresholds during removal of the dams and associated infrastructure. Similar thresholds were not identified for construction emissions in Oregon, so the Siskiyou thresholds were applied to construction activity occurring in Oregon. Peak daily emissions of NOx would reach 1,520 pounds per day (lbs/day), while the relevant threshold is 250 lbs/day. Peak daily emissions of PM10 would reach 272 lbs/day, while the relevant threshold is 250 lbs/day. Other elements of the proposed project are not expected to exceed relevant thresholds (see appendix J).

Implementation of mitigation measures AQ-1 through AQ-5 would reduce construction emissions, however, for the following reasons the amount of emission reduction cannot be stated with certainty. The use of EPA Tier 4 engines, as proposed in AQ-1, can reduce diesel exhaust (i.e., PM10) and NOx emissions by up to 90 percent over Tier 1 engines (SMAQMD, 2016). However, construction fleets in California comprise a combination of engines, ranging from Tier 1 to Tier 4, and as older equipment is rebuilt or replaced, the composition of higher tiered engines will increase. At this time, it cannot be determined as to what ratio of Tier 4 or Tier 3 engines the construction fleet would have. Further, certain equipment types/sizes are not always available in Tier 4 engines, so it cannot be guaranteed that the entire fleet would be composed of Tier 4 engines. As shown in appendix J (and in California Water Board, 2020a, table RE-N-6), maximum daily emissions of NOx were estimated to be as high as 1,520 lbs/day during a worst-case scenario where two or more dams were being deconstructed concurrently. Therefore, an 84 percent reduction in emissions would be needed to achieve the 250 lbs/day threshold. Considering that statewide average construction fleet emissions continue to improve, and the unlikeliness that Tier 4 engines would be available for all equipment types, the needed 84 percent reduction in NOx emissions would not be achieved and emissions would remain above the 250 lbs/day threshold for NOx (appendix J). NOx emissions would be considered a temporary, significant, and unavoidable adverse effect.

The use of on-road construction equipment and heavy-duty trucks that meet model year 2010 or newer emissions standards, as proposed in AQ-2 and AQ-3, can also reduce diesel exhaust (i.e., PM10) and NOx emissions. However, due to the uncertainty of the specific model year emissions standards that would be included in the construction fleet for the proposed project, providing an accurate quantification of these reductions was not feasible. Therefore, it is estimated that the needed 84 percent reduction in NOx emissions would not be achieved and emissions would remain above the 250 lbs/day threshold for NOx (see appendix J).

Implementation of the dust control measures in AQ-4 and AQ-5 can reduce fugitive dust by up to 50 percent. As noted above, the implementation of mitigation measure AQ-1 could also significantly reduce exhaust emissions (i.e., PM10). As shown in appendix J (and in California Water Board, 2020a, table RE-N-6), maximum daily emissions of PM10 were estimated to be as high as 272 lbs/day, and approximately 77 percent of these emissions would be from fugitive dust and 23 percent would be from exhaust. Therefore, implementation of AQ-4 and AQ-5 would achieve a 50 percent or greater reduction in fugitive dust and exhaust emissions would reduce PM10 emissions well below the 250 lbs/day threshold.

With the implementation of mitigation measures AQ-1 through AQ-5, construction emissions from the proposed project would still result in short-term, significant, and unavoidable adverse effect from NOx emissions.

In 2014, CARB adopted the 2014 Progress Report, which concludes that based on the reductions in anthropogenic source emissions in California and the concurrent improvement in visibility, the Regional Haze Plan strategies were sufficient for California to meet its progress goals (development of the current plan is underway). Oregon's 2009 Regional Haze Plan (development of the current plan is underway) indicates that the current rules addressing construction-related activities in Oregon are sufficient to prevent visibility impairment in Oregon Class I areas.

Due to the temporary nature of the construction activity associated with the proposed action, significant concentrations of haze-causing pollutants are not anticipated. The proposed action would not increase operational emissions because operational emissions under current conditions are expected to be greater than operational emissions post-dam removal. With implementation of mitigation measures AQ-1 through AQ-5, the proposed action would not conflict with the Regional Haze Plans of the area.

3.15.3.2 Noise

Temporary effects on noise and vibration levels would occur as a direct result of construction activities. Heavy construction equipment would be used in multiple locations throughout the project area to perform demolition, excavation, loading, land reclamation, and load hauling. The temporary effect is an increase in the level of noise, which is characterized by volume levels, as measured in dBA.

Elevated construction noise from equipment and traffic would be generated during construction but would return to existing or lower levels upon project completion.

Noise levels in the California portion of the area of analysis are regulated by the Siskiyou County General Plan Noise Element (Siskiyou County, 1978), which contains criteria for maximum allowable noise levels from construction equipment. Most of the equipment listed for use in this project is limited to peak noise levels of 81 dBA. There are exceptions for scrapers and pavers (86 dBA), and impact equipment (pile drivers at 101 dBA, rock drills and pneumatic tools at 86 dBA). In Klamath County noise levels are regulated by Chapter 340, Division 35 – Department of Environmental Quality. Section 5 (g) exempts construction noise emissions from the state regulations. No local construction noise regulations were identified.

Although the proposed project does not involve highway construction, federal and state highway traffic noise criteria provide a basis for analyzing traffic noise effects. The Federal Highway Administration requires highway agencies to define a "substantial" noise increase as an increase of 5 to 15 dBA over existing noise levels (23 C.F.R. Part 772). Caltrans defines a "substantial" increase in noise levels from traffic as a predicted increase greater than or equal to 12 dBA at the receptor over existing 1-hour equivalent noise levels (Leq) (Caltrans, 2006). For this analysis, an action would be significant if it resulted in any of the following:

- Use of construction equipment that exceeds Siskiyou County maximum allowable noise levels from construction equipment; or
- A greater than 10 dBA increase in the daytime or nighttime outdoor one-hour Leq at the receptor from on-site construction operations; or
- A greater than 12 dBA increase above existing one-hour Leq for traffic-related noise.

Our Analysis

Our analysis for noise focuses on construction-related activities, which include the pre-removal period, the dam removal period (zero to one years), and one to five years after dam removal, where the latter includes most of the anticipated restoration and monitoring activities. Although sporadic activities would occur throughout these periods and are analyzed herein, our analysis focuses on the six-month period during the peak of the construction-related activity, when the dams would be removed and noise levels from construction would be greatest. There would be no long-term, significant noise effects from the proposed project because the construction activities would be temporary in nature and cease when deconstruction is complete.

The short-term and worst-case noise levels, with the exception of blasting, were calculated to be between 88 and 91 dBA at 50 feet from the dam removal sites during both daytime and nighttime shifts. Noise levels would vary over the course of the work shift and over the course of the dam removal as tasks and associated noise levels change.

Where blasting is required for dam removal, there would be momentary instances where noise levels may reach 94 dBA at 50 feet from the source. However, due to the duration of this elevated noise level – usage factor of 1 percent – the elevated noise level would not significantly affect the overall construction Leq levels.

Given the maximum allowable noise levels identified in the Siskiyou County General Plan Noise Element (Siskiyou County, 1978), any use of dozers, jackhammers, and/or tractors that exceeds the Siskiyou County noise levels during construction of the proposed project would constitute an exceedance of County maximum allowable noise levels; this would be a temporary, significant, and unavoidable adverse effect.

Receptors near Iron Gate Dam would experience significant noise levels increases during the daytime shift. Receptors near the Copco No. 1 Dam would experience temporary, significant, and unavoidable increases in noise levels during both daytime and nighttime. The threshold of significance for this effect is “a greater than 10 dBA increase in the daytime or nighttime outdoor one-hour Leq at the receptor from on-site construction operations.” To be conservative, an increase of 9 dBA during Shift 2 at Copco No. 1 Dam was also identified as significant.

The proposed NVCP (Definite Plan, appendix O5)[209] would minimize short-term outdoor noise effects, and specifies that a final NVCP, with additional details, would be required of the construction contractor. The proposed NVCP requires preparation and implementation of the final NVCP and would be necessary to reduce potential noise effects to the degree feasible. However, the final NVCP would not require equipment noise levels from dozers, jackhammers, and tractors to comply with the Siskiyou County maximum allowable noise levels for these specific equipment types because the maximum allowable noise levels are lower than the typical noise levels produced by those equipment types according to the Federal Highway Administration's Roadway Construction Noise Model User's Guide (FHWA, 2006). Therefore, the effects would be temporary, significant, and unavoidable.

3.15.3.3 Climate Change

Climate change is the variation in climate (including temperature, precipitation, humidity, wind, and other meteorological variables) over time that cannot be characterized by an individual event or anomalous weather pattern. For example, a severe drought or abnormally hot summer in a particular region is not a certain indication of climate change. However, a series of severe droughts or hot summers that statistically alter the trend in average precipitation or temperature over decades may indicate climate change. Recent research (United States Global Change Research Program [USGCRP], 2018) has begun to attribute certain extreme weather events to climate change.

USGCRP is the leading U.S. scientific body on climate change, and it is composed of representatives from 13 federal departments and agencies.[210] The Global Change Research Act of 1990 requires USGCRP to submit a report to the President and Congress no less than every four years that "1) integrates, evaluates, and interprets the findings of USGCRP; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change, both human

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[209] This measure is included in appendix O of KRRC's 2018 version of the Definite Plan. Although appendix O was not included in the revised Definite Plan filed with KRRC's amended license surrender application or in its final management plans, this was likely an oversight and consider it to be part of KRRC's proposal. We recommend revising the Construction Management Plan to include this measure.

[210] USGCRP issues reports every four years that describe the state of the science relating to climate change and the effects of climate change on different regions of the United States and on various societal and environmental sectors, such as water resources, agriculture, energy use, and human health.

induced and natural, and projects major trends for the subsequent 25 to 100 years." These reports describe the state of the science relating to climate change and the effects of climate change on different regions of the United States and on various societal and environmental sectors, such as water resources, agriculture, energy use, and human health.

In 2017 and 2018, USGCRP issued its *Climate Science Special Report: Fourth National Climate Assessment, Volumes I and II* (Fourth Assessment Report; USGCRP, 2018; 2017). The Fourth Assessment Report states that climate change has resulted in a wide range of impacts across every region of the country. Those impacts extend beyond atmospheric climate change alone and include changes to water resources, transportation, agriculture, ecosystems, and human health. According to the Fourth Assessment Report, the United States and the world are warming, global sea level is rising and acidifying, and certain weather events are becoming more frequent and more severe. These changes are driven by accumulation of GHG in the atmosphere through combustion of fossil fuels (e.g., coal, petroleum, and natural gas), combined with agriculture, clearing of forests, and other natural sources. These impacts have accelerated throughout the end of the 20th and into the 21st century (USGCRP, 2018). Since the issuance of the Fourth Assessment Report, the Intergovernmental Panel on Climate Change has issued a portion of the Sixth Assessment Report, *Climate Change 2021: The Physical Science Basis*, which discusses acceleration of impacts of GHG on the global climate.

EPA identified GHGs as pollutants in the context of climate change. GHG emissions do not result in proportional local and immediate impacts; it is the combined concentration in the atmosphere that affects the global climate, and these are fundamentally global impacts that feed back to local and regional climate change impacts. Thus, the geographic scope for cumulative analysis of GHG emissions is global rather than local or regional. For example, a project 1 mile away emitting 1 ton of GHGs would contribute to climate change in a similar manner as a project 2,000 miles distant also emitting 1 ton of GHGs.

Although climate change is a global phenomenon, for this analysis, we focus on the existing and potential cumulative climate change impacts in the project area. USGCRP's Fourth Assessment Report notes that the following observations of environmental impacts are attributed to climate change in the Northwest region of the United States(USGCRP, 2018; 2017):

- the region has warmed nearly 2°F since 1900;
- warmer winters have led to reductions in mountain snowpack, resulting in drought, water scarcity, and large wildfires;

- declines in dissolved oxygen in streams and lakes have caused fish kills and loss of aquatic species diversity; and
- moderate to severe spring and summer drought areas have increased 12 to 14 percent.

USGCRP's Fourth Assessment Report notes the following projections of climate change impacts in the Northwest region with a high or very high level of confidence[211]:

- increases in stream temperature indicate a 22 percent reduction in salmon habitat by the late 21st century;
- more frequent severe winter storms, which may contribute to storm surge, large waves, coastal erosion, and flooding in low-lying coastal areas;
- accentuation of the warming trend in certain mountain areas in the Northwest in late winter and spring, further exacerbating snowpack loss and increasing the risk for insect infestations and wildfires;
- longer periods of time between rainfall events that may lead to declines in recharge of groundwater and decreased water availability, and responses to decreased water availability, such as increased groundwater pumping, may lead to stress or depletion of aquifers and strain on surface water sources; and
- increases in evaporation and plant water loss rates may alter the balance of runoff and groundwater recharge, which would likely to lead to saltwater intrusion into shallow aquifers.

Findings of the Intergovernmental Panel on Climate Change's Sixth Assessment Report project similar climate change impacts in northern North America to USGCRP's Fourth Assessment Report. The Panel projects the following with high confidence: temperature and precipitation increases; increases in relative sea-level rise and associated coastal flooding and erosion; and increases

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[211] The report authors assessed current scientific understanding of climate change based on available scientific literature. Each "Key Finding" listed in the report is accompanied by a confidence statement indicating the consistency of evidence or the consistency of model projections. A high level of confidence results from "moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus." A very high level of confidence results from "strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus." Available at: https://science2017.globalchange.gov/chapter/front-matter-guide/.

in coastal water temperatures and ocean acidification. Note that, while the impacts described above taken individually may be manageable for certain communities, the impacts of compound events (such as simultaneous heat and drought, wildfires associated with hot and dry conditions, or flooding associated with high precipitation on top of saturated soils) can be greater than the sum of the parts (USGCRP, 2018).

Project-related GHG emissions, including those resulting from using petroleum-powered machinery to perform deconstruction, material hauling and worker commuting (construction emissions), changes in land cover including the removal of surface water and exposure of previously flooded land, and removal of renewable power generation, are discussed in the following section.

We include herein the discussion of GHG emissions prepared by the California Water Board's 2018 draft EIR (California Water Board, 2018) and revised in the recirculated portions of California Water Board's EIR (California Water Board, 2020a), including the recirculated appendix O.[212] For a detailed derivation of the project's GHG emissions, see appendix O in California Water Board (2020a).

Direct sources of GHG emissions from the proposed action include two years of construction emissions, temporary emissions from the reservoir sediment, and long-term annual emissions from the conversion of the reservoir areas to riverine, wetland, and terrestrial habitat types. Additionally, there could be long-term indirect emissions from the proposed action from PacifiCorp's energy mix (which includes coal, natural gas) that would be used to replace the hydropower associated with the Lower Klamath Project facilities.

Carbon offsets would be issued and certified by one of the following: California Air Resources Board, Climate Action Reserve, California Air Pollution Control Officers Association, the Air Pollution Control District, or any other equivalent or verifiable registry.

Construction Greenhouse Gas Emissions

The Global Warming Solutions Act of 2006 (AB 32) requires California to reduce its GHG emissions to 1990 levels by 2020. Pursuant to AB 32, CARB must adopt regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions. AB 32 directs CARB to develop the Climate Change Scoping Plan that outlines a set of actions to achieve the AB 32 goal of reducing GHG emissions to 1990 levels by 2020 (CARB, 2008) and to maintain such reductions thereafter. The CARB Scoping Plan identifies the purchase of carbon offsets as a viable method to reduce or eliminate the impact of GHG

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[212] See California Water Board (2020a) and its recirculated appendix O for more details regarding how the analyses were conducted.

emissions, as long as the offsets represent real reductions in GHG (CARB, 2017). To mitigate the estimated emissions from construction activity, KRRC has agreed to purchase carbon offsets per GHG mitigation measure ENR-1.

As table 3.15-4 shows, deconstruction-related aspects of the proposed action would generate 20,128 metric tons of carbon dioxide equivalents[213] (MTCO2e) of GHG emissions over a two-year period. These direct GHG emissions would be generated by pre-dam removal activities, dam and powerhouse deconstruction, and restoration activities. Sources of emissions from these activities include on- and off-site construction equipment, construction worker commuting, and haul truck emissions. As discussed above, prior to the start of pre-dam removal activities and any construction activities, and according to mitigation measure ENR-1, KRRC would purchase and retire carbon offsets for the estimated 20,128 MTCO2e of GHG emissions that would be generated by the proposed action, resulting in a net zero GHG emissions associated with construction activities.

Reservoir Sediment-Related Emissions

GHG emissions due to biological processes during reservoir drawdown, and emissions due to the conversion of inundated lands to riverine, wetland, and terrestrial habitats were calculated in California Water Board (2020a) and in appendix O to that EIR. The sediment release associated with this restoration project would result in the release of methane and oxidation of the sediment deposits, which is conservatively estimated to result in a one-time release of 19,350 MTCO2e of GHG emissions. The majority of these emissions would occur within six months of reservoir drawdown, and these GHG emissions would have occurred gradually on an annual basis if the dams had not been built. California’s CARB Scoping Plan does not contain guidance on assessing or mitigating the potential GHG emissions impacts from dam removal and habitat restoration activities. Generally, the CARB Scoping Plan encourages the rehabilitation of natural ecosystems as part of the state’s climate solution.

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[213] Global warming potential is a concept developed to compare the ability of a GHG to trap heat in the atmosphere relative to another gas. It is based on several factors, including the relative effectiveness of a gas absorbing infrared radiation, and length of time that the gas remains in the atmosphere. The global warming potential of each GHG is measured relative to CO2, the most abundant GHG. The concept of CO2-equivalency (CO2e) is used to account for the different global warming potentials of GHGs to absorb infrared radiation.

Conversion of the Lower Klamath Project Reservoirs to Riverine, Wetland, and Terrestrial Habitat Types

Conversion of the impounded areas of the four reservoirs to free-flowing riverine habitats has the potential to result in long-term changes in total annual GHG emissions from aquatic and terrestrial habitats within the reservoir footprint. Detailed methodology and calculation of GHG emissions are provided in California Water Board (2020a) and appendix O to that EIR. In some cases, habitat conversion would result in fewer GHG emissions, but in other cases it would result in greater emissions.

To assess the potential changes in GHG emissions due to habitat conversion under the proposed action, GHG production estimates were multiplied by the water surface areas of the four reservoirs (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) as well as the areas of riverine habitat with and without the reservoirs in place. In addition, because wetland and terrestrial habitats are expected to develop in the reservoir footprint in the decades following drawdown, estimates of future GHG emissions of wetlands, grasslands, and forests were adapted from a recent USGS assessment of changes in carbon storage and GHG production and/or sequestration associated with ecosystems of the Western United States through 2050 (California Water Board, 2020a).

These estimates show that GHG emissions from the system's reservoirs decreased by a range of between 936 MTCO2e and 2,621 MTCO2e, and emissions from riparian habitat decreased by a range of between 76 MTCO2e and 288 MTCO2e. While GHG emissions from land under water and riparian habitats decreased, emissions generated by the new riverine habitat increased by a range of between 13,485 MTCO2e and 27,500 MTCO2e. Additionally, GHG emissions generated by new wetland and grassland habitat increased by a range of between 25 MTCO2e and 139 MTCO2e. In total, there would be a net, annual increase of an estimated 24,900 MTCO2e.

Decommissioning of Renewable Power Generation

The average annual electricity generation from the Lower Klamath Project is 686,000 MWh, representing approximately 2 percent of PacifiCorp's total generation capacity (California Water Board, 2020a). According to PacifiCorp's Integrated Resource Plan, system carbon dioxide (CO2) emissions are projected to fall from 39.1 million tons in 2021 to 4.8 million tons in 2040—a reduction of 88 percent (PacifiCorp, 2021b). Assuming that the 686,000 MWh of renewable energy was replaced with non-renewable sources generated with the mix of fuel sources currently used by PacifiCorp, the loss of the Lower Klamath Project capacity would result in the emission of approximately 782,000 tons of CO2 annually.

However, compliance with the California Renewable Portfolio Standard requires PacifiCorp to develop and implement an integrated resource plan that demonstrates it is on schedule to comply with the state requirements of providing 33 percent renewable sources by 2020 and 60 percent renewable sources by 2030. The most recent Integrated Resource Plan prepared by PacifiCorp was in September 2021 and accounts for the assumed loss of the Lower Klamath Project facilities (PacifiCorp, 2021b). The 2021 plan indicates that, with the decommissioning of the Lower Klamath Project facilities, system-wide GHG emissions are projected to continue decreasing throughout the planning period. The Integrated Resource Plan specifically indicates that CO2 emissions in 2026 are expected to decrease 26 percent relative to 2019. Although the proposed action would result in the loss of renewable energy sources, overall PacifiCorp would be increasing the percentage of renewable energy sources in its power mix to comply with the California Renewable Portfolio Standard and increasing renewable energy at a rate that more than covers the loss from the baseline condition. Because the 2021 Integrated Resource Plan plans for PacifiCorp to add new sources of renewable power or purchase renewable energy credits to comply with the California Renewable Portfolio Standard, it appears that the proposed action would not result in an increase in GHG emissions from the replacement of a renewable power source with a non-renewable power source.

Conclusion

The project would result in the following direct GHG emissions. Construction-related aspects would generate approximately 20,128 MTCO2e GHG emissions over a two-year period, associated with pre-dam removal activities, dam and powerhouse deconstruction, and restoration activities. These emissions would be offset by the purchase of carbon credits as discussed above, resulting in net zero GHG emissions. In addition, GHG emissions would occur in association with reservoir sediments following initiation of reservoir drawdown, and emissions associated with habitat conversion under the proposed action. Emission from sediments released during reservoir drawdown and oxidation of sediment-associated organic matter would result in a one-time release up to 19,350 MTCO2e. Emissions from habitat conversion could emit a net increase of up to 24,900 MTCO2e annually.

Direct emissions from the deconstruction of the project would increase the atmospheric concentration of GHGs in combination with past, current, and future emissions from all other sources globally and contribute incrementally to future climate change impacts. To assess impacts on climate change associated with the project, we will apply the presumptive significance threshold for GHG emissions identified in the Commission’s Interim Policy Statement on “Consideration of Greenhouse Gas Emissions in Natural Gas Infrastructure Project Reviews” issued on February 18, 2022, in Docket No. PL21-3-000. The interim policy statement established a presumptive significance threshold of 100,000 metric tons per year of CO2e.[214] As identified above, after consideration of the mandatory mitigation of the deconstruction emissions through carbon offsets the project’s direct emissions could potentially increase emissions by

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[214] *Consideration of Greenhouse Gas Emissions in Natural Gas Infrastructure Project Reviews*, 178 FERC ¶ 61,108 (2022) (Interim GHG Policy Statement) (Accession Number 20220218-3033).

44,250 metric tons per year of CO_2e, which is below the Commission's presumptive threshold of significance.

3.15.4 Effects of the Proposed Action with Staff Modifications

The effects of the proposed action with staff modifications would be the same as the proposed action. For clarity, we recommend, pursuant to conditions in the WQC, revising the Construction Management Plan to include: (1) AQ-1 Off-Road Construction Equipment Engine Tier; (2) AQ-2 On-Road Construction Equipment Engine Model Year; (3) AQ-3 Heavy-Duty Trucks Engine Model Year; (4) AQ-4 Blasting-Related Dust Control Measures; (5) AQ-5 General Construction Dust Control Measures; (6) Noise and Vibration Control Plan; and (7) ENR-1 Purchase of Carbon Offsets.

3.15.5 Effects of the No-action Alternative

Under the no-action alternative, GHG emissions would be the same as for existing conditions. Although the project reservoirs currently settle out organic material transported into the reservoirs from the upstream Klamath River before it can be converted to CO2, and the reservoirs sequester carbon through direct uptake of CO2 from the atmosphere into phytoplankton, followed by subsequent burial in reservoir bottom sediments, the reservoirs are net producers of GHG. However, while the project reservoirs are net producers of GHGs, they produce considerably less GHGs than the riverine portions of the hydroelectric reach. The reservoirs also produce more GHGs than the small areas of wetlands and uplands (grasslands) associated with the reservoirs within the hydroelectric reach.

In the short term under the no-action alternative, there would be no change to the level of power production, no anticipated change to operational energy requirements or related GHG emissions, no significant sediment release with associated GHG emissions, no conversion of reservoirs to a riverine system, and no additional construction above existing conditions. In addition, there would be no change to short-term emissions with the potential to conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs. Without removal of the dams, in the short term under the no-action alternative, there would be no effect on the energy supply grid. Therefore, there would be no net increase in GHG emissions relative to existing conditions.

Similarly, there would be no changes to operational energy requirements from the current baseline, and no additional construction emissions or changes to energy infrastructure in the short term. Therefore, the no-action alternative would not result in changes to energy use that could result in wasteful, inefficient, or unnecessary consumption of energy resources that could cause significant environmental effects or have a substantial effect on local and regional energy supplies and/or on requirements for additional capacity. Because the energy facilities are renewable energy, their continued operation in the short term would not have the potential to conflict with or obstruct a state or local plan for renewable energy or energy efficiency.

Table 3.15-1. Criteria pollutant with federal, state, and county attainment status in Oregon and California counties near the project (Source: Interior and California DFG, 2012; CARB, 2020b; Oregon DEQ, 2020b; California Water Board, 2020a)

Criteria Pollutant	Federal Status: Siskiyou County	Status in California (Siskiyou County)	Federal Status: Klamath and Jackson Counties, Oregon
Ozone	Unclassified/Attainment	Attainment	Attainment
Carbon Monoxide	Unclassified/Attainment	Unclassified	Maintenance (Klamath Falls Urban Growth Boundary, Medford-Ashland Air Quality Maintenance Area)
Nitrogen Dioxide	Unclassified/Attainment	Attainment	Attainment
Sulfur Dioxide	Unclassified/Attainment	Attainment	Attainment
PM_{10}	Unclassified	Attainment	Attainment (Project Area) Maintenance (Klamath Falls Urban Growth Boundary, Medford-Ashland Air Quality Maintenance Area)
$PM_{2.5}$ (2012)	Unclassified/Attainment	Attainment	Attainment
Lead	Unclassified/Attainment	Attainment	NA
Sulfates	NA	Attainment	NA
Hydrogen Sulfide	NA	Unclassified	NA
Visibility Reducing Particles	NA	Unclassified	NA

Table 3.15-2. Existing noise environment at proposed construction sites at and near Lower Klamath Project facilities (Source: staff)

Construction Site	Nearest Receptor Description	Distance from Construction Site	Estimated Existing Daytime Leq (dBA)	Estimated Existing Nighttime Leq (dBA)
John C. Boyle Dam	Residence off OR-66	2,700 feet west	40	30
John C. Boyle Powerhouse, Infrastructure	Upper Klamath Wild and Scenic River Camp	1,400 feet south of facility	40	30
Copco No. 1 Dam	Residential Area on Janice Avenue	2,200 feet east of Copco No 1 Dam	40	30
Copco No. 1 Powerhouse, Infrastructure	Residential Area on Janice Avenue	2,200 feet east of Copco No 1 Dam	40	30
Copco No. 2 Dam	Residential Area on Janice Avenue	3,700 feet east of Copco No 1 Dam	40	30
Copco No. 2 Powerhouse, Infrastructure	Residence on Iron Gate Road	3,700 feet north	40	30
Iron Gate Dam, Associated Infrastructure	Residential Area off Copco Rd and Tarpon Drive	3,000 feet southwest of Iron Gate Dam	40	30

Note: Leq = one-hour equivalent noise level; dBA = A-weighted decibels

Table 3.15-3. Estimated highway noise levels at proposed construction sites at and near Lower Klamath Project facilities (Source: staff)

Haul Route/Commute Segment	**Existing Daytime Peak Hour Leq (dBA)[a]**	
	50 Feet	**500 Feet**
Topsy Grade County Road/ Ager-Beswick Road	53	42
US 97	75	64
Oregon State Route 66	60	49
Copco Road	58	46
I-5 between Medford, OR, and Oregon State Route 66	77	66
1-5 between OR-66 and Yreka	76	66

[a] Daytime one-hour Leq estimated by modeling traffic counts using TNM2.5.

Note: dBA = A-weighted decibels; Leq = one-hour equivalent noise level

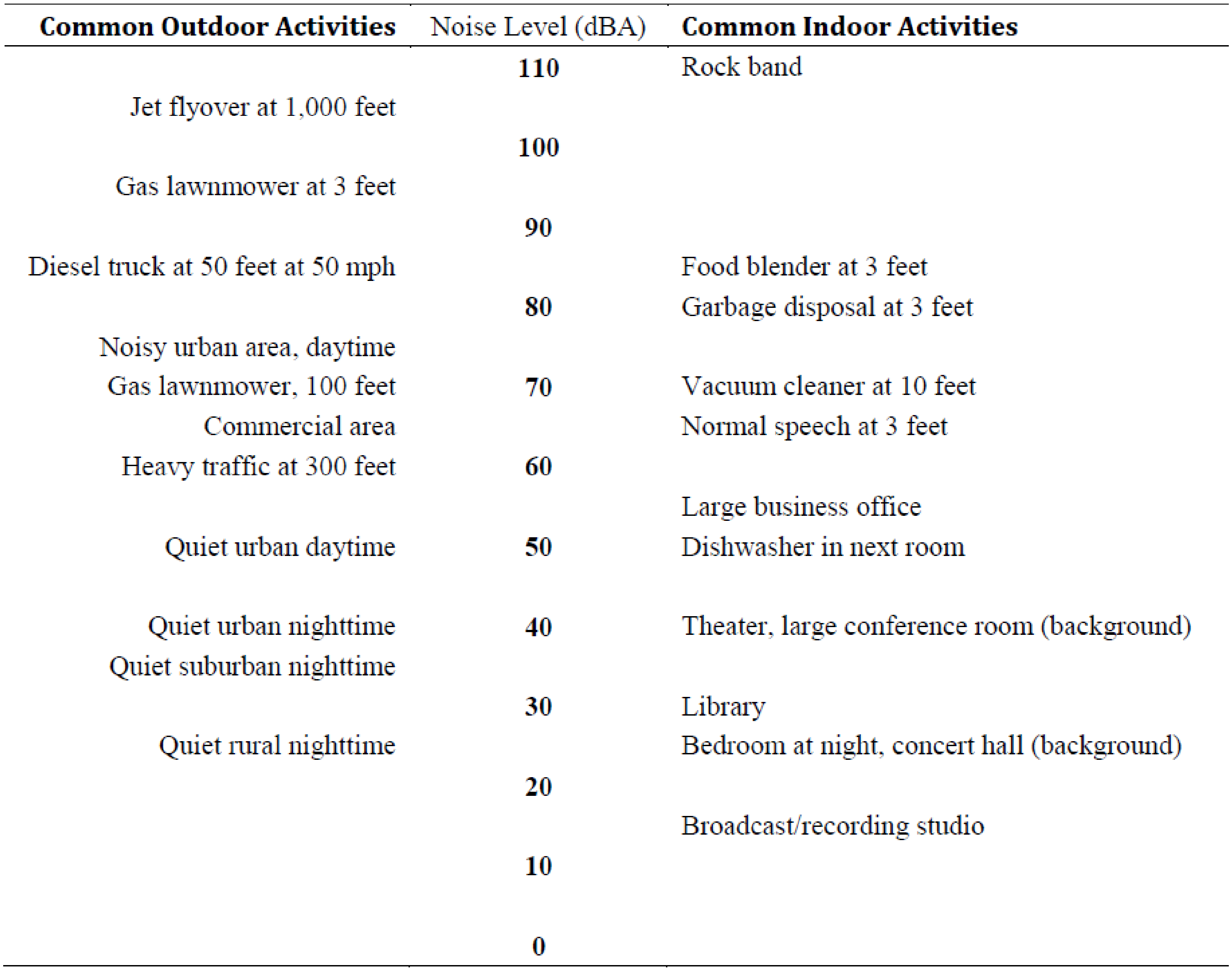
Table 3.15-4. Unmitigated direct GHG emissions associated with decommissioning of Lower Klamath Project facilities (Source: California Water Board 2020a, appendix O)

Project Activity	**Emissions (MTCO2e)[c]**
Pre-Dam Removal Activities[a]	663
Dam and Powerhouse Deconstruction	17,059
Restoration	2,406
Total Construction GHG Emissions	**20,128**
Emission from Sediments during Drawdown[b]	30–550
Estimated Emissions from Oxidation of Sediment-Associated Organic Matter	18,800
Total Reservoir Sediment-Related GHG Emissions	**19,350**
Conversion of the Lower Klamath Project Reservoirs to Riverine, Wetland, and Terrestrial Habitat Types	**24,900**

[a] Pre-dam removal activities include Fall Creek Hatchery modifications; access road, bridge, and culvert improvements; recreation facilities removal; flood improvements; Yreka water supply pipeline relocation; seed collection; invasive exotic vegetation control; and Iron Gate Hatchery modifications.

[b] CH_4 emission range depends on the seasonality and timing of the reservoir drawdown.

[c] GHG emissions represent the total emissions for the proposed action and would occur over an approximate two-year period.



Common Outdoor Activities	Noise Level (dBA)	**Common Indoor Activities**
	110	Rock band
Jet flyover at 1,000 feet		
	100	
Gas lawnmower at 3 feet		
	90	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower, 100 feet	**70**	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	**60**	
		Large business office
Quiet urban daytime	**50**	Dishwasher in next room
Quiet urban nighttime	**40**	Theater, large conference room (background)
Quiet suburban nighttime		
	30	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20	
		Broadcast/recording studio
	10	
	0	

Figure 3.15-1. Decibel scale and examples of commonly encountered noise sources (Source: Caltrans, 2013)

4.0 STAFF'S CONCLUSIONS

4.1 COMPARISON OF ALTERNATIVES

Table 4-1 compares and contrasts the relative environmental effects of the no-action alternative with the proposed action with staff modifications. The proposed action with staff modifications includes all the conditions of section 401WQCs issued by the California Water Board and Oregon DEQ, and the terms and conditions specified by NMFS and FWS in their BiOps to monitor incidental take, as well as several minor modifications to KRRC's proposed measures recommended by staff. KRRC has continued to consult with the relevant agencies to refine its management plans to address the requirements of the WQCs and filed a revised version of the management plans on December 14, 2021, documenting changes made as an outcome of consultation to date. As a result of this consultation, in combination with the minor nature of staff's modifications, the overall effects and benefits of the proposed action with staff modifications are not substantively different from the proposed action.

Table 4-1. Comparison of effects of the proposed action with staff modifications to the no-action alternative (Source: staff)

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Geology and Soils		
Bank Stability	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect** – Draining J.C. Boyle, Copco No. 2, and Iron Gate Reservoirs is expected to have minimal effect on bank stability and would be monitored. **Short-term, significant, adverse effect** – Draining Copco No. 1 Reservoir could cause bank instability at some private properties along the reservoir, but these effects would be mitigated. **Permanent, significant, beneficial effect** – Revegetation of the reservoir footprint area after drawdown would decrease erosion of fine sediments from exposed reservoir terraces.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Sediment Transport		
Hydroelectric Reach (Defined as the reach extending from the upstream extent of J.C. Boyle Reservoir downstream to Iron Gate Dam)	**Long-term, significant, adverse effect** – The reservoirs would continue to intercept sediments, having an adverse effect on channel morphological conditions in the hydroelectric reach.	**Short-term, significant, unavoidable, adverse effect** – Reservoir sediments mobilized during drawdown and dam removal would result in increased suspended sediment concentrations and some fine sediment deposition in the river channel and floodplain in the hydroelectric reach. **Permanent, significant, beneficial effect** – Erosion and mobilization of reservoir sediment would restore the natural geomorphology in the hydroelectric reach.
Downstream from Iron Gate Dam	**Long-term, significant, adverse effect** – The reservoirs would continue to intercept sediments and adversely affect channel morphological conditions and the abundance of gravel suitable for salmon spawning downstream of Iron Gate Dam.	**Short-term, significant, unavoidable, adverse effect** – Reservoir sediments mobilized during drawdown and dam removal would result in increased suspended sediment concentrations and some fine sediment deposition in the river channel and floodplain. Both effects would diminish with distance downstream. **Short-term, significant, unavoidable, adverse effect** – Bedload transport of larger sediments from the formerly impounded reaches would cause aggradation of the river channel, primarily in the first 8 miles downstream from the Iron Gate Dam site with lesser effects extending another 11 miles to Humbug Creek. **Permanent, significant, beneficial effect –** Normal

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		sediment transport processes would be restored, improving spawning gravel and restoring natural geomorphology.
Klamath River Estuary and Pacific Ocean	**No effect** – The sediment loads contributed from the Klamath River and its tributaries would not change.	**Short-term, less than significant, unavoidable, adverse effect** – The volume of sediment delivered into the estuary and ocean during the drawdown year would increase by 25 to 39 percent compared to the average amount of sediment delivered under existing conditions. However, the total amount of sediment delivered would likely be within the normal range of variation.
Navigation	**No effect** – No change from existing conditions.	**Short-term, less than significant, unavoidable, adverse effect –** Transport of reservoir sediments to the estuary and the Pacific Ocean could add to siltation at boat ramps in the Lower Klamath River and in Crescent City Harbor, but these effects would be mitigated.
Water Quantity		
Flows (Note: Resource-specific beneficial or adverse effects of changes in flow regime are identified in subsequent sections of this table.)	**Long-term, significant, effects** – Operation of the project would continue to reduce flows in the bypassed reaches and cause large daily flow variations in the J.C. Boyle peaking reach. Although peaking flows benefit whitewater boating, the altered flow regime adversely affects aquatic resources.	**Short-term, less than significant effect –** Flows downstream of Iron Gate Dam would be elevated during drawdown, but larger increases would be avoided by restricting the drawdown rate and the incremental deconstruction of dams and cofferdams.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Floods	**Long-term, less than significant, beneficial effect** – A small amount of available storage in the project reservoirs would continue to provide some attenuation of minor floods but have no effect on larger floods.	**Long-term, significant, unavoidable, adverse effect –** Streambed aggradation could result in changes to the 100-year floodplain in the first 10 to 20 miles downstream from the Iron Gate Dam site. **Long-term, less than significant, adverse effect –** Flooding in the first 10 to 20 miles downstream of Iron Gate Dam would have little effect on existing structures with proposed implementation of mitigation measures. **Permanent, less than significant, unavoidable, adverse effect –** The ability of available reservoir storage to attenuate minor floods would be lost.
Surface Water Supply and Water Rights	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect –** Implementation of the Water Supply Management Plan would mitigate effects on water rights holders and water supply downstream from the Iron Gate Dam site. **Temporary, less than significant, adverse effect –** Construction of the Yreka Water Supply Pipeline would cause water supply to be interrupted briefly during transition to the use of the new pipeline.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Groundwater Supply Wells	**No effect** – No change from existing conditions.	**Long-term, less than significant, adverse effect** – Draining the reservoirs would lower groundwater levels in the aquifer adjacent to the reservoirs, which could affect existing wells. Proposed mitigation would address adverse effects on wells owned by parties that agree to participate in well monitoring.
Water Right Transfer	**No effect** – No change from existing conditions.	**Permanent, significant, beneficial effect –** Upon decommissioning, PacifiCorp would convert its existing hydroelectric water rights in Oregon to instream water rights and abandon its hydroelectric water rights at the Copco No. 1, Copco No. 2, and Iron Gate facilities, avoiding continued negative effects of hydroelectric generation.
Water Quality		
Water Temperature	**Long-term, significant, adverse effect** – Impoundment of water in the reservoirs would continue to cause a seasonal shift in water temperatures that would not meet applicable Oregon DEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the hydroelectric reach.	**Permanent, significant, beneficial effect –** Draining of reservoirs would restore the natural thermal regime of the river to earlier warming in the spring and earlier cooling in the fall, meeting Oregon DEQ and California Basin Plan water quality objectives.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Nutrients	**Long-term, significant, adverse effect** – Impoundment of water in the reservoirs would continue to result in long-term interception and retention of total phosphorus and total nitrogen, causing algae blooms and seasonal increases in nutrients released from sediments in the reservoirs.	**Short-term, less than significant, adverse effect** – Draining the reservoirs and release of sediment would cause short-term increases in sediment-associated nutrients within and downstream of the project. **Permanent, significant, beneficial effect –** Conversion of reservoirs to free-flowing river conditions would eliminate internal loading of ammonia and orthophosphate.
Dissolved Oxygen	**Long-term, significant, adverse effect** – Impoundment of water in the reservoirs would continue to cause long-term seasonal and daily variability in dissolved oxygen concentrations in the hydroelectric reach, and low dissolved oxygen levels below the project that do not meet California North Coast Basin Plan water quality objectives and have an adverse effect on beneficial uses.	**Short-term, significant, unavoidable, adverse effect** – Draining reservoirs and release of sediment would cause short-term increases in oxygen demand and reductions in dissolved oxygen within the hydroelectric reach and downstream of the Iron Gate Dam site. This effect would diminish with distance downstream due to aeration and tributary inflows, with minimal effects downstream of Seiad Valley. **Permanent, significant, beneficial effect –** Conversion of reservoir areas to free-flowing river conditions would cause long-term increases in dissolved oxygen within and downstream of the hydroelectric reach.
pH	**Long-term, significant, adverse effect –** Impoundment of water in the reservoirs would continue to cause elevated and daily variability in pH in the hydroelectric reach and in the Lower Klamath River.	**Permanent, significant, beneficial effect –** Conversion of reservoirs to free-flowing river conditions would eliminate large pH fluctuations caused by phytoplankton blooms in Copco No. 1 and Iron Gate Reservoirs.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Algal Toxins	**Long-term, significant, adverse effect** – The reservoirs would continue to support toxin-producing nuisance algal species such as *M. aeruginosa*, resulting in high seasonal concentrations of algal toxins (i.e., microcystin) within and downstream of the hydroelectric reach.	**Permanent, significant, beneficial effect –** Conversion of the reservoirs to free-flowing river conditions would substantially reduce or eliminate algal toxins (i.e., microcystin) within and downstream of the hydroelectric reach.
Inorganic and Organic Contaminants	**Long-term, less than significant effect** – Impoundment of water and the retention of sediments behind the dams would continue to cause low-level exposure to inorganic and organic contaminants for freshwater aquatic species and humans in the hydroelectric reach.	**Short- to long-term, less than significant, adverse effect –** Draining the reservoirs and sediment release could cause short-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species and humans within and downstream of the hydroelectric reach.
Yreka Water Supply Pipeline Relocation	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect –** Construction of the Yreka Water Supply Pipeline could cause short-term increases in suspended material in the hydroelectric reach during the construction period.
Aquatic Resources		
Coho Salmon, Chinook Salmon, Steelhead, and Pacific Lamprey	**Long-term, significant, adverse effect –** Access to historical habitat would be limited to below Iron Gate Dam, recruitment of gravel would continue to be blocked by the project dams, and disease outbreaks would continue to cause mortality of juvenile and adult salmon due to poor water quality,	**Short-term, significant, unavoidable, adverse effect –** High suspended sediment concentrations and fine sediment deposition in spawning gravel during and following drawdown and deconstruction activities and associated decreases in dissolved oxygen, would have adverse effects on all life stages of anadromous fish that are present

Resource/Attribute	No Action	Proposed Action with Staff Modifications
	crowding in available cool-water refugia, and high levels of pathogens. Ongoing increases in water temperature are likely to contribute to a severe decline in the abundance of both naturally produced and hatchery-produced salmon within several decades.	in the Lower Klamath River during the drawdown year. **Permanent, significant, beneficial effect** – Access to additional habitat and cool-water refugia upstream of Iron Gate Dam would increase the numbers of naturally produced salmon and steelhead and increase the resiliency of these populations to ongoing increases in water temperature. Any short-term, adverse effects from barriers to passage formed via mobilized sediments would be minimized by KRRC's proposed measures. **Permanent, significant, beneficial effect** – The proposed action would improve the water temperature regime for anadromous fish spawning, rearing, and migrating in the mainstem Klamath River. **Permanent, significant, beneficial effect** – Increased recruitment of gravel downstream of Iron Gate Dam would improve spawning habitat for salmon and reduce habitat for the polychaete host of *C. Shasta*. **Permanent, significant, beneficial effect** – Reduced crowding, temperature stress, and pathogen densities would decrease disease incidence and associated kills of anadromous fish in the Lower Klamath River, including fish produced in tributaries that migrate through the Lower Klamath River on their migrations to and from the ocean.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Redband Trout	**No effect** – No change from existing conditions.	**Permanent, less than significant, adverse effect –** Restoration of access for anadromous fish to upstream habitat could increase disease transmission to upstream habitat, but most pathogens (including *C. Shasta*) are already present in upstream areas. **Permanent, less than significant, adverse effect –** Restoration of access for anadromous fish to upstream habitat could increase competition with fry and juvenile redband trout for food and habitat. **Permanent, significant, beneficial effect –** Fry and juvenile anadromous fish produced in upstream habitat would increase the available food base for adult redband trout.
Freshwater Mussels	**Long-term, significant, adverse effect** – Impoundment of riverine mussel habitat and blockage of the migration of host fish species would continue to adversely affect native freshwater mussels.	**Short-term, significant, adverse effect –** Reservoir drawdown and dam removal would increase suspended sediment concentrations and bedload sediment transport and deposition in the Lower Klamath River, which would adversely affect freshwater mussels in the short term. Some mussels would also be killed during in-river construction activities, but this effect would be minimized by translocating mussels prior to in-water construction activities. **Permanent, significant, beneficial effect** – Dam removal would restore connectivity for host fish species and increase

Resource/Attribute	**No Action**	**Proposed Action with Staff Modifications**
		available riverine habitat in previously impounded reach benefiting freshwater mussels.
Benthic Macroinvertebrates	**Long-term, significant, adverse effect –** Impoundment of water within the reservoirs and associated poor water quality and substrate conditions would continue to have adverse effects on the diversity and abundance of benthic macroinvertebrates in the hydroelectric reach.	**Short-term, significant, adverse effect** – Increased suspended sediment concentrations, sediment deposition, and bedload transport of larger sediments would cause mortality to many macroinvertebrates in the hydroelectric reach and Lower Klamath River, but populations would recover quickly. **Permanent, significant, beneficial effect** – Dam removal would restore connectivity through the hydroelectric reach and would rehabilitate and increase availability of riverine habitat within and downstream of the hydroelectric reach, benefiting benthic macroinvertebrates.
Hatchery Production	**Long-term, significant, adverse effect** – Iron Gate Hatchery would continue to produce Chinook and coho salmon consistent with its existing Hatchery and Genetics Management Plan. Salmon returns to the Klamath River would remain highly variable but would continue to exhibit ongoing decreases in abundance over time. **Long-term significant, beneficial effect** – Southern Oregon/Northern California Coasts (SONCC) coho salmon produced at Iron Gate Hatchery would continue to	**Short-term, significant, adverse effect –** The elimination of hatchery-produced Chinook and coho salmon at Iron Gate Hatchery would likely result in a short-term reduction in adult returns in post-dam removal years (before the benefits of dam removal are realized). **Permanent, significant, beneficial effect –** Hatchery operations during, and for at least eight years following dam removal, would likely facilitate the repopulation of newly available Chinook and coho salmon habitat upstream from Iron Gate Dam. The expected increase in natural production

Resource/Attribute	No Action	Proposed Action with Staff Modifications
	protect and conserve the population's genetic resources and reduce extinction risks, but this benefit would diminish over time as conditions in the migration corridor continue to degrade.	would likely be higher than what would be lost due to the decommissioning of Iron Gate Hatchery.
Commercial, Recreational, and Tribal Fisheries	**Long-term, significant, adverse effect –** Although fish produced at Iron Gate Hatchery currently contribute to higher harvest rates in the fishery than what would happen without hatchery stocks, frequent closures and/or fishing curtailments (associated with low abundance) are likely to become more restrictive over time.	**Permanent, significant, beneficial effect –** The potential for harvest is predicted to be greater under the proposed action due to the expected increase in the production of wild salmon and steelhead in the Klamath River Basin. The proposed action would also likely reduce the frequency of low escapement leading to fishery closures.
Botanical Resources		
Wetlands	**Long-term, significant, beneficial effect –** Continued impoundment of water in the reservoirs would support reservoir-dependent wetland and riparian communities.	**Short-term, significant, unavoidable, adverse effect –** Dam removal would result in the loss of reservoir-dependent wetland and riparian vegetation communities, but wetland restoration efforts would result in no net loss of riparian and wetland acreage.
Vegetation	**Long-term, significant adverse effect –** Continued inundation of the reservoir footprint would exclude upland and riparian vegetation development. Continued use and management of lands with project facilities would affect botanical resources, including special status species, if present.	**Short-term, unavoidable, significant, adverse effect–** Draining reservoirs would create exposed, unvegetated soils susceptible to erosion and colonization by invasive species in the short term, but revegetation efforts would prevent long-term effects. **Short-term, significant, unavoidable, adverse effect –** Removal of dams and associated

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		facilities, staging and storage areas would cause short-term ground disturbance and vegetation removal. **Permanent, significant, beneficial effect –** Recontouring, grading, and revegetation of reservoir footprints using native species and exotic weed control would result in riparian and upland vegetation establishment.
Special Status Plant Species	**Long-term, significant, adverse effect –** The continued use and management of lands with project facilities could affect special status species.	**Short-term, significant, unavoidable, adverse effect –** Reservoir drawdown and the construction of temporary access roads or the improvement of existing roads could have adverse effects on these plants, but these effects would be minimized by avoiding special status plant species sites, if feasible, and salvaging and transplanting special status plant species. **Permanent, significant, beneficial effect –** Transplanting special status plant species combined with recontouring, grading, and revegetation of reservoir footprints would expand potential special status plant species habitat.
Wildlife Resources		
Wildlife Habitat	**Long-term, significant adverse effect –** The continued inundation of lands in the reservoir footprint and continued use and management of lands with project facilities would exclude these lands as terrestrial wildlife habitat.	**Permanent, significant, unavoidable, adverse effect –** Draining reservoirs and deconstruction of project facilities would have adverse effects on wildlife that prefer reservoir habitats. **Permanent, significant, beneficial effect –** Restoration of

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		inundated lands and deconstructed facilities would benefit terrestrial wildlife that prefer upland habitats.
Large Mammals	**Long-term, significant, adverse effect** – The project reservoirs would continue to inundate habitat and present a barrier to movement of some terrestrial species.	**Permanent, significant, beneficial effect** – Dam removal and restoration activities would restore upland and riparian riverine habitat and reduce movement barriers to large mammals.
Reptiles and Amphibians	**Long-term, significant beneficial effect** – The reservoirs would continue to support amphibians and reptiles that use reservoir habitats.	**Short-term, less than significant, adverse effect** – Reservoir drawdown and construction activities could result in direct mortality or harm to amphibian and reptile species, but relocation of reptiles and amphibians at construction sites would minimize adverse effects on these species. Long-term or population-level effects would be permanent, less than significant, and beneficial or adverse, depending on species (terrestrial or aquatic, respectively).
Nesting Birds	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect** – Removal of vegetation at and near construction sites could result in short-term, adverse effects on nesting birds but effects would be minimized with mitigation measures. **Permanent, significant, beneficial effect –** Revegetation efforts and establishment of native upland and riparian communities would expand existing wildlife habitat and have

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		long-term benefits for nesting birds.
Special Status Wildlife Species	**Long-term, significant, beneficial effect** – The continued impoundment of water in the reservoirs and management of upland habitats would support aquatic and upland dependent special status wildlife species.	**Permanent, significant, unavoidable, adverse effect** – Removal of the reservoirs would reduce habitat for species that prefer reservoir habitats. **Short-term, significant, adverse effect** – Construction at upland sites would disturb existing wildlife habitat for special status species. **Permanent, less than significant, beneficial effect –** Revegetation and establishment of native upland and riparian communities would expand existing wildlife habitat for special status species.
Sensitive Species		
Bald and Golden Eagles	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide foraging opportunities to nesting and wintering bald eagles.	**Short-term, less than significant, adverse effect** – Use of heavy machinery, blasting, and material transport may disturb nesting and foraging eagles. **Permanent, significant, unavoidable, adverse effect** – Loss of the reservoirs would reduce foraging areas for bald eagles. **Permanent, significant, beneficial effect** – Restored salmon runs would increase foraging resources for bald eagles and restoration of the reservoir footprints to open grasslands and shrublands would create foraging habitat for golden eagles.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Bats	**Long-term, significant, beneficial effect** – Project facilities and appurtenant structures would continue to provide roosting, hibernating and maternity sites for bats.	**Short-term, significant, adverse effect –** Removal of facility structures and deconstruction-related activities would have adverse effects on roosting, hibernating, and maternity sites of bat species, but such effects would be reduced by prohibiting removal of structures when maternity colonies are present and following the National White-Nose Syndrome Decontamination Protocol. Long-term effects would be mitigated by creating or enhancing artificial roosting habitat and using bat gates to continue to provide access to tunnels and conveyances to maternity, roosting, and hibernating sites.
Threatened and Endangered Aquatic Species		
Southern Distinct Population Segment (DPS) Green Sturgeon, and Eulachon (See Aquatic Resources section for effects on SONCC evolutionarily significant unit [ESU] coho salmon)	**Short-term, less than significant effect** – Green sturgeon and eulachon would continue to occupy the Lower Klamath River, Klamath River estuary, and nearshore environment during the winter and spring, and use these areas for spawning, egg incubation, and early rearing. However, all green sturgeon that have been documented to occur in the Klamath River are members of the unlisted Northern DPS.	**Short-term, significant adverse effect –** Elevated suspended sediment concentration (SSC) levels in the Lower Klamath River resulting from the proposed action are likely to adversely affect Southern DPS eulachon in the short term. **Short-term, less than significant, adverse effect –** Because there would be no predicted substantial decrease in green sturgeon abundance or substantial decrease in habitat quality or quantity, implementation of the proposed action would have a less than significant, adverse effect on these species in the short term.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		Long-term, less than significant, beneficial effect – In the long term, green sturgeon and the eulachon population may benefit from the more normative ecological processes that would develop under the proposed action.
Southern Resident Killer Whales	**Long-term, significant, adverse effect –** Although Klamath River salmon only contribute approximately 2.3 percent of the prey base for Southern Resident killer whales, the potential for a severe and permanent decline in Klamath River salmon abundance under the no-action alternative would have a significant, adverse effect on the whale's prey base.	**Short-term, less than significant, adverse effect –** Because the Klamath River contributes a small number of Chinook salmon to the Southern Resident killer whale prey base, short-term, adverse effects on salmon from elevated SSCs would have a less than significant effect on Southern Resident killer whales. Similarly, long-term, beneficial effects on salmon abundance would have a less than significant, beneficial effect on Southern Resident killer whales.
Lost River and Shortnose Suckers	**No effect** – The reservoirs would continue to provide rearing habitat for suckers that emigrate into this habitat.	**Short-term, significant, unavoidable, adverse effect** – Dam removal and conversion of the reservoir areas to a free-flowing river would likely cause mortality to the suckers residing in the project reservoirs, but the suckers in the reservoirs do not reproduce or contribute to recovery.
Bull Trout	**No effect –** Access to spawning habitat and water quality conditions would not change.	**No effect –** Dam removal would not affect access, spawning habitat or water quality for bull trout.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Threatened and Endangered Wildlife Species		
Franklin's Bumble Bee, Monarch Butterfly, and Western Bumble Bee	**Long-term, significant, adverse effect** – Inundated lands in the reservoir footprint and occupied by project facilities would not be available to support these species.	**Short-term, less than significant, adverse effect –** Vegetation clearing and other ground disturbance for dam removal and structure demolition could destroy or disturb potentially suitable habitat for bumble bees and monarch butterflies. **Permanent, significant, beneficial effect –** Vegetation restoration and increased pollen and nectar sources would have long-term, beneficial effects on nectar feeding species such as bumble bees and monarch butterfly.
Little Brown Bat	**Long-term, significant, beneficial effect** – Project facilities and appurtenant structures would continue to provide roosting, hibernating and maternity sites to bats.	**Short-term, significant, adverse effect –** Removal of facility structures and deconstruction-related activities would have adverse effects on roosting, hibernating, and maternity sites of bat species, but such effects would be reduced by prohibiting removal of structures when maternity colonies are present and following the National White-Nose Syndrome Decontamination Protocol. Long-term effects would be mitigated by creating or enhancing artificial roosting habitat and using bat gates to continue to provide access to tunnels and conveyances to maternity, roosting, and hibernating sites.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Northern Spotted Owl	**No effect** – No change from existing conditions.	**Short-term, less than significant, adverse effect** – Decommissioning and restoration activities could disturb nearby suitable northern spotted owl habitat, which is limited near the project; the closest suitable habitat that could be used by owls for nesting is located approximately 1.3 miles southeast of the Copco No. 1 Reservoir. **Permanent, less than significant, beneficial effect** – The proposed action would not modify any suitable habitat for northern spotted owl nesting, roosting, or foraging. Restoration of the river channel and riparian forest would increase northern spotted owl dispersal habitat over the long term.
Oregon Spotted Frog	**No effect** – No change from existing conditions.	**Long-term, less than significant, beneficial effect** – The proposed action is not likely to affect the Oregon spotted frog because all known occupied habitat occurs upstream of the project, but improved water quality and habitat conditions could benefit dispersing Oregon spotted frog. Removal of reservoirs would also reduce, but not eliminate, populations of predatory non-native bullfrogs.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Western Pond Turtle	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide habitat for western pond turtle.	**Temporary, significant, adverse effect** – Drawdown, deconstruction, bank failures, floodplain entrapment, and habitat alterations could cause mortality to some individual western pond turtles. **Permanent, significant, beneficial effect** – Dam removal and free-flowing aquatic habitat would provide for western pond turtle dispersal and increased genetic exchange among isolated populations, reduce predatory non-native bullfrogs and warmwater fishes, and improve water quality.
Recreation		
Recreation Access	**Long-term, significant, beneficial effect** – Continued access to recreational facilities would benefit recreational users of whitewater and flatwater reaches in and downstream of the project.	**Temporary, significant, adverse effect –** To protect public safety, access would be restricted to some areas during project deconstruction, which would limit recreational access. **Permanent, significant, adverse effect –** Eleven recreation sites would be removed, preventing access and displacing recreational users in- and downstream of the hydroelectric reach. **Permanent, significant, beneficial effect –**Measures at remaining facilities and potential newly developed sites would provide river access, depending on a party committing to funding their construction and operation.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Reservoir Recreation	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide reservoir-based recreational opportunities.	**Permanent, significant, unavoidable, adverse effect –** Draining the reservoirs would eliminate reservoir-based recreational opportunities.
Whitewater Boating	**Long-term, significant, beneficial effect –** Operation of the project would continue to provide predictable whitewater boater opportunities in the Hell's Corner reach.	**Permanent, significant, unavoidable, adverse effect –** Eliminating peaking operations would reduce whitewater boating opportunities in the Hell's Corner reach. **Permanent, significant, beneficial effect –** Removing encroaching vegetation in the Copco No. 1 bypassed reach and remaining construction debris at Sidecast Slide would enhance whitewater boating safety. **Permanent, significant, beneficial effect** – New whitewater opportunities would be created along the hydroelectric reach, including Ward's Canyon.
Water Contact Recreation	**Long-term, significant, adverse effect** – Poor water quality conditions and high microcystin concentrations would continue to adversely affect recreational activities.	**Permanent, significant, beneficial effect –** Improved water quality conditions would negate the safety risk from exposure to microcystin toxin.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Wild and Scenic Rivers	**Permanent, significant, adverse effect –** The declining fish populations in future decades would have a permanent, significant, adverse effect on the fisheries outstandingly remarkable values (ORV) in the Recreational River segment (Iron Gate Dam to the Pacific Ocean).	**Short-term, significant, adverse effect –** Short-term decreases in water clarity would adversely affect recreation. **Permanent, significant, beneficial effect –** The proposed action would have beneficial effects on the scenic landscape, fisheries, and recreation ORVs in the Scenic River segment reach below J.C. Boyle reach and the fisheries ORV in the Recreation River segment (Iron Gate Dam to the Pacific Ocean).
Land Use		
Fire Suppression	**Long-term, significant, beneficial effect** – The reservoirs would continue to provide fire breaks and a water source for ground and air based wildfire suppression efforts.	**Permanent, less than significant, adverse effect** – Draining of reservoirs would eliminate fire breaks and use of the reservoirs as a water source for wildfire suppression efforts. Measures to improve early detection of wildfires, assistance with improving defensible space around home sites, and development of additional sites to access water for ground-based and aerial fire suppression efforts would reduce adverse effects. However, the additional water source locations would not be suitable for refilling some types of aircraft that require large expanses of water to collect water without landing.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Land Exchange	**Short- and long-term, less than significant effect** – Parcel B lands would continue to be managed by PacifiCorp for hydropower operations, recreation, and natural (fish, wildlife and botanical) resources.	**Short- and long-term, significant, beneficial effect –** PacifiCorp Parcel B lands are expected to be transferred to the States of Oregon and California to be managed for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access.
Aesthetics		
Viewshed	**Long-term, significant, adverse effect** – Hard lines of the dam and large expanses of water in the reservoirs would continue to affect visual qualities in areas surrounding the project.	**Permanent, significant, unavoidable, adverse effect –** Neighboring landowners on Copco No. 1 and Iron Gate Reservoirs would lose open-water views. **Temporary, significant, unavoidable, adverse effect –** Deconstruction activities would have a temporary, adverse effect on scenic quality of the viewshed. **Short-term, significant, unavoidable, adverse effect –** Draining the reservoirs would expose barren, formerly inundated areas adversely effect on scenic quality of the viewshed until vegetation becomes established. **Permanent, significant, beneficial effect –** After dam removal and landscape restoration, hard lines of the dams and large expanses of water in the reservoirs would transform into natural river canyon landforms with a more natural flow regime and landscape character.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Cultural Resources		
Archaeological Sites	**Long-term, significant, beneficial effect** – The Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and traditional cultural properties (TCPs) that are located within the area of potential effects (APE) would remain under federal protection afforded by NHPA.	**Permanent, significant, adverse effect –** Removal of federal protection of archaeological sites and resources on lands under the Commission's jurisdiction would have adverse effect on cultural resources protection under section 106. **Short-term, significant, adverse effect to long-term, less than significant, adverse effect –** Erosion and slumping along reservoir shorelines, ground-disturbance activities, and vandalism of exposed, previously submerges sites could have adverse effects on archaeological resources.
Built Environment Resources	**Long-term, significant, beneficial effect** – The Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and TCPs that are located within the APE would remain under federal protection afforded by NHPA.	**Permanent, significant, unavoidable, adverse effect –** Deconstruction of the Lower Klamath Project facilities would have adverse effects on archaeological resources that may be eligible for listing in the National Register of Historic Sites. Historic American Building Survey/Historic American Engineering Record/Historic American Landscapes Survey documentation would help to mitigate adverse effects of decommissioning of historic buildings and implementation of the HPMP would avoid, minimize, or mitigate various adverse effects on cultural resources listed or eligible for inclusion in the National Register.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Traditional Cultural Properties	**Long-term, significant, beneficial effect** – The Commission's jurisdiction over historic hydroelectric facilities, archaeological sites, and TCPs that are located within the APE would remain under federal protection afforded by NHPA.	**Permanent, significant, beneficial effect –** Restoring the impounded reaches to a free-flowing river would have significant beneficial effect on restoring salmon runs, access to traditional foods, Tribal cultural practices, and a characteristic fluvial landscape.
Tribal Trust Responsibilities		
	Permanent, significant, adverse effect – Under the no-action alternative, it is likely that the Klamath salmon fisheries will become severely diminished within several decades. The continued lack of a healthy fishery would not enable the Tribes to operate successful Tribal commercial fishery endeavors. Absent these opportunities for employment and self-sufficiency, Tribal unemployment and the associated Tribal economy would continue to suffer. This would result in a continued disproportionate and permanent significant, adverse effect on Tribal communities. **Long-term, significant, adverse effect** – Under the no-action alternative, the continued occurrence of toxic algae blooms would impede the Tribes' ability to safely continue their many rituals that involve bathing or other means of contact with the waters of the Lower Klamath	**Permanent, significant, beneficial effect** – The proposed action would result in benefits to water quality, aquatic resources, fisheries, and terrestrial resources used by all Tribes. These benefits would aid in the continuation and restoration of Tribal practices and traditions that have been adversely affected.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
	River. This would result in a continued disproportionate and permanent significant, adverse effect on Tribal communities.	
Socioeconomics		
Employment, Recreation, Property Values, Tax Revenues and Electric Rates	**Long-term, significant, beneficial effect** – Property owners near reservoirs would not have adverse effects on their properties, and employment, property values, tax revenue, and electric rates would remain similar to existing conditions.	**Short-term, significant, adverse effect** – Property owners near the reservoirs could have adverse economic effects on wells, slope instability, property values, and susceptibility to damage from wildfires. Dam removal could have adverse effects on employment, whitewater boating and reservoir recreation, property values, tax revenue, and electric rates. **Short-term, significant, beneficial effect** – The regional economy would benefit in the short term by construction and restoration activities associated with dam removal. **Permanent, significant, beneficial effect –** Dam removal and restoration would have beneficial effects on income from commercial fishing, subsistence fishing, ocean and in-river sport fishing, riverine recreation, and tourism.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Environmental Justice		
Environmental Justice Communities	**Disproportionately high and adverse effect on environmental justice populations –** The dams would continue to negatively affect environmental justice communities by affecting water quality and decreasing the quality of the salmon fishery.	**Disproportionately high and adverse effect on environmental justice populations –** Adverse effects associated with the removal of the Copco No. 1, Copco No. 2, and Iron Gate project facilities, including effects on property values, noise, traffic, sediment deposition on private property and private well productivity would disproportionately affect environmental justice communities.
Public Safety		
Hazardous, Toxic, and Radiological Waste	**No effect** – No change from existing conditions.	**Temporary, less than significant, adverse effect –** Implementation of a Hazardous Material Management Plan during deconstruction and removal would minimize the potential for adverse effects from the transport, use, and disposal of hazardous materials.
Construction Traffic	**No effect** – No change from existing conditions.	**Temporary, significant, adverse effect** – Traffic volume and heavy equipment use due to construction activities would have adverse effect on congestion, road safety and conditions, and emergency response time, but measures included in the Construction Management Plan would minimize adverse effects.

Resource/Attribute	No Action	Proposed Action with Staff Modifications
Other Construction-Related Hazards	**No effect** – No change from existing conditions.	**Temporary, less than significant, adverse effect –** Implementation of the proposed Health and Safety Plan and Emergency Response Plan would effectively minimize risks to public safety associated with deconstruction and restoration activities.
Air Quality, Noise and Vibration		
Air Quality	**No effect** – No change from existing conditions.	**Temporary, significant, unavoidable, adverse effect** – Vehicle exhaust and fugitive dust emissions from the removal of dams and appurtenant facilities could increase emissions of NOx, that could exceed applicable thresholds of significance.
Noise and Vibration	**No effect** – No change from existing conditions.	**Temporary, significant, unavoidable, adverse effect** – Increase in outdoor noise levels (heavy equipment operation, hauling) and vibrations (blasting) due to deconstruction activities would have a temporary significant adverse effect on residents living near deconstruction sites.
Greenhouse Gas Emissions		
Deconstruction and Restoration	**No effect** – No change from existing conditions.	**Temporary, less than significant, adverse effect –** Over a two-year period, direct greenhouse gas (GHG) emissions would be generated by decommissioning- and restoration activities but purchasing carbon offsets would have a net-zero GHG result. **Short-term, less than significant, unavoidable, adverse effect** – GHG emissions

Resource/Attribute	No Action	Proposed Action with Staff Modifications
		due to reservoir drawdowns and to the conversion of inundated lands to riverine, wetland and terrestrial habitats would exceed the no net increase threshold but would not conflict with any applicable plan, policy, or regulation. **Permanent, less than significant, unavoidable, adverse effect** – Loss of renewable hydropower would be offset by increasing renewable energy in PacifiCorp power mix at a rate that more than covers the loss from the baseline condition to comply with the California Renewable Portfolio Standard.

4.2 COMMISSION STAFF RECOMMENDATIONS

Based on our independent review and evaluation of the environmental and economic effects of the proposed action, the proposed action with staff modifications, and the no-action alternative with the best available information at the time of this analysis, we recommend the proposed action with staff modifications, as the preferred alternative. We recommend this because: (1) the environmental protection, mitigation, and enhancement measures proposed by KRRC, along with staff's additional recommendations, would adequately protect most environmental resources, restore project lands to good condition, minimize adverse effects on environmental resources, maximize benefits to the Chinook salmon fishery that is of vital importance to the Tribes, and restore the landscape of the entire hydroelectric reach to a more natural state consistent with the Wild and Scenic designated sections within and downstream of the hydroelectric reach; (2) there are no proponents currently in place to ensure the long-term maintenance or needed upgrades to facilities left in place under the no-action alternative; and (3) section 6 of the Federal Power Act (FPA) and the Commission's regulations allow licensees to surrender existing project licenses and cease project operation.

Commission staff's independent analysis indicates that while some significant short-term, adverse effects would occur from decommissioning the project as proposed, KRRC's proposed environmental protection, mitigation, and enhancement measures would provide significant protection for environmental resources. In addition, a number of agencies, Tribes, and non-governmental organizations support the proposed action, as evidenced by the signing of the amended KHSA on November 30, 2016,[211] which established a process for the timely decommissioning of the project facilities. The Karuk Tribe, the Yurok Tribe, and the States of Oregon and California reaffirmed their support for the proposed action by signing the November 17, 2020, MOA to implement the amended KHSA.

Although the Yurok and Karuk Tribes are the only Tribes that signed these agreements, the record of consultation with other participating Tribes regarding the proposed action indicates support for the removal of the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams, with the general consensus being that removal is necessary to restore anadromous fish habitat and improve water quality in the Lower Klamath River. However, some Tribes have also expressed concern regarding issues such as sediment passage and exposure or erosion of significant cultural resources (see appendix K for a summary of Tribal views expressed in the public record on the proposed action).

Members of the community surrounding the project have filed numerous comments and protests making staff aware that the removal of the reservoirs would adversely affect their way of life. Our analysis verifies that some existing benefits from the presence of the reservoirs would cease if the dams are removed. Staff recognizes in this draft EIS that the proposed action would adversely affect residents living near the reservoirs.

Under the proposed action with staff modifications, the Commission would authorize the decommissioning of the Lower Klamath Project. However, the surrender of license would become effective only upon completion of the requirements of any surrender order issued by the Commission, including all decommissioning activities and required mitigation measures. In addition, the conditions of water quality certificates issued by the California Water Board and Oregon DEQ, and conditions of BiOps issued by NMFS or FWS, would be made part of any order issued.

4.2.1 Effects on Energy

The proposed action would result in the loss of an existing 163-MW operating hydroelectric project that produces an average annual generation of about 686,000 MWh of electricity. This loss of capacity and generation would have an adverse effect on the region. The Commission is aware of the myriad advantages of hydropower over thermal

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[211] The amended KHSA was signed by representatives from PacifiCorp, KRRC, Interior, NMFS, the State of California, California DFW, California Natural Resources Agency, the State of Oregon, Oregon DEQ, Oregon DFW, Oregon WRD, the Karuk Tribe, the Yurok Tribe, Humboldt County (California), American Rivers, California Trout, Institute for Fisheries Resources, Northern California/Nevada Council Federation of Fly Fishers, Pacific Coast Federation of Fishermen’s Associations, Sustainable Northwest, and Trout Unlimited.

sources of electricity. Hydropower is a renewable, domestic source of electricity that displaces the use of fossil fuels and related pollution and provides indirect operational benefits. These include the ability to maintain a reliable electric grid through black-start capability, power factor correction, and almost instantaneous load following. As well as the operational benefits, hydropower projects such as the Lower Klamath Project can provide recreational benefits to the public and benefits to species of fish and wildlife that use reservoir habitats. Despite these benefits, the Commission is bound by the FPA and its implementing regulations and must act, while following the legislated procedure, on a surrender application and determine whether, and on what conditions, the owner of a licensed hydropower project may be authorized to surrender the license and remove project facilities when it no longer wants to operate the project.

4.2.2 Staff Recommendations

Based on this independent analysis and issues previously discussed in section 3 of this EIS, we recommend the following additional environmental measures (above those measures already proposed by KRRC) be included in any order the Commission may issue for the proposed surrender of the Lower Klamath Project:

- Require that all consultations, final management plans, delineations, pre-drawdown mitigation measures, agreements, wetland delineations, and certifications, must be completed before any surface disturbance commences.
- Modify the Construction Management Plan to include measures AQ-1 through AQ-5 to minimize effects of deconstruction activities on air quality, measure ENR-1 to purchase carbon offsets, and the Noise and Vibration Control Plan. These measures, which KRRC has agreed to implement, are described in section 2.1.3.
- Specify measures in the California Slope Stability Monitoring Plan (a subplan of the Reservoir Drawdown and Diversion Plan) about repairs and replacements of private property to be implemented if any reported structural damage to properties abutting Copco No. 1 Reservoir is found to be related to the drawdown, following monitoring and inspection.
- Extend the planned LiDAR monitoring of the reservoir and embankment rim for six months after completion of the drawdown—at a reduced survey interval of once per month and limited to 1,780-linear-foot long segments of the Copco No. 1 Reservoir rim identified to be potentially affected by slope failure. The rationale for limiting this measure to Copco No. 1 Reservoir is discussed in section 3.1, *Geology and Soils*.

- Modify the Del Norte Sediment Management Plan (a subplan of the Sediment Deposit Remediation Plan) to require that Del Norte County be reimbursed by KRRC for any increase in the cost of maintaining the Klamath River boat ramps in an operable condition that is attributable to sediment deposited as a result of the proposed action.
- Modify the Aquatic Resource Management Plan to include translocation of freshwater mussels as modified in KRRC's October 10, 2018, letter to the California Water Board.
- Modify the Hatchery Management and Operations Plan to clarify whether and when ownership would be transferred to California DFG or another entity.
- Modify the Reservoir Area Management Plan to include two periods of vegetation sampling each year. One sampling period should occur in late spring/early summer as proposed. The second sampling period should occur in late fall, but prior to the onset of woody vegetation dormancy.
- Modify the Reservoir Area Management Plan to include detailed maps that identify areas of grading, water runoff control measures, planting, seeding, mulching, and irrigation areas. These maps should include final limits of work zones, delineated wetlands within areas of proposed disturbance, the reservoir footprints, the J.C. Boyle canal and scour hole, and all areas of temporary disturbance where revegetation activities would occur.
- Develop an eagle conservation plan that includes occupancy and nest productivity surveys; timing restrictions on vegetation clearing and construction noise; monitoring of active eagle nests; coordination with FWS, California DFW, and Oregon DFW; and reporting as described in California Water Board WQC condition 17.
- Modify the Oregon and California TWMPs to include: (1) additional criteria for the potential removal of structures containing bats between April 16 and August 31. If it is necessary to remove structures during this period, conduct surveys to determine whether the structure is occupied as a maternity roost and prohibit removal of structures with maternity roosts. In the absence of maternity roosts, only remove structures when bats are active (i.e., at night) and when less than 0.5 inch of rain is predicted within the following 24 hours; (2) use of bat gates to close portal outlets, tunnels, and other water conveyance structures; and (3) require staff entering areas with potential bat activity to follow the National White-Nose Syndrome Decontamination Protocol (WNS Response Team, 2020).

- Modify the Recreation Facilities Plan to include: (1) removal of remaining construction-related debris in the river at the Sidecast Slide location and encroaching vegetation growth within the river channel in the Copco No. 2 bypassed reach that create hazardous boating conditions; (2) developing a plan for funding the construction and maintenance of the potential access sites described in the Recreation Facilities Plan to include, at a minimum, development of the planned access points that are within the existing reservoir footprints; (3) consulting with UKOA to schedule construction activities and access restrictions to minimize adverse effects on whitewater boaters; and (4) signage related to recreation site closures in Spanish and Hmong.
- Prepare a supplemental Historic Properties Management Plan in consultation with the Oregon SHPO, California SHPO, participating Tribes, and other appropriate agencies and organizations to address the following: (1) results of Phase II archaeological studies; (2) results of additional surveys and evaluations of historic structures; (3) results of the pending TCP studies and Tribal consultation; (4) identification of specific effects on all historic properties, and resource-specific measures to resolve effects determined to be adverse; and (5) additional items identified by the Commission requiring clarification.
- Modify the Reservoir Area Management Plan to incorporate the pre- and post-drawdown requirements for cultural resources inspections, surveys, evaluations, mitigation, and management as specified in the HPMP. Additionally, should ground conditions permit access for depositional sediment grading during reservoir drawdown, include provisions in the Reservoir Area Management Plan for a cultural monitor to be present to ensure that if any cultural resources are identified on the historical pre-dam ground surface, grading stops and the measures outlined in appendix C, section 7.1 of the HPMP (Monitoring and Inadvertent Discovery Plan, Procedures) are closely followed within 48 hours. These protocols include (1) notifying the team supervisor of any discovery of cultural or archaeological resources, (2) suspending work within 100 feet of the find in all non-dewatering situations, (3) completing an initial assessment of the discovery, (4) notifying the Commission, SHPO, and participating Tribes of the find, and (5) consulting with these entities to determine and implement agreed-upon treatment measures for discoveries that are potentially eligible for listing on the National Register.
- Modify the Sediment Deposit Remediation Plan, the Water Supply Management Plan, the Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services, to include a public outreach component that specifically addresses communication with environmental justice communities.

- Modify the Fire Management Plan (a subplan of the Water Supply Management Plan) and the Construction Management Plan in consultation with the California Department of Forestry and Fire Protection, Oregon Department of Forestry, and the Fire Safe Council of Siskiyou County to address the following issues raised by stakeholders:
    1. Insufficient stream depth and lift requirements at proposed locations for dry fire hydrants
    2. Location of dry fire hydrants on blind corners
    3. Lack of suitable locations for fire trucks to turn around near dry fire hydrants
    4. Lack of any proposed river access boat ramps within the Copco No. 1 Reservoir area
    5. Identification of the entity that would be responsible for storage, deployment, and refill of portable water tanks
    6. The potential need to install additional water sources (such as dip tanks) to address the potential filling of existing dip sites by gravel transported from the reservoirs.

In conclusion, Commission staff finds that any short- and long-term, adverse environmental effects and the loss of power generation resulting from the proposed action would be outweighed by the substantial long-term environmental benefits gained from project decommissioning, as stated in this draft EIS. The environmental and public benefits of the proposed action, with additional staff recommendations, would exceed those of the no-action alternative (status quo). Therefore, Commission staff recommends approval of KRRC’s application for surrender of license, as proposed, with the above-stated additional staff recommendations and conditions from the water quality certifications issued by the California Water Board and Oregon DEQ and the BiOps issued by NMFS and FWS.

APPENDIX A—ALTERNATIVES, INFORMATION, AND ANALYSES SUBMITTED DURING SCOPING

APPENDIX A

ALTERNATIVES, INFORMATION, AND ANALYSES SUBMITTED DURING SCOPING

A.1 ALTERNATIVES SUBMITTED DURING SCOPING

A.1.1 Provide Fish Passage with Dams in Place

Numerous commenters recommended keeping the dams in place and providing fish passage through the project reservoirs using fish ladders, tunnels, and/or a Whooshh fish passage system. This alternative may require federal takeover or transfer of the project license to another entity. While most of the commenters provided limited details on how upstream and downstream fish passage would be provided, several of the approaches and technologies suggested were discussed in detail during scoping for the California Water Board's 2020 Environmental Impact Report (EIR).

Maintaining the project dams and providing fish passage would avoid potential impacts of reservoir drawdown and dam removal on fish and other aquatic life via downstream sediment transport. Power generation would continue, and the project reservoirs would continue to provide the benefits that they afford for local residents, including serving as important water sources for fire suppression needs. However, keeping the dams in place would not adequately address the long-term trends of declining water quality and increases in disease incidence, and important historical anadromous fish habitat would remain inundated, including cold-water springs that provide important thermal refugia.

Currently, the only dams with fish passage facilities on the Klamath River are Keno Dam and J.C. Boyle Dam, but these fishways do not meet current passage criteria and would be unlikely to provide effective passage for anadromous fish. Prior analysis of alternatives that include volitional fish passage with dams remaining in place concluded that there are significant technical and economic challenges, and that they would fail to address the factors that jeopardize the long-term survival of salmon and steelhead runs on the Klamath River. In the 2007 environmental impact statement (EIS) on PacifiCorp's relicensing proposal, the Federal Energy Regulatory Commission (FERC or Commission) concluded that providing fish passage with the reservoirs in place could cause stress or mortality for upstream and downstream migrating fish from seasonally poor water quality conditions, consumption of juvenile salmon by predatory fish in project reservoirs, and injuries or cumulative stress from passing through multiple fish ladder and screening facilities (FERC, 2007). The Commission also noted that, with volitional passage without dam removal, modeling indicated that smolts/juveniles migrating downstream from Iron Gate would suffer an estimated mortality rate of 66 percent (see table 3-74 in the 2007 EIS).

Fish cannons (a system developed by Whooshh Innovations), which can be used to move individual fish over obstacles by transporting them in pressurized tubes, were raised as potential methods to allow fish passage with dams remaining in place during scoping for the California Water Board EIR (California Water Board, 2020). Fish cannons present several implementation challenges at the Lower Klamath Project. Even if it is assumed that passage at J.C. Boyle Dam would be provided by a separate facility, the distance separating Iron Gate Dam and Copco No. 1 Dam (6 miles), along with the height of Iron Gate Dam (173 feet), are prohibitive to current fish cannon technology. To date, the longest distance and height of successful transport using fish cannon technology was 1,700 feet in length and 165 feet in height at Cle Elum Dam in Washington. Thus, if fish cannons were used at one or more Lower Klamath Project dams, they would most likely have to be used in combination with other fish passage facilities at the dams where the technology is not feasible. Furthermore, the National Marine Fisheries Service (NMFS) has not identified fish cannons as a type of conventional fish passage facility, so their use at the project dams would be experimental (NMFS, 2011). To date, no implementation of fish cannon technology has successfully demonstrated safe, timely, or effective passage for listed anadromous species, and NMFS has not approved a design. Thus, consistent with NMFS (2011) guidance on fishway facility design standards, their use would require design and development of a conventional fish passage facility at each dam where experimental fish cannons would be used. Lastly, providing passage in either the upstream or downstream direction would require a means to attract or divert fish to a location where they could be loaded individually into tubes of the appropriate diameter relative to their size. For these reasons, fish cannons are considered unfeasible as a method for fish passage at the project.

Potential methods for providing downstream fish passage would generally include fish screens capable of diverting outmigrating fish from the river into bypass structures such as tunnels or cannons. Guiding fish to the downstream passage route would likely be at least as costly as the upstream systems. Predation on outmigrating smolts by warm-water fish species (e.g., bass and perch) in the reservoirs would also limit the benefit of providing fish with access to habitat upstream. Trapping and hauling juvenile fish for release downstream could limit the potential for predation but would require handling and hauling fish in unnatural conditions that could affect swimming performance, increase disease transmission risks, and even lead to fish mortality (Colvin et al., 2018; Kock et al., 2021). Constructing downstream fish passage facilities to divert fish as they enter each reservoir in order to limit predation would be more costly to design and construct because the entire river flow, and not just the powerhouse flow, would need to be screened (and would be subject to the river's entire debris load during high flow events).

Digging a long tunnel (e.g., the proposed Shasta tunnel referenced in some comments) to guide migrating fish entirely around the dams would also not solve the water quality problems created by the dams, would be of uncertain effectiveness, and would likely be far more expensive than dam removal. The California Water Board (2020) EIR concluded that there is no engineering support for such a tunnel, which would have to burrow for many miles through rugged country and under dozens (perhaps hundreds) of properties for which there is no existing right-of-way or legal access. We assume that such a tunnel would be a large, culvert-like structure, which could result in higher water velocities with changes in elevation that could potentially prevent and impair fish passage. According to Mefford (2011, as cited in California Water Board, 2020), providing fish passage through a 4.75-mile tunnel proposed in this alternative would be risky and there would be little flexibility to easily modify the structure if fish avoid using the tunnel. Additionally, because a tunnel would not maintain the ecological function of the stream to promote fish passage, it would not adhere to NMFS' conventional fish passage design guidelines (NMFS, 2011).

Keeping the four dams in place would also not meet the need for timely action to address deteriorating water quality conditions and the increasing incidence of diseases that are causing substantial fish kills. It would not address many other impacts of the project, including the seasonal shift in water temperature, sediment starvation of the reach downstream of Iron Gate Dam, the inundation of historical cool-water refugia, adverse effects on water quality from blue-green algae blooms in the reservoirs, and the contribution of these effects to fish disease. Finally, prior analysis suggests that the costs of operating the dams with fish passage would exceed the costs of removing them. The U.S. Department of the Interior (Interior) Klamath Dam Removal Overview Report (Interior and NMFS, 2013) states that, based on PacifiCorp's analyses, capital costs of providing fish passage at the four dams (in 2010 dollars) would be in excess of $400 million, and annual operating and maintenance costs would be in excess of $60 million. Escalated to 2021, this would be $515 million in capital costs and annual operating and maintenance costs in excess of $77 million. This makes it unlikely that the United States or another entity would be willing to take over and operate the dams. For all these reasons, we do not consider continued dam operation with fish passage to be a reasonable alternative.

A.1.2 Remove Iron Gate Dam and Copco No. 2 Dam and Provide Fish Passage at Copco No. 1 Dam

Mark Dana suggested removing Iron Gate Dam and Copco No. 2 Dam and providing fish passage through or around Copco No. 1 Reservoir. This would allow Copco No. 1 Reservoir to continue to serve as a source of water for fire suppression and preserve the aesthetic values, recreation, and wildlife habitat that is provided by the reservoir.

Relative to the proposed action, leaving two dams in place would reduce the amount and duration of sediment release, reduce construction impacts and waste disposal, and thus reduce the overall short-term impacts from dam removal. However, leaving J.C. Boyle and Copco No. 1 Dams in place would limit the extent of water quality improvement, reduce the amount of mainstem habitat that is restored (including cold-water refugia), and would not reduce predation on outmigrating smolts by warm-water fish during migration through the J.C. Boyle and Copco No. 1 Reservoirs.

Providing for volitional fish passage would remain a substantial engineering challenge, as discussed above in section A.1.1, with no guarantee of success. The greatest challenge would involve constructing a fish tunnel or other passage system to pass outmigrating juvenile salmon downstream, which would require a large fish screening system to guide them into the tunnel or bypass, or an extensive collection system. It would take several years of study, design, and permitting to develop a system capable of safely diverting fish over a wide range of inflow, debris loads, and water quality conditions.

In summary, removing Iron Gate and Copco No. 2 Dams and providing fish passage at Copco No. 1 Dam would only partially meet the project purpose and objectives of advancing the preservation and long-term restoration of the natural fish populations in the Klamath River Basin, providing timely improvements to water quality, ameliorating conditions underlying high disease rates among Klamath River salmonids, and restoring anadromous fish passage to viable habitat currently made inaccessible by the Lower Klamath Project dams. Thus, we do not consider a two-dam removal scenario to be a reasonable alternative.

A.1.3 Phased Dam Removal

Siskiyou County requested an analysis of a "Phased Approach Alternative" that would remove the dams one at a time. After the initial dam is removed and the health of the environment is adequately monitored and determined to meet a certain biological threshold, the second upstream dam could be removed, and so on. Siskiyou County stated that this would provide a more scientifically driven approach to dam removal and ensure that sensitive environmental resources are protected from unproven, potentially catastrophic action.

A phased approach to dam removal would reduce the concentration of sediments released during dam removal because sediments would be released over an extended timeframe. Additionally, depending on the amount of time between dam removals, this alternative could allow for evaluation of model assumptions and restoration approaches. However, the California Water Board's (2020) analysis of phased dam removal (over three to seven years) indicates that this approach would extend the period of sediment release over multiple years and significantly increase the mortality of fish populations in the Klamath River. Dam removal across multiple years and resulting elevated suspended sediment concentrations would extend, rather than limit, adverse effects on fish because the increased duration of impact would occur across more life stages and/or additional year-classes of salmon and steelhead (Stillwater Sciences, 2011). Thus, although the maximum suspended sediment concentration would be reduced, phased dam removal would extend the period of adverse impacts and be less likely to advance the long-term restoration of the salmonids and other native fish populations in the Klamath River. The Yurok Tribe, Karuk Tribe, and numerous other commenters expressed an urgent need for rapid approval and implementation of dam removal to protect Klamath salmon runs from deteriorating water quality conditions and increased disease incidence.

We conclude that phased removal would limit progress towards preserving and advancing the long-term restoration of salmonids and other fish populations in the Klamath River Basin and would not meet the need for timely action required to address deteriorating water quality conditions and associated increases in salmon disease incidence. Thus, we do not consider a phased dam removal scenario to be a reasonable alternative.

A.1.4 Experimental Drawdown

Chrissie Reynolds suggested drawing the reservoirs down for a period of three years to see if that would improve conditions and allow salmon to survive above the reservoirs. Under this alternative, some structures would remain in place, and the construction footprint would be reduced compared to the proposed action. No details were provided about the methods to be used for providing fish passage or managing reservoir area sediments.

Assuming that provisions for fish passage would be included in this alternative, it could partially meet the purpose and objectives of the proposed action. However, providing upstream and downstream volitional fish passage would be a major challenge, as discussed above in section A.1.1. Fish passage would need to be installed at the Lower Klamath Project dams prior to reservoir drawdowns, but it is uncertain if it would be feasible to design fish passage systems that allow upstream and downstream passage under all hydrologic conditions and reservoir elevations. Constructing fish passage facilities would also require substantial time and money for their design and construction, which would further delay recovery of Lower Klamath River anadromous fishes and their habitat, and risk their demise due to the delay in water quality improvements and addressing the factors that contribute to fish kills from disease outbreaks.

Drawing down the reservoirs without implementing measures to stabilize sediments could result in greater impacts from high suspended sediment concentrations downstream of the dams. In addition, unless the discharge capacity of the dam outlet structures were increased substantially, the reservoirs would refill during high flow events and cause erosion of additional sediments from the reservoir areas. Thus, during high flows, an experimental drawdown alternative would result in elevated suspended sediment concentrations over an extended period, which would adversely affect fish and other aquatic biota. For these reasons, we do not consider experimental drawdown to be a reasonable alternative.

A.1.5 Repurpose the Reservoirs for Environmental Purposes

Mark Dana suggested that the reservoirs could be repurposed to allow stored water to be used for environmental purposes, including providing flushing flows, modifying flows to better support different life stages of salmon, and/or providing flood control.

Keeping the dams in place under this alternative would prolong ongoing adverse effects on anadromous fish. Even if fish passage were provided (see discussion in section

A.1.1), anadromous fish access to historical habitat would be limited, including to the low-gradient riverine habitat under Copco No. 1 and Iron Gate Reservoirs that was historically important for salmonid spawning and rearing. Salmonid access to cold-water springs within the hydroelectric reach that once provided refugia during the summer would continue to be reduced. Also, it is assumed that the Iron Gate Fish Hatchery would continue producing juvenile salmon, which could continue to exacerbate fish disease associated with high densities of juvenile and adult anadromous fish downstream of Iron Gate Dam. High water temperatures in the river and reservoirs would continue to promote parasites and predatory fish, and there have been no specific management actions proposed that could achieve the temperature targets assigned to Copco No. 1 and Iron Gate Reservoirs under the Klamath River Total Maximum Daily Loads (TMDLs). Numerous flow measures have been implemented over the years at the project dams to better support the different life stages of salmonids, but numbers of fish remain at significantly suppressed levels and fish kills continue with increased frequency and severity. Thus, although some effects could be mitigated through flow modifications, the project dams would directly and indirectly decrease the survival and reproduction of native, cold-water salmonids. Furthermore, implementing additional flow measures to better support different life stages of salmon would require several years of study and evaluation, and would not meet the need for timely action required to address adverse water quality conditions and disease incidence. In contrast, there is a high degree of certainty, based on the available science and lack of contrary studies, that dam removal would benefit Chinook salmon, coho salmon, and steelhead by improving water quality, reducing disease incidence, and providing access to historical habitat upstream of Iron Gate Dam (Dunne et al., 2011; Goodman et al., 2011; Hamilton et al., 2011; Hendrix, 2011; and Lindley and Davis, 2011).

A.1.6 Establish Additional Reliable Storage Facilities and Implement Juniper Removal Projects

Gerald Bacigalupi suggested an alternative that includes establishing additional reliable water storage facilities within the Klamath River Basin, including increasing storage capacities of high-elevation lakes, and implementing juniper removal projects.

Several options to build new reservoirs have been explored over the years. The U.S. Bureau of Reclamation's (Reclamation) 2016 *Klamath River Basin Study* provides a summary of previously identified water storage options (Reclamation, 2016). Potential options were identified and developed in the 1990s through the Klamath Basin Water Supply Initiative, a public input process involving potentially affected state, local, and Tribal interests and concerned stakeholders (e.g., potential new storage in the Long Lake Valley [Reclamation, 2010]). The *Initial Alternatives Information Report, Upper Klamath Basin Offstream Storage Study* (Reclamation, 2011) further investigated options, including an aquifer storage and recovery groundwater option at Gerber Reservoir and a hybrid option involving aquifer storage and recovery at Clear Lake and surface storage at a new dam (to be named Boundary Dam). Reclamation, under authority of the Klamath Basin Water Supply Enhancement Act of 2000 (Public Law106-489), studied the feasibility of increasing storage capacity in the Upper Klamath River Basin and Reclamation's Klamath Irrigation Project through surface or groundwater supplies (CRS, 2005). Reclamation explored options to expand the storage capacity of Upper Klamath Lake, identifying six primary options for expanding the lake onto adjacent lands. These lands could store an additional 100,000 acre-feet of water, but the reservoir would be shallow, and half of the water held in this additional storage could be lost to evaporation. To date, progress has been limited toward achieving these options because there are several uncertainties associated with expanding storage at Upper Klamath Lake. For example, water releases from the expanded storage could be limited by reservoir elevation requirements established by the U.S. Fish and Wildlife Service (FWS) to protect Endangered Species Act (ESA)-listed suckers in the reservoirs (CRS, 2005).

The commenter that recommended additional storage be established by increasing storage capacities of high-elevation lakes pointed to recommendations in the California Department of Water Resources (California DWR) 1991 *Scott River Flow Augmentation Study* (California DWR, 1991). However, that report does not recommend increasing storage of high-elevation lakes; on the contrary, California DWR (1991) recommends against developing the lakes studied because there are not enough benefits to offset the negative aspects of the proposal. Reasons cited as to why the proposal is impractical include: (1) over two-thirds of the high-elevation lakes studied are in federally designated wilderness where development is not permitted; (2) site access would make several lakes very challenging [and costly] to enlarge; (3) water management would be difficult due to a large number of sources; and (4) aesthetic values would be affected. These reasons justify not considering new high-elevation lake storage as a sufficient alternative to dam removal. Thus, after many investigations, no viable storage options have been identified after a benefit-cost analysis.

Western juniper trees have expanded across the Klamath Basin. If allowed to encroach on sagebrush steppe communities, riparian areas, and other lands, juniper competes with other vegetation for water, space, sunlight, and available soil nutrients, causing significant abiotic and biotic effects (Bedell et al., 1993). To quantify whether juniper removal results in increased stream flows, Deboodt et al. (2008) conducted a 15-year paired watershed study that examined how removing junipers affects hydrologic processes in eastern Oregon shrublands, finding significant increases in late season spring flow by 225 percent, increased days of recorded groundwater by an average of 41 days, and increased availability of late season soil moisture (Deboodt et al., 2008). Although this study and other investigations (Ochoa et al., 2014, 2018) provide support for implementing juniper removal to increase water supply and water availability for plant growth, Ochoa et al. (2018) recommends more study before expanding the practice to regional landscapes. Kuhn et al. (2008) conclude that due to the semi-arid environment where juniper occurs, a significant watershed-scale increase in water yield resulting from widespread juniper treatment in the Klamath Basin would be unlikely. We anticipate that juniper removal will continue across the Klamath Basin, providing many ecosystem benefits such as sagebrush restoration, fuels management, wildlife habitat enhancement, increased water availability, and reduced soil erosion. Additional research may shed more light on the issue of hydrologic responses to juniper removal.

New water storage projects in the vicinity of the Lower Klamath Project, by itself or combined with large-scale juniper removal, would not be a practical alternative to achieve the objectives of the proposed action. Because no viable options for new water storage projects have yet been identified, it would take years to determine feasibility and implement, and would not serve to address deteriorating water quality conditions and associated salmon disease issues in a timely manner. Furthermore, these actions would not meet the underlying project purpose of restoring anadromous fish passage to viable habitat currently made inaccessible by the Lower Klamath Project dams. Therefore, we conclude that the water storage and juniper removal alternative is not technically feasible to meet the purpose of taking action in this proceeding.

A.1.7 Increase Flows Provided from Sources with Good Water Quality

Gerald Bacigalupi suggested an alternative could include increasing flows provided from sources with good water quality (e.g., Lake Shastina or groundwater sources). This may include trading with lower quality water from the Upper Klamath Basin. Tricia Plass and Tom Connick also recommended restoring flows in the Trinity River, which is currently diverted from Lewiston Reservoir to Whiskeytown Lake in the Sacramento River Basin for the Central Valley Project.

As one example, transferring water from Lake Shastina would involve constructing a conveyance to transfer water from Iron Gate Reservoir (or J.C. Boyle Reservoir or Keno Reservoir) to the Shasta River watershed as irrigation supply in exchange for Lake Shastina discharges to go directly into the Shasta River rather than being used as irrigation supply first. In this example, releasing water from Lake Shastina would improve water quality and fish habitat in the downstream reaches of the Shasta River, but is unlikely that Lake Shastina could provide a sufficient amount of water to improve water quality in the Klamath River (38 miles downstream from Dwinnell Dam and Reservoir). Also, in this example, or other proposed water transfer scenarios, there would be no guarantee of having reliable water supplies into the future and there would likely be challenges to constructing new canals or other conveyances. Lastly, the California Water Board (2020) states that there are currently no project proponents with authority to implement such water transfers.

Increasing flows in the Klamath River from other sources is also complicated by disputes dealing with competing water rights. Management of the Trinity River, the largest tributary of the Klamath River, has been a topic of ongoing debate and litigation. Until the late 1990s, nearly 90 percent of the water in the Trinity River was exported to the Central Valley, but a NMFS Record of Decision in 2000 increased flows in the Trinity River. This was opposed by the Central Valley Project water users and resulted in the case *Westlands Water District v. U.S. Department of the Interior*. A 2004 court decision in this case directed Reclamation to release into the Trinity River the amount of water called for in NMFS' 2000 Record of Decision (CRS, 2005). Litigation over Trinity River water continues today between the Hoopa Valley Tribe, Westlands, and Interior.

For the reasons discussed above, this alternative, whether it involves the Shasta River, Trinity River, or other potential water sources, is likely unworkable given the current level of conflict among water users. Even if feasible, such water transfers would only improve water quality in localized areas and not address the water quality issues related to toxins from blue-green algae in the project reservoirs. Also, this alternative also would not meet the underlying project purpose of restoring anadromous fish passage to viable habitat currently made inaccessible by the Lower Klamath Project dams, including cold-water refugia and spawning habitat inundated by the reservoirs. For all the reasons above, we do not consider a water transfer alternative to be a reasonable alternative.

A.1.8 Reduce Predator Abundance, or Restrict/Ban Commercial Fishing

Tricia Plass recommended reducing the predator population (sea lions) at the mouth of the Klamath River, and Tom Connick recommended that commercial salmon fishing be suspended until the salmon population recovers.

Predation of anadromous salmonids by sea lions, seals, and cormorants and other seabirds certainly affects migrating salmon and steelhead in the Klamath River. In particular, seals and sea lions are a documented predator within the Klamath River Estuary and nearshore environment. A summary of investigations into California sea lion and Pacific harbor seal impacts on salmonids on the West Coast is provided by Scordino (2010), which confirms that seals and sea lions (pinnipeds) can have negative impacts on salmonids in certain situations, and Pacific harbor seal and California sea lions have increased dramatically since the 1970s (Chasco et al., 2017). However, the Yurok Tribal Fisheries Program conducted investigations on seal and sea lion predation on fall-run Chinook salmon in the Lower Klamath River from 1997 to 1999. Predation rates for the entire fall Chinook salmon run during 1998 and 1999 ranged from 2.3 to 2.6 percent with California sea lions being responsible for 89.8 to 93.5 percent of this predation (Williamson, 2001a, 2001b). This suggests that pinniped predation rates may not be a primary contributor to salmon mortality. The levels of California sea lion predation observed could have more significant adverse effect when returns of fall Chinook salmon are small. However, it is worth noting that salmonids of the Klamath River Basin have coexisted with pinnipeds within Pacific Ocean ecosystems for thousands of years. Also, seals and sea lion are protected under the Marine Mammal Protection Act, so hazing or lethal removal of seals and sea lions requires federal approval from NMFS, and it is unknown if such actions would be permitted. NMFS (2020) recently evaluated the Bonneville Power Administration's proposal to remove sea lions in the Columbia River, which would test the efficacy of lethal removal of sea lions to reduce predation impacts on salmon and steelhead, but results of this effort would not be known for several years.

In conclusion, there is limited evidence for the efficacy of predator control to increase salmon and steelhead abundance, there is currently no funding or project proponent to implement it, there are regulatory obstacles that would need to be overcome, and the proposed action would not preclude future predator control activities.

Restricting or banning commercial fishing would have economic impacts on coastal communities that depend on fishing. Commercial fishermen and their communities have already experienced adverse impacts from decreases in fish numbers and subsequent harvest limitations. Interior and California DFG (2012) reported that the removal of Lower Klamath Project facilities at all four dam complexes would result in positive regional economic benefits due to increases in the commercial ocean fishery.

In addition, this alternative would not meet the objective of restoring anadromous fish passage to viable habitat currently made inaccessible by the Lower Klamath Project dams. It would also not address downstream project-influenced water quality conditions, including seasonal shifts in water temperature; the blockage of spawning gravel recruitment downstream of Iron Gate Dam; nuisance and/or noxious phytoplankton blooms, including blue-green algae blooms within and downstream of the reservoirs; and the contribution of these impacts to fish disease. Thus, we do not consider predator removal to be a reasonable alternative to dam removal.

A.1.9 Build More Hatcheries

Tricia Plass and Jennifer Dickinson recommended increasing hatchery production as a cost-effective way to augment salmon runs.

KRRC's proposed alternative includes a Hatcheries Management and Operations Plan, which following dam removal, includes moving hatchery operations from the Iron Gate Hatchery to Fall Creek Fish Hatchery and performing necessary upgrades to replace operations at Iron Gate Fish Hatchery. We discuss KRRC's proposed plan for hatchery operations in section 3.4.3.8, *Effects of Changes in Hatchery Operations*. Hatcheries have played a major role in supplying Pacific salmon and trout to the region, estimated by Flagg et al. (2000) as contributing 70-80 percent of coastal fisheries. However, the extent that hatchery salmon have negatively impacted wild salmon populations and their recovery has been debated for decades in the Pacific Northwest (see Brannon et al., 2004). Hatcheries are now understood to be one of the factors causing wild salmonid stocks to decline. A summary of the ecological, genetic, and behavioral impacts of hatcheries on wild salmonids is provided in Flagg et al. (2000) and Einum and Fleming (2001). The NMFS (2021) Biological Opinion on the proposed action discusses hatcheries as a factor negatively impacting salmon in the Klamath Basin. California DFW and PacifiCorp (2014) listed the following eight potential mechanisms for potential negative impact to coho salmon: (1) competition for food and space between natural and hatchery coho salmon yearlings; (2) predation of wild salmonid young-of-the-year by hatchery yearlings; (3) disease transfer between hatchery and natural coho salmon stocks; (4) influencing outmigration behavior of natural coho salmon; (5) incidental coho salmon catch in Chinook salmon and steelhead fisheries; (6) artificial selection of spawners leading to fewer effective spawners; (7) loss of genetic diversity or replacement of natural stocks, and (8) inbreeding and out-breeding depression. A model by California DFW and PacifiCorp (2014) indicates that the release of 75,000 coho salmon juveniles from Iron Gate Hatchery has the potential to cause up to 6 percent mortality of wild coho salmon juveniles through increased predation, competition, and disease. However, the cumulative negative impacts of hatcheries on wild salmon in the Klamath River Basin is difficult to quantify.

Steelhead and salmon in certain drainages are dependent on hatchery production to various degrees, but continued reliance on hatcheries to offset declining salmon without dam removal would not meet the objective of long-term restoration of natural fish populations in the Klamath River Basin. Increasing the number of salmon released from hatcheries without the restoration of fish passage would increase salmon crowding and disease transmission to wild adults (Naish et al., 2007; Levin et al., 2001; Belchik et al., 2004; Sergeant et al., 2017). Furthermore, more hatchery production would not necessarily equate to increased populations because salmon and steelhead abundance is affected by ocean conditions and other unquantified associated factors. Thus, we do not consider increased hatchery production to be a reasonable alternative to the proposed action.

A.1.10 Improve Water Quality via Treatment

Jennifer Dickinson recommended that the Commission focus on how to mitigate the effects of the existing dams, including addressing water quality conditions with treatment.

Under current conditions, water quality in the mainstem of the Klamath River in both California and Oregon is listed as impaired for the following parameters: temperature, sedimentation, pH, organic enrichment, dissolved oxygen, nutrients, and toxic algae (microcystin), and ammonia. There is a direct cause-and-effect link between the project dams and water quality (see section 3.3, *Water Quality*, of the EIS).

Several nutrient treatment options have been identified, which include wetland treatment systems, wastewater treatment systems, algae/biomass removal, ambient water treatment systems, sediment nutrient sequestration, sediment removal, wetland restoration, oxidation technologies, and diffuse source treatment systems (WQST, 2011, cited in Interior and NMFS, 2013). The KBRA included large water quality monitoring programs and research to inform the dam removal process. The amended KHSA, which specifies provisions for the interim operation of the Lower Klamath Project by PacifiCorp prior to implementation of dam removal, includes several existing and ongoing interim measures to improve water quality. IM-10 includes a basin-wide technical conference for stakeholders and experts to explore nutrient removal technologies (including treatment wetlands), and IM-11 provides funding to conduct research on addressing water quality issues. PacifiCorp has implemented many studies and pilot projects as part of IM-11, as described in the KHSA Implementation Report (PacifiCorp, 2020). Working with the Interim Measures Implementation Committee, PacifiCorp developed a list of priority project categories for water quality improvement, including diffuse source treatment wetlands, natural wetlands restoration, riparian fencing and grazing management, and irrigation efficiency and water management. While specific projects are in development, PacifiCorp continues to carry out studies under IM-11, including several studies on cyanobacteria (PacifiCorp, 2020). Examples of these studies include evaluating the ability of physical mixing to reduce cyanobacteria growth within Mirror Cove in Iron Gate Reservoir and genetic analysis of *Microcystis* populations in Copco No. 1 and Iron Gate reservoirs (PacifiCorp, 2016a), and an assessment of potential algae harvesting and removal techniques at Link River Dam (PacifiCorp, 2016b). Lastly, the KHSA includes IM-15, which requires PacifiCorp to fund baseline water quality monitoring from Upper Klamath Lake to the Klamath River Estuary at the Pacific Ocean. The water quality monitoring under IM-15 entered its twelfth year in 2020.

Following dam removal, the Klamath River would likely still experience high levels of nutrients and organic matter originating from upstream sources, unless measures are implemented by other entities to reduce nutrient input. Given the high inputs to project waters, nutrients would continue to persist in project-area waters in the absence of water treatment by other parties, especially water entering the Klamath River from the Link River and the Klamath Irrigation Project. Dam removal, however, would diminish conditions that support planktonic algae like *Microcystis*, *Aphamizomenon flos-aquae*, and other species that cause blooms in project reservoirs. These algal communities would be diminished because such algae do not thrive in free-flowing reaches with turbulent conditions, such as would exist without project dams. Therefore, the geographical extent of Klamath River impairment would likely be reduced with removal of the Lower Klamath Project dams.

Without dam removal, water treatment solutions would require several years of study, design, and permitting work. For example, to address water temperature, Reclamation has spent significant resources on the design, performance testing, and monitoring of selective withdrawal structures and temperature curtains to meet temperature objectives at various facilities. After reviewing various temperature control options for reservoir release flows, Reclamation (2019) found that "major infrastructure modifications are expensive to build and maintain. Operations-based approaches have competing priorities and limited flexibility. More tools are needed to provide management techniques that are appropriate for specific applications."

In summary, the persistent water quality issues in the Lower Klamath Project are complex, and investigations to resolve them are ongoing. However, numerous studies demonstrate that dam removal would be an effective solution to greatly improving water quality in the hydroelectric reach and the Lower Klamath River. By itself, water treatment does not meet the need for timely action required to address water quality conditions and salmon disease incidence or to restore anadromous fish passage to viable habitat currently made inaccessible by the Lower Klamath Project dams. In addition, treatments to reduce water temperatures could be very energy-intensive and costly. Thus, this alternative is not considered a reasonable alternative to the proposed action.

A.1.11 Retain the Dams for Another 50 Years and Develop a New Plan

Deb Gilliam recommended keeping the dams for another 50 years while we establish a new plan. No changes in project facilities or operations were suggested.

Section 3.4.2 of the EIS provides a summary of existing conditions for aquatic resources, including the water quality issues and reduced anadromous fish populations that would be expected to continue under this alternative. Leaving all reservoirs in place would not allow any improvement in water quality conditions, and historical habitat would remain inundated, including cold-water springs that provide important thermal refugia. Disease problems associated with crowding of fish below Iron Gate Dam would likely persist and increased water temperatures in the river and its reservoirs would encourage warm-water parasites and predators. This alternative would not meet the need for timely action required to address water quality conditions and salmon disease incidence. See also our response above under *Continued Operations with Environmental Management*.

A.2 INFORMATION AND ANALYSES SUBMITTED DURING SCOPING

A.2.1 Project Purpose

Comment: Siskiyou County and several other commenters stated that the purpose and need for the project stated in KRRC's Definite Plan and the Commission's Notice of Intent statement are improperly narrow, essentially precluding any alternative that has the potential to reduce environmental impacts other than dam removal. One commenter noted that the California Water Board's EIR includes the following, broader list of goals: (1) improve the long-term water quality conditions associated with the Lower Klamath Project in the California reaches of the Klamath River, including water quality impairments due to *Microcystis aeruginosa* and associated toxins, water temperature, and levels of biostimulatory nutrients; (2) advance the long-term restoration of the natural fish populations in the Klamath River Basin, with particular emphasis on restoring the salmonid fisheries used for subsistence, commerce, Tribal cultural purposes, and recreation; (3) restore volitional anadromous fish passage in the Klamath River Basin to viable habitat currently made inaccessible by the Lower Klamath Project dams; and (4) ameliorate conditions underlying high disease rates among Klamath River salmonids. Other commenters stated that even the EIR's goal of restoring volitional fish passage is problematic in that it would not be met by alternatives such as providing passage via trapping and trucking salmon to upstream areas or increasing hatchery production.

Response: We have adopted a broad statement of purpose and need that does not preclude options other than dam removal (see section 1.3, *Purpose and Need*). A series of alternatives (A1.1-A.1.11) were considered; however, none of these were considered a reasonable alternative to the proposed action and were not considered further considered for environmental analyses (see section 2.0, *Proposed Action and Alternatives*). Consequently, the draft EIS considered three alternatives; (1) the proposed action (KRRC's proposal); (2) the proposed action with staff modifications; and (3) no -action (continued project operation with no changes). The no-action alternative includes ongoing measures to mitigate for some of the adverse effects of the Lower Klamath Project facilities and hydroelectric operations. Thus, alternatives other alternatives besides dam removal have been considered.

Increasing hatchery production and providing passage via means other than dam removal have been considered (see A.1.9). Steelhead and salmon in certain drainages are dependent on hatchery production to various degrees, but continued reliance on hatcheries to offset declining salmon with no dam removal would not meet the objective of the preservation and long-term restoration of natural fish populations in the Klamath River Basin. Increasing the number of salmon released from hatcheries without the restoration of fish passage would increase salmon crowding and disease transmission to wild adult and juvenile salmon. Furthermore, more hatchery production would not necessarily equate to increased populations because salmon and steelhead abundance is affected by ocean conditions and other unquantified associated factors affect salmon and steelhead abundance. Thus, we do not consider increased hatchery production to be a reasonable alternative to the proposed action (see appendix A, A.1, *Alternatives Submitted During Scoping*).

A.2.2 Effects on Wells and Water Supply to Municipalities, Agriculture, and Wildlife Refuges

Comment: Many commenters expressed concern of the proposed action on nearby wells and the limited scope of KRRC's proposed mitigation. In their letter filed on August 12, 2021, Mark and Lisa Fischer raised several questions about factors that could add to the cost of restoring well production and the hardships that may occur until adequate well production is restored.

Response: KRRC's California Water Management Plan and Oregon Groundwater Well Management Plan propose short- and long-term measures to return the production rates of affected groundwater wells to existing conditions and would mitigate potential effects on private well owners who choose to participate in KRRC's proposal to monitor effects on well production (see section 3.2.3.4, *Short- and Long-term Effects on Groundwater Supply Wells)*.

Comment: Many commenters stated that, with increasing droughts in the region, more dams should be built to store water instead of removing them, and that draining the reservoirs will waste the water that they contain. Several commenters expressed concern regarding impacts to people, farms, livestock, and wildlife due to loss of water.

Response: Reclamation's 2016 *Klamath River Basin Study* provides a summary of previously identified water storage options that have been explored over the years. To date, progress has been limited toward achieving these options, and no viable storage options have been identified after a cost-benefit analysis of increasing storage capacities of high-elevation lakes points (see A.1.6, above).

Comment: Many commenters stated that the proposed action violates the Klamath River Basin Compact, whose purposes include the orderly, integrated, and comprehensive development, use, conservation, and control for various purposes, including, among others: the use of water for domestic purposes; the development of lands by irrigation and other means; the protection and enhancement of fish, wildlife and recreational resources; the use of water for industrial purposes and hydroelectric power production; and the use and control of water for navigation and flood prevention.

Response: Water supply in the Klamath River Basin is controlled by existing water rights, irrigation demands, and environmental flow requirements (see section 3.2.3.3, *Effects of Changes in Water Quantity on Water Supply Diversions and Water Rights*). None of the water rights for the Lower Klamath Project facilities are for seasonal water storage or irrigation purposes (see section 3.2.2.2, *Surface Water Rights, Water Supply, and Water Demand*). The States of Oregon and California, Oregon and California Departments of Fish and Wildlife, federal agencies, including Interior and NMFS, and water users (Klamath Water Users Association [KWUA]) signed the Klamath Power and Facilities Agreement in 2016. This agreement affirmed the parties' desire to address important settlement implementation, negotiations, and/or dispute resolution related to the Lower Klamath Project. This and other agreements do not violate the Klamath River Basin Compact. Furthermore, we conclude that the proposed action is the most viable option for the protection and enhancement of fish, wildlife and recreational resources.

Comment: KWUA noted that the operable storage in PacifiCorp's reservoirs is often used to provide releases to the Klamath River to limit the releases from Upper Klamath Lake, and that this "borrowing" practice, which is undertaken for environmental purposes, would not be possible if the operable storage in the PacifiCorp reservoirs is eliminated. Representative LaMalfa noted that this borrowing practice has been important for protecting waterfowl in the Tule Lake National Wildlife Refuge and suckers in Sump 1B.

Response: Existing storage within the Lower Klamath Project reservoirs is sometimes used to support Reclamation in meeting minimum instream flows downstream of Iron Gate Dam (see section 3.2.2.2). We acknowledge that the proposed action would permanently remove the storage available for this "water borrowing" agreement. As such, during extreme dry water years the proposed action would potentially result in reduced supplemental deliveries of 10,000 to 20,000 acre-feet of water used for consumptive uses, or 8.5 percent of the historical irrigation demand for the region. However, the Lower Klamath Project has no obligation to apply the water stored in the project reservoirs to meet Reclamation's Biological Opinion requirements (see section 3.2.3.3, *Effects of Changes in Water Quantity on Water Supply Diversions and Water Rights*). In addition, based on reservoir evaporation estimates (11,000 acre-feet of water per year) and the expected evapotranspiration (4,800 acre-feet of water per year) that would occur in the same reaches, the proposed action could result in a net gain of up to 6,200 acre-feet of water per year for the Klamath River (California Water Board, 2020).

Comment: Siskiyou County stated that that the EIS should evaluate effects on water supply, noting that City of Yreka and communities of Hornbrook, Copco Village, and Beswick, among many others, rely on groundwater and surface water supply from the Klamath River. The City of Yreka commented that the construction of a new hatchery at Fall Creek, which will divert water and is proposed to rear and release endangered species, could, in the future, cause further restrictions on Yreka's right to take water under its consumptive water permit. Yreka noted that according to California, Oregon and the United States Code, municipal water use has the highest priority of any other use, including those uses related to fish and wildlife considerations. Yreka requested that: (1) its water transmission pipeline be replaced in a manner that is safe and secure from external threats that could cause any interruption in municipal water service; (2) the EIS include a discussion of the decommissioning or repurposing of the hatchery at the end of the proposed eight-year operating period, and the funding of that decommissioning; and (3) that chemical imprinting techniques be used to encourage coho salmon produced at the hatchery to return to streams other than Fall Creek to avoid having the coho return solely to Fall Creek, which Yreka is concerned may lead to its designation as critical habitat. In addition, Yreka noted that Interior and California DFG (2012) has requested that penstock roads be returned to native grades, and Yreka requests that all roads to their diversion facility, including penstock roads, and to Fall Creek Hatchery, remain accessible by ordinary maintenance vehicles.

Response: KRRC's California Water Management Plan and Oregon Groundwater Well Management Plan would provide short- and long-term measures to return the production rates of affected groundwater wells to existing conditions and would mitigate potential effects on private well owners who choose to participate in KRRC's proposal to monitor effects on well production (see section 3.2, *Water Quantity*). In section 3.4.3.8, *Effects of Changes in Hatchery Operations*, we recommend that KRRC and the resource managers consider the City of Yreka's recommendation to imprint coho salmon to return to other tributaries, and also to allocate a portion of the juvenile salmon produced at Fall Creek Hatchery for outplanting to other tributaries to accelerate the recolonization process. We also recommend that KRRC revise the Hatchery Management Operations Plan to clarify whether ownership of the facility would be transferred to the State of California or another entity. Water supply has been fully evaluated in the EIS (section 3.2, *Water Quantity*).

Concerns about water supply to the City of Yreka and others are addressed in KRRC's Water Supply Management Plan that proposes to construct a new, fully operational replacement water supply pipeline and implement the measures outlined in its California Public Water Supply Management Plan. This would ensure that the City of Yreka has an adequate supply of water and the water supply amount diverted from Fall Creek would not change. In addition, the California Water Board's 401 condition 8 would ensure any potential water supply outages due to project deconstruction are short in duration and mitigated for with additional water supplies. Furthermore, KRRC's proposal to coordinate with the California Water Board and the Oregon Department of Environmental Quality (Oregon DEQ) and undertake short- and long-term measures to return the production rates of affected groundwater wells to conditions existing prior to the proposed action would mitigate potential impacts on private well owners (see section 3.2.3.3, *Effects of Changes in Water Quantity on Water Supply Diversions and Water Rights*). As noted in section 3.8.3.4, *Road Management and Traffic*, existing roads required to operate and maintain the Fall Creek facility that are also used by the City of Yreka to manage their water supply system would not be affected, and the roads would continue to be maintained in an operable condition for maintenance vehicles.

Comment: Reclamation recommended that the Water Quantity section of the EIS evaluate any temporary flow control measures that may be needed during the various phases of decommissioning. KWUA stated that the negative effects to agriculture and wildlife refuges from reasonably foreseeable, increased regulatory burdens (such as screening diversions) resulting from species occupying or migrating in new areas must be analyzed and considered, as must any demand for Klamath River flows to flush sediment or otherwise facilitate the proposed action or its overall objectives.

Response: Proposed reservoir drawdown methods, procedures, schedules, and monitoring efforts are detailed in section 2.1.2.1, *Reservoir Drawdown and Diversion Plan*. Any temporary flow control measures at the Klamath Irrigation Project would be determined between Reclamation and KRRC (see section 3.2.3.1, *Effects of Project Deconstruction Activities on Water Quantity*). Our analysis in section 3.1.3.2, *Effects from Mobilization of Sediments*, indicates that KRRC's proposal to time reservoir drawdown and sediment jetting to coincide with seasonal high flows will rapidly transport nearly all fine sediment to the Pacific Ocean without the need for any supplemental flow releases from Upper Klamath Lake. We acknowledge that there is some potential that listed species such as coho salmon could eventually colonize habitat in tributaries to Upper Klamath Lake, and that this has the potential to increase regulatory burdens for agricultural operations, but it will likely take many decades for water quality conditions in Upper Klamath Lake and Keno Reservoir to improve to an extent that would make such colonization possible.

A.2.3 Effects on Flood Control

Comment: Several commenters expressed concern that removal of the dams would cause downstream flooding, and several commenters asked whether the dams could be modified to improve flood control. Pacific Coast Federation of Fishermen's Associations (PCFFA) noted that the analysis in Interior and NMFS's 2013 EIS/EIR indicates that the reservoirs provide less than 7 percent attenuation of any 100-year flood event, and then only for a few hours' time (i.e., until their reservoirs are full). Conversely, Gerald Bacigalupi contended that the dams provide substantial (26.7 percent) flood protection based on historic hydrographs.

Response: The controlled flow release that would occur during drawdown of the project reservoirs would not increase short-term flood risks downstream of the projects because these flows would be well within the range of historical flows recorded in each reach. If KRRC expects excess flows (i.e., flood conditions) during drawdown, it would continue to use each facility's spillway as a fail-safe for overflow situations and would retain flood flows using the newly available storage capacity due to reservoir drawdown (see section 3.2.3.2, *Effects of Changes in Water Quantity on Downstream Flooding*).

Our analysis in section 3.2.3.2 indicates that the Lower Klamath Project dams would have no effect on the magnitude of major flood events, since the reservoirs provide a very limited amount of active storage and the reservoirs fill to capacity very quickly during major flood events. After the reservoirs are filled to capacity, they pass all inflow and provide no buffering of peak flows in the Lower Klamath River.

A.2.4 Effects on Water Quality

Comment: Several commenters expressed concern that removing the dams would adversely affect downstream water temperatures and nutrient levels and the opportunity to use reservoir storage to provide flushing flows to reduce disease incidence. Some commenters state that water quality was poor historically and improved after the dams were constructed. One commenter stated that FERC should require PacifiCorp to mitigate water quality issues. PCFFA stated that Interior and NMFS's 2012 EIS/EIR concluded that the dams: (1) slow down and allow excessive heating of water in the reservoirs behind the dams, as well as concentrate nutrients in these artificially created warm-water lakes, encouraging the widespread growth of toxic blue-green algae in the reservoirs; (2) destroy the effectiveness of numerous cold-water springs that once provided refugia for cold-water fish such as salmon during the summer months (i.e. those springs are now under heated reservoir waters); (3) increase the average water temperatures of the river and its reservoirs in various ways that encourage warm-water parasites and predators, and directly and indirectly decreasing the survival rates of native, cold-water salmonids downriver until well below Iron Gate Dam. One commenter stated that a tagged salmon study confirmed a higher survival of salmon in the area directly below Iron Gate Dam than within any other reach above the coastal influence, supporting local experience that salmon disease is actually lessened by the dams.

Response: Under the proposed action the project reservoirs would be converted into riverine reaches resulting in more normative temperature regime within the former reservoir reaches and in the Klamath River downstream from the project. The proposed action would release nutrients (total N and total P) stored in the reservoirs' sediments during and following drawdown with a less then significant short-term effect because nutrients would be exported quickly through the system. Long-term effects resulting from conversion of the reservoirs to riverine reaches are expected to have the beneficial effect of nearly eliminating the seasonal release of nutrients from deep anoxic reservoir waters that cause phytoplankton algae blooms (including blue-green algae blooms) and periods of low DO levels (see section 3.3.3.3, *Nutrients, Dissolved Oxygen, and pH*;

section 3.3.3.4, *Microcystin*). Review of water quality conditions shows that current water quality conditions have declined significantly compared to historical conditions and continue to deteriorate (see section 3.3, *Water Quality*). The comments by PCFFA are supported by review of past and current water quality conditions within and downstream of the project.

The proposed action would reduce fish disease in the Lower Klamath River in the long-term by: (1) providing access to additional cool-water refuges for salmonids; (2) reducing crowding of juvenile and adult salmon and concentration of disease pathogens through access to additional suitable habitat; (3) eliminating phytoplankton produced in the project reservoirs as a food source for the polychaete host of the myxozoan parasites *C. shasta* and *P. minibicornis* that infect and cause regular substantial salmonid mortality; and (4) restoring sediment transport processes in the Lower Klamath River that would reduce algal mats that provide favorable polychaete habitat that in turn would reduce myxozoan parasitic infections of salmonids (see section 3.4.3.2, *Effects on Diseases Affecting Salmon and Steelhead*).

A.2.5 Toxic Algae/microcystin

Comment: One commenter noted that a study of Iron Gate and Copco No. 1 Reservoirs found that there were no health consequences were experienced by people recreating on the lakes, and in over one hundred years of dams in place not a single case of toxicity was ever reported to the regional health department that originated from either the lakes or the river. Another commenter stated there have been no fish die-offs from blue-green algae blooms within the lakes, nor "toxic" impacts to birds and animals who inhabit the shoreline. Several commenters believed that warning signs posted around Copco No. 1 Reservoir warning to avoid swimming or eating fish due to toxic algae were a scare tactic designed to reduce support for retaining the dams.

Response: Some blue-green algae species (e.g., *Anabaena flos-aquae* and *Microcystis aeruginosa*) produce algal toxins (e.g., microcystin) that can reach levels that are harmful to humans, fish, and mammals (see section 3.3.3.4, *Microcystin*). Blooms of *Microcystis aeruginosa* currently occur seasonally each year resulting in microcystin attain levels determined to have the potential to affect human health in Copco No. 1 and Iron Gate Reservoirs and the Lower Klamath River. We have not located any documentation of microcystin-related adverse health effects in humans or animals that are specifically associated with the project reservoirs. However, the lack of such information does not diminish the risks that are associated with contact with or consumption of water and/or aquatic organisms (e.g., fish and mussels) with high microcystin concentrations.

A.2.6 Effects of Sediment Movement and Suspended Sediment

Comment: Numerous commenters were concerned about the potential adverse effects of sediment movement (including high levels of suspended sediment and toxins in sediments) on downstream biota, property, and navigation. Siskiyou County commented that impacts from downstream sedimentation could last for years, and the suspended sediments analysis in the EIS should assess the worst-case scenario and possible negative impacts to salmonids (steelhead, Chinook salmon, and coho salmon) and other riverine and estuarine species. Representative LaMalfa noted that Interior and NMFS's liability report (Camp Dresser & McKee, Inc., 2008) identifies seven additional unquantifiable liabilities associated with the sediment behind J.C. Boyle, Copco No. 1, and Iron Gate Dams, and that the complete cleanup of this sediment was estimated to cost more than $4 billion. PCFFA noted that this report and cost estimate was prepared prior to multiple studies being conducted that show there are no significant concerns about toxic sediment problems in any of the reservoirs, as indicated in a letter from the U.S. Environmental Protection Agency (EPA) dated November 4, 2015 (included as Attachment A to PCFFA's comment letter). PCFFA also noted that EPA's letter also states that in general, detections of potential toxic chemicals in sediment core samples were generally within the range of natural background levels and were all well below the range of significant concern for human health. PCFFA also noted that Interior and California DFG's 2012 EIS/EIR concluded that the dams trap and hold coarse sediments that would normally be recruited to the river to provide good spawning and rearing habitat, thus impoverishing natural spawning and rearing gravel recruitment as far downriver as 50 miles below Iron Gate Dam.

Response: Drawdown of the reservoirs and dam removal would result in the suspension and mobilization of fine sediments from the reservoirs, which would cause elevated suspended sediment concentrations in the hydroelectric reach and the Lower Klamath River and some deposition of fine sediment in and adjacent to the river channel and in the Klamath River Estuary. Increased sediment loads for a short period of time would have adverse effects on anadromous fish below the project. The proposed action would have effects of contaminants (chemicals of potential concern) ranging from no adverse effect from long-term exposure to the sediment deposits on the reservoir terrace and/or riverbank on terrestrial biota to minor or limited effects from short-term exposure to reservoir sediments flushed downstream (see section 3.3.3.1, *Suspended Sediment and Contaminants*). This supports comments by PCFFA's comments and addresses LaMalfa concerns. For a discussion of reservoir drawdowns, sediment evacuation, sediment concentrations, contaminants, and flows, within the hydroelectric reach and downstream of Iron Gate Dam in the Klamath River to the estuary, reference is made to section 3.1.3.2, *Effects from Mobilization of Sediments*; section 3.1.3.3, *Effects of Coastal Sediment Deposition on Navigation*; section 3.3.3.1, *Suspended Sediment and Contaminants*; section 3.2.3.1, *Effects of Project Deconstruction Activities on Water Quantity*; and section 3.4.3.3, *Effects of Changes in Suspended Sediment Concentrations on Aquatic Resources*.

Comment: PCFFA noted that Interior and California DFG's 2012 EIS/EIR concludes that the dams trap and hold coarse sediments that would normally be recruited to the river to provide good spawning and rearing habitat, thus impoverishing natural spawning and rearing gravel recruitment as far downriver as 50 miles below Iron Gate Dam.

Response: Dam-released sediment and resupply would increase the proportion of sand in the channel bed and decrease median bed substrate size, which would have short-term adverse effects on the spawning habitat for anadromous fish downstream of Iron Gate Dam. Long-term effects in the river channel of this reach would be beneficial for the aquatic ecosystem as natural sediment transport processes are restored.

A.2.7 Urgency for Action to Protect Salmon Runs

Comment: The Yurok Tribe, Karuk Tribe, and numerous other commenters expressed an urgent need for rapid implementation of dam removal to protect Klamath River salmon runs from deteriorating water quality conditions and the increased incidence of diseases affecting salmon and steelhead. The Yurok Tribe requested that FERC enlist outside services to help compile and use the existing record to expedite analysis and complete a final EIS no later than April 2022 to enable preparatory work necessary for reservoir drawdown. The Yurok Tribe stated that another year of delay could lead to the tipping point beyond which we can save Klamath River salmon, and states that in 2021, an entire year-class of salmon was lost to *Ceratonova shasta (C. shasta)*. Numerous commenters urged FERC to move quickly to approve the proposed action to protect salmon runs by: (1) providing access to additional habitat, including cold-water springs (many of which are currently inundated by the reservoirs), that will provide access to areas of thermal refuge and reduce crowding of salmon that contributes to disease outbreaks; and (2) improving water quality conditions, including reducing the incidence of toxic algae blooms. These commenters also noted that: (1) restoring the salmon runs and water quality is of great cultural importance to the Tribal communities that reside along the Lower Klamath River; (2) retaining the dams would be more costly to ratepayers than removing them; (3) the proposed action has been through multiple previous environmental reviews; (4) several rounds of scoping meetings have been conducted to identify the issues that need to be considered; (5) the effects of dam removal have been evaluated in dozens of studies, including many that have been peer-reviewed; and (6) KRRC has worked closely with stakeholders to develop management plans to minimize adverse environmental impacts.

Response: Our analysis of effects of the proposed action on salmon and steelhead fisheries is provided in section 3.4, *Aquatic Resources*. We agree that the salmon fishery is at risk of collapse due to the ongoing trend of increasing water temperatures and other conditions that cause regular fish disease outbreaks inflicting substantial mortality to juvenile and adult salmon in the Lower Klamath River. The proposed action would reduce fish disease in the Lower Klamath River by: (1) providing access to additional cool-water refuges for salmonids; (2) reducing crowding of juvenile and adult salmon in the Lower Klamath River through access to additional suitable habitat and reduced reliance on hatchery production; (3) eliminating phytoplankton produced in the project reservoirs as a food source for the polychaete host of the myxozoan parasite *C. shasta* and *P. minibicornis* that infect and cause regular substantial salmonid mortality; and (4) restoring sediment transport processes in the Lower Klamath River that would reduce algal mats that provide favorable polychaete habitat that in turn would reduce myxozoan parasitic infections of salmonids (see section 3.4.3.2, *Effects on Diseases Affecting Salmon and Steelhead*).

A.2.8 Upstream Limit of Anadromous Fish Distribution Prior to Construction of Copco No. 1 Dam

Comment: Numerous commenters cited evidence of a lava reef near the site where Copco No. 1 Dam was constructed that may have prevented salmon from accessing upstream habitat. One commenter stated that the Siskiyou County Water Users' Association conducted sonar depth soundings to confirm the presence of a lava reef in Copco No. 1 Reservoir near the Copco No. 1 Dam, and some commenters believed the reef would be a barrier if the reservoir were drained. Representative LaMalfa commented that when J.C. Boyle began work on the Copco No. 1 Dam, he made several notes that contain a diagram of the proposed construction which depicts a 31-foot-tall basalt dam roughly one-fifth mile upstream from the current site of Copco No. 1 Dam. Boyle also noted the geological evidence that an ancient 130-foot-tall andesite dam once blocked the river near this site.

PCFFA stated that geologists have long been aware that a natural lava reef did indeed partially block the Klamath River and form a broad lake in the Upper Klamath Basin about 140,000 years ago but was hydrologically long-gone through natural erosion by the time the Copco No. 1 Dam was built in 1918. One commenter summarized the findings of reports that reviewed historical documentation of the pre-dam distribution of salmon, most of which indicate there were abundant runs of salmon beyond Iron Gate Dam as far as the Sprague River above Upper Klamath Lake.

One commenter noted that an archaeological study, often cited as proof of anadromous fish presence in the Upper Klamath River Basin, found only 8 likely bones (otoliths) from anadromous fish out of 15,000 fish bones, and that these otoliths likely came from salmon traded from downriver Tribes. He further noted that a report prepared in 1851 stated that the Klamath's coastal Yurok and Hoopa Tribes routinely traded preserved salmon with the heads (where the otolith bones are located) intact. Two commenters noted that the speciation of redband trout in the upper basin indicates that the upstream distribution of anadromous fish was limited historically.

Response: While there is some concern that a historical lava ledge near the Copco No. 1 Dam site may have prevented anadromous fish from accessing upstream habitat, there are numerous credible accounts of salmon reaching Upper Klamath Lake and its tributaries prior to dam construction. In addition, based on our review of available information, it appears that Boyle (1913 and 1976) did not provide any definitive indication that a 31-foot-tall lava dam (or similar barrier) existed around the time of construction of Copco No. 1 Dam. Regardless, the measures included in KRRC's Fish Presence Monitoring Plan would aid in the identification any historical barriers in the reach, and if present, aid in the identification of actions needed to remedy any human-made impediments or impediments caused by the proposed action to anadromous fish migration (see section 3.4.3.7, *Effects on Fish Habitat Access*).

A.2.9 Effects on ESA-listed Suckers

Comment: Several commenters noted the adverse effects of the proposed action on the populations of ESA-listed suckers in the reservoirs. Siskiyou County stated that the sucker populations downstream of Keno Dam should be denoted as metapopulations that have broken off from the main populations upstream to form new groups in the lower river, thus expanding the range of the endangered populations.

Response: Suckers residing in the hydroelectric reach are not likely to be self-sustaining as a result of low recruitment from the lack of access to spawning habitats and consequently, are considered "sink populations[1]" by FWS. Little or no reproduction occurs downstream from Keno Dam and there is little potential for interaction with upstream populations. Therefore, these sucker populations cannot be considered part of the larger metapopulation and do not substantially contribute to the achievement of conservation goals or recovery (see section 3.6.3, subsection *Lost River and Shortnose Suckers*).

A.2.10 Terrestrial Species

Comment: The Wildlands Network stated that the Klamath-Siskiyou ecoregion is home to many large mammals (mule deer, pronghorn, elk, bobcats, badgers, etc.) that often suffer from habitat fragmentation due to road construction that does not incorporate wildlife migration features. As a result, FERC should analyze terrestrial species connectivity and migration issues as part of the Lower Klamath Project's EIS, and ideally, terrestrial wildlife migration considerations and crossing infrastructure should be incorporated into the road and culvert construction plans in the final, FERC-Approved decommissioning plan. FWS recommended that the EIS evaluate effects to bald and golden eagles, including impacts as considered under the Bald and Golden Eagle Protection Act.

Response: Adverse effects of large mammals that suffer from the effects of habitat fragmentation due to road construction that are not related to the proposed action were not considered because there is no federal nexus to the proposed action. Moreover, once decommissioning is completed and the license surrendered, FERC has no jurisdiction

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[1] Sink populations exist in low quality habitat patches that would not be able to support a population in isolation. Without the contribution of individuals from a source population, they would become extinct.

over former FERC project lands. Conversion of the reservoirs to river reaches may facilitate crossings of the reconstituted Klamath River by large mammals that could increase species' population connectivity and facilitate migration. Thus, the proposed action may benefit large mammals that are affected by habitat fragmentation by facilitating crossing former reservoir reaches. KRRC is in the process of developing an Eagle Conservation Plan and Eagle permit, in accordance with the Bald and Golden Eagle Protection Act and in consultation with FWS (see section 3.5.3.9, subsection *Bald and Golden Eagles*).

A.2.11 Killer Whales

Comment: The Orca Salmon Alliance stated that the expected recovery of Klamath Chinook salmon following dam removal will increase the prey available for Southern Resident orcas in the coastal part of their range, an area that was recently designated as critical habitat for the Southern Residents.

Response: Comment noted (see also see section 3.6.3, subsection *Southern Resident DPS Killer Whale*).

A.2.12 Revegetation and Landscape Restoration

Comment: Several commenters critiqued aspects of the plans for revegetating lands included in the Reservoir Area Management Plan. Some commenters expressed concern that failure of revegetation efforts could lead to dust storms and exposure to toxins contained in the reservoir sediments. One commenter questioned how the native seeds and plants planned for restoration would survive without water given the drought situation, and comments that local residents were not consulted during preparation of mitigation plans.

Response: KRRC's proposed seeding would result in a substantial reduction of bare ground within one growing season. Seeding would be expected to stabilize soils and prevent soil erosion and nuisance dust. To determine revegetation success, KRRC's Reservoir Area Management Plan (RAMP) includes monitoring and adaptive management measures, including reseeding and additional irrigation, mulching, composting, and fencing, provide reasonable measures that would mitigate the most likely causes of poor seed germination and plant establishment (see section 3.5.3.1, *Restoration of Vegetation Within Reservoir Footprints*).

Comment: The Bureau of Land Management (BLM) stated that given the outstanding scenic, biological, cultural, and recreational resources existing in the Upper Klamath River canyon, all BLM lands within the FERC project boundary should be reasonably restored to biotic and topographic conditions reflective of the adjacent canyon conditions. BLM encouraged KRRC to integrate the J.C. Boyle scour hole into the restoration plan and revegetate this site with native plants, and states that restoration efforts for the canal demolition area should include a planting plan with associated metrics for plant establishment and survival, and that the site be contoured as much as possible to reflect the original grade.

Response: KRRC's RAMP includes grading to recontour disturbed (deconstruction) areas to match neighboring conditions, installing sediment and erosion control BMPs (included in appendix C of the RAMP), and revegetating with upland seed mixes. The plan includes specific measures to be used at concrete disposal sites, staging areas and temporary access roads, hydropower demolition areas, the J.C. Boyle canal, J.C. Boyle scour hole, and project recreational areas (see section 3.5.3.2, *Restoration of Vegetation in Disturbed Uplands*).

A.2.13 Effects on Reservoir-based Recreation, Aesthetics, and Existing Ecosystem

Comment: Numerous commenters expressed concern that the proposed action would alter the natural beauty and nature-related activities, particularly the natural serenity of the lake settings behind the reservoir. Several commenters expressed concern over the loss of lake habitat and associated flora, fish species, waterfowl, birds, and animals. Some commenters noted the number of bird species that are sighted near the reservoirs and the importance of the reservoirs as resting areas for migratory birds. Several commenters noted that the Klamath River above Copco No. 1 Reservoir is considered a blue-ribbon trout stream that could be adversely affected by the introduction of salmon.

Many commenters noted the impact to reservoir-based recreation activities, and many commenters specifically mention the quality of fishing in Copco No. 1 Reservoir. Siskiyou County recommended that this impact be mitigated, and noted that other lakes and reservoirs in the region that are listed in the California Water Board's EIR as being replacement reservoir-based recreation facilities are located in Oregon, and that reaching these facilities would require passing through Siskiyou Summit, which is notably challenging with a trailer.

Response: Reservoir areas that would be converted to flowing river segments would lose open water and lake vistas in exchange for more natural river, canyon, and valley vistas that may be interpreted by the viewer as beneficial or adverse, depending on their preference (see section 3.9, *Aesthetics*).

Loss of the reservoirs would provide significant, long-term, adverse effects on some lentic-dependent species due to loss in habitat area. With the presence of similar lentic habitat in the region, many affected species would be able to relocate to suitable habitat near the project area. Over the long-term, restoration of a free-flowing Klamath River would continue to provide habitat for many of these species. Furthermore, restoration of the reservoir footprints to upland habitat would also provide additional habitat for upland species including terrestrial reptiles, small mammals, big game species, and upland nesting birds (see section 3.5.3.6, *Wildlife Habitat*; section 3.5.3.7, *Reptiles and Amphibians*; and section 3.5.3.8, *Nesting Birds*).

Under the proposed action, increased abundance of anadromous salmon species could adversely affect trout through competition for food and habitat. However, long-term, beneficial effects on the redband trout population would be likely due to increased habitat quality and quantity that benefits both redband trout and anadromous salmon species (California Water Board, 2018). Existing redband trout and colonizing anadromous steelhead are expected to co-exist, as they do in other watersheds, although there may be shifts in abundance related to competition for space and food (Interior and California DFG, 2012).

Comment: Many commenters noted the impact of the proposed action to reservoir-based recreation activities, and many commenters specifically mentioned the quality of fishing in Copco No. 1 Reservoir. Siskiyou County recommended that this impact be mitigated, and noted that other lakes and reservoirs in the region that are listed in the California Water Board's EIR as being replacement reservoir-based recreation facilities are located in Oregon, and that reaching these facilities would require passing through Siskiyou Summit, which they state is notably challenging with a trailer.

Response: Several lakes and reservoirs in the vicinity of the project reservoirs provide similar opportunities for recreation in an uncrowded setting. Therefore, the loss of the project reservoirs under the proposed action would not result in long-term loss in regional lake-based recreational activities that would affect a large area or a substantial number of people. Furthermore, KRRC's Recreation Facilities Plan proposes to retain and enhance most existing river access facilities and transfer project lands to the States of Oregon and California that would potentially allow for the development of additional access points for future river-based recreation opportunities. Therefore, the proposed action would be unlikely to result in a loss of rare or unique recreational facilities affecting a large area or substantial number of people (California Water Board, 2020). We recommend that KRRC revise the Recreation Facilities Plan to clarify whether KRRC would fund construction and operation of new riverine access facilities, and that, at minimum, KRRC should construct access facilities that would be located in areas that would be affected by land disturbance during implementation of the proposed action.

A.2.14 Effects on Wild and Scenic River

Comment: Some commenters suggested that the proposed action would adversely affect a designated Wild and Scenic River. The National Park Service (NPS) and BLM noted that in 2012, BLM, NPS, and the U.S. Department of Agriculture, Forest Service (Forest Service) developed a preliminary section 7 determination in response to the draft EIS that was developed by Reclamation under the 2010 KHSA. The preliminary section 7 determination found the proposed action (removal of the lower four Lower Klamath Project dams) was consistent with the Wild and Scenic Rivers Act. Anadromous fisheries were recognized as an outstandingly remarkable value when the 189-mile-long Lower Klamath River was designated by Congress in 1981 as a Wild and Scenic River. Regarding the surrender application currently pending before FERC, NPS and BLM stated that the agencies intend to make a final determination as to Wild and Scenic River

Act consistency upon review of KRRC's refined design proposals and this EIS. A report entitled *Whitewater Recreation On The Upper Klamath River, Planning And Priorities For Dam Removal*, (American Whitewater and UKOA, 2019) attached to UKOA's comments, states that "after dam removal, the entire Upper Klamath River below Keno Dam will likely be designated as a National Wild and Scenic River. When combined with the Lower Klamath River, which was designated in 1981, the entire 234 miles of the Klamath River—from Keno Dam to the Pacific Ocean—would become the longest Wild and Scenic River in the lower 48 states and state that this is sure to spark more interest in boating on this river."

Response: Comment noted (also see section 3.7.2.1, subsection *Wild and Scenic Rivers*.

A.2.15 Effects on River-based Recreation

Comment: The Upper Klamath Outfitters Association, American Whitewater, and several individuals commented that dam removal would increase whitewater boating opportunities, and they support dam removal. Several commenters noted the need to develop timely river access and boat launching sites and to remove construction spoil and vegetation from the reach between Copco No. 2 and Iron Gate Dam, which BLM also recommended. The Upper Klamath Outfitters Association noted the need for continued access to the current whitewater run below J.C. Boyle Dam for as long as possible during deconstruction activities and stated that it is critical to perform channel restoration before restoring natural flows. Siskiyou County noted that the proposed action includes the addition of several new river-based recreation opportunities, including river access points, campsites, day use amenities, and trails, but that KRRC has not identified how these facilities will be maintained. American Whitewater described recreation mitigation required in previous dam removals, as well as detailed comments on the recreation plan and whitewater boating study, which the Upper Klamath Outfitters Association fully supports.

Response: River recreation under the proposed action would be expected to change significantly in reservoir and bypassed reaches, and more moderately in other reaches (from J.C. Boyle Dam to Copco No. 1 Reservoir), but the overall result would be beneficial to recreational river users. KRRC developed conceptual designs for new river access facilities and supports their development. As noted above, we recommend that KRRC revise the Recreation Facilities Plan to clarify whether KRRC would fund construction and operation of the new river access facilities, and that, at minimum, KRRC should construct access facilities that would be located in areas that would be affected by land disturbance during implementation of the proposed action. We also recommend that the plan be revised to remove in-channel vegetation to address stakeholder concerns regarding hazardous tree encroachment into the Copco No. 2 bypassed reach, as well as remaining construction material that contributes to hazardous boating conditions at Sidecast Slide (see section 3.7.3.2, *River Recreation*).

A.2.16 California National Historic Trail

Comment: NPS noted that J.C. Boyle Dam is located approximately 1.75 miles from the designated alignment of the California National Historic Trail. The trail alignment crosses the northwestern section of the J.C. Boyle Reservoir. There is one high potential site, the Lower Klamath River Crossing, and one high potential route segment, the Cascade Mountain Crossing of the Applegate Trail that are located approximately 2 miles north of the dam.

Response: The proposed action would return the J.C. Boyle Reservoir to a riverine state, a landscape condition that is more similar to what existed when the trail was being used in the early to mid-1800s by settlers emigrating from the central Midwest to southern Oregon (see section 3.10.2.2, *Cultural History Overview*; section 3.9, *Aesthetics*; and section 3.8.3.3, *Specially Designated Areas*).

A.2.17 Effects on Fire Fighting

Comment: Numerous parties commented that the Fire Management Plan (FMP) is not sufficient to avoid increased risk of damage by wildfires due to reduced access to water for firefighting and the loss of fire breaks that the reservoirs provide. Several commenters stated that the town of Ashland was saved from wildfire by water provided from the reservoirs, and Kathy and Dan McGuigan stated that CAL FIRE dipped at least 500 loads and prevented their house and property from being burned in the Klamathon fire in 2018. Representative LaMalfa commented that without the reservoir behind Copco No. 1 Dam, air attack craft would be required to fly farther for water and increase overall resources needed from CAL FIRE or the Forest Service. Several commenters provided detailed critiques of specific elements in the FMP, including letters filed on August 9, 2021, by Loy and John Beardsmore and the Copco Lake Fire Protection District, August 18, 2021, by Chrissie Reynolds, and August 19, 2021, by Siskiyou County. Several commenters noted that loss of the reservoirs would increase the cost and reduce the availability of fire insurance. One commenter noted that some of the most effective aircraft (specifically the Canadian Otter) used for firefighting need a large body of water for refilling. Siskiyou County stated that the FMP should be revised to include permanent water sources (such as dip tanks) strategically placed along the Klamath River corridor to support aircraft firefighting activities. One commenter questioned whether increased use of chemicals as a fire-suppression agent due to elimination of lake water sources would be worse for salmon.

The Forest Service concurred with CAL FIRE’s assessment that the FMP is more than adequate. The Forest Service noted that while the plan would affect some water dipping sites that have been used during prior fire suppression efforts, it does not anticipate the FMP would adversely affect the ability to respond to fires quickly and effectively.

Response: KRRC’s FMP would provide improvements for early detection of wildfires, measures to assist property owners with improving defensible space around home sites, and measures to provide additional water source locations for ground-based and aerial fire suppression efforts. Access to open water bodies for water scooping planes would be reduced, but other bodies of water remain available in the vicinity, and other types of tanker planes and helicopters are also used for aerial firefighting. Access to water for ground-based water trucks would be improved with the construction of new river and stream access sites, and early detection of new fires would be improved with the installation of additional MDS sites (see section 3.8.3.2, *Fire Management Plan*).

Comment: The Forest Service concurred with CAL FIRE's assessment that the FMP is more than adequate. It noted that while it would affect some water dipping sites which have been used during prior fire suppression efforts, they do not anticipate it would adversely affect their ability to respond to fires quickly and effectively.

Response: Comment noted (also see section 3.8.3.2, *Fire Management Plan*).

A.2.18 Effects on Emergency Response

Comment: Numerous commenters stated that increased traffic during deconstruction would affect travel times for local residents for a period of one to two years and would affect emergency response times for a population that includes many elderly residents. One commenter reported that Ager Beswick Road is the only route out of the canyon that can handle meaningful traffic, and that use of that road by construction equipment would severely affect emergency response time.

Response: KRRC's Oregon and California Traffic Management Plans, subplans of its proposed Construction Management Plan, identify measures to minimize the effects of short-term construction-related impacts, prevent incidents, ensure preparedness, and maintain consistency with all applicable traffic, highway, and roadway regulations in Siskiyou County, California and Klamath County, Oregon. The road and traffic measures described in KRRC's Traffic Management Plans for Oregon and California address increased traffic levels on existing public roads. Existing road deficiencies for heavy truck traffic and weights have been identified, with improvements proposed to minimize the effect to local roads and community traffic (see section 3.8.3.4, *Road Management and Traffic*).

A.2.19 Effects on Property Values and Mitigation of Impacts to Properties on Copco No. 1 Reservoir

Comment: Numerous commenters expressed concern about effects on property values, and several indicated that property valuations in the vicinity of the dams have already decreased with the mere prospect of dam removal. Representative LaMalfa stated that County officials have informed him that tax revenues would decrease between $600,000 and $800,000 per year, and effectively require at least one school district to be shut down. Several commenters noted that there is uncertainty about what types of impacts would be compensated for through the proposed Local Impacts Mitigation Fund. Siskiyou County asked that the EIS include a professional engineering analysis of rim stability and apply any necessary mitigation measures. One commenter was concerned about cracked foundations, windows, or doors due to settling.

Response: Under the proposed action, the regional economy would be affected in the short term by construction activities associated with dam removal and restoration actions, and in the long-term by effects on property values, tax revenue, electric rates, commercial and recreational fishing, subsistence fishing, reservoir and riverine recreation, and tourism. Property owners near the reservoirs could also be economically affected by effects on wells, slope instability, susceptibility to damage from wildfires, and property values. KRRC proposes several measures to address these potential effects (see section 3.2.3.4, *Short- and Long-term Effects on Groundwater Supply Wells*; section 3.1.3.1, *Effects of Bank Sloughing Caused by Reservoir Drawdown*; and section 3.8.3.2, *Fire Management Plan*). In the long-term, river restoration, the development of trails within the restored areas, and the reestablishment of salmon and steelhead runs through the hydroelectric reach would at least partially compensate for the loss of lake frontage to property values, but the magnitude of this effect could not be quantified (see section 3.12, *Socioeconomics*).

Comment: PCFFA commented that the KRRC's restoration plans for formerly inundated lands (including replanting of natural vegetation, with trails, and new boat ramps) should make these lands more valuable for landowners to have nearby as recreational lands, and other commenters note that having a river with salmon and steelhead nearby should increase property values. One commenter noted that these property owners have the option of adapting to the changes to their own benefit (e.g., by building alternative dwelling unit(s) on their land to rent via an online vacation rental service).

Response: See response to previous comment.

A.2.20 Environmental Justice

Comment: Siskiyou County stated that the effects on property values should be evaluated as impacts to environmental justice communities and that the project meet the policies of Executive Order 13985, Advancing Racial Equity and Support for Underserved Communities through the Federal Government. One commenter noted that local, disadvantaged populations (Hmong, among others) face the loss of their lake fishery food sources. One commenter noted that removal of this food source in favor of a different species that is more expensive and difficult to catch could be in contradiction to civil rights regulations. One commenter noted that most of the hundreds of people living in the communities around and near Copco No. 1 and Iron Gate Reservoirs are retired and elderly, and barely getting-by on social security. Many commenters stated that input from local residents (who would be the most impacted by the proposed action) has not been solicited sufficiently, and that votes by the citizens of Siskiyou and Klamath counties opposing dam removal have been ignored. One commenter noted that the expanse of open water provided by the reservoirs benefits residents by keeping the air cooler.

Response: The proposed action would have a disproportionately high and adverse effect on environmental justice populations (see section 3.13, *Environmental Justice*). However, the effects associated with the proposed action would mostly be mitigated, and beneficial effects associated with dam removal would outweigh the long-term, adverse effects associated with the proposed action. To reduce potential adverse effects on environmental justice populations, the proposed action with staff modifications would require KRRC to revise the Sediment Deposit Remediation Plan, Water Supply Management Plan, Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services, to include a required public outreach component that specifically addresses communication with environmental justice communities, with consideration that public outreach to environmental justice communities can be complicated by limited access to on-line resources, language barriers, and potential distrust of government or corporate entities. The proposed action with staff modifications would also require KRRC to include signs in Spanish and Hmong at recreational sites to increase potential for non-English speakers to access the information.

A.2.21 Noise and Air Quality

Comment: Numerous commenters expressed concern about the effects of construction activity on noise levels and air quality during dam deconstruction and restoration work, and the potential for dust storms if revegetation efforts are not successful.

Response: The proposed action includes measures proposed in the Noise and Vibration Control Plan that would minimize short-term outdoor noise impacts (see section 3.15, *Air Quality and Noise*). Several mitigation measures are proposed to control fugitive dust and exhaust emissions. Reference is made to A.2.12 regarding proposed revegetation measures in the reservoir footprint that would eliminate the potential for dust storms associated with the proposed action.

A.2.22 Greenhouse Gas Emissions and Electricity Supply

Comment: Numerous commenters stated that removing the dams would affect the availability of carbon-free energy at a time when the need for electricity is growing due to the increased use of electric cars. One commenter stated that it seems prudent to take advantage of and refurbish the energy-producing infrastructure already in place at the dams to help meet increasing demands. Another commenter stated that their region wants the hydropower generated by the Klamath River dams, which provide 70,000 homes with green renewable power. PCFFA contended that it would cost PacifiCorp ratepayers far more to retrofit and relicense these aging and now economically obsolete dams than to replace their small amount of power from other, newer and much more cost-efficient resources.

Response: PacifiCorp plans to increase the percentage of renewable energy sources in its power mix to comply with the California Renewable Portfolio Standard at a rate that would replace the loss of renewable energy generated by the Lower Klamath Project (see section 3.15.3.3, subsection *Decommissioning of Renewable Power Generation*).

Comment: PCFFA contended that it would cost PacifiCorp ratepayers far more to retrofit and relicense these aging and now economically obsolete dams than to replace their small amount of power from other, newer and much more cost-efficient resources.

Response: Mandatory FERC relicense conditions of the Lower Klamath Project would cost in excess of $400 million (2010 dollars) in capital expenses and $60 million annually in operating expenses. PacifiCorp also reported that these costs are uncertain and uncapped, and that FERC relicensing represents a substantial financial risk to its customers (Interior and NMFS, 2013).

A.2.23 Construction Costs and Cost/Benefit Analysis

Comment: Many commenters stated that the estimated construction costs are now long out of date and that costs are likely to escalate and exceed available funding. Some commenters noted that construction costs and delays have increased due to the Covid-19 pandemic. Other commenters indicated that lawsuits would result in additional costs. Several commenters stated that money provided by California and Oregon is better spent helping PacifiCorp fund relicensing requirements and upgrade or recondition their equipment and lake infrastructure and improve downstream habitat. Some commenters stated that PacifiCorp should bear the costs of restoring fish passage and improving water quality, while others argued that ratepayers and taxpayers should not be obligated to pay for dam removal. Other commenters suggested that it would be cheaper to install "Whooshh" tubes to provide fish passage than remove the dams.

Response: In the transfer order, the Commission found that with KRRC and the states of Oregon and California as co-licensees, the co-licensees have the ability, financially and otherwise, to undertake dam removal. The states bring additional legal and technical expertise and their assurance that there will be sufficient funding to complete the project. PacifiCorp has committed to providing additional funding, if necessary, through the contingency fund and partially covering any cost overruns. The Independent Board of Consultants has reviewed the cost estimates and risk analyses and expressed its satisfaction that the analyses reflect that efforts were made to minimize costs as appropriate and that the cost estimates reflect an acceptable risk. Based on the commitments of these parties, and the review of the Independent Board of Consultants, the required funds should be available and adequate to complete the project as proposed.

In response to the concern that the cost of the project may be affected by Covid-19-related cost increases, the project is mostly a demolition project, so any potential Covid-19-related material shortages or delays are not expected to have a significant adverse effect on costs, and as stated above, KRRC and the states of Oregon and

California remain committed to completing the project even if the final cost exceeds currently available funds.

In addition, prior analyses suggests that the costs of operating the dams with fish passage and other mitigation measures would exceed the costs of removing them. The Klamath Dam Removal Overview Report (Interior and NMFS, 2013) reports that, based on PacifiCorp's analyses, capital costs of providing fish passage at the four dams (in 2010 dollars) would be in excess of $400 million, and annual operating and maintenance costs would be in excess of $60 million (see appendix A, A.1, *Alternatives Submitted During Scoping*, A.1.1, *Provide Fish Passage with Dams in Place*). Escalated to 2021, this would be $515 million in capital costs, and annual operating and maintenance costs in excess of $77 million.

Comment: One commenter asked how many salmon can reasonably be expected to be produced by the project and how many salmon would be needed to balance the cost/benefit of the project. Several commenters including Representative LaMalfa cited studies that indicate that salmon runs throughout the Pacific Northwest have been declining for many years, including many that use rivers that are not affected by dams. Other commenters suggested that overfishing, predation by sea lions, or ocean conditions including the Pacific Decadal Oscillation may be the primary factors limiting salmon runs and note that salmon runs in the Klamath River had declined substantially before the dams were constructed. One commenter noted that much of the available spawning habitat in tributaries to the lower river is underutilized, suggesting that providing access to additional upstream habitat would provide limited benefit. The commenter also noted that these lower tributaries, which are subject to coastal influence and have greater precipitation, provide far superior salmon habitat than exists upstream of Iron Gate Dam. They further stated that pre-dam habitat in the Upper Klamath River was subject to high temperatures and poor water quality due to high phosphorous content, noting that the first known explorations to the Upper Klamath River Basin in the 1820s by Ogden related degraded (toxic) stagnant marsh waters and much difficulty finding potable water for them and their animals. They further stated that flows often went subsurface in late summer prior to project storage and Lost River inputs. One commenter noted that water is not available in the same quantities as it was in pre-agricultural California and does not appear to be sufficient to support the numbers of salmon that returned to the river historically.

Response: Keeping the four dams in place would not meet the need for timely action to address deteriorating water quality and increased salmon disease incidence, which we conclude is necessary to ensure the long-term viability of the Klamath River salmon runs. The no-action alternative would not address many other impacts of the project, including the blockage from access to cold-water habitat that could provide refuge from increasing water temperatures, sediment starvation of the reach downstream of Iron Gate Dam, nuisance and/or noxious blue-green algae blooms in the reservoirs and the l transport of blue-green algae from the reservoirs into the Klamath River, and the contribution of these effects to fish disease (see appendix A, A.1. *Alternatives Submitted During Scoping*, A.1.1, *Provide Fish Passage with Dams in Place*).

Comment: PCFFA noted that removing the dams will restore access to cold-water springs that, prior to inundation by the reservoirs, provided refugia for cold-water fish such as salmon during the summer. PCFFA also stated that the dams create ideal environmental conditions downriver of Iron Gate Dam for disease "hot spots" for the pervasive spread of the myxosporean fish parasite *C. shasta*, which in recent years has devastated the juvenile salmon populations. PCFFA also noted that the West Coast's salmon fisheries all the way from Monterey, California, to the Oregon-Washington border are often closed or severely limited, based on "weak stock management" constraints often triggered by the depressed salmon runs of the Klamath River, which typically migrate and intermingle with other more abundant salmon stocks within those regions. PCFFA commented that all too often the socioeconomic and environmental impacts of the current status quo, including major and ongoing harms, are ignored or tacitly unaccounted for, even when they consist of major environmental degradation causing severe economic deficits. They stated that a true cost vs. benefits analysis must therefore consider all the costs as well as all the benefits of all options—including continuing the status quo. They included with their comment letter two guidance documents which they stated were prepared by the foremost natural resource economists in the country, on how to account for all the benefits as well as deficits with regard to salmon restoration efforts.

Response: Dam removal and implementation of KRRC's proposed plans would improve fish populations by increasing access to historical habitat, restoring mainstem habitat, and by improving key biological and physical factors that heavily influence fish populations (e.g., sediment transport, water quality, fish disease, toxic algal blooms, and water temperature). Despite some short-term mortalities associated with project deconstruction and suspended sediment releases, the likelihood of the potential for persistence of naturally produced salmon, steelhead trout and other native anadromous fish species is anticipated to improve under the proposed action (see section 3.4.3.3, *Effects of Changes in Suspended Sediment Concentrations on Aquatic Resources,* and section 3.4.3.9, *Effects on Commercial, Recreational and Tribal Fisheries*).

A.2.24 Socioeconomics

Comment: Del Norte County urged that the area of analysis include the Crescent City Harbor (due to potential effects of sediment deposition on boat ramps and Crescent City Harbor); socioeconomic impacts to the county's fishing and tourism; and analysis of whether "short-term" physical impacts could have long-term socioeconomic impacts on its small, fragile economy.

Response: Effects of the proposed action on Crescent City Harbor are considered in section 3.1.3.3, *Effects of Coastal Sediment Deposition on Navigation*. Some of the sediment released by the drawdown of the reservoirs may ultimately be deposited in

Crescent City Harbor. KRRC proposes to mitigate the increase in dredging costs based on a study monitoring nearshore currents to estimate the among of sediment that would be deposited in the harbor as a result of the proposed action. We suggest that developing an estimate of the potential contribution of sediment from the proposed action to Crescent City Harbor and the boat rams using best available existing information and reasonable assumptions, could assist the involved parties in reaching an agreement on an appropriate mitigation approach.

Comment: Several commenters noted that the potential costs and benefits to local communities, including agricultural and ranching interests, have not been addressed. One commenter was concerned that any reduction in water supply would have severe effects on the people of southern Oregon who have invested their lives (and generations) building homes, businesses, ranches, and farms.

Response: Under the proposed action, construction activities associated with dam removal and restoration actions would affect the regional economy in the short term, and effects on property values, tax revenue, electric rates, commercial fishing, subsistence fishing, ocean and in-river sport fishing, reservoir and riverine recreation, and tourism would affect the regional economy in the long term. Overall, the proposed action would provide a net economic benefit that would have a long-term, significant, beneficial effect on a county, state, and national level (see section 3.12, *Socioeconomics*). The project reservoirs are not used to store water for consumptive uses, and there are no water users that obtain water directly from the reservoirs. Any effects on downstream facilities used to divert water for consumptive use would be mitigated by measures included in KRRC's California Water Supply Management Plan. Property owners near the reservoirs could also be affected economically by adverse effects on wells, slope instability, and susceptibility to damage from wildfires. Effects on private property would be mitigated or minimized by measures proposed by KRRC to address these potential effects (see section 3.2.3.4, *Short- and Long-term Effects on Groundwater Supply Wells*; section 3.1.3.1, *Effects of Bank Sloughing Caused by Reservoir Drawdown*; and section 3.8.3.2, *Fire Management Plan*).

Comment: Two commenters opposed the project and demanded: (1) a cease and desist order for all actions pertaining to Klamath River Dams Removal project, (2) an opportunity to examine and challenge validity of all documents, (3) an opportunity to present contradictory evidence without time constraints, and (4) full, open and unbiased public disclosure. They contended that water in dams is not private property, and the government's job is to protect and maintain the dams for the betterment of the people.

Response: The EIS documents the views of governmental agencies, non-governmental organizations, affected Native American Tribes, the public, the license applicants, and Commission staff. It contains staff evaluations of the applicants' proposal and alternatives for surrendering/decommissioning the Lower Klamath Project. Before the Commission decides to issue a license surrender, it will consider all concerns relevant to the public interest.

A.2.25 Cultural and Tribal Resources

Comment: Many commenters noted that restoring the salmon runs and improving water quality are of great cultural importance to the Tribal communities that reside along the Lower Klamath River. BLM and EPA recommended that each alternatives analysis fully account for, and integrate, a Tribal perspective on resource impacts.

Response: The protection and restoration of anadromous fish to historically accessible habitat would benefit local Tribes by providing dietary and economic benefits and the continuance and restoration of cultural practices and traditions related to this resource (see sections 3.11, *Tribal Trust Responsibilities,* and 3.13, *Environmental Justice*). Consulted Tribes included the Hoopa Valley Tribe, Karuk Tribe, Yurok Tribe, Klamath Tribes, Modoc Tribe, Quartz Valley Indian Community of the Quartz Valley Reservation of California, Resighini Rancheria, Confederated Tribes of Siletz Indians of Oregon, Trinidad Rancheria, Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes of the Grand Ronde Community of Oregon, Cow Creek Tribes of the Warm Springs Reservation of Oregon, Elk Valley Rancheria (California), Pit River Tribe (California), and the Tolowa Dee-Ni Nation (see section 1.5, *Tribal Consultation*). Perspectives of Tribes on the proposed action are summarized in appendix K of the EIS. In general, consultation with the participating Tribes indicates strong support from most Tribes in the project area for the removal of the project dams with the consensus being that removal is necessary to ensure the survival of salmon and steelhead and restore anadromous fish habitat and improve water quality in the Lower Klamath River. Commission staff considered this Tribal consultation history as well as other comments received from the Tribes in developing this EIS.

Comment: Many commenters noted that draining the reservoirs would expose many Tribal burial grounds and cultural artifacts to potential looting and vandalism. BLM recommended using electronic surveillance and exclusion barriers at strategic sites of vulnerability to reduce the risk of off-road vehicle damage until the vegetative community is fully established to minimize damage to vegetation and disturbance of cultural resources.

Response: Sites exposed during reservoir drawdown would be the most susceptible to illicit and unauthorized activities. Appendix D of the draft Historic Properties Management Plan (HPMP) provides a Looting and Vandalism Plan that proposes coordination with local law enforcement for crimes occurring on privately held lands. Additionally, a public education program would be developed that informs visitors of the site protection. No electronic surveillance is proposed, but the Looting and Vandalism Plan calls for the restriction of public access during the drawdown and dam removal process. Security measures would also include the on-site presence of security personnel during drawdown and decommissioning. Finally, regular site condition monitoring would be conducted to document instances of looting and vandalism (see section 3.10.3.4, *Management of Historic Properties*).

Comment: Siskiyou County stated that the EIS should include a determination by the California and Oregon State Historic Preservation Offices regarding the Klamath River Hydroelectric Project District's eligibility for listing in the National Register of Historic Places. Another commenter suggested that Copco No. 1 development should qualify for historic preservation.

Response: KRRC evaluated eligibility of the proposed Klamath River Hydroelectric Project District and four other hydroelectric system historic districts (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) and recommended all hydroelectric districts as eligible for listing on the National Register. According to the draft HPMP, in September 2003, PacifiCorp documented the overall Klamath River Hydroelectric Project Historic District and identified the Copco No. 1 development as contributing to the larger Klamath River Hydroelectric Project District (see section 3.10.3.4, subsection *Management of Built Resources*). KRRC's proposal to remove the Lower Klamath River hydroelectric facilities would result in adverse effects to historic properties including districts. Some of these effects would be significant and permanent. KRRC's draft HPMP provides general measures that are consistent with the Advisory Council and Commission's 2002 guidelines.

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APPENDIX B—STATUTORY AND REGULATORY REQUIREMENTS

APPENDIX B

STATUTORY AND REGULATORY REQUIREMENTS

B.1 CLEAN WATER ACT

Under section 401(a)(1) of the Clean Water Act, 33 United States Code (U.S.C.) § 1341(a)(1), a license applicant must obtain either a water quality certification (WQC) from the appropriate state pollution control agency verifying that any discharge from the project would comply with applicable provisions of the Clean Water Act or a waiver of such certification. A waiver occurs if the state agency does not act on a request for certification within a reasonable period, not to exceed one year after receipt of such request.

On September 11, 2017, the Klamath River Renewal Corporation (KRRC) submitted an application to the Oregon Department of Environmental Quality (Oregon DEQ) for section 401 certification for surrender of the license for the Lower Klamath Project. On September 7, 2018, Oregon DEQ issued the section 401 water quality certificate for the project (Oregon DEQ, 2018). On September 23, 2017, KRRC submitted an application to the California State Water Resources Control Board (California Water Board) for section 401 certification for surrender of the license for the Lower Klamath Project. The California Water Board received the request on October 21, 2016. On April 7, 2020, the California Water Board issued a section 401 certificate for the project (California Water Board, 2020b). The conditions of the Oregon DEQ and California Water Board certifications are described under section 2.2, *Mandatory Conditions*, and are included in full in appendices D and E, respectively.

Section 404 of the Clean Water Act requires authorization from the Secretary of the Army, acting through the U.S. Army Corps of Engineers, for the discharge of dredged or fill material into all waters of the United States, including wetlands. Discharges of fill material generally include, without limitation; placement of fill that is necessary for the construction of any structure or impoundment requiring rock, sand, dirt, or other material for its construction; site-development fill for recreational, industrial, commercial, residential, and other uses; causeways or road fills; dams and dikes; artificial islands; property protection or reclamation devices such as riprap, groins, seawalls, breakwaters, and revetments; beach nourishment; levees; fill for intake and outfall pipes and subaqueous utility lines; fill associated with the creation of ponds; and any other work involving the discharge of fill or dredged material. A U.S. Army Corps of Engineers' permit is required whether the work is permanent or temporary.

B.2 ENDANGERED SPECIES ACT

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. On August 2, 2021, we notified the

U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) that we had reviewed the Biological Assessment (BA) prepared by KRRC and adopted it as our final BA. The BA evaluates effects of license surrender and removal of the Lower Klamath Project on nine species: the Southern Oregon Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*), southern distinct population segment (DPS) green sturgeon (*Acipenser medirostris*), southern DPS eulachon (*Thaleichthys pacificus*), Lost River sucker (*Deltistes luxatus*), shortnose sucker (*Chasmistes brevirostris*), bull trout (*Salvelinus confluentus*), northern spotted owl (*Strix occidentalis caurina*), Oregon spotted frog (*Rana pretiosa*), and the Southern Resident killer whale (*Orcinus orca*). In the final BA, we conclude that license surrender and removal of project *may affect and is likely to adversely affect* SONCC coho salmon and its critical habitat, southern DPS eulachon and its critical habitat, Lost River sucker, shortnose sucker, and bull trout. We conclude the proposed surrender and removal of the project *may affect but is not likely to adversely affect* southern DPS green sturgeon or its critical habitat, Southern Resident killer whale and its critical habitat, bull trout critical habitat, Lost River sucker critical habitat, shortnose sucker critical habitat, northern spotted owl and its critical habitat, and the Oregon spotted frog. We find the proposed surrender and removal of the project would have *no effect* to critical habitat of the Oregon spotted frog.

On August 24, 2021, FWS published its final rule to list Franklin's bumble bee (*Bombus franklini*) as an endangered species under the ESA (86 *Federal Register* 47221). FWS did not designate critical habitat. The listing status became effective on September 23, 2021. Our analysis of the effects of the proposed surrender and removal of the project on Franklin's bumble bee is presented in section 3.6.3, *Threatened and Endangered Species, Effects of the Proposed Action.* We conclude the proposed surrender and removal of the project *may affect but is not likely to adversely affect* Franklin's bumble bee because the species is unlikely to occur in the project area, and KRRC would implement measures to minimize potential effects of herbicides on bumble bee habitat. Following revegetation of the reservoir footprints, foraging habitat for Franklin's bumble bee would experience a net increase. We will request concurrence with our finding from FWS.

On September 3, 2021, FWS determined that the BA and supplemental information provided were sufficient to initiate formal consultation for the project. FWS also noted the listing of Franklin's bumble bee as an endangered species to be included in the consultation. On December 22, 2021, FWS (2021e) issued its BiOp for the project that concurred with the KRRC's (2021b) effects determination that the project *may affect but is not likely to adversely affect* the northern spotted owl and its critical habitat, Franklin's bumble bee, Oregon spotted frog, and critical habitat for the Lost River sucker, shortnose sucker and bull trout. FWS (2021e) made no response to the determination that the project will have *no effect* to critical habitat for the Oregon spotted frog. FWS (2021e) also concurred with the determinations that the project *may affect and is likely to adversely affect* the Lost River sucker, shortnose sucker, and bull trout and further concluded that the proposed action is not likely to jeopardize the continued existence of these species. Lastly, FWS (2021e) acknowledged that the project includes minimization measures to reduce effects on the monarch butterfly (*Danaus plexippus*), a candidate for ESA listing. FWS is also currently reviewing the listing status of the little brown bat (*Myotis lucifugus*), western bumble bee (*Bombus occidentalis*), and western pond turtle (*Actinemys marmorata*). We evaluated effects on these species in section 3.6.3, *Threatened and Endangered Species, Effects of the Proposed Action,* and conclude that the project would have minor, less than significant effects on possibly other species we do not yet know about. FWS (2021e) recommended drafting conservation measures for these species to minimize possible delays to the project if any of these species were to become listed prior to surrender and decommissioning.

On August 19, 2021, NMFS determined the BA and associated materials provided sufficient information to initiate formal consultation for SONCC coho salmon and its critical habitat, southern DPS eulachon and its critical habitat, Southern Resident killer whale and its critical habitat, and informal consultation for southern DPS green sturgeon and its critical habitat. On December 17, 2021, NMFS (2021b) issued its BiOp for the project, which concurred with the KRRC's (2021b) effects determination that the project *may affect but is not likely to adversely affect* the Southern DPS green sturgeon and its critical habitat. NMFS (2021b) also concurred with the KRRC's (2021b) effects determination that the project *may affect and is likely to adversely affect* the SONCC coho salmon ESU and its critical habitat, and the Southern DPS eulachon and its critical habitat. The NMFS (2021b) BiOp did not concur with the KRRC's (2021b) effects determination for the Southern Resident DPS killer whale but found that the project *may affect and is likely to adversely affect* the species and its critical habitat. NMFS (2021b) further concluded that the proposed action is not likely to jeopardize the continued existence of these species, nor is it likely to destroy or adversely modify their critical habitat.

B.3 COASTAL ZONE MANAGEMENT ACT

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456(c)(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA Program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

In Oregon, the Klamath River is not included in the state's coastal watersheds. In California, the Klamath River flows into the Pacific Ocean where the delta and estuary are designated as a Critical Coastal Area within the coastal zone.

During the California Water Board's review of the application for WQC pursuant to section 401 of the Clean Water Act, the California Coastal Commission indicated that it may issue a determination of consistency with the CZMA if KRRC prepares and submits a consistency certification and if the National Oceanic and Atmospheric Administration's Office for Coastal Management grants such authority (California Water

Board, 2020b). In its surrender application, KRRC proposes to obtain a consistency determination with the CZMA if determined to be necessary.

As discussed in section 3.1, *Geology and Soils*, most of the sediment released during drawdown of the reservoirs is expected to be transported to the Pacific Ocean. However, some sediment may be deposited in coastal areas, namely Crescent City Harbor. While we acknowledge here that the location and depth of sediment deposition is difficult to predict, we do expect some deposition to occur in these coastal areas.

Therefore, we find that a consistency certification with the CZMA is warranted. By letter dated January 7, 2022, Commission staff requested that KRRC seek such a determination from the California Coastal Commission and timely file it with the Commission to avoid any delay in Commission action.

KRRC filed documentation of its request for a consistency certification on February 4, 2022, and we await the California Coastal Commission's determination regarding KRRC's submittal.

B.4 NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act (NHPA), 54 U.S.C. § 306108, requires that a federal agency "take into account" how its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American History, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

By letter dated October 18, 2017, Commission staff initiated consultation with participating Tribes. This was followed by Tribal consultation meetings from January 16 to January 19, 2018. The purpose of this consultation was to seek the Tribes' input on the proposed action and its potential effects on environmental resources, including historic properties. Consulted Tribes included the Hoopa Valley Tribe, Karuk Tribe, Yurok Tribe, Shasta Indian Nation, Shasta Tribe, Klamath Tribes, Modoc Tribe, Quartz Valley Indian Community of the Quartz Valley Reservation of California, Resighini Rancheria, Confederated Tribes of Siletz Indians of Oregon, Trinidad Rancheria, Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes of the Grand Ronde Community of Oregon, Cow Creek Tribes of the Warm Springs Reservation of Oregon, Elk Valley Rancheria (California), Pit River Tribe (California), and the Tolowa Dee-Ni Nation. Commission staff has considered the comments received by all Tribes in the development of the environmental impact statement.

In its May 20, 2021, response to the Commission's request for additional information, KRRC stated that it had not requested formal review of the draft Historic Properties Management Plan (HPMP) by the California State Historic Preservation Office (SHPO) or the Oregon SHPO and that it understood that the SHPOs would provide formal review only after the Commission initiated consultation with them under section 106 of the NHPA.

By letter filed on September 28, 2021, the Commission formally requested that the SHPOs provide their comments on the draft HPMP within 45 days with the caveat that the Commission anticipates that KRRC would file a supplement to the HPMP that includes the results of the outstanding studies (Phase II studies, additional structures studies, Traditional Cultural Property [TCP] studies). The Commission's letter also directed KRRC to file, by November 30, 2021, an update on the status of those studies. In a letter dated November 10, 2021, the Oregon SHPO stated that it prefers to review the draft HPMP and Memorandum of Agreement (MOA) simultaneously. In addition, the Oregon SHPO indicated that if consultation with Tribes regarding historic properties and cultural significance and TCPs is ongoing, and information on eligibility is still being gathered, the draft HPMP seems somewhat premature. In a letter filed on November 18, 2021, the California SHPO responded that it would review the section 106 efforts once the Phase II studies are complete, the findings have been reviewed and commented on by consulting parties, and formal National Register eligibility determinations have been made for each resource.

On December 1, 2021, Commission staff issued a letter to the California and Oregon SHPOs in response to their letters and requested they review the draft HPMP and provided the draft MOA for review, as requested by the Oregon SHPO. Commission staff stated that, even though the draft HPMP may be incomplete, it does address the following; (1) background information on the project; (2) discussion of the types of effects that may be expected and proposed mitigation and management measures; (3) identification of the area of potential effects (APE); (4) provisions for additional survey and monitoring (e.g., post-drawdown and during construction), inadvertent discoveries, and the treatment of human remains; and (5) implementation procedures that include but are not limited to staff training, reporting, ongoing consultation with the Cultural Resources Working Group, and internal review procedures.

In a November 29, 2021, filing, KRRC stated it would provide the final HPMP to the Commission on or before March 31, 2022. In addition, KRRC stated it would provide the California and Oregon SHPOs a draft Historic Built Environment Report on December 10, 2021, for review and comment. KRRC said it intends to use the information contained in the report, with any comments received, to update the HPMP. KRRC stated that the data collected from the Phase II studies are sufficient for analysis of project-related effects and conditional eligibility determinations. Moreover, KRRC did not receive any further comments on the ethnographic context statements or TCPs from the Tribes. However, KRRC noted that if it receives any further information from the Tribes regarding TCPs or ethnographic studies, it will include this information in the consultation record and update the HPMP, as appropriate. Commission staff requested the California and Oregon SHPOs provide comments on the draft MOA within 45 days of the date of the December 1, 2021, letter. In addition, Commission staff requested any preliminary comments regarding the draft HPMP, as well as the Historic Built

Environment Report. In a letter filed on January 14, 2022, the California SHPO provided comments on the draft MOA and also on the draft HPMP. In its comments on the MOA, the California SHPO stated that the MOA did not include needed components and that because the completion of the identification and evaluation of historic properties and assessment of effects cannot be completed until the removal of project facilities is underway, effects cannot be determined. The California SHPO instead suggested that a PA executed under 36 CFR 800.14(b)(1)(ii) would be more appropriate. A PA is a type of agreement document that is typically executed when the effects of an activity on historic properties cannot be determined prior to approval of the activity. In correspondence filed on January 24, 2022, the Oregon SHPO provided its comments on the draft MOA and draft HPMP. Commission staff is currently reviewing the California and Oregon SHPOs' comments. As appropriate, the Commission will respond to the comments or will direct KRRC to address the comments in the updated HPMP. Commission staff is currently reviewing the California SHPO's comments on the draft HPMP. As appropriate, the Commission will respond to the comments or will direct KRRC to address the comments in the updated HPMP.

Our analysis of project effects on cultural resources is presented in section 3.10.3, *Cultural Resources*. Historic properties occur in the project's APE, including contributing resources of several proposed historic districts. The results of National Register evaluations of most of the potentially affected cultural resources are still pending; however, we anticipate that the proposed decommissioning and removal of the Lower Klamath Project dams would result in adverse effects on historic properties.

We agree that execution of a PA would be more appropriate for the removal of the Lower Klamath Project facilities. To meet the requirements of section 106 of the NHPA, we intend to execute a PA with the Oregon SHPO and the California SHPO for the protection of historic properties from the effects of the proposed decommissioning and dam removal. The participating agencies, Tribes, and KRRC will be invited to concur with the terms of the agreement. The terms of the agreement would ensure that KRRC protects, manages, or mitigates all historic properties identified within the project's APE through the implementation of a final HPMP.

B.5 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Section 305 of the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1855(b)(2), requires federal agencies to consult with NMFS on all actions that may adversely affect Essential Fish Habitat (EFH). In the proposed action area, EFH has been designated for Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*), ground fish, and coastal pelagic species.

Our descriptions of Chinook salmon, coho salmon, ground fish, and coastal pelagic species EFH is based on our analysis in section 3.6.2, *Threatened and Endangered Species*, *Affected Environment,* and our analysis of project effects on EFH is in section 3.6.3, *Threatened and Endangered Species, Effects of the Proposed Action*.

We conclude that the proposed action, with staff's modifications, would result in adverse effects on Chinook and coho salmon EFH conditions for adult migration, spawning, egg-to-fry survival, juvenile rearing, and smolt migration habitat downstream of Iron Gate Dam in the short term, and result in no adverse effect on estuarine rearing for Chinook and coho salmon. Over time, as deposited sediments and sediments that remain in the reservoir footprints are transported or stabilized, respectively, the proposed action, with staff's modifications, would have no adverse effect, or may benefit Chinook and coho salmon habitat. The proposed action, with staff's modifications, would have a small and temporary adverse effect on Pacific Coast groundfish EFH from the elevated suspended sediment. Long-term effects are likely not adverse for Pacific Coast groundfish EFH. The proposed action, with staff's modifications, would have a small and temporary adverse effect on EFH for coastal pelagic species associated with short-term increases in suspended sediment concentrations. Long-term effects are likely not adverse for coastal pelagic species.

B.6 WILD AND SCENIC RIVERS ACT

Section 7(a) of the Wild and Scenic Rivers Act, 16 U.S.C. § 1278(a), provides that the Commission "shall not license the construction of any dam, water conduit, reservoir, powerhouse, transmission line, or other project works. . . on or directly affecting any river which is designated" as a component of the wild and scenic rivers system.

Congress added about 189 miles of the mainstem of the Klamath River to the Wild and Scenic Rivers system in 1981 as part of a total of 286 miles designation of river segments in the basin. The upstream end of the designated river segment begins about 3,600 feet downstream of Iron Gate Dam in the vicinity of the Iron Gate Hatchery. Most of the river was designated by Congress as recreational; 24 miles was designated as scenic; and 12 miles was designated as wild. The outstanding remarkable value for this reach of the Wild and Scenic River system is anadromous fisheries.

In 1994, the Secretary of the Interior added an 11-mile segment of Klamath River from downstream of the J.C. Boyle Powerhouse to the Oregon and California state line to the Wild and Scenic Rivers system. This segment was designated by the Secretary of the Interior as scenic, with outstanding remarkable values of quality whitewater boating, diverse wildlife, prehistoric sites, quality rainbow trout fishery, habitat for endangered species, historic places, scenery, and evidence of Native American traditional uses.

The current proposal is to remove an existing project, not the licensing of any project works. Consequently, section 7 of the Wild and Scenic Rivers Act does not apply here. We do, however, identify effects from the proposed surrender and removal of the project on those designated reaches in section 3.0, *Affected Environment and Environmental Consequences*.

B.7 REFERENCES

California Water Board (California State Water Resources Control Board). 2020b. Water Quality Certificate for Federal Permit or License; Klamath River Renewal Corporation Lower Klamath Project License Surrender. April 2020. Available at https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/lkp_final_wqc_7april2020.pdf. Accessed November 16, 2021.

FWS (U.S. Fish and Wildlife Service). 2021e. Transmittal of Biological Opinion and Conclusion of Formal and Informal Consultation for the Surrender and Decommissioning of the Lower Klamath Hydroelectric Project, Nos. 14803-001, 2082-063. FERC eLibrary accession number 20211222-5170.

NMFS (National Marine Fisheries Service). 2021b. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Surrender and Decommissioning of the Lower Klamath Hydroelectric Project No. 14803-001, Klamath County, Oregon and Siskiyou County, California. FERC eLibrary accession number 20211220-5034.

Oregon DEQ (Oregon Department of Environmental Quality). 2018. Attachment B. Clean Water Act Section 401 Certification for the Klamath River Renewal Corporation License Surrender and Removal of the Lower Klamath Project (FERC No. 14803), Klamath County, OR. September 7, 2018.

APPENDIX C—COST OF ENVIRONMENTAL MEASURES

Table C-1. Cost of decommissioning and environmental measures proposed by KRRC and recommended by staff (Source: staff)

Measure Description	**Capital Cost**	**Annual Cost**
Dam removal and decommissioning.	$452,250,000	Included in capital cost.
Implement the 16 management plans filed on December 14, 2021, listed in table ES-1.	Included in dam removal and decommissioning cost.	Included in dam removal and decommissioning cost.
Require that all consultations, final management plans, delineations, pre-drawdown mitigation measures, agreements, and wetland delineations be completed before any surface disturbance commences.	$0	No additional cost.
Modify the Construction Management Plan to include measures AQ-1 through AQ-5 to minimize effects of deconstruction activities on air quality, measure ENR-1 to purchase carbon offsets, and the Noise and Vibration Control Plan. These measures, which KRRC has agreed to implement, are described in section 2.1.3.	$0[a]	$0
Geology and Soil Resources		
Specify measures in the California Slope Stability Monitoring Plan (a subplan of the Reservoir Drawdown and Diversion Plan) about repairs and replacements of private property to be implemented if any reported structural damage to properties abutting Copco No. 1 Reservoir can be reasonably tied to the drawdown following monitoring and inspection.	$0	No additional cost.
Extend the planned radar and/or LiDAR monitoring of the reservoir and embankment rim for six months after completion of the drawdown—at a reduced survey interval of once per month and	$0	$5,000 per survey including interpretation, once a month for ½ year. Total $30,000.

Measure Description	**Capital Cost**	**Annual Cost**
limited to 1,780-linear-foot long segments of the Copco No. 1 Reservoir rim identified to be potentially affected by slope failure.		
Modify the Del Norte Sediment Management Plan (a subplan of the Sediment Deposit Remediation Plan) to require that Del Norte County be reimbursed for any increase in the cost of maintaining the Klamath River boat ramps in an operable condition that is attributable to sediment deposition as a result of the proposed action.	$0	We expect that the funding contribution would not likely be any more than the cost of the approach proposed by KRRC.
Water Quality		
Modify the Water Quality Monitoring and Management Plan to include submittal of all reports and correspondence to Native American Tribes that have obtained Clean Water Act treatment-as-a-state status.	$0	No additional cost.
Aquatic Resources		
Modify the Aquatic Resource Management Plan to include translocation of freshwater mussels as modified in KRRC's October 10, 2018, letter to the California Water Board.	$0[a]	$0
Modify the Hatchery Management and Operations Plan to clarify whether and when ownership would be transferred to California DFG or another entity.	$0[a]	$0[a]
Terrestrial Resources		
Modify the Reservoir Area Management Plan (RAMP) to include two periods of vegetation sampling each year. One sampling period should occur in late spring/early summer as proposed. The second sampling period should occur in late fall, but prior to the onset of woody vegetation dormancy.	$0	$20,000/year in years 1-6

Measure Description	Capital Cost	Annual Cost
Modify the RAMP to include detailed maps that identify areas of grading, water runoff control measures, planting, seeding, mulching, and irrigation areas. These maps should include final limits of work zones, delineated wetlands within areas of proposed disturbance, the reservoir footprints, the J.C. Boyle canal and scour hole, and all areas of temporary disturbance where revegetation activities would occur.	$10,000 in year 1	$0
Develop an eagle conservation plan that includes occupancy and productivity surveys; timing restrictions on vegetation clearing and construction noise; monitoring of active eagle nests; coordination with FWS, California DFW, and Oregon DFW; and reporting as described in California Water Board WQC condition 17.	$0	$0
Modify the Oregon and California Terrestrial Wildlife Management Plan to include: (1) additional criteria for the potential removal of structures containing bats between April 16 and August 31. If it is necessary to remove structures during this period, conduct surveys to determine whether the structure is occupied by a maternity roost and prohibit removal of structures with maternity roosts. In the absence of maternity roosts, only remove structures when bats are active (i.e., at night) and when less than 0.5 inch of rain is predicted within the following 24 hours; (2) use of bat gates to close portal outlets, tunnels, and other water conveyance structures; and (3) require staff entering areas with potential bat activity to follow the National White-Nose Syndrome Decontamination Protocol.	$50,000 in year 1	$15,000 in years 2-6
Recreation		
Modify the Recreation Facilities Plan to include: (1) removal of remaining construction-related debris in the river at the Sidecast	$50,000 in year 1	$0

Measure Description	Capital Cost	Annual Cost
slide location and encroaching vegetation growth within the river channel in the Copco No. 2 bypassed reach that create hazardous boating conditions; (2) developing a plan for funding the construction and maintenance of the potential access sites described in the Recreation Facilities Plan and filing a revised Recreation Facilities Plan with the Commission to include, at a minimum, development of the planned access points that are within the existing reservoir footprints; and (3) consulting with the Upper Klamath Outfitters Association to schedule construction activities and access restrictions to minimize adverse effects on whitewater boaters.		
Land Use		
Prepare a revised Fire Management Plan and Construction Management Plan in consultation with California Department of Forestry and Fire Protection, Oregon Department of Forestry, and the Fire Safe Council of Siskiyou County to address the following issues raised by stakeholders; (1) insufficient stream depth and excessive lift requirements at proposed locations for dry fire hydrants; (2) location of some dry fire hydrants on blind corners; (3) lack of locations near dry fire hydrants for fire trucks to turn around; (4) lack of any proposed river access boat ramps within the Copco No. 1 Reservoir area; (5) identification of the entity that would be responsible for storage, deployment, and refill of portable water tanks; and (6) potential need to install permanent water sources (such as dip tanks) strategically placed along the Klamath River corridor to address the potential filling of existing dip sites by gravel transported from the reservoirs.	$25,000	$0

Measure Description	**Capital Cost**	**Annual Cost**
Cultural Resources		
Prepare a supplemental Historic Properties Management Plan (HPMP) in consultation with the Oregon State Historic Preservation Office (SHPO), California SHPO, participating Tribes, and other appropriate agencies and organizations to address the following; (1) results of Phase II archaeological studies; (2) results of additional surveys and evaluations of historic structures; (3) results of the pending TCP studies and tribal consultation; (4) identification of specific effects to all historic properties, and resource-specific measures to resolve effects determined to be adverse; and (5) additional items identified by the Commission requiring clarification.	$35,000	$0
Modify the Reservoir Area Management Plan to incorporate the pre- and post-drawdown requirements for cultural resources inspections, surveys, evaluations, mitigation, and management as specified in the HPMP. Additionally, should ground conditions permit access for depositional sediment grading during reservoir drawdown, include provisions in the RAMP for a cultural monitor to be present to ensure that if any cultural resources are identified on the historical pre-dam ground surface, grading stops and the measures outlined in appendix C, section 7.1 of the HPMP (Monitoring and Inadvertent Discovery Plan, Procedures) are closely followed within 48 hours. These protocols include, but are not limited to; (1) notifying the team supervisor of any discovery of cultural or archaeological resources, (2) suspending work within 100 feet of the find in all non-dewatering situations, (3) completing an initial assessment of the discovery, (4) notifying the Commission, SHPO, and participating Tribes of the find, and (5) consulting with these entities	$0	$0

Measure Description	Capital Cost	Annual Cost
to determine and implement agreed-upon treatment measures for discoveries that are potentially eligible for listing on the National Register.		
Environmental Justice		
Modify the Sediment Deposit Remediation Plan, the Water Supply Management Plan, the Slope Stability Monitoring Plan, and any other plans that require landowners to contact KRRC for mitigation services, to include a public outreach component that specifically addresses communication with environmental justice communities.	$5,000	$0

[a] We assume that the cost of these measures is included in KRRC's cost estimate for implementing the management plans.

APPENDIX D—STATE OF OREGON WATER QUALITY CERTIFICATE CONDITIONS

APPENDIX D

STATE OF OREGON WATER QUALITY CERTIFICATE CONDITIONS

September 7, 2018

1. Proposed Action

The KRRC proposes to remove J.C. Boyle Dam, J.C. Boyle powerhouse and all appurtenant facilities consistent with the procedures and schedule described in the Klamath Hydroelectric Settlement Agreement (KHSA) and associated Detailed Plan, the application for section 401 water quality certification, and the September 30, 2017, Technical Support Document, which by this reference, are incorporated in their entirety (the "Proposed Action"). In accordance with applicable law, the Licensee shall notify DEQ if FERC authorizes modification to the Proposed Action to allow DEQ to determine whether such changes may affect compliance with water quality standards that may require amendment of this certification.

2. Water Quality Management Plan

The Licensee shall submit to DEQ a Water Quality Management Plan (WQMP) for review and approval within 90 days of issuance of the surrender order. Upon approval by DEQ, the Licensee shall file the WQMP with FERC and implement the WQMP in accordance with its terms.

At a minimum, the WQMP shall include the following information:

a) Water Quality Monitoring Plan Content
    i. Data collection protocol, analytical methods, and laboratory method reporting limits;
    ii. Location and description of monitoring points;
    iii. Flow monitoring at USGS gauges 11509500 and 11510700;
    iv. Applicable compliance criteria and associated compliance time schedule;
    v. Instrument calibration schedule and procedures;
    vi. Data validation procedures and quality assurance methodology;
    vii. Contingency procedures for inoperable or malfunctioning equipment; and
    viii. Data interpretation procedures, and
    ix. Adaptive management plan.

b) Monitoring Locations
The Water Quality Management Plan shall establish monitoring stations at the following monitoring locations:

Station	Existing USGS Location	Approximate River Mile	Measurement Type
Keno	USGS 11509500	RM 213.9	Flow, data sonde, grab
JC Boyle Powerhouse	USGS 11510700	RM 219.7	Flow, data sonde, grab

i. The Licensee shall secure all field equipment as necessary to ensure safe reliable placement, stability, and retrieval during seasonally high flows and drawdown conditions;
ii. The Licensee shall install monitoring equipment as necessary to meet data collection schedule as described in Section 3(d) or an alternate schedule approved by DEQ;

c) Parameters

The WQMP shall include monitoring for the following parameters:

Continuous Data Sonde Collection. The Licensee shall maintain operable data sondes and collect continuous measurements for the following parameters:

i. Temperature;
ii. Conductance;
iii. pH;
iv. Dissolved oxygen, oxygen saturation; and
v. Turbidity

Grab Sample Collection. The Licensee shall collect grab samples for the following parameters:

vi. Nitrogen: ammonia, nitrate, nitrite, total nitrogen;
vii. Phosphorus: orthophosphate, organic phosphorus, total phosphorus; viii. Carbon: dissolved organic carbon, particulate carbon;
ix. Chlorophyll-a; and
x. Suspended sediment concentration.

d) Monitoring Frequency and Duration

i. Initiating data collection: The Licensee shall begin sample and data collection at least 12 months prior to initiating drawdown of J.C. Boyle Reservoir unless otherwise approved by DEQ;
ii. Data sonde sampling frequency: The Licensee shall record data at 15-minute intervals.
iii. The Licensee shall collect grab samples for suspended sediment concentrations per the following schedule:
    A. Twice monthly through September of the drawdown year;
    B. Monthly beginning October 1 of the drawdown year.

iv. The Licensee shall collect all other grab samples monthly;
v. Duration: The Licensee shall monitor water quality in accordance the schedule in WQMP for a minimum of four years after initiating reservoir drawdown. Upon receipt and review of annual water quality monitoring reports DEQ may, at its discretion, continue or discontinue the requirement to monitor certain water quality parameters as warranted by water quality conditions.

e) Suspended Sediment Load

The Licensee shall propose procedures to quantify sediment export during and following reservoir drawdown using suspended sediment concentrations and flow measurements recorded at USGS gauges 11510700 and 11509500 and other methodologies as appropriate. Upon approval by DEQ, the Licensee shall implement this methodology.

f) Non-Reservoir Drawdown Activities

The Licensee shall propose procedures to monitor turbidity at the locations of actions that may discharge or increase sedimentation in runoff to the Klamath River and its tributaries. Except for activities that occur within the 24-month compliance time period identified in Section 3, the Licensee shall monitor turbidity approximately 100 feet upstream and 300 feet downstream during proposed activities at the following locations:

i. Activities to maintain fish passage as required by Section 4(a);
ii. J.C. Boyle scour hole restoration as required by Section 8(c);
iii. Removal of recreation areas required by Section 8(d);
iv. Backfilling and restoring the J.C. Boyle powerhouse tailrace as required by Section 8(f).

g) Water Quality Reporting

The Licensee shall present, summarize, and interpret water quality data in the Annual Compliance Report prepared in accordance with Section 11 of this certification. Water quality data shall be presented using graphs, tables, or other means to clearly demonstrate trends, relationships, and compliance. Raw data must be made available to DEQ either from accessible external websites, CDs, or other means to effectively transfer electronic data files.

3. Compliance Time Schedule

Pursuant to OAR 340-041-0185(5), DEQ establishes a compliance time schedule of 24 months following drawdown after which dam removal is not expected to cause an exceedance of Oregon water quality standards. If water quality monitoring demonstrates that project actions may contribute to exceedances of the applicable water quality standards beyond the compliance time schedule established by this certification, DEQ may require the Licensee to develop an adaptive management plan in consultation with DEQ, which includes alternative measures, an assessment of impacts, and a schedule to achieve compliance. Once approved by DEQ, the Licensee shall implement the plan in accordance with its terms, including any modifications made by DEQ as conditions of its approval.

4. Biological Criteria; Protection of Beneficial Uses; Other Requirements of State Law

a) Fish Passage

i. The Licensee shall provide or maintain fish passage at all artificial obstructions created or affected by the Proposed Action that prevent or delay the migration of native migratory fish;

ii. The Licensee shall, in consultation with ODFW and subject to approval by DEQ, remove or modify artificial fish barriers created or affected by the Proposed Action until the effective date of license surrender at all locations where native migratory fish are currently or have historically been present. Until the effective date of license surrender the Licensee shall reduce or eliminate project-related obstructions such as sediment barriers and erosional head cuts resulting in a vertical step higher than six inches;

iii. Potential artificial barrier locations may include but are not limited to the following:

A. Topsy Grade Road culverts;

B. Unnamed tributary north of Keno Access Road;

C. Spencer Creek.

b) Aquatic Resource Measure AR-6: Sucker

The Licensee shall implement Aquatic Resource Measure AR-6 presented in Appendix H of the Technical Support Document (KRRC 2017) to mitigate project effects on adult Lost River Sucker and Shortnose Sucker in J.C. Boyle Reservoir prior to drawdown.

c) Western Pond Turtle Mitigation

Subject to approval by DEQ, in consultation with ODFW, the Licensee shall conduct abundance and overwintering studies. The Licensee shall, as DEQ deems warranted, implement appropriate mitigation actions to reduce potential impacts to Western Pond Turtle populations prior to drawdown of JC Boyle Reservoir. DEQ's determination of the need for both initiation and extent of mitigation actions, if any, shall be based upon ongoing survey data, anticipated impacts, and potential additional impacts associated with capture and transport.

d) On-Site Septic Systems

To reduce the potential for bacterial pollution, the Licensee shall decommission Lower Klamath Project on-site septic systems proposed for removal in accordance with Oregon Administrative Rule Chapter 340, Division 71.

e) NPDES Construction Stormwater Permit

The Licensee shall register with DEQ for coverage under National Pollution Discharge Elimination System general permit 1200-C before any construction activities occur that cumulatively disturb more than one acre of and may discharge stormwater to surface waters of the state.

5. Reservoir Drawdown and Diversion Plan

Within 90 days of issuance of the surrender order, the Licensee shall submit to DEQ for review and approval a Reservoir Drawdown and Diversion Plan. Upon approval by DEQ, the Licensee shall file the Reservoir Drawdown and Diversion Plan with FERC and implement the plan upon receipt of all required authorizations. The Reservoir Drawdown and Diversion Plan shall propose drawdown procedures, schedule, and monitoring efforts. At a minimum, the plan shall include the following elements:

a) Drawdown Procedure

The plan shall include the following minimum information:

i. Description of all relevant reservoir drawdown facilities;

ii. Flood frequency evaluation;

iii. Anticipated drawdown rates and schedule;

iv. Slope-stability analysis;

v. Schedule for the sequenced removal of structural elements whose removal will affect discharge during drawdown.

b) Monitoring

The plan should include the following:

i. Location, schedule, and installation procedures for piezometer wells proposed for the upstream shell and core of J.C. Boyle Dam and procedures to monitor water levels and pore pressure at these locations;

ii. Description of all proposed survey monuments and inclinometer installations to monitor slope stability during and following drawdown;

iii. Visual monitoring schedule for evidence of potential slumping, cracking, or slope failure of dam embankment during dam removal;

iv. Monitoring of J.C. Boyle Reservoir elevation and stream flow at USGS gauge 11509500 below Keno Reservoir and USGS gauge 11509500 below J.C. Boyle powerhouse during drawdown.

c) Contingency and Notification Procedures

The plan shall include procedures to assess and respond to confirmed or suspected issues including but not limited to the following:

- i. Obstructions to reservoir discharge caused by physical blockages, mechanical failure, or other conditions that may restrict outflow;
- ii. Embankment instability, slumping, loss of erosion protection;
- iii. Cultural resource discovery;
- iv. Other events that directly or indirectly affect reservoir drawdown schedule.

d) Notification

KRRC shall notify DEQ within 72 hours of an event that may substantially delay drawdown or cause the timeline to complete drawdown to exceed the anticipated schedule.

6. Reservoir Area Management Plan

Within 90 days of issuance of a license surrender order from FERC, the Licensee shall submit to DEQ a Reservoir Area Management Plan for review and approval. Upon approval by DEQ, the Licensee shall file the Reservoir Area Management Plan with FERC and implement the plan upon receipt of all required authorizations. The plan shall include the following elements.

a) Reservoir Restoration Activities

The plan should include procedures to stabilize and restore the former reservoir area following dam removal. The plan should include the following:

i. Performance criteria for evaluating restoration efforts to meet the following objectives:

- A. Unobstructed stream continuity;
- B. Fish passage;
- C. Sediment stability;
- D. Invasive exotic vegetation abatement and native vegetation cover establishment.

ii. Proposed actions for meeting plan objectives including:

- A. Actions to ensure tributary connectivity following drawdown;
- B. Strategies to create or enhance wetlands, floodplain, and off-channel habitat features;
- C. Actions to improve revegetation success by enhancing floodplain roughness; Locations for placement of large wood or other structures to improve channel margin complexity;

iii. The Licensee shall not use nitrogen- or phosphorus-based fertilizers in hydroseeding applications unless expressly authorized by DEQ.

b) Monitoring

i. The Licensee shall annually conduct aerial LiDAR reconnaissance surveys of the affected area to measure sediment stability and estimate the volume of sediment export following reservoir drawdown. Annual sediment stability monitoring shall be supplemented with visual inspections, physical measurements, and photo-documentation at monitoring locations identified in the Reservoir Area Management Plan;

ii. The Licensee shall twice annually conduct surveys to determine the area of invasive exotic vegetation and native vegetation cover in the reservoir restoration area;

iii. The Licensee shall annually inspect mainstem Klamath River and affected tributaries for the presence of physical barriers to volitional fish passage. Annual inspections shall occur following the wet season.

iv. Monitoring is required for a minimum of three years following completion of reservoir drawdown.

c) Adaptive Management

If monitoring demonstrates that runoff from exposed embankment areas may cause erosion, sedimentation, or a lowering of water quality DEQ may require the Licensee to analyze the situation and propose an appropriate corrective response. Corrective actions may include measures to increase soil stability through additional plantings, irrigation to maintain revegetated areas, contouring sediment to reduce slope, adding energy dissipating features such as large wood or boulders, modifying stream channel slope, or other methods deemed appropriate to achieve the goals and objectives of the plan. Upon DEQ approval, the Licensee shall implement the corrective measures.

7. Remaining Facilities and Operations Plan

Within six months of license surrender and prior to initiating the Proposed Action, the Licensee shall submit to DEQ a Remaining Facilities and Operations Plan for review and approval. Upon approval by DEQ, the Licensee shall implement the plan in accordance with its terms, including any modifications made by DEQ as conditions of its approval. The Remaining Facilities and Operations Plan shall include, at a minimum, the following information:

a) A description of all Project facilities and/or structures that will not be physically removed or permanently modified during project implementation;

b) A description of all potential water quality impacts associated with retaining proposed project structures;

c) Proposed measures, including but not limited to potential modifications and best management practices, to reduce potential water quality impacts associated with retaining Project facilities and/or structures; and

d) Provisions deemed necessary by DEQ to ensure that any ongoing measures will be implemented once title of the Lower Klamath Project facilities and/or responsibility for operations is transferred to another entity, which shall not occur later than the effective date of surrender of FERC license No. P-14803.

8. Site Restoration, Erosion and Sediment Control

a) Erosion and Sediment Control Plan

Within 90 days of issuance of a surrender order, the Licensee shall submit to DEQ an Erosion and Sediment Control Plan for review and approval. Once approval by DEQ, the Licensee shall implement the plan in accordance with its terms, including any modifications made by DEQ as conditions of its approval. The ESCP shall include best management practices to minimize pollution from sediment erosion caused by facilities removal and restoration activities. The Licensee and its contractors shall ensure the following actions are implemented to minimize sediment runoff during project activities:

i. Maintain an adequate supply of materials necessary to control erosion at the project construction site;

ii. Deploy compost berms, impervious materials, or other effective methods during rain events or when stockpiles are not moved or reshaped for more than 48 hours. Erosion of stockpiles is prohibited;

iii. Inspect erosion control measures daily and maintain erosion control measures as often as necessary to ensure the continued effectiveness of measures. Erosion control measures must remain in place until all exposed soil is stabilized;

iv. If monitoring or inspection shows that the erosion and sediment controls are ineffective, the Licensee must make repairs, install replacements, or install additional controls as necessary;

v. If sediment has reached 1/3 of the exposed height of a sediment or erosion control the Licensee must remove the sediment to its original contour;

vi. Use removable pads or mats to prevent soil compaction at all construction access points through, and staging areas in, riparian or wetland areas to prevent soil compaction, unless otherwise authorized by DEQ;

vii. Flag or fence off wetlands not specifically authorized to be impacted to protect from disturbance and/or erosion;

viii. Place dredged or other excavated material on upland areas with stable slopes to prevent materials from eroding back into waterways or wetlands;

ix. Place clean aggregate at all construction entrances, and utilize other BMPs, including, but not limited to truck or wheel washes, when earth-moving equipment is leaving the site and traveling on paved surfaces. The tracking of sediment off-site by vehicles is prohibited.

b) J.C. Boyle Disposal Site

i. The Licensee shall place earthen material generated during deconstruction of J.C. Boyle Dam in the disposal site located near the right abutment of the dam. Final contours, elevation, and slope of the disposal site shall reflect the design specifications presented in the J.C. Boyle Right Abutment Disposal Site Plan & Section diagram presented as Figure 5.2-8 of the Technical Support Document (KRRC 2017) or subsequent version approved by DEQ;

ii. The Licensee shall implement inspection procedures to identify and divert non-earthen material from placement in the J.C. Boyle disposal site location;

iii. Site preparation, grading, and vegetative restoration shall be performed in accordance with the ESCP to reduce the potential for erosion and sediment runoff;

iv. The Licensee shall inspect the J.C. Boyle disposal site annually for at least five years following completion or an alternate schedule approved by DEQ. The Licensee shall submit to DEQ an Annual Report in accordance with Section 11, which includes inspection records documenting the physical condition of cover placement, status of revegetation, evidence of erosive conditions or sediment runoff, and corrective actions performed or proposed to ensure long-term stability.

c) J.C. Boyle Scour Hole Restoration

i. The Licensee shall restore the eroded scour hole beneath the J.C. Boyle emergency spillway based on the design specifications presented in the J.C. Boyle Forebay Spillway Scour Hole Backfill Plan & Sections diagram presented as Figure 5.2-9 in the Technical Support Document (KRRC 2017) or subsequent version approved by DEQ;

ii. The Licensee shall prepare the site and source material as necessary to achieve stable, long-term placement of fill and cover material;

iii. Site preparation and grading shall be performed in accordance with the ESCP to reduce the potential for erosion and sediment runoff;

iv. The Licensee shall inspect the restored scour hole for annually for at least five years or an alternate schedule approved by DEQ. The Licensee shall submit to DEQ an Annual Report in accordance with Section 11, which includes inspection records documenting the physical condition of cover placement, status of revegetation, evidence of erosive conditions or sediment runoff, and corrective actions performed or proposed to ensure long-term stability.

d) Recreation Areas

i. Topsy Campground

The Licensee shall remove all permanent water-related improvements at Topsy Campground including boat launches, floating dock, fishing pier and concrete. Compacted surface areas shall be prepared in a manner that increases surface permeability and reduces surface runoff. The Licensee shall grade, seed and replant affected areas in a manner that promotes riparian revegetation. Site restoration shall be performed according to the ESCP prepared in accordance with Section 9(a).

ii. Pioneer Park

The Licensee shall remove all features at the two separate day use areas on the east and west side of J.C. Boyle Reservoir identified as Pioneer Park. Compacted surface areas shall be prepared in a manner that increases surface permeability and reduces surface runoff. The Licensee shall grade, seed and replant affected areas in a manner that promotes riparian revegetation. Site restoration shall be performed according to the ESCP prepared in accordance with Section 9(a).

e) J.C. Boyle Power Canal

The Licensee shall remove all concrete wall portions of the J.C. Boyle power canal except for shotcrete applied to the upstream wall to maintain stability against erosion. Concrete shall be placed in the J.C. Boyle emergency spillway scour hole in accordance with Section 8(c). Alternatively, material may be placed at the disposal site in accordance with Section 8(b). If the Licensee removes the invert slab, the Licensee shall restore the former canal area by decompacting the canal floor to support revegetation.

f) J.C. Boyle Powerhouse Tailrace

i. The Licensee shall select and place material near the mouth of the former tailrace channel in a manner that resists erosion and scour;

ii. Tailrace backfill material sourced from beneath industrial areas such as the adjacent substation and maintenance building must first be screened for the presence of hazardous materials prior to use as fill material in the tailrace. Soils containing oil or hazardous substances may not be used as fill below the ordinary high water level.

iii. The Licensee shall perform all restoration activities in accordance with the ESCP to reduce the potential for erosion and sedimentation.

9. Waste Disposal and Management Plan

Within 90 days of issuance of a surrender order, the Licensee shall submit to DEQ a Waste Disposal and Management Plan for review and approval. Once approved by DEQ, the Licensee shall implement the plan in accordance with its terms, including any modifications made by DEQ as conditions of its approval. The plan shall describe procedures for characterizing and appropriately managing all waste streams generated during facilities removal. The plan shall, at a minimum, include the following components:

a) Hazardous Materials

The plan must include the following information:

i. Prior to drawdown, the Licensee shall commission a Phase I Environmental Site Assessment to identify the presence, nature, and quantities of hazardous substances associated with Lower Klamath Project facilities;

ii. Prior to drawdown, the Licensee shall implement recommendations of the Phase I ESA including, as necessary, a Phase II ESA to characterize the magnitude, extent, and risk of hazardous materials in the environment. In consultation with DEQ, the Licensee shall undertake remedial actions to mitigate risks from residual hazardous materials in accordance with applicable state and federal law;

iii. Procedures to manage disposal of hazardous and solid wastes in compliance with applicable state and federal law;

iv. Comprehensive investigative and sampling procedures to confirm adequate abatement of hazardous materials;

v. Procedures to manage all records, disposal receipts and/or manifests confirming transportation and disposal of hazardous materials.

The Licensee shall file a report with DEQ documenting the investigation, management and disposal of hazardous materials within 90 days of completing actions or an alternate schedule approved by DEQ.

b) Deleterious Waste Materials:

The Licensee is prohibited from placing biologically harmful materials including, but not limited to petroleum products, chemicals, cement cured less than 24 hours, welding slag and grindings, concrete saw cutting by-products, sandblasted materials, chipped paint, tires, wire, steel posts, and asphalt where such materials could enter waters of the state, including wetlands. The Licensee must do the following:

i. Cure concrete, cement, or grout for at least 24 hours prior to any contact with flowing waters;

ii. Use only clean fill, free of waste and polluted substances;

iii. Employ all practicable controls to prevent discharges of spills of deleterious materials to surface or ground water;

iv. Maintain at the project construction site, and deploy as necessary, an adequate supply of materials needed to contain deleterious materials during a weather event;

v. Remove foreign materials, refuse, and waste from the project area; and

vi. Employ general good housekeeping practices at all times.

10. Spill Response

a) The Licensee shall maintain a Spill Prevention, Control, and Countermeasure Plan in effect at all times in accordance with 40 CFR Part 112. The following specific requirements apply during site activities:

i. Vehicle staging, cleaning, maintenance, refueling, and fuel storage must be performed at least 150 feet from waters of the state. An exception may be authorized upon written approval by DEQ if all practicable prevention measures are employed and this distance is not possible because;

A. Physical constraints that make this distance not feasible (e.g., steep slopes, rock outcroppings);

B. Natural resource features would be degraded as a result of this setback;

C. Equal or greater spill containment and effect avoidance is provided even if staging area is less than 150 feet of any waters of the state.

D. If staging areas are within 150 feet of any waters of the state, as allowed under subsection (a)(iii) of this condition, full containment of potential contaminants must be provided to prevent soil and water contamination, as appropriate.

ii. All vehicles operated within 150 feet of any waters of the state must be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected in the vehicle staging area must be repaired before the vehicle resumes operation;

iii. Before operations begin and as often as necessary during operation, equipment must be steam cleaned (or undergo an approved equivalent cleaning) until all visible external oil, grease, mud, and other visible contaminants are removed if the equipment will be used below the bank of a waterbody;

iv. All stationary power equipment (e.g., generators, cranes, stationary drilling equipment) operated within 150 feet of any waters of the state must be covered by an absorbent mat to prevent leaks, unless other suitable containment is provided to prevent potential spills from entering any waters of the state

v. An adequate supply of materials (such as straw matting/bales, geotextiles, booms, diapers, and other absorbent materials) needed to contain spills must be maintained at the project construction site and deployed as necessary;

vi. All equipment operated in state waters must use biodegradable hydraulic fluid. A maintenance log documenting equipment maintenance inspections and actions must be kept on-site and available upon request.

b) Spill Incident Reporting;

i. If petroleum products, chemicals, or any other deleterious materials are discharged into state waters, or onto land with a potential to enter state waters, the Licensee must promptly report the discharge to the Oregon Emergency Response System (OERS), at 1-800-452-0311);

ii. If a release of petroleum products, chemicals, or other materials results in distressed or dying fish, the Licensee must immediately do the following: cease operations; take appropriate corrective measures to prevent further environmental damage; collect fish specimens and water samples; and notify DEQ, ODFW and other appropriate regulatory agencies.

11. Annual Compliance Report

The Licensee shall prepare and submit to DEQ an Annual Compliance Report by April 1 for the preceding year in which activities are performed pursuant to conditions required by this certification. The Annual Compliance Report shall include, as appropriate:

a) Monitoring data including graphical representations, as appropriate;

b) Records documenting required consultations and/or approvals;

c) Narrative interpretation of results;

d) Compliance evaluations;

e) Efforts undertaken by the Licensee to achieve the objectives of the Aquatic Resource mitigation measures set forth in section 4 of this certification;

f) A comprehensive presentation of all actions performed in accordance with the Reservoir Area Management Plan and include all data, observations, measurements, photo-documentation, findings and recommendations. The report shall compare reservoir restoration conditions with the objectives of the Reservoir Area Management Plan and document corrective or adaptive methods performed or recommended to meet those objectives.

g) Efforts undertaken by the Licensee to achieve the objectives of the Groundwater Well Management Plan, including all well installations, field activities, outreach efforts, and monitoring results. The report shall include drill logs and well as-builts for project-installed monitoring wells; a comparison with installation depths and techniques from representative nearby wells; the results of any pumping or drawdown tests; an interpretation of the results; mitigation to improve water quality or quantity from affected wells; and findings and recommendations; and

h) Efforts undertaken and anticipated completion of site restoration activities required in this certification.

The Licensee may also include a request for DEQ to consider approval of alternative or additional measures. As used in this section, alternative measures are methods or approaches not included in the Proposed Action that will provide or assist in providing, reasonable assurance that the Proposed Action will not cause or contribute to a violation of water quality standards beyond the compliance schedule described in Section 3. DEQ shall respond to any request for consideration of alternative measures within 60 days of receipt. DEQ shall notify the Licensee in writing of its approval or denial of the proposed alternative measures. Following DEQ approval, the Licensee shall implement the plan in accordance with the approved plan's terms and schedule, including any modifications made to the plan by DEQ as a condition of approval.

12. General

a) Section 401 Certification Modification

DEQ, in accordance with Oregon and Federal law including OAR Chapter 340, Division 48 and, as applicable, 33 USC 1341, may modify this Certification to add, delete, or alter Certification conditions as necessary to address;

i. Adverse or potentially adverse Project effects on water quality or designated beneficial uses that did not exist or were not reasonably apparent when this § 401 certification was issued;

ii. TMDLs (not specifically addressed above in these section 401 certification conditions);

iii. Changes in water quality standards;

iv. Any failure of these § 401 Certification Conditions to protect water quality or designated beneficial uses as expected when this § 401 Certification was issued; or

v. Any change in the Project or its operations that was not contemplated by this § 401 Certification that might adversely affect water quality or designated beneficial uses.

b) Project Modification

The Licensee shall obtain DEQ review and approval before undertaking any change to the Proposed Action that may affect water quality other than modifications authorized or required by this certification.

c) Inspection

The Licensee shall allow DEQ such access as necessary to inspect the Project area and Project records required by these section 401 Certification Conditions and to monitor compliance with these section 401 Certification Conditions, upon reasonable notice and subject to applicable safety and security procedures when engaged in such access.

d) Posting

The Licensee shall maintain a copy of the section 401 water quality certification at the project site for the duration of the project. The certification shall be available for review by the Licensee and its contractors, as well as by DEQ, the US Army Corps of Engineers, National Marine Fisheries Service, Oregon Department of Fish and Wildlife, and other appropriate state and local government inspectors for the duration of the project.

e) Water Quality Standards Compliance

Notwithstanding the conditions of this Certification, no wastes shall be discharged and no activities shall be conducted which will violate state water quality standards.

f) Conflict Between Certification Conditions and Application

To the extent that there are any conflicts between the terms and conditions in this certification and how the Proposed Action, activities, obligations, and processes are described in the Application, the terms and conditions in this certification, as interpreted by DEQ, shall control.

13. Project Specific Fees

In accordance with ORS 543.080, the Licensee shall pay project-specific fees, in 2018 dollars adjusted according to the formula in Section 13b below, to DEQ for costs of overseeing implementation of this certification. The licensee shall pay an initial pro-rated payment to DEQ within 30 days of license surrender for the period from the date of license surrender to the first June 30, which follows license surrender.

a) Schedule

The Licensee shall pay project-specific fees to DEQ, made payable to State of Oregon, Department of Environmental Quality, according to the following schedule:

FERC License Surrender	Annual Project-Specific Fee Subject to Adjustment	Due
Year 1	$42,578	Within 30 days
Year 2	$40,000	July 1
Year 3	$33,219	July 1
Year 4	$7,254	July 1
Year 5	$7,254	July 1

b) Annual Adjustment

Fee amounts shall be adjusted annually, according to the following formula:

AD = D x (CPI-U)/(CPI-U-June 2018)

Where:

AD = Adjusted dollar amount payable to agency.

D = Dollar amount pursuant to Section 13a and Section 13b above,

CPI-U = the most current published version of the Consumer Price Index-Urban. The CPI-U is published monthly by the Bureau of Labor Statistics of the U.S. Department of Labor. If that index ceases to be published, any reasonably equivalent index published by the Bureau of Economic Analysis may be substituted by written agreement between DEQ and the Licensee.

c) Payment Schedule

Fees shall be paid pursuant to a written invoice from DEQ. Except as provided below, project-specific fees shall be due on July 1 of each year following issuance of the new FERC License. The Licensee shall pay an initial prorated payment to DEQ within 30 days of license surrender, for the period from the date of license surrender to the first June 30 that follows license surrender.

d) Credits

DEQ will credit against this amount any fee or other compensation paid or payable to DEQ, directly or through other agencies of the State of Oregon, during the preceding year (July 1 to June 30) for DEQ's or ODFW's costs of oversight.

e) Expenditure Summary

DEQ shall provide the Licensee with a biennial summary of project specific expenditures.

f) Duration

The project-specific fee shall expire 5 years after the first July 1 following the issuance of the new FERC license, unless DEQ terminates it earlier because oversight is no longer necessary. One year before the expiration of the fee, or earlier if mutually agreed, DEQ and the Licensee shall review the need, if any, to modify, extend, or terminate the fee, in accordance with ORS 543.080. The Licensee shall pay any project-specific fee required after such review as provided in ORS 543.080.

APPENDIX E—STATE OF CALIFORNIA WATER QUALITY CERTIFICATE CONDITIONS

APPENDIX E

STATE OF CALIFORNIA WATER QUALITY CERTIFICATE CONDITIONS

April 7, 2020

CONDITION 1. WATER QUALITY MONITORING AND ADAPTIVE MANAGEMENT

The Klamath River Renewal Corporation (Licensee) shall submit the Water Quality Monitoring Plan (WQMP) for review and approval by the Deputy Director for the Division of Water Rights (Deputy Director) no later than six months following issuance of a Federal Energy Regulatory Commission (FERC) license surrender order and prior to Lower Klamath Project License Surrender (Project) implementation. The WQMP shall be developed in consultation with staff from the State Water Resources Control Board (State Water Board), North Coast Regional Water Quality Control Board (North Coast Regional Board), Oregon Department of Environmental Quality (ODEQ), and California Department of Fish and Wildlife (CDFW). The WQMP shall include comments received during the consultation process and identify how the Licensee addressed the comments.

The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director-approved WQMP, together with any required plan modifications, with FERC. Any changes to WQMP shall be approved by the Deputy Director prior to implementation. Upon receiving all necessary approvals, the Licensee shall implement the WQMP for the duration of the license surrender order or until otherwise approved by the Deputy Director in writing. The Deputy Director may require modifications to the WQMP, including implementation of additional adaptive management measures informed by monitoring results, as part of review and approval of reports as specified below.

At a minimum, the WQMP shall include: (1) a monitoring program to assess Project impacts to water quality; (2) a reporting schedule; (3) adaptive management measures based on water quality monitoring results; and (4) provisions for collection and submittal of water quality data to inform the Licensee's implementation of a water quality compliance schedule (Condition 2). Additionally, the WQMP shall describe; field sampling and analytical methods; monitoring locations; types of sampling (e.g., continuous, grab) and frequency by the category (as enumerated below); pre-drawdown monitoring; quality assurance plan and quality control measures; sediment load quantification; reporting and adaptive management; and other Project-related monitoring.

Field Sampling and Analytical Methods

The Licensee shall implement field sampling and monitoring methods consistent with the State of California's Surface Water Ambient Monitoring Program or equivalent methods approved by the Deputy Director. The Licensee shall use analytical methods that comply with Code of Federal Regulations, title 40, part 136, or methods approved by California's Environmental Laboratory Accreditation Program (ELAP), where such methods are available. Samples that require laboratory analysis shall be analyzed by ELAP-certified laboratories.

Types of Sampling and Frequency by Category

At a minimum, the WQMP shall identify the parameters and sampling frequency[2] for the three categories of sampling outlined below. Water quality monitoring shall be implemented at the noted frequency or more often.

Category 1: Continuous Water Quality Monitoring

The Licensee shall continuously monitor the following water quality parameters;

(1) dissolved oxygen (DO) in milligrams per liter (mg/L) and percent saturation;
(2) water temperature;
(3) turbidity;
(4) conductivity; and
(5) pH.

Category 1 Frequency; At a minimum, 30-minute interval recordings.

Category 2: Water Quality Grab Samples

The Licensee shall collect and analyze water quality grab samples for the following parameters;

(1) total nitrogen;
(2) nitrate;
(3) nitrite;
(4) ammonia
(5) total phosphorus;
(6) particulate organic phosphorus;
(7) orthophosphate;
(8) particulate organic carbon;
(9) dissolved organic carbon;
(10) chlorophyll-a (beginning May 1 following drawdown activities and continuing annually from May 1 through October 31);
(11) turbidity;

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[2] See pre-drawdown monitoring below for minimum monitoring frequency prior to drawdown.

(12) microcystin (beginning May 1 following drawdown activities and continuing annually from May 1 through October 31);
(13) suspended sediment concentrations;
(14) methylmercury (only at Klamath River monitoring locations below Copco No. 1);
(15) settleable solids; and
(16) particulate and dissolved aluminum (only at Klamath River monitoring locations below Iron Gate).

Category 2 Frequency: At a minimum, monthly (with the exception of suspended sediment concentrations), at approximately the same time of day, during and following drawdown. For suspended sediment concentrations, monitoring shall occur every two weeks.

Category 3: Klamath Riverbed Sediment Grab Samples

The Licensee shall collect and analyze sediment samples from the Klamath Riverbed prior to and following dam decommissioning. At a minimum, sediment samples shall be analyzed for the following parameters;

(1) arsenic;
(2) lead;
(3) copper;
(4) nickel;
(5) iron;
(6) aluminum;
(7) dioxin;
(8) cyanide;
(9) mercury;
(10) ethyl benzenes;
(11) total xylenes;
(12) dieldrin;
(13) 4,4’-dichlorodiphenyltrichloroethane (DDT);
(14) 4,4’-dichlorodiphenyldichloroethane (DDD);
(15) 2,3,7,8-tetrachlorodibenzodioxin (TCDD);
(16) 4,4’-dichlorodiphenyldichloroethylene (DDE); and
(17) 2,3,4,7,8-pentachlordibenzofuran (PECDF).

Category 3 Frequency; One monitoring event prior to drawdown activities[3] and one event within 12 to 24 months of completing drawdown activities.

Monitoring Locations (Categories 1 through 3)

The Licensee shall consider the following when selecting monitoring locations; existing water quality monitoring stations in the Klamath River Basin, site access, land use, and input received during consultation. Whenever feasible, the Licensee shall select monitoring locations at or near existing water quality monitoring locations. At a minimum, the Licensee shall monitor at the following locations;

Category 1 (Continuous Water Quality Monitoring) and Category 2 (Water Quality Grab Samples[4]) shall be conducted at the following locations;

- Klamath River at or near United State Geological Survey (USGS) gage no. 11509500 (below Keno)
- Klamath River at or near USGS gage no. 11510700 (below J.C. Boyle)
- Klamath River upstream of Copco No. 1 Reservoir, and downstream of Shovel Creek;
- Klamath River downstream of Copco No. 2 Powerhouse, no further downstream than the Daggett Road bridge crossing of the Klamath River;
- Klamath River at or near USGS gage no. 11516530 (below Iron Gate);
- Klamath River at or near Walker Bridge (Category 1 monitoring only);
- Klamath River at or near USGS gage no. 11520500 (below Seiad Valley);
- Klamath River at or near USGS gage no. 11523000 (Orleans);
- Klamath River at or near USGS gage no. 11530500 (Klamath); and
- Klamath Estuary near the mouth of the Klamath River.

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[3] In lieu of collecting additional pre-drawdown [in-reservoir] samples, the Licensee may rely on the results of previously-analyzed sediment samples, to the extent they provide the necessary information.

[4] Samples shall be collected at the same location, or as close as possible, each time.

Category 3 (Klamath Riverbed Sediment Grab Samples) shall be collected at the following locations[5];

- Klamath River upstream of Copco No. 1 Reservoir and downstream of Shovel Creek;
- Three locations in the Copco No. 1 Reservoir footprint, in areas where sediments will likely be terraced. If terracing does not occur at the previously sampled location, the sample location shall be moved to a location with terraced sediments;
- Klamath River downstream of Copco No. 2 Powerhouse, no farther downstream than the Daggett Road bridge crossing of the Klamath River;
- Three locations in the Iron Gate Reservoir footprint, in areas where sediments will likely be terraced. If terracing does not occur at the previously sampled location, the sample location shall be moved to a location with terraced sediments;
- Klamath River at or near USGS gage no. 11516530 (below Iron Gate);
- Klamath River at or near USGS gage no. 11523000 (Orleans); and
- Klamath Estuary.

Pre-Drawdown Monitoring (Categories 1 through 3)

At a minimum, prior to drawdown activities the Licensee shall monitor as follows;

- Category 1 (Continuous Water Quality Monitoring); One year of continuous monitoring at all Category 1 monitoring locations.

- Category 2 (Water Quality Grab Samples); One year with samples collected monthly, at all Category 2 monitoring locations.

- Category 3 (Klamath Riverbed Sediment Grab Samples); One collection event at all Category 3 monitoring locations, except as specified in Footnote 13.

Quality Assurance Project Plan

The Licensee shall develop a Quality Assurance Project Plan (QAPP) using the State Water Board's and United States Environmental Protection Agency's (USEPA's) guidance resources to describe the Project's monitoring goals, data needs and assessment, responsible individuals, quality assurance plan, equipment maintenance, quality control measures, and reporting deadlines. The QAPP shall be submitted as part of the WQMP.

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[5] Samples shall be collected at the same location, or as close as possible, each time. Locations should target slow-velocity depositional areas (eddies and backwaters) where fine sediment accumulation is most likely to occur.

Sediment Load Quantification

The Licensee shall submit reports to the Deputy Director describing the status of sediment movement at 12 and 24 months, respectively, following completion of drawdown activities. The reports shall; (a) quantify the amount of sediment present in each Project reservoir footprint; (b) quantify the total amount of sediment exported from the Project reservoirs; (c) quantify the amount of sediment that has settled in the Klamath River between Iron Gate Dam and Cottonwood Creek (River Mile[6] [RM] 185); and (d) describe remediation activities planned or undertaken, if any. For (a) and (b) estimates shall be provided in million cubic yards, tons (dry weight), and percentage of sediment present compared to total amount of sediment present prior to drawdown. For (c) estimated sediment deposition shall be presented as total estimated quantities in million cubic yards, tons (dry weight), average depth change from pre-drawdown conditions, and percent particle size composition. The reports shall be submitted to the Deputy Director at 15- and 27-months following completion of drawdown activities, respectively.

Reporting and Adaptive Management; Prior to, during, and for a minimum of one year following completion of drawdown, the Licensee shall provide monthly monitoring reports to the State Water Board, ODEQ, and North Coast Regional Board. Monitoring and monthly reporting shall continue until otherwise approved by the Deputy Director in writing. The monthly report shall, at a minimum;

1) summarize the results of the month's monitoring; 2) be provided in a Microsoft Excel spreadsheet format and include all data collected during the reporting period; 3) highlight any exceedances of water quality objectives; 4) highlight observed trends; 5) request any changes to the WQMP; and 6) report on any adaptive management measures taken and propose any additional or substitute adaptive management measures to address exceedances. Any proposal to modify, reduce, or discontinue monitoring and reporting shall be included in the reports with a request for Deputy Director approval and must include information to support the request. Such requests must also comply with Tribal Water Quality Standards (Condition 22). Modifications to the WQMP or additional or substitute adaptive management measures requested by the Licensee require Deputy Director approval prior to implementation.

As noted in the Sediment Load Quantification section above, at 15 months and 27 months following completion of drawdown activities, the Licensee shall submit the reports describing the status of sediment movement.

Based on monitoring results, the Deputy Director may require the Licensee to modify monitoring parameters, frequency, methods, duration, constituents, reporting, or other elements of the WQMP, or to implement additional adaptive management measures. The Licensee shall implement changes upon receiving Deputy Director and any other required

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[6] River Mile (RM) refers to the distance, along the Klamath River, upstream from the mouth of the Klamath River at the Pacific Ocean.

approvals. The Licensee shall file the Deputy-Director-approved updates to the WQMP with FERC. The Licensee may integrate the reporting in this condition with other reporting requirements outlined in this water quality certification (certification).

Other Project-Related Monitoring

The WQMP shall identify other monitoring efforts the Licensee plans to conduct under other plans or aspects of the Project, which include, but are not limited to monitoring under the following conditions; Sediment Deposits (Condition 4); Public Water Supplies (Condition 8); Construction: General Permit Compliance, and Water Quality Monitoring and Protection Plans (Condition 10); Hatcheries (Condition 13); and Recreation Facilities (Condition 19).

CONDITION 2. COMPLIANCE SCHEDULE

Project activities related to drawdown and the export of reservoir sediments into the Klamath River are anticipated to result in temporary exceedances of water quality objectives related to sediment. Temporary exceedance of a water quality objective is permissible for restoration projects with long-term benefits to water quality and beneficial uses. Pursuant to this certification, discharges to the Klamath River that exceed sediment-related water quality objectives can temporarily occur during and following reservoir drawdown, dam removal, and associated sediment flushing activities. The Licensee shall demonstrate that, in the long term, these Project activities attain all sediment-related water quality objectives listed in *the Water Quality Control Plan for the North Coast Region* (North Coast Basin Plan) as outlined in this condition. Implementation of this condition shall also serve to demonstrate compliance with North Coast Basin Plan prohibitions.

The Licensee shall monitor water quality consistent with Water Quality Monitoring and Adaptive Management (Condition 1) to assess attainment of water quality objectives listed in the North Coast Basin Plan. Within 36 months of beginning drawdown, unless otherwise approved by the Deputy Director in writing, the Licensee shall submit a report that documents; 1) Project attainment of sediment-related water quality objectives over a range of flows, including high winter flows and low summer flows; and 2) post-dam removal Klamath River water quality conditions following attenuation of impacts associated with drawdown and establishment of new riverine conditions.

The Licensee shall document changes in water quality following drawdown and assess trends in water quality parameters. The Licensee’s report shall evaluate the Project’s effects on all California portions of the Klamath River (i.e., from California/Oregon Stateline to Klamath Estuary) and Klamath River tributaries, including attainment of; (i) numeric water quality objectives outlined in Table 1;and (ii) narrative water quality objectives in the North Coast Basin Plan. Outlier exceedances that are localized or isolated may be accepted if the Project is consistently in attainment with water quality standards. Localized or isolated exceedances may be addressed through adaptive management associated with Restoration (Condition 14) or other measures proposed by the Licensee. If data indicate that a water quality objective is exceeded and the Licensee believes the exceedance is not a result of Project activities, the Licensee shall provide information and support demonstrating that the exceedance is not related to Project activities. The Deputy Director will consider the information provided by the Licensee in evaluating the Licensee's attainment of water quality objectives.

Table 1: Minimum Parameters to Demonstrate Attainment of Numeric Water Quality Objectives

Parameter	Water Quality Objective*
Turbidity	Turbidity shall not be increased more than 20% above naturally occurring background levels.
pH	pH shall be between 7.0 (minimum) and 8.5 (maximum). Changes in normal ambient pH levels shall not exceed 0.2 units in waters designated marine or saline beneficial uses nor 0.5 units within the range specified above in fresh waters with designated COLD** or WARM***.
Dissolved Oxygen (percent saturation)	Stateline to the Scott River; • October 1 to March 31: 90% • April 1 to September 30: 85% Scott River to Hoopa; • All year: 90% saturation Downstream of Hoopa to Turwar; • June 1 to August 31: 85% • September 1 to May 31: 90% Upper and Middle Estuary: • September 1 to October 31: 85% • November 1 to May 31: 90% • June 1 to July 31: 85% • August 1 through August 31: 80%
Temperature	Elevated temperature waste discharges into COLD** interstate waters are prohibited. Thermal waste discharges having a maximum temperature greater than 5°Fahrenheit above natural receiving water temperature are prohibited. At no time or place shall the temperature of WARM*** intrastate water be increased more than 5°Fahrenheit above natural receiving water temperature.

Parameter	Water Quality Objective*
Specific Conductance	Klamath River above Iron Gate Dam and including Iron Gate and Copco Reservoirs: • 275 micromhos (50% upper limit)****; and • 425 micromhos (90% upper limit)***** Middle Klamath River below Iron Gate Dam: • 275 micromhos (50% upper limit); and • 350 micromhos (90% upper limit) Lower Klamath River: • 200 micromhos (50% upper limit); and • 300 micromhos (90% upper limit)

* Naturally occurring background levels, for the purpose of numeric water quality objectives in Table 1, are defined as the post-dam-removal condition of the Klamath River with successful implementation of revegetation and bank stabilization. It does not include discharges from construction or restoration activities, including failures of vegetation and/or bank stabilization.

** COLD is defined as Cold Freshwater Habitat uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

*** WARM is defined as Warm Freshwater Habitat uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

**** 50% upper and lower limits represent the 50 percentile values of the monthly means for the calendar year. 50% or more of the monthly means must be less than or equal to an upper limit and greater than or equal to a lower limit.

***** 90% upper and lower limits represent the 90 percentile values of the monthly means for the calendar year. 90% or more of the monthly means must be less than or equal to an upper limit and greater than or equal to a lower limit.

At 32 months following the beginning of drawdown, the Licensee shall submit an assessment of whether Project activities are anticipated to result in exceedance of a water quality objective(s) beyond 36 months following the beginning of Project drawdown. The assessment shall be submitted to the Deputy Director and the Executive Officer of the North Coast Regional Board (Executive Officer), and consistent with Tribal Water Quality Standards (Condition 22). If the assessment indicates a high risk of continued exceedance beyond this timeline, the Licensee shall immediately commence consultation with staff from the State Water Board and North Coast Regional Board regarding the development of a report and compliance proposal for actions to address the anticipated exceedance(s). The report and proposal shall be submitted to the Deputy Director for review and approval no later than 35 months following the beginning of Project drawdown activities and shall at a minimum include;

- A summary of which water quality objective(s) and compliance location(s) continue to exceed a water quality objective(s);
- An explanation of why the water quality objective(s) continues to be exceeded in relation to Project activities;
- A description of Licensee actions taken to date to address the exceedance(s); and
- A proposal to address the water quality objective(s) exceedance and associated timeline for attainment of compliance with the water quality objective(s).

The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director's approval, together with any required modifications, with FERC. The Licensee shall implement the compliance plan upon receiving Deputy Director and any other required approvals. Any changes to the compliance plan shall be approved by the Deputy Director prior to implementation.

If the Licensee is unable to demonstrate attainment of water quality objectives within 36 months of beginning Project drawdown activities, the Licensee shall notify the Deputy Director and immediately begin implementation of the approved compliance proposal, or the approved portions of the proposal if the entire proposal has not yet been approved.

CONDITION 3. RESERVOIR DRAWDOWN

No later than six months following issuance of the FERC license surrender order, the Licensee shall prepare and submit a Reservoir Drawdown and Diversion Plan (Drawdown Plan) to the Deputy Director for review and approval. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director's approval, together with any required modifications, with FERC. The Licensee shall implement the Drawdown Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Drawdown Plan shall be approved by the Deputy Director prior to implementation.

At a minimum, the Drawdown Plan shall include;

(1) The material elements of the drawdown plan presented in Section 4 of the Licensee's 2018 Definite Plan. If the Licensee proposes to change any elements material to water quality, the Drawdown Plan shall highlight such changes and provide a rationale, including any new information relied on;

(2) A description of the facilities that will be used to draw down the reservoirs;

(3) An updated flood frequency analysis and associated average flows;

(4) Anticipated drawdown rates for each reservoir. The drawdown rate for each reservoir shall be determined using best available science and consider any potential slope instability issues;

(5) Drawdown scenarios for different water years (e.g., wet, dry, etc.);

(6) Construction schedule, including anticipated schedule for drawdown, and each reservoir's anticipated drawdown start and end dates;

(7) Anticipated total (drawdown and inflow) and drawdown only discharge rates (cubic feet per second [cfs]) associated with each structure (e.g., spillways, diversion tunnels, outlets, etc.);

(8) Public notice of Project schedule and potential impacts, including but not limited to closure of reservoirs, recreation facilities, and impacts to water quality;

(9) Surface water elevation at which each reservoir is considered drawn down;

(10) A detailed description of all structures related to reservoir operations that are proposed to be removed during drawdown;

(11) Compliance with cofferdam requirements in this condition, and a detailed description of cofferdams that will be installed as part of drawdown that includes locations, timing and duration of installations, and other information related to how the installation and removal of cofferdams will be coordinated to limit impacts;

(12) A detailed description of operations required to maintain reservoir water at the gated spillway crest elevation on Copco No. 1 Dam between the conclusion of the first phase and initiation of the second phase of drawdown. (The two phases of Copco No. 1 Reservoir drawdown are described below.);

(13) Detail on how long Project powerhouses are anticipated to be operational during drawdown of the reservoirs; and

14) An overview of the sequence of drawdown activities for all four reservoirs, including a detailed sequence of how drawdown activities will be implemented at each reservoir.

<u>Cofferdams</u>; Construction areas in active streams shall use cofferdams or equivalent barriers to isolate construction areas from instream flows. Instream water shall be routed around the isolated construction area either by pipe or by isolating the stream in phases so that construction does not impede stream flow around the construction area. In addition, all dewatering pump intakes shall be screened to avoid potential impacts to fish and all bypass routes (e.g., pipelines, outlets, etc.) shall be properly removed or sealed upon completion of Project activities unless otherwise approved by the Deputy Director as part

of review and approval of the Drawdown Plan. Any fish entrained by a Project cofferdam shall be safely relocated.

The Licensee shall notify the Deputy Director, in writing, within 24 hours of initiation and conclusion of drawdown activities at each reservoir. The Licensee shall notify the Deputy Director within 72 hours of knowledge that reservoir drawdown has the potential to be delayed or extended while still meeting the requirements outlined in this certification. The notification shall include the reason for the delay or extension and a proposed revised drawdown schedule that complies with this condition. The Deputy Director may require modifications to the proposed revised drawdown schedule. Development of a proposed revised drawdown schedule shall include consultation with State Water Board staff.

Drawdown of the reservoirs shall occur over no more than a single six-month period between November 1 (earliest date to start drawdown) and May 1 of the following year (latest date to conclude drawdown), and shall occur as more specifically outlined below;

- Copco No. 1 Reservoir drawdown is divided into two timeframes based on the rate of drawdown[7] allowed at specific reservoir elevations.
  - The first phase of Copco No. 1 Reservoir drawdown, from its normal operating reservoir elevation (2,609.5 feet) to gated spillway (crest elevation 2,597.0 feet), shall start no sooner than November 1 and no later than December 15. The maximum drawdown rate during the initial drawdown of Copco No. 1 Reservoir is two feet per day, unless otherwise approved by the Deputy Director based on new information provided in the Drawdown Plan. The initial phase of Copco No. 1 Reservoir drawdown shall be concluded no later than January 1.
  - The second phase of Copco No. 1 Reservoir drawdown, from the gated spillway until empty, shall not start until at least two weeks after Iron Gate Reservoir drawdown begins and shall start no later than February 15 of the year directly following the initial drawdown of Copco No. 1 Reservoir. Copco No. 1 Reservoir drawdown shall conclude no later than March 15 of the year in which the second phase of Copco No. 1 Reservoir drawdown is initiated. The maximum drawdown rate for the second phase of Copco No. 1 Reservoir drawdown shall be five feet per day, unless otherwise approved by the Deputy Director based on new information provided in the Drawdown Plan.

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[7] For purposes of this certification, the actual drawdown rates may be less than what is described in the Drawdown Plan and may even be negative during storm events due to increased inflow to the reservoirs. The drawdown rates shall be sufficient to end drawdown of Copco No. 1 Reservoir by March 15 of the year directly following the initiation of Copco No. 1 Reservoir drawdown.

The maximum additional discharge below Copco No. 1 Dam associated with Copco No. 1 Reservoir drawdown shall be limited to 6,000 cfs, unless otherwise approved by the Deputy Director based on new information provided in the Drawdown Plan. If initial drawdown of Copco No. 1 Reservoir has not started by December 15, drawdown activities shall be delayed until at least November 1 of the following calendar year.

- Iron Gate Reservoir drawdown shall start no sooner than January 1 of the year directly following the initiation of Copco No. 1 Reservoir drawdown and no later than January 15 of the same year. Iron Gate drawdown shall conclude no later than March 15 of the same year Iron Gate drawdown is initiated. The maximum drawdown rate for Iron Gate shall be five feet per day. The maximum additional discharge below Iron Gate Dam associated with Iron Gate Reservoir drawdown activities shall be limited to 6,000 cfs, unless otherwise approved by the Deputy Director based on new information provided in the Drawdown Plan.

- J.C. Boyle Reservoir drawdown shall start no sooner than January 1 and no later than February 1 of the year directly following the initiation of Copco No. 1 drawdown. J.C. Boyle Reservoir drawdown shall conclude no later than March 15 of the same year in which J.C. Boyle drawdown is initiated.

- Copco No. 2 Reservoir drawdown shall conclude no later than May 1 of the year following initiation of Copco No. 1 Reservoir drawdown.

Removal of the Project facilities shall begin and be completed, to the extent feasible, during drawdown to minimize the duration of sediment releases, and to comply with the schedule set forth in the Compliance Schedule (Condition 2) of this certification. Additionally, drawdown and dam deconstruction shall be conducted to ensure instream flow requirements[8] below Iron Gate Dam are maintained.

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[8] The United States Bureau of Reclamation's (USBR) Klamath River Project must meet flows below Iron Gate Dam that are specified in the *Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat response for Klamath Project operations from April 1, 2019 through March 31, 2024 (NMFS 2019)* and the *Biological Opinion on the Effects of the Proposed Klamath Project Operations from April 1, 2019, through March 31, 2024, on the Lost River Sucker and the Shortnose Sucker (USFWS, 2019)*(jointly 2019 BiOp). USBR has released two Biological Assessments (in February and April 2020) for amended operations, including amended flow requirements; one of these proposals - or other amendments - could occur prior to drawdown. Drawdown shall not interfere with implementation of the required instream flow requirements that are current at that time.

CONDITION 4. SEDIMENT DEPOSITS

Unless otherwise approved in writing by the Deputy Director, by no later than December of the first full calendar year following completion of drawdown activities, the Licensee shall assess and remediate (if appropriate) visibly obvious sediment deposits along the Klamath River from below Iron Gate Dam to the mouth of the Klamath Estuary that may have been deposited during reservoir drawdown activities. Assessment is limited to sediment deposits on parcels with a current or potential residential or agricultural (e.g., row crop) land use, for which the property owner has notified the KRRC of a potential sediment deposit that may be associated with reservoir drawdown activities.

Within 60 days of property owner notification, visibly obvious sediment deposits shall be assessed by the Licensee to determine if the deposits are consistent with physical sediment properties associated with Project reservoir sediments. Sediment deposits consistent with the physical sediment properties of Project reservoirs shall be tested for arsenic or remediated without testing per the requirements of this condition. If testing is performed, soil samples in the vicinity of the deposited sediments (e.g., from the adjacent riverbank and/or floodplain), shall also be tested for arsenic to determine the local background arsenic concentrations. No additional actions or remediation shall be required if the measured arsenic concentrations in the deposited sediments are less than or equal to measured local background soil concentrations for arsenic. If the concentration of arsenic in the deposited sediments on the river banks and floodplain of the Klamath River exceed local background levels and USEPA or California Environmental Protection Agency human health residential screening levels, the deposited sediments shall be remediated to local background levels through removal of the deposited sediments or soil capping, if sediment removal is infeasible or poses a greater risk than soil capping.

For Sediment Deposits that Require No Further Action. Within 30 days of a determination that a reported deposit does not require remediation, either because it is not consistent with reservoir sediment deposits or because sediment testing does not indicate a need for further action, the Licensee shall notify the property owner and submit a report to the Deputy Director. At a minimum, the report shall include the location of the reported deposit, a summary of actions taken, and support for the determination that no further action is needed. If sampling was performed, the report shall also include, at a minimum;

- Estimated quantity of the reported sediment deposit;
- Arsenic testing method(s) used and the number, location, and depth of samples collected from the reported sediment deposit and surrounding soils (background); and

- Arsenic concentrations associated with each sample.

The Deputy Director may require additional testing, remediation, or other actions based on the report. The Licensee shall provide additional information upon request by the Deputy Director.

For Sediment Deposits that Require Further Action. Within 14 days following completion of the inspection of a reported sediment deposit that requires further action (including any associated sediment sampling results), the Licensee shall submit a Sediment Deposit Remediation Plan to the Deputy Director for review and approval. At a minimum, the Sediment Deposit Remediation Plan shall include;

- Estimated location and quantity of the reported sediment deposit;

- If testing was performed, the arsenic sediment testing methods used and the number, location, depth, and concentration associated with each sediment samples collected from the reported sediment deposit and surrounding soils (background); and

- Proposed remediation actions, including a schedule for remediation and any proposed post-remediation soil sampling. If soil capping is proposed, the Licensee shall provide documentation supporting why soil removal is infeasible or poses a greater risk than soil capping.

The Deputy Director may require modifications to the Sediment Deposit Remediation Plan as part of any approval. The Licensee shall file the Deputy Director's approval, together with any required modifications, with FERC. The Licensee shall implement the Sediment Deposit Remediation Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Sediment Deposit Remediation Plan shall be approved by the Deputy Director prior to implementation.

Within 30 days of completing remediation activities, the Licensee shall provide the property owner and Deputy Director with a report documenting completion of the remediation. At a minimum, the report shall include the location of the remediation, a summary of action(s) taken including the quantity of soil removed or area capped, and support for the determination that no further remediation is needed. Additionally, if post-remediation soil sampling was performed, the report shall include, at a minimum; arsenic soil testing method(s) used; the number, location, and depth of soil samples collected and their relation to the area remediated; and the associated arsenic soil concentrations.

The Deputy Director may require additional testing, remediation, or other actions based on the report. The Licensee shall provide additional information upon request by the Deputy Director.

CONDITION 5. ANADROMOUS FISH PRESENCE

The purpose of fish presence surveys is to ensure that following Project implementation anadromous fish can volitionally access the Klamath River and its tributaries within and upstream of the California portion of the Hydroelectric Reach[9]). Accordingly, the Licensee shall conduct surveys to document anadromous fish presence and access to the tributaries and mainstem Klamath River.

No later than 24 months following issuance of a FERC license surrender order, the Licensee shall submit a Fish Presence Monitoring Plan (Fish Presence Plan) to the Deputy Director for review and approval. The Fish Presence Plan shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, CDFW, and National Marine Fisheries Service (NMFS). The Licensee shall solicit comments from the agencies listed above. Additionally, the Fish Presence Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Fish Presence Plan, together with any required plan modifications, with FERC. The Licensee shall implement the Fish Presence Plan upon Deputy Director and any other required approvals. Any changes to the Fish Presence Plan shall be approved by the Deputy Director prior to implementation.

At a minimum, the Fish Presence Plan shall include: (1) a list of anadromous fish species covered by the plan; (2) California survey reaches; (3) timing, frequency, and duration of surveys; (4) survey methods; and (5) reporting. Additional information on the minimum requirements for each of these plan elements is provided below. Additionally, the Fish Presence Plan may include a discussion of how the information collected under Action 1 (Tributary-Mainstem Connectivity) of the Mainstem Spawning Aquatic Resources Measure (Condition 6) will be used to inform implementation of the Fish Presence Plan.

<u>Fish Species</u>; The Fish Presence Plan shall, at a minimum, include surveys for the following anadromous fish species; spring-run and fall-run Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), Pacific lamprey (*Entosphenus tridentatus*), and steelhead (*Oncorhynchus mykiss*).

<u>California Survey Reaches</u>; Unless otherwise approved by the Deputy Director in writing, the Licensee shall survey, in California, all tributaries with potentially viable anadromous fish habitat that have a confluence in the Hydroelectric Reach, as well as the mainstem Klamath River to the state line to determine if anadromous fish are present. Specific survey reaches of the mainstem Klamath River shall include areas upstream of the California Project reservoir footprints.

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[9] The Hydroelectric Reach refers to the stretch of the Klamath River that begins at the confluence of J.C. Boyle Reservoir with the Klamath River and continues to the base of Iron Gate Dam, and includes both J.C. Boyle and Copco No. 2 bypass reaches, and tributaries in this reach such as Jenny Creek, Fall Creek, Spencer Creek, and Shovel Creek.

Timing, Frequency, and Duration; Fish presence surveys shall begin in the third year following the completion of drawdown. Fish presence surveys shall be conducted for at least four consecutive years and until otherwise approved or modified by the Deputy Director. The Licensee, through annual reporting (discussed below), may request to reduce the duration or scope of surveys based on new information (e.g. survey results that substantiate either anadromous fish presence or lack of fish passage barriers related to Project implementation).

Survey Methods; The Licensee shall propose appropriate survey methods (e.g., carcass surveys, snorkel surveys, etc.) to evaluate anadromous fish presence. Information provided shall include; number of days required for surveys with approximate field crew size; equipment that will be used to assess fish presence; global positioning system (GPS) and map of survey areas; field documentation methods (e.g., data sheets, photo documentation); and survey timing. The results of tributary fish presence surveys may be used to determine the need for surveys of the mainstem Klamath River (e.g., anadromous fish present in tributaries above Copco No. 1 Reservoir footprint would indicate anadromous fish can access portions of the mainstem Klamath River below that point, eliminating the need for additional evaluation). A minimum of four weeks prior to conducting fish presence surveys, the Licensee shall notify staff from the State Water Board, North Coast Regional Board, CDFW, and NMFS so that agency staff may participate in the surveys, if desired.

Reporting; The Licensee shall report fish presence survey results annually to the Deputy Director.

Annual reports shall, at a minimum, include;

(1) A summary of the fish presence results; and
(2) An overall assessment of fish presence in the newly accessible Klamath River and tributaries. The Licensee shall consider fish return projections and observations (e.g., barrier) as part of the fish surveys in the reports.

Additionally, the fourth annual report shall, at a minimum, include;

(1) An analysis of whether any encountered fish passage impediment is Project-related; and
(2) Proposed actions to remedy any Project-related impediments to anadromous fish.

The Deputy Director may require the Licensee to submit proposed actions to address a fish passage impediment that the Deputy Director finds is Project-related. Prior to implementing any proposed actions, the Licensee shall receive approval from the Deputy Director. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director’s approval, together with any required modifications, with FERC. The Licensee shall implement the action upon receipt of Deputy Director and any other required approvals.

CONDITION 6. AQUATIC RESOURCES

The Licensee shall implement the Aquatic Resource (AR) Measures; as proposed in Appendix I of the 2018 Definite Plan (Appendix I); updated by the Licensee's October 10, 2018 letter to the State Water Board; and based on the requirements presented in this condition. Except to the extent changes are required by this condition, the Licensee shall submit to the Deputy Director any proposed changes in the material terms of the measures described in the June 2018 Appendix I and October 2018 updates, along with an explanation of the reason for the proposed change and any additional information relied on. The Deputy Director may approve, deny, or conditionally approve any changes to the AR Measures proposed by the Licensee.

Mainstem Spawning Aquatic Resource Measure

The Mainstem Spawning AR Measure includes two actions; 1) Tributary-Mainstem Connectivity; and 2) Spawning Habitat Evaluation.

Action 1; Tributary-Mainstem Connectivity. No later than six months following issuance of a FERC license surrender order and prior to Project implementation, the Licensee shall submit the Tributary-Mainstem Connectivity Plan for Deputy Director review and approval. The Tributary-Mainstem Connectivity Plan shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, ODEQ, NMFS, and CDFW. The Licensee shall solicit comments from the agencies listed above. Additionally, the Tributary-Mainstem Connectivity Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Tributary-Mainstem Connectivity Plan, together with any required plan modifications, with FERC. The Licensee shall implement the Tributary-Mainstem Connectivity Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Tributary-Mainstem Connectivity Plan shall be approved by the Deputy Director prior to implementation.

The Tributary-Mainstem Connectivity Plan shall assess tributary confluences with the Klamath River for connectivity that provides coho salmon, Chinook salmon, steelhead, and Pacific lamprey passage. At a minimum, the Tributary-Mainstem Connectivity Plan shall include; proposed monitoring elements such as methods, timing, duration, frequency, and locations; and proposed reporting. The Tributary-Mainstem Connectivity Plan shall also include potential actions the Licensee may implement to remove Project-related obstructions to tributary connectivity and fish passage. The Tributary-Mainstem Connectivity Plan shall monitor and address tributary connectivity and fish passage in at least the tributaries identified in Action 1 of the Mainstem Spawning AR Measure (i.e., at least four tributaries in the Hydroelectric Reach and five tributaries from below Iron Gate to Cottonwood Creek), as well as all newly created stream channels that were previously inundated by Project reservoirs prior to drawdown.

The Tributary-Mainstem Connectivity Plan shall include monitoring for at least two years directly following the completion of drawdown activities, and within one month following a five-year flow event[10][11] unless it is unsafe for field crews, in which case monitoring shall be conducted as soon thereafter as safe conditions occur.

Reporting; The Licensee shall submit annual reports to the Deputy Director. Annual reports shall, at a minimum, include;

(1) A summary of monitoring results;

(2) An overall assessment of fish passage in the newly accessible Klamath River and tributaries; and

(3) A summary of tributary obstructions that limit fish passage and proposed remedial actions.

Action 2: Spawning Habitat Evaluation. The Licensee shall implement spawning gravel surveys as proposed in Action 2 of the Mainstem Spawning AR Measure. The Licensee shall develop a Spawning Habitat Availability Report and Plan (SHARP) that; (i) summarizes the survey of newly-accessible anadromous fish spawning habitat; and (ii) proposes actions to augment spawning habitat in the mainstem Klamath River and its tributaries. The SHARP shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, CDFW, NMFS, United States Fish and Wildlife Service (USFWS), ODEQ, and Oregon Department of Fish and Wildlife. The SHARP shall be submitted to the Deputy Director for review and approval no later than December 31 of the year in which drawdown is completed. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved SHARP, together with any required plan modifications, with FERC. The Licensee shall implement the actions identified in the Deputy-Director-approved SHARP upon receipt of Deputy Director and any other required approvals. Any changes to the SHARP shall be approved by the Deputy Director prior to implementation.

The SHARP shall include the following elements for proposed actions to improve spawning habitat; 1) a detailed description of each proposed action; 2) locations of the proposed actions; 3) duration and timing (e.g., season) for implementation of the proposed actions; 4) assessment of estimated spawning habitat benefits resulting from the proposed action compared to the targets identified in Action 2 of the Mainstem Spawning AR Measure; and 5) reporting on SHARP implementation. In the SHARP, the Licensee shall evaluate a range of actions to meet the spawning targets identified in Action 2 (Table 3-2) of the Mainstem Spawning AR Measure. When spawning gravel

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[10] A 5-year flow event is 10,908 cfs as recorded at USGS gage no. 11516530 (below Iron Gate).

[11] A 5-year flow event may occur outside of the two years following completion of drawdown, in which case the monitoring described here would be required.

augmentation is not appropriate[12], the Licensee shall evaluate and propose other actions to improve spawning and rearing habitat that meet the targets identified in Table 3-2 (Action 2 of the Mainstem Spawning AR Measure). Other actions may include; installation of large woody material, riparian planting for shade coverage, wetland construction or enhancement, and cattle exclusion fencing.

Juvenile Outmigration Aquatic Resource Measure

The Juvenile Outmigration AR Measure includes three actions; 1) Mainstem Salvage of Overwintering Juvenile Salmonids; 2) Tributary-Mainstem Connectivity Monitoring; and 3) Rescue and Relocation of Juvenile Salmonids and Pacific Lamprey from Tributary Confluence Areas.

Action 1; Mainstem Salvage of Overwintering Juvenile Salmonids. Except as modified by this condition, the Licensee shall implement overwintering juvenile salmonid salvage and relocation efforts as proposed in Action 1 of the Juvenile Outmigration AR Measure. The Licensee shall survey sites in the Klamath River between Iron Gate Dam (RM 192.9) and the Trinity River (RM 43.4) during the pre- and early-drawdown surveys described in Action 1 of the Juvenile Outmigration AR Measure to evaluate the presence and relative abundance of yearling coho salmon. Site selection and survey methods shall be developed in consultation with staff from CDFW, NMFS, State Water Board, and North Coast Regional Board, and implemented as approved by the Deputy Director.

Action 2; Tributary-Mainstem Connectivity Monitoring. The Licensee shall implement Action 2 of the Juvenile Outmigration AR Measure as proposed, with the same modifications identified in Action 1 of the Mainstem Spawning AR Measure, above.

Action 3; Rescue and Relocation of Juvenile Salmonids and Pacific Lamprey from Tributary Confluence Areas. No later than six months following issuance of the FERC license surrender order, the Licensee shall submit a Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan (Juvenile Salmonid Plan) to the Deputy Director for review and approval. The Juvenile Salmonid Plan shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, NMFS, and CDFW. The Licensee shall solicit comments from the agencies listed above. Additionally, the Juvenile Salmonid Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Juvenile Salmonid Plan, together with any required plan modifications, with FERC prior to initiating drawdown. The Licensee shall implement the Juvenile Salmonid Plan upon receipt of Deputy Director and any other required

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[12] Gravel augmentation shall only be performed in the mainstem Klamath River, unless the Deputy Director-approved SHARP allows otherwise.

approvals. Any changes to the Juvenile Salmonid Plan shall be approved by the Deputy Director prior to implementation.

At a minimum, the Juvenile Salmonid Plan shall include;

(1) Methods that will be used to find and relocate juvenile salmonids and lamprey;

(2) Potential relocation areas and/or criteria that will be used to identify potential relocation areas;

(3) Detailed description of water quality monitoring to be performed at each confluence of the Klamath River and the 13 tributaries[13] listed in Action 3 of the Juvenile Outmigration AR Measure. In addition, the plan shall include water quality triggers for implementation of lamprey and juvenile salmonid relocation efforts. The Licensee shall perform the water quality monitoring required here consistent with the sampling methods and quality control procedures identified in the Deputy-Director-approved WQMP and its QAPP (Condition 1). The Licensee shall provide the proposed frequency, duration, and location of water quality monitoring that will be conducted under Action 3 of the Juvenile Outmigration AR Measure. The Licensee may use water quality monitoring results from implementation of the WQMP (Condition 1), as applicable. The plan shall identify what monitoring results from Condition 1 may be used under this action;

(4) Detailed description of proposed rescue efforts that includes; duration, method of rescue, target number of fish, locations for capture and relocation;

(5) Provisions for incidental rescue and relocation of Pacific lamprey encountered in tandem with any juvenile salmonid rescue and relocation efforts: and

(6) Reporting to the Deputy Director on implementation of Action 3 of the Juvenile Outmigration AR Measure within six months following implementation of rescue and relocation efforts. At a minimum, reporting shall include; a summary of the water quality data collected; any actions taken by the Licensee to rescue and relocate lamprey and juvenile salmonids, including number of lamprey and juvenile salmonids rescued (including age class), release location, and the success of such efforts.

Iron Gate Hatchery Management Aquatic Resource Measure

The Licensee shall implement the Iron Gate Hatchery Management AR Measure– as listed in the Licensee’s June 2018, Appendix I.

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[13] The 13 tributaries are; Bogus Creek, Dry Creek, Cottonwood Creek, Shasta River, Humbug Creek, Beaver Creek, Horse Creek, Scott River, Tom Martin Creek, O’Neil Creek, Walker Creek, Grider Creek, and Seiad Creek.

Suckers Aquatic Resource Measure

The Licensee shall implement the Suckers AR Measure as listed in the Licensee's June 2018, Appendix I. The Licensee shall submit the summary reports to the Deputy Director no later than six months after each sampling event or no later than three months following issuance of the FERC license surrender order for sampling events implemented before license surrender order issuance. The Licensee shall submit summary reports to the Deputy Director detailing relocation efforts implemented under this measure no later than three months following completion of the relocation efforts.

Freshwater Mussels Aquatic Resource Measure

The Licensee shall implement the Freshwater Mussels AR Measure, as listed in the Licensee's October 2018 letter to the State Water Board. The Licensee shall submit summary reports to the Deputy Director detailing relocation efforts implemented under this measure no later than three months following completion of the relocation efforts.

CONDITION 7. REMAINING FACILITIES

No later than six months following issuance of the FERC license surrender order, and prior to Project implementation, the Licensee shall submit a Remaining Facilities Plan to the Deputy Director for review and approval. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director-approved Remaining Facilities Plan, together with any required plan modifications, with FERC. The Licensee shall implement the Remaining Facilities Plan upon receiving Deputy Director and any other required approvals. Any changes to the Remaining Facilities Plan shall be approved by the Deputy Director prior to implementation.

At a minimum, the Remaining Facilities Plan shall include;

(1) A list and description of all Project facilities and structures that will be retained during Project implementation[14], including but not limited to facilities buried in place;

(2) An analysis of potential water quality impacts associated with remaining facilities and operations, including hazardous materials or wastes present at the facilities and the potential for erosion or runoff to surface waters;

(3) Measures the Licensee will implement to ensure remaining facilities do not contribute to water quality impairments; and

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[14] While all remaining facilities shall be listed in the Remaining Facilities Plan, it is not necessary to include a description and other information for recreational facilities addressed under Recreation Facilities (Condition 19) and hatcheries addressed under Hatcheries (Condition 13).

(4) Provisions to ensure that any ongoing measures will be implemented when ownership of the facilities and/or responsibility for operations is transferred to another entity.

CONDITION 8. PUBLIC DRINKING WATER SUPPLIES

This condition outlines provisions to ensure protection of public drinking water supplies that may be impacted by Project implementation, including drinking water supplies sourced from the Klamath River and the City of Yreka's water supply. The provisions for each of these types of water supplies are provided below.

Drinking Water Supplies Sourced from the Klamath River. No later than three months following issuance of the FERC license surrender order, and prior to Project implementation, the Licensee shall consult with community water systems, transient non-community water systems, or other drinking water providers that use Klamath River surface water for drinking water to identify appropriate measures to reduce water supply impacts associated with Project implementation. The Licensee shall ensure that Project implementation does not result in service of water that fails to meet drinking water quality standards. Potential measures shall include, as appropriate; (1) providing an alternative potable water supply; (2) providing technical assistance to assess whether existing treatment is adequate to treat the potential increase in sediments and sediment-associated contaminants to meet drinking water standards; (3) providing water treatment assistance to adequately treat Klamath River water to minimize suspended sediments and associated constituents that may impact human health; (4) ensuring that transient, non-community supplies are temporarily shut off for drinking; and/or (5) ensuring that water not intended for drinking is clearly marked as non-potable.

At least six months prior to initiating drawdown, the Licensee shall submit a report to the Deputy Director that; (i) identifies all drinking water supplies sourced from the Klamath River that may be impacted by the Project; (ii) details measures the Licensee will implement to protect each potentially affected water supply and why such measures are sufficient to protect the drinking water supplies; and (iii) documents consultation with the applicable water supplier and how any comments made on the proposed measures were addressed in the report. The Licensee shall implement the measures sufficiently prior to, during, and following the reservoir sediment releases to ensure protection of water supplies. The Deputy Director may require modifications or additional measures. The Licensee shall provide the Deputy Director with a summary of its implementation of this provision within three months of concluding implementation of the measures.

City of Yreka's Water Supply. Prior to initiating drawdown of Project reservoirs, the Licensee shall construct a new, fully operational replacement pipe for the City of Yreka's current water supply pipeline for the section of pipe that crosses Iron Gate Reservoir. The new replacement pipeline section shall be connected to the existing City of Yreka water supply pipeline and installed in a location that prevents Klamath River flows during and after drawdown from affecting the City of Yreka's water supply.

Any work the Licensee undertakes to ensure that the City of Yreka water supply intake structures comply with fish screen criteria shall be completed within the water delivery outage period specified in this condition. Installation of a fish barrier that does not impact the City of Yreka's water supply and associated intake structures may be performed at an alternate time outside of the water delivery outage period.

Except as provided in this condition, the Licensee shall ensure uninterrupted water supply during replacement of the water pipeline section, any required intake structure modifications, and throughout Project implementation. A short water delivery outage is necessary to make the final connections following construction of the new pipeline. The Licensee shall limit the water delivery outage to a maximum of 12 hours or another water delivery outage timeframe agreed upon between the City of Yreka and the Licensee. The Licensee shall coordinate the water delivery outage period with the City of Yreka to ensure the City of Yreka has an adequate supply of water stored to cover the maximum water delivery outage period.

Water pipeline and intake work shall not cause impacts to water quality that exceed North Coast Basin Plan standards. If the Licensee proposes any in-water work, the Licensee shall prepare a water quality monitoring and protection plan in compliance with Condition 10 of this certification for Deputy Director review and approval.

CONDITION 9. AQUATIC VEGETATION MANAGEMENT

In the event chemical vegetation control is proposed to control algae or aquatic weeds, the Licensee shall consult with staff from the United States Army Corps of Engineers (USACE), CDFW, North Coast Regional Board, and State Water Board and submit a proposal to the Deputy Director for review and approval. The proposal shall include; (1) the Licensee's plans to implement chemical vegetation management, including any public noticing or additional measures proposed beyond those required in this certification; (2) the timeline for the application of chemicals and any potential impacts to beneficial uses of water, including Native American culture uses; (3) comments and recommendations made in connection with the consultation and how they were incorporated into the proposal; and (4) a description of how the proposal incorporates or addresses use of glyphosate in an aquatic formulation, avoidance of glyphosate formulations containing the surfactants POEA or R-11, and prohibition of application if precipitation is predicted within 24 hours of intended use. If another herbicide is selected for use, it shall meet the characteristics of low soil mobility and low toxicity to fish and aquatic organisms and shall be applied using low use rates (i.e., spot treatments), avoidance of application in the rain, avoidance of treatments during periods when fish are in life stages most sensitive to the herbicide(s) used, and adherence to appropriate buffer zones around stream channels as specified in Bureau of Land Management 2010[15].

The Deputy Director may approve, deny, or require modifications of the proposal. The Licensee shall file any Deputy-Director-approved proposal, together with any required proposal modifications, with FERC. The Licensee shall implement the proposal upon Deputy Director and any other required approvals. Any changes to the proposal shall be approved by the Deputy Director prior to implementation.

At a minimum, the Licensee shall comply with the terms in State Water Board Order No. 2013-0002-DWQ (as amended by Order 2014-0078-DWQ), National Pollutant Discharge Elimination System (NPDES) No. CAG990005, *Statewide National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Water of the United States from Algae and Aquatic Weed Control Applications* and any amendments thereto.

CONDITION 10. CONSTRUCTION GENERAL PERMIT COMPLIANCE AND WATER QUALITY MONITORING AND PROTECTION PLANS

The Licensee shall comply with the terms and conditions in the State Water Board's *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities* (Construction General Permit; State Water Board Order 2009-0009-DWQ, as amended by State Water Board Orders 2010-0014-DWQ and 2012-0006-DWQ), and ongoing amendments during the life of the Project.

For any ground-disturbing activities that could impact water quality (including beneficial uses) that are neither addressed by the Construction General Permit nor addressed in other conditions of this certification (e.g., Reservoir Drawdown [Condition 3], Hatcheries [Condition 13], and Restoration [Condition 14]) site-specific water quality monitoring and protection plans shall be prepared and implemented following Deputy Director approval. Prior to construction or other activity that could impact water quality or beneficial uses, the Licensee shall submit the water quality monitoring and protection plan to the Deputy Director for review and approval. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director's approval, together with any required modifications, with FERC. The Licensee shall implement site specific water quality monitoring and protection plans upon receipt of Deputy Director and any other required approvals.

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[15] Bureau of Land Management (BLM). 2010. Final environmental impact statement. Vegetation treatments using herbicides on BLM lands in Oregon. Volume 2-Appendices. FES 10-23 BLM/OR/WA/AE-10/077+1792. Prepared by BLM, Pacific Northwest Region, Portland, Oregon.

Any water quality monitoring and protection plans shall include measures to control erosion, stream sedimentation, dust, and soil mass movement. The plans shall be based on actual-site geologic, soil, and groundwater conditions and at a minimum include;

(1) Description of site conditions and the proposed activity;

(2) Detailed descriptions, design drawings, and specific topographic locations of all control measures in relation to the proposed activity, which may include;

  a. Measures to divert runoff away from disturbed land surfaces;
  b. Measures to collect and filter runoff from disturbed land surfaces, including sediment ponds at the sites; and
  c. Measures to dissipate energy and prevent erosion;

(3) Revegetation of disturbed areas using native plants and locally-sourced plants and seeds; and

(4) A monitoring, maintenance, and reporting schedule.

Potential best management practices (BMPs) include those identified in the Licensee's 2018 Definite Plan*,* the Licensee's September 30, 2017, Technical Support Document, *Water Quality Management for Forest System Lands in California –Best Management Practices* (USFS 2012), California Department of Transportation's May 2017 *Construction Site Best Management Practices (BMP) Manual* (Caltrans BMP Manual) (Caltrans 2017), or other appropriate documents.

CONDITION 11. WASTE DISPOSAL

No later than six months following issuance of the FERC license surrender order, the Licensee shall submit a Waste Disposal Plan to the Deputy Director for review and approval. The Waste Disposal Plan shall describe how the Licensee will manage and dispose of all non-hazardous wastes[16] generated as part of the Project in a manner protective of water quality. The Waste Disposal Plan shall be developed in consultation with staff from the North Coast Regional Board and State Water Board. The Licensee shall solicit comments from the agencies listed. Additionally, the Waste Disposal Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director's approval, together with any required modifications, with FERC. The Licensee shall implement the Waste

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[16] Management of hazardous materials is covered in Hazardous Materials Management (Condition 12). Additionally, the Licensee shall provide support for why other appropriate BMPs from the Caltrans Manual are sufficient to protect water quality and beneficial uses.

Disposal Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Waste Disposal Plan shall be approved by the Deputy Director prior to implementation.

At a minimum, the Waste Disposal Plan shall include;

(1) The elements of the waste disposal description presented in Section 5 of the Licensee's 2018 Definite Plan, that influence water quality, and as updated based on the requirements presented in this condition. If the Licensee proposes to change any elements material to water quality, the Waste Disposal Plan submittal shall highlight such changes and provide a rationale, including any new information relied on;

(2) An estimate of the quantity and nature of anticipated waste generated by dam removal and other Project decommissioning activities and a description of where all materials and debris will be disposed;

(3) A detailed description of on-site disposal, including the proposed locations and associated size of sites;

(4) Erosion control measures for on-site disposal activities; and

(5) A proposal to restore on-site disposal sites with topsoil and native vegetation, including monitoring, reporting, and follow up actions (if needed) to ensure the long-term stability of the restored disposal site and protection of water quality.

On-site disposal of inert, non-hazardous debris resulting from dam removal and other Project decommissioning activities may be buried in accordance with requirements in division 2, title 27 of the California Code of Regulations. With exception of the J.C. Boyle scour hole and powerhouse tailrace disposal sites identified in the 2018 Definite Plan, the Licensee shall ensure that the disposal sites are above the ordinary high-water mark (OHWM) and in a location that does not drain directly to surface waters. The Licensee shall select disposal site locations where drainage patterns can be preserved. If a waste disposal site has the potential to drain into surface waters, catch basins shall be constructed whenever feasible[17] and other appropriate BMPs from the Caltrans BMP Manual shall be implemented, to intercept runoff before it reaches surface waters. On-site disposal areas that will remain uncovered through the rainy season (between October 16 and May 14) shall be protected with appropriate BMPs from the Caltrans BMP Manual to prevent erosion. Reinforced steel and other recyclable materials should be recycled at local recycling facilities. Excavated embankment material may be used as topsoil to cover on-site disposal areas prior to grading and being sloped for drainage. Concrete rubble resulting from demolition of the powerhouses may be buried in the existing tailrace channel. All mechanical and electrical equipment shall be hauled to a

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[17] The Licensee shall provide justification for any determination that a catch basin is infeasible at a disposal site with the potential to drain into surface water.

suitable commercial landfill or salvage collection point. Prior to Project completion, all on-site disposal locations shall be graded and vegetated to reduce the potential for erosion.

CONDITION 12. HAZARDOUS MATERIALS MANAGEMENT

No later than six months following issuance of the FERC license surrender order, the Licensee shall submit a Hazardous Materials Management Plan to the Deputy Director for review and approval. The Hazardous Materials Management Plan shall be developed in coordination with State Water Board staff. The Hazardous Materials Management Plan shall include the following; (a) proper disposal or abatement of hazardous materials and wastes that are encountered as part of decommissioning activities (e.g., asbestos tiles or building materials, batteries, etc.); (b) proper storage, containment, and response to spills of hazardous materials and wastes that are part of Project implementation (e.g., gasoline and diesel for vehicles, oil and other fluids for construction equipment, etc.); and (c) proper removal and disposal of septic tanks. At a minimum, the Hazardous Materials Management Plan shall include the requirements presented in this condition and;

(1) The elements of the hazardous materials management description presented in Appendix O3 of the Licensee’s 2018 Definite Plan, that influence water quality, as updated based on the requirements presented in this condition. If the Licensee proposes to change any elements material to water quality, the Hazardous Material Management Plan submittal shall highlight such changes and provide a rationale, including any new information relied on;

(2) A list with contact information of federal, state, and local officials the Licensee will contact to respond in the event of a hazardous materials spill. The list and contact information shall be maintained and updated by the Licensee. In the event of a hazardous materials spill, at a minimum, the Licensee shall immediately inform the California Emergency Management Agency, CDFW, North Coast Regional Board, and the State Water Board staff of the magnitude, nature, time, date, location, and action taken for the spill;

(3) An inventory of hazardous materials and wastes at each facility and the plan for final disposition of the hazardous materials and wastes;

(4) Description of hazardous materials storage, spill prevention, and cleanup measures, including the deployment and maintenance of spill cleanup materials and equipment at each facility/site to contain any spill from Project activities. Onsite containment for storage of chemicals classified as hazardous shall be away from watercourses and include secondary containment and appropriate management as specified in California Code of Regulations, title 27, section 20320; and

(5) Testing, monitoring, and reporting that will be implemented if a spill occurs to ensure water quality is not affected.

The Deputy Director may require modification as part of any approval. The Licensee shall file the Deputy Director’s approval, together with any required modifications, with

FERC. The Licensee shall implement the Hazardous Materials Management Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Hazardous Materials Management Plan shall be approved by the Deputy Director prior to implementation.

For structures being removed, the Licensee shall inspect each structure prior to removal for hazardous materials (e.g. asbestos-containing material, lead-based paint, and polychlorinated biphenyls [PCBs]) and perform any necessary sampling or testing when inspection alone does not provide sufficient information to determine whether the material is hazardous. Any material with asbestos, lead, PCBs, or other hazardous waste shall be handled and disposed of as hazardous waste at approved hazardous waste facilities in accordance with applicable waste management regulations. Other deconstruction materials shall be disposed of as non-hazardous waste in accordance with Waste Disposal (Condition 11) provisions of this certification.

All hazardous materials removed from inside existing structures during Project implementation (e.g., paints, oils, and welding gases) shall be either returned to the vendor, recycled, or managed and disposed of as hazardous waste at an approved hazardous waste facility in accordance with applicable federal and state regulations. Transformer oils shall be tested for PCBs if no data exist. Any tanks that contained hazardous materials shall be decontaminated prior to disposal. Universal hazardous waste (e.g., lighting ballasts, mercury switches, and batteries) shall be handled in accordance with applicable federal and state universal waste regulations.

Existing septic tanks associated with Project facilities shall be decommissioned in place or removed and disposed of in accordance with the corrective action requirements specified in the State Water Board's *Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Treatment Systems* (OWTS Policy)[18] (State Water Board 2012).

CONDITION 13. HATCHERIES

No later than six months following issuance of a FERC license surrender order, the Licensee shall submit a Hatcheries Management and Operations Plan (Hatcheries Plan) to the Deputy Director for review and approval. The Hatcheries Plan shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, CDFW, and NMFS. The Licensee shall solicit comments from the agencies listed above. Additionally, the Hatcheries Plan shall include the comments received during the consultation process and identify how the Licensee addressed the comments. The Deputy

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[18] The OWTS Policy was adopted by the State Water Board on June 19, 2012 per Resolution No. 2012-0032; it was approved by the Office of Administrative Law on November 13, 2012; and consistent with OWTS Policy section 13.0, became effective on May 13, 2013. On April 17, 2018, per Resolution No. 2018-0019, the State Water Board amended the OWTS Policy renewed its conditional waiver.

Director may require modifications as part of any approval. The Licensee shall file the Deputy Director-approved Hatcheries Plan, together with any required plan modifications, with FERC. The Licensee shall implement the Hatcheries Plan upon receipt of Deputy Director and any other required approvals. Following Deputy Director approval of the Hatcheries Plan, any changes to the Hatcheries Plan with the potential to increase impacts to water quality shall be approved by the Deputy Director prior to implementation. At a minimum, the Hatcheries Plan shall include;

(1) The Licensee's plans to construct, modify, operate, maintain, and facilitate transfer of ownership and continued operation of the Fall Creek and Iron Gate hatcheries, as presented in Section 7.8 of the 2018 Definite Plan, and as updated based on the requirements in this certification. If the Licensee proposes to change any elements material to water quality, the Hatcheries Plan shall highlight such changes and provide a rationale, including any new information relied on;

(2) Annual fish production goals that include the target production numbers by species, life stage, and hatcheries locations;

(3) Identification of water supplies that will be used to operate the Iron Gate and Fall Creek hatcheries including; location; anticipated diversion rates (cfs) and total diversion amounts (annual and monthly); minimum amount of flow that will be bypassed below the diversions to provide volitional fish passage; and summaries of and compliance with any water right requirements associated with water diversions;

(4) Implementation actions for protection of hatchery and natural fish populations (as impacted by hatchery operations) in the event water supply to Iron Gate or Fall Creek hatcheries is unavailable due to drought or other limitations;

(5) The proposed construction BMPs for ground-disturbing activities associated with construction of the hatcheries, including establishment of a 20-foot buffer around delineated wetlands, unless site-specific conditions require adjustment of the buffer in a manner that remains protective of delineated wetlands and is acceptable to a qualified and approved biologist. Construction associated with these activities shall be subject to the BMPs required under the Construction General Permit;

(6) Details regarding a minimum flow in Bogus Creek of 4.5 cfs, unless it is determined that an alternative minimum flow is required to provide volitional fish migration for Chinook salmon, coho salmon, and steelhead. If the hatchery diversions cause a flow within Bogus Creek downstream of the bypass that is less than 4.5 cfs (or the minimum flow identified for each species during their migration period), hatchery operations shall be adjusted, in coordination with NMFS and CDFW, to reduce the percentage of flow diverted from Bogus Creek and protect of anadromous fish passage;

(7) Expected duration of each hatchery's operations; and

(8) Reporting details, such as the amount of water diverted at each hatchery, bypass flows, and reporting requirements under the NPDES permit.

Prior to operation of the Fall Creek and Iron Gate hatcheries, the Licensee shall ensure that each hatchery has obtained coverage under and complies with a NPDES permit issued by the North Coast Regional Board. If the closure of the hatcheries is anticipated while the license surrender order is still in effect, the Hatchery Plan shall be updated to include the proposal for decommissioning of the facilities.

CONDITION 14. RESTORATION

No later than six months following issuance of the FERC license surrender order, and prior to initiation of drawdown activities, the Licensee shall submit a Restoration Plan to the Deputy Director for review and approval. The Restoration Plan shall be developed in consultation with staff from the North Coast Regional Board, State Water Board, and CDFW. The Licensee shall solicit comments from the agencies listed above. Additionally, the Restoration Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Restoration Plan, together with any required plan modifications, with FERC. The Licensee shall implement the Restoration Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Restoration Plan shall be approved by the Deputy Director prior to implementation. At a minimum, the Restoration Plan shall include;

(1) The material elements of the Licensee’s restoration plan for the Project, as presented in Section 6 of the Licensee’s 2018 Definite Plan, and as updated based on the requirements in this condition. If the Licensee proposes to change any elements material to water quality, the Restoration Plan submittal shall highlight such changes and provide the rationale, including any new information relied on;

(2) Detailed description of proposed restoration activities (e.g., grading, planting, swales, wetland construction, etc.) and preliminary map identifying proposed locations for restoration activities. The preliminary map shall be updated within two months following drawdown, as necessary. The description of proposed restoration activities shall include associated water quality protection measures the Licensee will implement as part of restoration;

(3) Exclusive use of native plants, with preference for plants that promote soil stabilization;

(4) Description and results of the Licensee’s evaluation of the presence of wetlands that could be affected by the Project, including wetlands in the potential disposal areas;

(5) Description of measures the Licensee will implement to ensure no net loss of wetland or riparian habitat. Measures shall include establishment of a minimum 20-foot buffer around all delineated wetlands potentially affected by construction impacts (unless site-specific conditions require adjustment of the buffer in a manner that remains protective of delineated wetlands and is acceptable to a qualified and approved biologist) to deter

heavy machinery from traversing the wetland and prevent runoff pollution associated with Project activities from directly entering wetlands;

(6) Description of how the Licensee will ensure floodplain connectively within the reservoir footprint;

(7) Description of how the Licensee will monitor for and address any invasive weeds in the restored area;

(8) Plan for installation of large woody material in the Hydroelectric Reach in California that includes;

a. Number or volume of large woody material to be installed;
b. Placement of a portion of large woody material at or above the OHWM to create habitat at higher flows,
c. Consistency with practices in *California Salmonid Stream Habitat Restoration Manual* (CDFG 2010) or guidance provided through consultation with staff from CDFW, NMFS, North Coast Regional Board, and State Water Board; and
d. Timeline for placement of large woody material, which shall not occur until active dam and facilities removal work is complete; and

(9) Monitoring and reporting on the implementation of the Restoration Plan, including adaptive management measures that will be implemented over time to ensure successful restoration (e.g., measures to address the loss of newly planted vegetation, soil instability[19], etc.). Monitoring shall occur frequently enough to determine whether plantings are successful and to facilitate implementation of adaptive measures (e.g., supplemental irrigation, re-seeding, changes in plant types) to ensure rapid establishment of vegetation.

Within six months of concluding drawdown activities, and annually thereafter until otherwise directed by the Deputy Director, the Licensee shall provide a report to the Deputy Director documenting implementation of the Restoration Plan, including highlights of any problems encountered and adaptive management measures deployed or proposed to address the problems. The Licensee shall provide additional reports or information related to implementation of the Restoration Plan if requested by the Deputy Director.

CONDITION 15. WATER SUPPLY MONITORING AND MANAGEMENT

The Licensee shall implement the following measures to protect water supply and beneficial uses. The Licensee shall annually prepare, and submit to the Deputy Director, a Water Supply Management Report that includes the elements described below. The

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[19] Adaptive management measures for soil stabilization may refer to the Slope Stability Monitoring Plan required in Slope Stability (Condition 18).

Deputy Director may require implementation of additional adaptive management measures informed by the report and associated monitoring results.

Surface Water Diversions; The Licensee shall identify all points of diversion on the Klamath River listed in the Electronic Water Rights Information Management System (eWRIMS). The Licensee shall contact all California water rights holders with points of diversion on the Klamath River to determine whether the water right holder is interested in working with the Licensee to evaluate potential Project impacts to the water right holder. If potential impacts are identified and if the water right holder is interested in working with the Licensee, the Licensee shall provide temporary accommodations (e.g., replacement water, settling basins, etc.) to address potential impacts. Following dam removal, the Licensee shall investigate any impacts reported by a diverter. If the investigation confirms an advise impact has occurred as a result of dam removal, the Licensee shall implement measures to reduce impacts and allow the water right holder to divert water in the same manner (e.g., amounts, suitable quality, and timing) as before dam removal.

The year prior to and annually for the first two years following drawdown, the Licensee shall submit a Water Supply Management Report to the Deputy Director on implementation of the surface water supply activities described above. At a minimum, the report shall include; a map showing the location of potentially affected points of diversion; a description of the potential adverse effects; a description of proposed/implemented mitigation measures; and the number of water right holders who agreed to work with the Licensee to address potential water supply issues.

Groundwater; To determine Project effects on surrounding groundwater wells, the Licensee shall, within a 2.5-mile range of the reservoirs' OHWM, monitor groundwater levels before, during, and after drawing down the reservoirs. To identify groundwater wells, the Licensee shall outreach to all residents and landowners within 2.5 miles of the California Project reservoirs to inquire about their groundwater wells. At least two months prior to commencing drawdown activities, the Licensee shall monitor groundwater levels at a minimum of 10 locations within 2.5 miles of the California reservoirs dispersed throughout the Hydroelectric Reach in California. The Licensee may begin groundwater elevation monitoring earlier, in order to integrate observations of natural seasonal fluctuations in groundwater elevation into the impact analysis.

The Licensee shall continue to monitor groundwater levels, at least monthly, until otherwise approved by the Deputy Director and for a term of at least two years following completion of drawdown of all Project reservoirs. Monitoring may occur at groundwater wells of landowners or residents with wells located within 2.5 miles of the California Project reservoirs who volunteer to allow testing or at other groundwater monitoring wells around the California Project reservoirs. Potential groundwater monitoring locations and measures to address potential water supply impacts are identified in Appendix N of the Licensee's 2018 Definite Plan. The Licensee shall provide the Deputy Director with the locations of groundwater wells that will be monitored per this condition, and the Deputy Director may require additional monitoring if the locations chosen do not provide sufficient information on potential impacts to groundwater levels.

The Licensee shall submit an annual Groundwater Report to the Deputy Director, for a minimum of two years directly following completion of drawdown. Monitoring duration may be adjusted based on groundwater levels reported in the annual Groundwater Report, and as approved by the Deputy Director. At a minimum, the annual Water Supply Management Report shall include a section on groundwater that;

- Documents groundwater level monitoring results;
- Highlights any trends or significant changes in groundwater levels; and
- Summarizes actions the Licensee has or will implement to address any impacts to groundwater supply associated with Project implementation. Actions implemented by the Licensee shall ensure disruptions in groundwater supply determined to be a result of the Project are limited. Actions shall include, but are not limited to, providing temporary water until Project impacts are adequately addressed.

Fire Protection; The first annual Water Supply Management Report shall include a list and map of locations where fire trucks and/or helicopters may access the Klamath River and its tributaries for residential fire protection efforts in the Hydroelectric Reach.

If the Deputy Director finds that the measures undertaken to address water supply impacts are insufficient or additional reporting is needed, the Deputy Director may require the Licensee to implement additional measures or continue reporting on implementation of this condition.

CONDITION 16. AMPHIBIAN AND REPTILE MANAGEMENT

No later than three months following issuance of a FERC license surrender order, the Licensee shall submit an Amphibian and Reptile Rescue and Relocation Plan (Amphibian and Reptile Plan) to the Deputy Director for review and approval. The Amphibian and Reptile Plan shall be developed in consultation with staff from CDFW, USFWS, and State Water Board. The Licensee shall solicit comments from the agencies listed above. Additionally, the Amphibian and Reptile Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Amphibian and Reptile Plan, together with any required modifications, with FERC. The Licensee shall implement the Amphibian and Reptile Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Amphibian and Reptile Plan shall be approved by the Deputy Director prior to implementation.

The Amphibian and Reptile Plan shall address protection of amphibians and reptiles previously found in the areas of the Project affected by drawdown and land-disturbing activities that are listed under the Federal Endangered Species Act (ESA) or the California ESA, or are designated as Species of Special Concern by CDFW. These species may include, but are not limited to foothill yellow-legged frog, and western pond turtle. At a minimum the Amphibian and Reptile Plan shall include;

(1) The amphibians and reptiles covered by the plan;

(2) Surveys and protocols that will be implemented to identify and relocate amphibians and reptiles identified in the plan;

(3) Protocols for relocation that will be implemented upon the incidental discovery of a listed species during surveys;

(4) Identification of the minimum qualifications for the individual(s) that will conduct the surveys and relocations, if necessary;

(5) Timing and locations where surveys will be conducted, including all areas of the Project affected by drawdown and land-disturbing activities in California with known amphibian or reptile habitat or presence;

(6) Identification of potential relocation areas, which may include lower reaches of Klamath River tributaries with suitable habitat approved by USFWS and CDFW;

(7) Pre-construction surveys and associated reporting for western pond turtles conducted by an on-site biologist approved by applicable agencies and familiar with western pond turtle ecology;

(8) Provisions for rescue and relocation of western pond turtles after reservoir drawdown that includes survey timing to cover multiple life stages, survey frequency, survey locations, relocation areas with suitable habitat, survey methodology, and reporting of survey results within 60 days of the completion of surveys to applicable agencies and the State Water Board; and

(9) Monitoring and reporting that will be implemented to document compliance with this condition, including notification and reporting identified by USFWS and CDFW through consultation to develop the plan. Reporting shall include a report submitted to applicable agencies within 30 days of completing the Project, regarding all species handled and relocated; location, date, time and duration of the handling; enumeration and identification of species handled; identification of species life stage; identification of capture personnel; the release location and time; stream, transport, and receiving water temperatures; and location, date, and time of release.

The Amphibian and Reptile Plan must be approved by the Deputy Director prior o drawdown, in-water work, and work in riparian areas. Prior to approval of the Amphibian and Reptile Plan, the Licensee may implement ground-disturbing activities occurring entirely above the OHWM, so long as a USFWS- and CDFW- approved biological monitor surveys the area, monitors construction, and takes appropriate actions to protect amphibians and reptiles.

CONDITION 17. BALD AND GOLDEN EAGLE MANAGEMENT

No later than three months following issuance of a FERC license surrender order, and prior to Project implementation, the Licensee shall submit a Bald and Golden Eagle Management Plan (Eagle Management Plan), to the Deputy Director for review and approval. The Eagle Management Plan shall be developed in consultation with staff from CDFW, USFWS, and State Water Board. The Licensee shall solicit comments from those agencies. Additionally, the Eagle Management Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Eagle Management Plan, together with any required modifications, with FERC. The Licensee shall implement the Eagle Management Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Eagle Management Plan shall be approved by the Deputy Director prior to implementation.

The Eagle Management Plan shall include, at a minimum, the following;

- A two-year survey for eagle use patterns shall be conducted prior to construction activities.
    - The first-year survey shall determine bird use patterns at any facilities to be removed or modified during the time of year most likely to detect bird usage (completed by the Licensee in 2017).
    - The second-year survey shall include focused surveys (see below).
    - Surveys shall be conducted by a qualified avian biologist, approved by CDFW and USFWS.
- A focused survey (two site visits) shall be conducted in a single nesting season within two years prior to drawdown to document the presence of nests. These focused surveys shall identify eagle nests within one mile of disturbance areas within the Limits of Work, including but not limited to demolition areas where there may be any loud noise disturbance (e.g., helicopter or plane, blasting, etc.). The early nesting season survey shall occur at a time when eagles are most likely to be found at the nest sites, and the second survey shall occur later in the season and prior to the fledglings leaving the nest to confirm nesting activity. All observations shall be reported to CDFW using the California Bald Eagle Nesting Territory Survey Form (CDFW 2017d).

- Within two weeks prior to commencing construction or ground-disturbing activities, the Licensee shall conduct at least one pre-construction survey within the survey area defined above.

- Wherever possible, clearing, cutting, and grubbing activities shall be conducted outside of the eagle nesting season (January 1 through August 31[20]).

- If active eagle nests are documented during the surveys, a one-mile[21] restriction buffer shall be established around the nest to ensure that nests are not disturbed. This buffer may be reduced in coordination with USFWS and CDFW, while taking into consideration components such as proposed activity, distance to activity, terrain, and line of site. For example, in coordination with agencies, if a nest is not within line-of-site, meaning that trees or topographic features physically block the eagle's view of construction activities, the buffer could be reduced to 0.25-mile. Further reduction of buffers or allowance of limited activity inside of buffers could occur in coordination with an on-site biologist, CDFW, and the USFWS, while being consistent with the Licensee's proposed Eagle Avoidance and Minimization Plan, if it is determined that the activities shall not jeopardize nesting success. To reduce the potential for nesting in a previously identified active nest, measures may be implemented prior to the nesting season such as removing the nest or making the nest temporarily unavailable (e.g., placing cone or ball in nest) in coordination with an on-site biologist, CDFW, and the USFWS.

- Nests within a one-mile buffer shall be monitored by an USFWS- and CDFW-approved biologist when there is a potential for noise disturbance, in order to assess whether eagle activity patterns are normal, as compared with that observed during baseline surveys described above.

- If activities are anticipated to result in take under the Bald and Golden Eagle Protection Act, it would be considered a significant impact and the Licensee shall coordinate appropriate measures, including procurement of any necessary take permits, with USFWS and CDFW. The Licensee shall report on the status of bald and golden eagle surveys within one month of survey completion to USFWS, CDFW, and State Water Board.

- Monitoring and reporting that will be implemented to document compliance with this condition, including notification and reporting identified by USFWS and CDFW through consultation to develop the Eagle Management Plan.

CONDITION 18. SLOPE STABILITY

The Licensee shall identify reservoir slopes and other Project areas prone to instability and implement site-specific measures to avoid potential slope erosion and associated increases in sedimentation to surface waters throughout Project implementation.

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[20] Eagle breeding season of January 1 through August 31, as identified by A. Henderson, CDFW, Environmental Scientist, pers. comm, November 2017.

[21] Eagle nest restriction buffer of 1.0 mile, as identified by A. Henderson, CDFW, Environmental Scientist, pers. comm, November 2017.

Additionally, the Licensee shall monitor for and address slope instability throughout the term of the Project, including restoration activities. No later than three months following issuance of the FERC license surrender order and prior to starting drawdown, the Licensee shall submit a Slope Stability Monitoring Plan to the Deputy Director for review and approval. The Slope Stability Monitoring Plan shall be developed in consultation with State Water Board staff. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Slope Stability Monitoring Plan, together with any required modifications, with FERC. The Licensee shall implement the Slope Stability Monitoring Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Slope Stability Monitoring Plan shall be approved by the Deputy Director prior to implementation. At a minimum, the Slope Stability Monitoring Plan shall include;

(1) The material elements of the Licensee's proposal related to stability of embankments and reservoir rims, as presented in the 2018 Definite Plan and the Licensee's commitment to implement final EIR Mitigation Measure GEO-1 (Slope Stabilization), and as updated based on the requirements presented in this condition. If the Licensee proposes to change any elements material to water quality, the Slope Stability Monitoring Plan shall highlight such changes and provide the rationale, including any new information relied on;

(2) A list of slopes and Project areas prone to instability;

(3) Number and location of piezometer wells the Licensee will use to monitor water levels and pore pressure;

(4) Number and location of inclinometer installations to monitor slope stability;

(5) A list of measures the Licensee will implement to prevent erosion and maintain soil stability;

(6) A description of soil stability monitoring, including locations and schedule;

(7) Visual monitoring for potential slumping, cracking, and other signs of slope instability throughout the Project area;

(8) Potential measures the Licensee will implement to address soil instability;

(9) Coordination with Reservoir Drawdown (Condition 3) to address the potential modification of drawdown rates to control slope instability if necessary to protect infrastructure, property, or resources;

(10) Slope inspections during drawdown of the reservoirs and after storm events, and implementation of any necessary repairs, replacements, and/or additional measures to minimize potential slope instability effects on water quality based on inspection information; and

(11) Submittal of the following reports to the Deputy Director until otherwise approved;

a. An annual report that summarizes; slope stability monitoring and inspection information; any repairs, replacements, or additional stabilization measures implemented; and any proposed changes to the Slope Stability Monitoring Plan; and

b. Monthly reports during the rainy season (October 16 – May 14) that identify any areas that have experienced slope instability, any actions taken to control and improve slope stability, and an assessment of the success of initial and any ongoing slope stability actions implemented.

Upon request, the Licensee shall provide additional information regarding slope stability measures undertaken to address identified slope instability. If monitoring and inspection indicate that the measures identified in the Slope Stability Monitoring Plan are insufficient to protect water quality, the Deputy Director may establish a timeframe and require the Licensee to re-consult on the Slope Stability Monitoring Plan, make changes, and resubmit the Slope Stability Monitoring Plan for Deputy Director approval.

CONDITION 19. RECREATION FACILITIES

No later than six months following issuance of the FERC license surrender order, the Licensee shall submit a Recreation Facilities Plan to the Deputy Director for review and approval. The Recreation Facilities Plan shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, and CDFW. The Licensee shall include comments received from the agencies consulted during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy Director-approved Recreation Facilities Plan, together with any required modifications, with FERC. The Licensee shall implement the Recreation Facilities Plan upon receipt of Deputy Director and any other required approvals. Any changes to the Recreation Facilities Plan shall be approved by the Deputy Director prior to implementation. At a minimum, the Recreation Facilities Plan shall include;

(1) The material elements of the Licensee's recreation proposal for the Project, as presented in Section 7.6 of the 2018 Definite Plan, and as updated based on the requirements presented in this condition. If the Licensee proposes to change any elements material to water quality, the Recreation Facilities Plan submittal shall highlight such changes and provide a rationale, including any new information relied on;

(2) A list of recreation facilities associated with the Project;

(3) Identification of recreation facilities that will be removed and a schedule for removal;

(4) Identification of any recreation sites to be added, modified, or maintained following dam removal, including location, the types of facilities to be added, modified, or maintained, and the proposed schedule for completion of new facilities or modifications to existing facilities;

(5) The Licensee's plans to facilitate transfer of ownership and/or operation of Project recreation facilities;

(6) Proposed measures to protect water quality and beneficial uses during any construction, removal, maintenance, or other activities associated with the Project recreation facilities;

(7) Water quality monitoring of Project recreation areas in compliance with this condition;

(8) Public education signage regarding aquatic invasive species and proper boat cleaning at established public boat access locations or visitor information kiosks in the vicinity;

(9) Installation, if necessary, and maintenance of boat cleaning stations at Project boat ramps for the removal of aquatic invasive species;

(10) Signage posted at Project recreation facilities for water quality impairments (e.g., *E. coli* or fecal coliform and microcystin toxin) discovered through sampling under this condition or other efforts. If water quality monitoring indicates the impairments are an ongoing problem, the Licensee shall propose implementation of appropriate measures as part of the annual reporting requirement outlined in this condition; and

(11) Annual reporting to the Deputy Director on implementation of the Recreation Facilities Plan that includes; the status of any proposed construction, removal, or modifications to Project recreation facilities; water quality monitoring results required per this condition; and any proposed modifications to the Recreation Facilities Plan requested by the Licensee.

Recreation Areas Water Quality Monitoring; The Licensee shall collect and analyze grab water samples as outlined below for protection of the recreational water contact (REC-1) beneficial use as defined in the North Coast Basin Plan. The Licensee may use the water quality results collected under the WQMP (Condition 1) and other water quality monitoring efforts[22] in the Klamath River watershed that comply with Water Quality Monitoring and Adaptive Management (Condition 1) and the provisions of the Deputy Director approved WQMP, as appropriate.

For fecal coliform and *E. coli;*

Timing; Prior to drawdown, samples shall be collected during the 30-day period that spans the Independence Day holiday (June-July) and the Labor Day holiday (August-September). Following completion of drawdown, sampling shall be performed as

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[22] Other water quality efforts may include Interim Measure 15 as described in Appendix D of the Klamath Hydroelectric Settlement Agreement, as amended November 30, 2016.

necessary to monitor for water quality and beneficial use protection, as approved by the Deputy Director in the Recreation Facilities Plan.

Frequency; Project facilities shall be monitored twice every year until each recreation facility is transferred to a new owner or as otherwise approved by the Deputy Director in the Recreation Facilities Plan.

Location; Samples shall be collected at all Project recreation facilities that provide for recreational water contact unless otherwise approved by the Deputy Director in the Recreation Facilities Plan. Samples shall be collected at locations near restrooms, recreation facilities, and other high use areas.

Method; The Licensee shall use the five samples in 30-day methodology or other future protocol identified in the North Coast Basin Plan.

For microcystin toxin;

Prior to drawdown, the Licensee shall annually monitor for microcystin toxin at all Project recreation sites that provide for recreational water contact unless otherwise approved by the Deputy Director in the Recreation Facilities Plan. At a minimum, monitoring shall continue monthly (May through October) for two years following the completion of drawdown unless the recreation site is removed. For newly constructed or modified-existing recreation sites, the Licensee shall monitor microcystin toxins for a minimum of two year beginning with completion of construction or modifications, unless otherwise approved by the Deputy Director in the Recreation Facilities Plan.

The Licensee shall report monitoring results annually. Reporting shall; summarize monitoring results; highlight any exceedances of fecal coliform, *E. coli*, or microcystin toxin and propose adaptive management measures to address exceedances. Based on monitoring results, the Deputy Director may require the Licensee to modify monitoring frequency, methods, duration, or to implement additional adaptive management measures. The Licensee shall implement changes upon receipt of Deputy Director direction and any other required approvals.

CONDITION 20. LIMITATIONS ON HYDROPOWER OPERATIONS

This water quality certification is for the proposed removal of Project facilities as described in the Licensee's application and shall not be construed as approval of more than incidental, short-term interim operation of the Project hydroelectric facilities until such removal can be implemented.

Not later than 24 months following issuance of the FERC license surrender order, if drawdown and dam removal are not initiated, the Licensee shall submit an Interim Hydropower Operations Plan (Operations Plan) to the Deputy Director for review and approval. The Operations Plan shall describe additional measures the Licensee will implement to protect water quality and fisheries in advance of drawdown and dam removal activities. The Operations Plan shall be developed in consultation with staff from the State Water Board, North Coast Regional Board, CDFW, NMFS, and USFWS. The Licensee shall solicit comments from the agencies listed above, and the Operations Plan shall include comments received during the consultation process and identify how the Licensee has addressed the comments. The Deputy Director may require modifications as part of any approval. The Licensee shall file the Deputy-Director-approved Operations Plan, together with any required plan modifications, with FERC. The Licensee shall implement the Operations Plan upon receipt of Deputy Director and any other required approvals.

Dam removal must be initiated no later than five years following issuance of the FERC license surrender order unless the Licensee can demonstrate to the satisfaction of the Executive Director of the State Water Board that the delay is due to factors outside of the Licensee's control.

CONDITION 21. WATER RIGHTS MODIFICATION

The Licensee shall provide the State Water Board with a description of the Licensee's proposal for the post-dam removal disposition of all water rights associated with Project facilities. Prior to changing any water diversion for implementation of the Project, the Licensee shall consult with State Water Board staff regarding potential modifications to or transfer of state-issued water right permits and licenses that may be required by the Project. The Licensee shall follow the procedures for any such modification, as described in the California Water Code and in California Code of Regulations, title 23. Nothing in this certification shall be construed as State Water Board approval of the validity of any water rights, including pre-1914 or riparian claims. The State Water Board has separate authority under the California Water Code to investigate and take enforcement action, if necessary, to prevent any unauthorized or threatened unauthorized diversion of water.

CONDITION 22. TRIBAL WATER QUALITY STANDARDS

Project implementation and compliance with the conditions in this certification are anticipated to result in improved compliance with downstream water quality standards for the Hoopa Valley Tribe, adopted in the *Water Quality Control Plan, Hoopa Valley Indian Reservation* (Hoopa Valley Tribe 2008)[23]. The Yurok Tribe and Karuk Tribe have applied to the USEPA for treatment-as-a-state status under the Clean Water Act, and it is possible that other tribes may similarly apply for and receive such status.

To ensure that the requirements of this certification ultimately meet tribal Clean Water Act standards, the 32-month report on anticipated compliance under Compliance Schedule (Condition 2) shall be submitted to the Hoopa Valley Tribe and any other Native American tribes that have obtained treatment-as-a-state status. Any comments

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[23] See also a February 1, 2017, letter from Robert Franklin, Division Lead, Hoopa Tribal Fisheries – Water Division to Parker Thaler, State Water Board, Division of Water Rights.

from such tribes received by the Deputy Director on the report shall be a factor in the Deputy Director's consideration of whether to require implementation of additional management measures.

Additionally, the Licensee shall submit to the Hoopa Valley Tribe, and any other tribe that has subsequently obtained treatment-as-a-state status, any request to end or modify monitoring under Water Quality Monitoring and Adaptive Management (Condition 1) at the location(s) closest to or within that tribe's reservation, along with a summary of that location's monitoring results and associated data, to date. Any comments from such tribes received by the Deputy Director on the report will be a factor in the Deputy Director's consideration of whether to approve the cessation or modification of monitoring at that location(s).

CONDITION 23. CONSULTATION REQUIREMENTS

For any condition that requires consultation with specific agencies, the Licensee may consult with additional parties (including, through "good neighbor" agreements or through consultation commitments under the Klamath Hydroelectric Settlement Agreement). The Licensee is particularly encouraged to consult with local agencies with expertise in siting issues and local conditions, and with tribes that have resources that may be affected by various plans or adaptive management measures. Such consultation is likely to result in plans that are better conceived and more likely to receive approval without the need for additional modification.

ADDITIONAL CONDITIONS (CONDITIONS 24-41)

CONDITION 24. The State Water Board's approval authority includes the authority to withhold approval or to require modification of a proposal or plan prior to approval. The State Water Board may take enforcement action if the Licensee fails to provide or implement a required plan in a timely manner. If a time extension is needed to submit a report or plan for Deputy Director approval, the Licensee shall submit a written request for the extension, with justification, to the Deputy Director no later than 60 days prior to the deadline. The Licensee shall file any Deputy-Director-approved time extensions with FERC.

CONDITION 25. The State Water Board reserves the authority to reopen this certification based on evidence that the Project may be contributing to fish passage impediment in the Hydroelectric Reach upstream of the California/Oregon Stateline.

CONDITION 26. The State Water Board reserves the authority to add to or modify the conditions of this certification to incorporate changes in technology, sampling, or methodologies.

CONDITION 27. The State Water Board shall provide notice and an opportunity to be heard in exercising its authority to add to or modify the conditions of this certification.

CONDITION 28. Notwithstanding any more specific conditions in this certification, the Project shall be operated in a manner consistent with all water quality standards and implementation plans adopted or approved pursuant to the Porter-Cologne Water Quality Control Act or section 303 of the Clean Water Act. The Licensee must take all reasonable measures to protect the beneficial uses of the Klamath River watershed.

CONDITION 29. Unless otherwise specified in this certification or at the request of the Deputy Director, data and/or reports shall be submitted electronically in a format accepted by the State Water Board to facilitate the incorporation of this information into public reports and the State Water Board's water quality database systems in compliance with California Water Code section 13167.

CONDITION 30. This certification does not authorize any act which results in the unauthorized taking of a threatened, endangered, or candidate species or any act which is now prohibited, or becomes prohibited in the future, under either the California ESA (Fish & Game Code §§ 2050-2097) or the federal ESA (16 U.S.C. §§ 1531 - 1544). If a "take" will result from any act authorized under this certification or water rights held by the Licensee, the Licensee must obtain applicable authorization for the take prior to any construction or operation of the portion of the Project that may result in a take. The Licensee is responsible for meeting all applicable requirements of the cited laws for the Project authorized under this certification.

CONDITION 31. The Licensee shall submit any change to the Project, including Project operation, implementation, technology changes or upgrades, or methodology, which would have a significant or material effect on the findings, conclusions, or conditions of this certification, to the Deputy Director for prior review and written approval. The Deputy Director shall determine significance and may require consultation with state and/or federal agencies. If the Deputy Director is not notified of a change to the Project, it will be considered a violation of this certification. If such a change would also require submission to FERC, the change must first be submitted and approved by the Deputy Director.

CONDITION 32. In the event of any violation or threatened violation of the conditions of this certification, the violation or threatened violation is subject to any remedies, penalties, process, or sanctions as provided for under applicable state or federal law. For the purposes of section 401(d) of the Clean Water Act, the applicability of any state law authorizing remedies, penalties, process, or sanctions for the violation or threatened violation constitutes a limitation necessary to ensure compliance with the water quality standards and other pertinent requirements incorporated into this certification.

CONDITION 33. In response to a suspected violation of any condition of this certification, the State Water Board or North Coast Regional Board may require the holder of any federal permit or license subject to this certification to furnish, under penalty of perjury, any technical or monitoring reports the State Water Board deems appropriate, provided that the burden, including costs, of the reports shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports (California Water Code sections 1051, 13165,13267 and 13383).

CONDITION 34. In response to any violation of the conditions of this certification, the State Water Board may add to or modify the conditions of this certification as appropriate to ensure compliance.

CONDITION 35. This certification shall not be construed as replacement or substitution for any necessary federal, state, and local Project approvals. The Licensee is responsible for compliance with all applicable federal, state, or local laws or ordinances and shall obtain authorization from applicable regulatory agencies prior to the commencement of Project activities.

CONDITION 36. Any requirement in this certification that refers to an agency whose authorities and responsibilities are transferred to or subsumed by another state or federal agency, will apply equally to the successor agency.

CONDITION 37. The Deputy Director and the Executive Officer shall be notified one week prior to the commencement of ground disturbing activities that may adversely affect water quality. Upon request, a construction schedule, and updates thereto, shall be provided to the State Water Board and North Coast Regional Board staff. The Licensee shall provide State Water Board and North Coast Regional Board staffs access to Project sites to document compliance with this certification

CONDITION 38. This certification is not intended and shall not be construed to apply to any activity involving a hydroelectric facility and requiring a FERC license or an amendment to a FERC license unless the pertinent application for certification was filed pursuant to California Code of Regulations, title 23, section 3855, subdivision (b) and that application for certification specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

CONDITION 39. This certification is conditioned upon total payment of any fee required in California Code of Regulations, title 23, article 4.

CONDITION 40. This certification is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to California Water Code, section 13330, and California Code of Regulations, title 23, division 3, chapter 28, article 6 (commencing with section 3867).

CONDITION 41. A copy of this certification shall be provided to any contractor and all subcontractors conducting Project-related work, and copies shall remain in their possession at the Project site(s). The Licensee shall be responsible for work conducted by its contractor, subcontractors, or other persons conducting Project-related work.

APPENDIX F—LITERATURE CITED

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APPENDIX I—RESERVOIR SUBSTRATE COMPOSITION

APPENDIX I

RESERVOIR SUBSTRATE COMPOSITION

The U.S. Bureau of Reclamation (Reclamation) sampled the reservoirs to determine the sediment composition and thickness throughout the reservoirs (Reclamation, 2010); table 1 describes the physical properties of the sediment in each reservoir.[24] Except for the Copco No. 2 Reservoirs, the sediment in the other reservoirs consists primarily of elastic silt and clay, with smaller amounts of elastic silt with fine sand (table 1). Sediments are, on average, coarser grained in upper reaches because coarser grain sizes settle out first and become finer toward the dam. The elastic silt in all the reservoirs had high water content and low cohesion and were found erodible. In locations with flow velocities of greater than 2 to 4 miles per hour, accumulated sediment was less than a few inches thick. The following sections summarize the findings for each reservoir from Reclamation (2010) and reflect conditions at the time of the survey.

I.1 J.C. BOYLE RESERVOIR

The upper reach of J.C. Boyle Reservoir primarily contains coarse-grained sediment, both as pre-reservoir alluvium and reservoir sediment. The reservoir has an abundance of gravel/sand bars and cobbles exposed above the reservoir water surface, with sub-surface sand and gravel found by stab-sampling. The reservoir also likely has small, local accumulations of fine-grained reservoir sediment within the upper 5,000 feet of the reservoir, but most of the reservoir sediment in this section was coarse-grained. The reservoir sediment became finer grained with distance downstream. Approximately 5,000 feet downstream, reservoir sediments were found to be 3 to 5 feet thick and composed of mostly of silty sand to poorly graded sand.

In the mid-section of the reservoir, sediment deposits were found to be thin, consisting of fine-grained elastic silt with substantial accumulations of organic material. Pre-reservoir material consisted of coarse-grained alluvium (silty gravel and sand), and bedrock consisted of volcaniclastic rock intensely weathered/decomposed to lean clay. Sediments were thickest (14 to 22 feet) in the lower section of the reservoir. Sediment in the lower section consisted uniformly of elastic silt. The sediment overlaid coarse-grained pre-reservoir alluvium consisting mostly of silty gravel with sand.

I.2 COPCO NO. 1 RESERVOIR

The upper section of the Copco No. 1 Reservoir contained sediment ranging in thickness from 3.5 to 8.0 feet and consisting of elastic silt with sand. Sediments in the remainder of the reservoir were relatively uniform and composed of elastic silt,

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[24] The study also addressed the chemical composition of the reservoir sediment. A summary of these results and the associated implications are addressed in section 3.3, *Water Quality*, of the draft EIS.

containing between 88 and 99 percent fine-grained material. The sediment thickness in the main reservoir ranged from 1.3 to 9.7 feet.

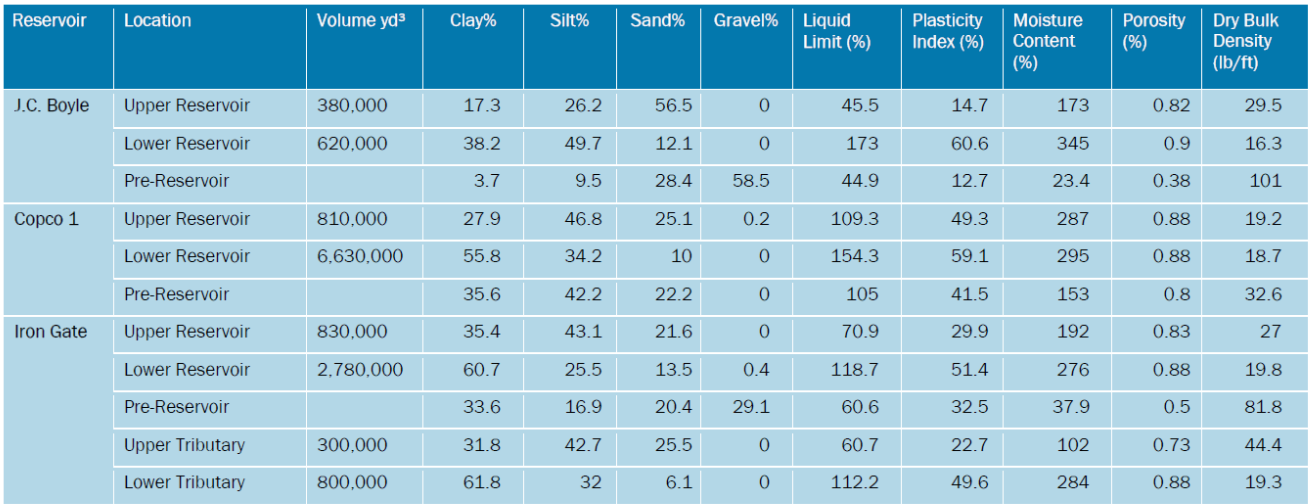
I.3 COPCO NO. 2 RESERVOIR

The upper 500 feet of the Copco No. 2 Reservoir contained deposits primarily composed of cobble boulders. Flow velocities in the reservoir channel at the time of sampling were relatively fast, suggesting that fine-grained sediment does not accumulate in this reservoir, which was also concluded from core drilling.

I.4 IRON GATE RESERVOIR

Iron Gate Reservoir has relatively steep side-slopes and a narrow channel with numerous tributaries. Two of these tributaries likely contribute substantial amounts of sediment. Only the upper 6,000 feet of the reservoir have a substantial percentage of sand within the reservoir sediment. Sediment thickness ranged from 1.4 to 9.2 feet, with most samples having a thickness of less than 5 feet. Reservoir sediment was relatively uniform throughout the reservoir and mostly fine-grained.

Table 1. Physical properties of reservoir sediment by facility (Source; Reclamation, 2010, 2011)



Reservoir	Location	Volume yd^3	Clay%	Silt%	Sand%	Gravel%	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Porosity (%)	Dry Bulk Density (lb/ft)
J.C. Boyle	Upper Reservoir	380,000	17.3	26.2	56.5	0	45.5	14.7	173	0.82	29.5
	Lower Reservoir	620,000	38.2	49.7	12.1	0	173	60.6	345	0.9	16.3
	Pre-Reservoir		3.7	9.5	28.4	58.5	44.9	12.7	23.4	0.38	101
Copco 1	Upper Reservoir	810,000	27.9	46.8	25.1	0.2	109.3	49.3	287	0.88	19.2
	Lower Reservoir	6,630,000	55.8	34.2	10	0	154.3	59.1	295	0.88	18.7
	Pre-Reservoir		35.6	42.2	22.2	0	105	41.5	153	0.8	32.6
Iron Gate	Upper Reservoir	830,000	35.4	43.1	21.6	0	70.9	29.9	192	0.83	27
	Lower Reservoir	2,780,000	60.7	25.5	13.5	0.4	118.7	51.4	276	0.88	19.8
	Pre-Reservoir		33.6	16.9	20.4	29.1	60.6	32.5	37.9	0.5	81.8
	Upper Tributary	300,000	31.8	42.7	25.5	0	60.7	22.7	102	0.73	44.4
	Lower Tributary	800,000	61.8	32	6.1	0	112.2	49.6	284	0.88	19.3

I.5 REFERENCES

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APPENDIX J—AIR QUALITY

APPENDIX J

AIR QUALITY

J.1 INTRODUCTION

The Lower Klamath Project is located on the Klamath River in Klamath County in south-central Oregon, and in Siskiyou County in north-central California (figure 1). It occupies 146.4 acres of federal land administered by the U.S. Department of the Interior, Bureau of Land Management. This appendix assesses the effects on air quality from the construction involved in the removal of four dams and associated infrastructure (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate), restoration activities on inundated land, and other construction activities associated with the Lower Klamath Project (proposed action).

The air quality of an area reflects the existing emission sources combined with the meteorology, climate, and topography of the area. Air pollution is harmful to health (e.g., respiratory distress, premature death), reduces visibility, and damages vegetation (e.g., agricultural crops, forests) (CARB, 2020a). Air quality standards are developed to protect health and the environment and are the maximum amount of a pollutant averaged over a specific period of time that can be present in the air without harming health or the environment (CARB, 2020a).

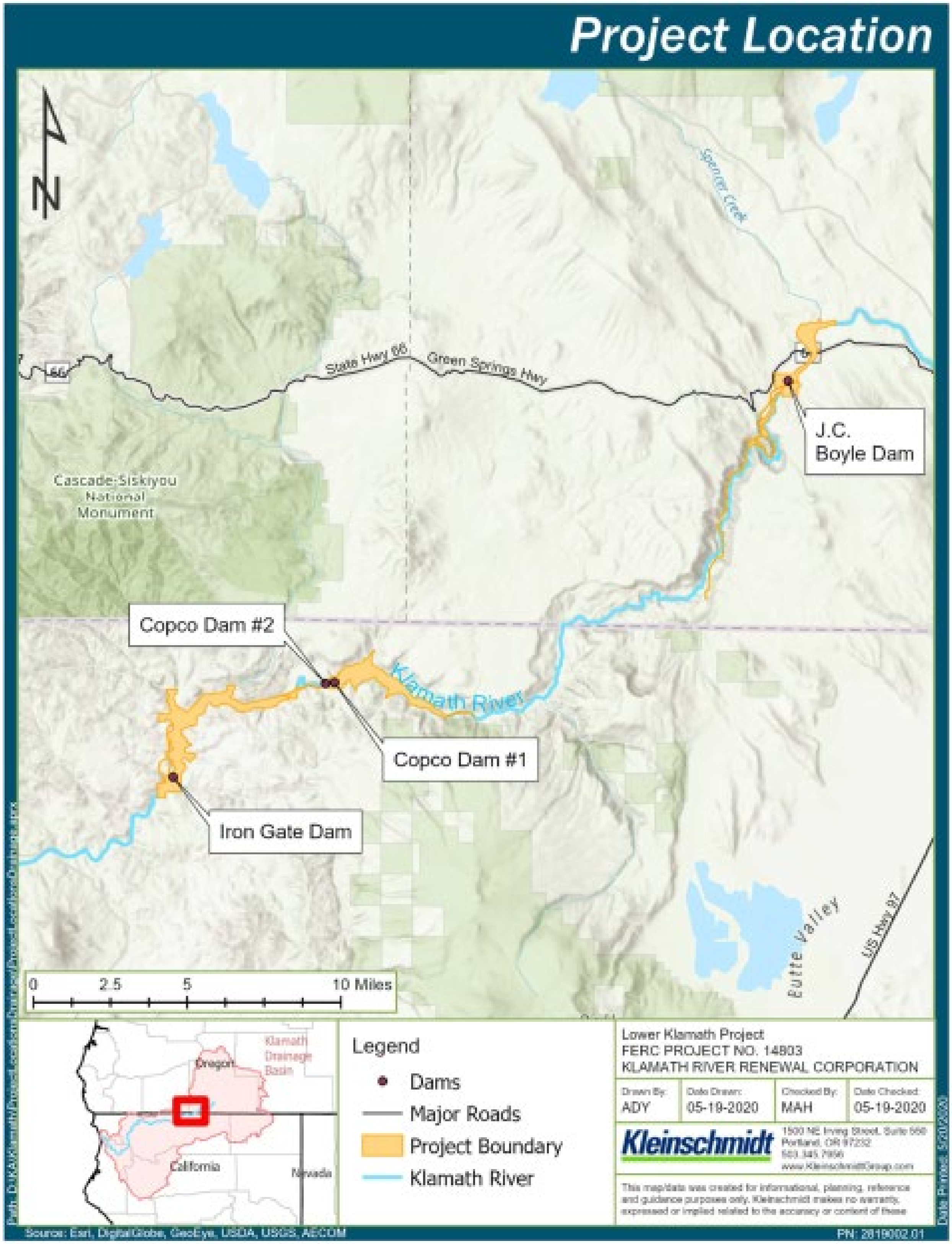

Figure 1. Lower Klamath Project Area (Source: KRRC and PacifiCorp, 2020).

J.2 AFFECTED ENVIRONMENT

The affected environment includes the counties in which the Lower Klamath Project is located or where construction vehicles or workers may travel. In California, the Lower Klamath Project and all associated construction and decommissioning activities are within the Siskiyou County Air Pollution Control District (SCAPCD), with activity at J.C. Boyle located in Klamath County, Oregon. As such, emissions estimated were conducted in accordance with SCAPCD guidance and approved methods.

The project area extends northeast along the Klamath River from the downstream end of Iron Gate Reservoir to the free-flowing water above the J.C. Boyle Reservoir. Elevations at the valley bottom rise from approximately 2,170 feet above mean sea level (amsl) at the southwestern end to approximately 3,800 feet amsl at the northeastern end. In the southwestern stretch, elevations rise several hundred feet on either side of the river. In the northeast, the river is more incised, with elevation rising as much as 1,000 feet above the valley bottom. The area surrounding the river valley is characterized by a mixture of vast arid and semi-arid basins and evergreen and hardwood forested uplands.

The entire bioregion is significantly influenced by the rain shadow effect of the Cascade Range to the west. Approximately 75 percent of the annual total rainfall occurs between November and April. Between June and September, normal rainfall typically is less than 1 inch per month. Temperatures in Siskiyou County average approximately 60 degrees Fahrenheit (°F) annually, with summer highs in the low 90°F range and winter lows in the mid 40°F range. Precipitation averages approximately 20 inches per year, although annual precipitation varies markedly from year to year (World Climate, 2016). Annual average wind speeds in Siskiyou County are approximately 6.1 miles per hour and predominantly blow from the south. The average wind speed ranges from a low of 5.0 miles per hour in the fall to a high of 7.7 miles per hour in the spring (Western Regional Climate Center, 2016).

J.2.1 Criteria Air Pollutants

The Clean Air Act requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants; ozone, carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter (PM), and lead (EPA, 2018). Particulate matter is further designated into two different size classes; PM10 (particle size less than 10 microns) and PM2.5 (particle size less than 2.5 microns). In addition, the state of California has developed California Ambient Air Quality Standards for 10 pollutants.

The status of criteria pollutants in an area is described by three categories; attainment, non-attainment, and unclassified (EPA, 2020a). An area that meets or exceeds the standard is designated as unclassifiable/attainment. Areas that do not meet the air quality standard are in non-attainment. Areas are designated as unclassifiable if EPA is unable to determine the status based on the available information (EPA, 2020a).

Maintenance areas are areas that were previously a non-attainment area but are now consistently meeting the NAAQS.

Siskiyou County is in attainment or unclassified for all criteria pollutants (CARB, 2020b) (table 1). The portion of the Lower Klamath Project in the state of Oregon is within an area that is designated as attainment for all criteria air pollutants. There are areas surrounding the Lower Klamath Project where construction vehicles or workers may travel that are in maintenance or non-attainment areas; these areas include the Klamath Falls Urban Growth Boundary (UGB), the Klamath Falls non-attainment area, and the Medford-Ashland Air Quality Maintenance Area (AQMA) (Oregon DEQ, 2020). The Klamath Falls UGB is designated as a maintenance area for CO and PM10. The Klamath Falls non-attainment area is in non-attainment for PM2.5. The Medford-Ashland AQMA is designated as a maintenance area for CO and PM2.5 (Oregon DEQ, 2020). Additional data regarding ambient air quality and attainment area designations is provided in the 2020 Environmental Impact Report (EIR) (California Water Board, 2020) and appendix N to that EIR. California Water Board 2020, Appendix N *Air Emissions Modeling for the Lower Klamath Project* provides a summary of the existing emission sources and monitoring data, detailed emission calculation methodologies, and detailed emission inventories.

Table 1. Project Area Attainment Status (Source; Interior and California DFG, 2012; CARB, 2020b; Oregon DEQ, 2020; California Water Board, 2020).

Criteria Pollutant	Federal Status: Siskiyou County	Status in California (Siskiyou County)	Federal Status: Klamath and Jackson Counties, Oregon
Ozone	Unclassified/Attainment	Attainment	Attainment
Carbon Monoxide	Unclassified/Attainment	Unclassified	Maintenance (Klamath Falls UGB, Medford-Ashland AQMA)
Nitrogen Dioxide	Unclassified/Attainment	Attainment	Attainment
Sulfur Dioxide	Unclassified/Attainment	Attainment	Attainment
PM10	Unclassified	Attainment	Attainment (Project Area) Maintenance (Klamath Falls UGB, Medford-Ashland AQMA)
PM2.5 (2012)	Unclassified/Attainment	Attainment	Attainment
Lead	Unclassified/Attainment	Attainment	NA

Criteria Pollutant	Federal Status: Siskiyou County	Status in California (Siskiyou County)	Federal Status: Klamath and Jackson Counties, Oregon
Sulfates	NA	Attainment	NA
Hydrogen Sulfide	NA	Unclassified	NA
Visibility Reducing Particles	NA	Unclassified	NA

J.2.2 Toxic Air Contaminants

Toxic air contaminants (TACs), referred to at the federal level as hazardous air pollutants, are defined as air pollutants that may cause or contribute to an increase in mortality or serious illness or pose a hazard to human health. TACs usually are present in small quantities in the ambient air. However, in some cases, their high toxicity or health risk may pose a threat to public health even at low concentrations. Of the TACs for which data are available in California, diesel PM, benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene pose the greatest risks. TACs can cause long-term health effects such as cancer, birth defects, neurological damage, and genetic damage; or short-term acute effects such as eye watering, respiratory irritation, rhinitis, throat pain, and headaches.

According to California Air Resources Board (CARB), most of the estimated health risk from TACs can be attributed to relatively few compounds, the most important being particulate matter from diesel-fueled engines (diesel PM) (CARB, 2013). Diesel PM differs from other TACs in that it is not a single substance but rather a complex mixture of hundreds of substances. Although diesel PM 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.

Statewide, diesel PM emissions account for approximately 2 percent of the annual average for on-road emissions, while other diesel PM emissions from off-road mobile sources (e.g., construction and agricultural equipment) account for an additional 3 percent (CARB, 2013). Statewide diesel PM emissions decreased approximately 37 percent from year 2000 to 2010, primarily from implementation of more stringent federal emission standards and cleaner burning diesel fuel (CARB, 2013). CARB anticipates that diesel PM emissions from on-road and other mobile sources (e.g., construction and agricultural equipment) will continue to decrease into 2035. This decrease would also be attributed to more stringent emissions standards and the introduction of cleaner burning diesel fuel.

In addition, asbestos is also considered a TAC. Naturally occurring asbestos, which was identified as a TAC in 1986 by CARB, is located in the existing geology in many parts of California. An investigation was conducted of the potential for naturally occurring asbestos to occur both in the bedrock of the Lower Klamath Project area, as well as in the concrete used to construction the dams (KRRC, 2019a). A survey of existing geologic information revealed that the mineral content typically associated with naturally occurring asbestos is not known to occur in the Lower Klamath Project boundary. According to the U.S. Geological Survey (USGS) and the Department of Conservation, Division of Mines and Geology, the geology of California has been extensively investigated. The Lower Klamath Project boundary is situated in the Western and High Cascade Range. This range consists of a suite of Tertiary and Quaternary flow rocks. Specifically, the mineral content of these mafic rocks includes andesite and basalt. Naturally occurring asbestos typically occurs in ultramafic rocks with a mineral content of serpentine and amphibole, which are not known to occur in the project area (USGS, 2019). This is confirmed by the California Water Board (2020), as well as several publicly available USGS publications focused on the Cascade Range and Northern California (USGS, 2011). While project construction activities are unlikely to disturb bedrock, these sources suggest that even if bedrock is disturbed, it is unlikely to contain naturally occurring asbestos (KRRC, 2019a).

Because of the lack of information pertaining to the specific concrete production of the dam facilities, it is not known for certain whether local aggregate was used in this process. Historical photographs suggest that concrete was locally sourced during the original construction. While available historical records do not specify the precise aggregate borrow sites, there is no evidence that aggregates were hauled long distances to the project sites. Since the aggregate was likely locally sourced, it is unlikely that the concrete would contain naturally occurring asbestos considering naturally occurring asbestos is not known to occur within the Lower Klamath Project boundary (KRRC, 2019a).

Between August and December 2018, the Klamath River Renewal Corporation (KRRC) conducted hazardous building materials surveys (HBMS) at the following sites; J.C. Boyle development, Copco No. 1 development, Copco No. 2 development, Iron Gate development, Iron Gate and Fall Creek Hatcheries, and the City of Yreka Intake Structure and Dam. Where accessible, bulk concrete samples were collected as part of these surveys in accordance with the CARB method 435 Method to determine the presence of naturally occurring asbestos. Concrete samples did not contain detectable naturally occurring asbestos above the polarized light microscopy point count threshold of 0.25 percent at each of the sites (KRRC, 2019a). Based on the above information, removal of these facilities is unlikely to release naturally occurring asbestos, and the proposed action is not subject to the requirements of 17 California Code of Regulations

93105 (Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations) (CARB, 2002).

The proposed action would result in the demolition of the existing structures and other infrastructure at the Lower Klamath Project facilities. Some of the existing structures on the project sites were constructed prior to 1978. Accordingly, there is the potential for asbestos-containing materials to be present in the structures that would be demolished as part of the proposed action. Demolition of structures with asbestos-containing materials can result in potential exposure of people to airborne asbestos. Inhalation of asbestos can cause long-term health effects such as reduced respiratory function, fibrotic lung disease (asbestosis), lung cancer, and mesothelioma. Enlargement of the heart can also occur as an indirect effect from the increase resistance of blood flow through the lungs.

KRRC conducted the most recent asbestos-containing materials surveys between August and December 2018 as part of the HBMS. During 2018, sample and analysis was performed in accordance with EPA Natural Emission Standards for Hazardous Air Pollutants requirements. Detectable asbestos above 0.1 percent was identified in several materials (e.g., surfacing materials, thermal system insultation, and miscellaneous materials). KRRC and its representatives will be performing a Level II Project Facilities Inspection in the future.

J.2.3 Regional Haze

To protect visibility in Class I federal lands (e.g., national parks and scenic areas), EPA adopted the Regional Haze Rule in 1999. This rule lays out specific requirements to ensure improvements in the anthropogenic components of visibility at 156 of the largest national parks and wilderness areas across the United States, which are referred to as Federal Class I areas. The goal of the Regional Haze Rule is to ensure that visibility on the 20 percent of the most impaired days continues to improve at each Federal Class I Area, and that visibility on the 20 percent least impaired days does not get worse. The vast majority of Class I Areas are in the West (118), with 29 in California, including Yosemite and Sequoia National Parks. Good visibility is essential to the enjoyment of national parks and scenic areas. Across the United States, regional haze has decreased the visual range in these pristine areas from 140 miles to 35–90 miles in the west, and from 90 miles to 15–25 miles in the east. This haze is composed of small particles that absorb and scatter light, affecting the clarity and color of what humans see in a vista. The pollutants (also called haze species) that create haze are measurable as sulfates, nitrates, organic carbon, elemental carbon, fine soil, sea salt, and coarse mass. Anthropogenic sources of haze include industry, motor vehicles, agricultural and forestry burning, and dust from soils disturbed by human activities. Pollutants from these sources, in concentrations much lower than those that affect public health, can impair visibility anywhere (CARB, 2009).

To comply with the Regional Haze Rule, CARB developed a Regional Haze Plan in 2009 (2009 Plan) that sets out a long-term path towards attaining improved visibility in national parks and other scenic areas, with the goal of achieving visibility which reflects natural conditions by year 2064. Unlike State Implementation Plans that require specific targets and attainment dates, the Regional Haze Rule requires states to provide for a series of interim goals to ensure continued progress. The state Haze Plans must be submitted to EPA for review and approval. Progress towards the interim goals is evaluated in a progress report that is required to be prepared every five years. Additionally, a plan revision with new interim goals is required every 10 years.

The 2009 Plan sets forth visibility goals and represents California's broader western regional effort to assess the visibility improvements for the first interim goal period of 2018. Currently, no other interim goals have been finalized.

An update of the 2009 Plan will address the second planning period from 2018 to 2028. The western states have built upon the lessons learned in the first planning period (i.e., 2009–2018) to work toward new tools and methodologies for understanding regional haze in the second planning period. Regional haze planning in the future will require additional improvements in the analysis of anthropogenic emissions, as well as improvements to quantify natural and international emissions (Uhl et al., 2019).

J.3 ENVIRONMENTAL EFFECTS DETERMINATION METHODS

This analysis uses estimates of emissions that would occur from construction activities involved with the removal of the dams and related infrastructure, haul and worker commuter trips, land restoration activities, as well as other project elements. These estimates came from a variety of emissions models and spreadsheet calculations, as identified in California Water Board 2020, Appendix N, *Air Emissions for the Lower Klamath Project*. Appendix N analyses include emissions generated by off-road equipment exhaust, off-road fugitive dust, on-road fugitive dust and exhaust, and supporting activities (restoration activities using helicopters and marine workboats).

No increases in operational emissions would occur as part of the proposed action; therefore, this analysis considers only construction-related air quality impacts. Operational emissions under current conditions are estimated to be significantly greater than operational emissions under the proposed action because the existing operational emissions generated by the four Lower Klamath Project facilities (e.g., emissions from employee traffic, emissions from maintenance equipment and minor repairs, fugitive dust from traffic on unpaved roads) would be eliminated, and production levels at the two hatcheries post-dam removal would decrease relative to current conditions. Overall, it is anticipated that there would be a net decrease in operational emissions post-dam removal under the proposed action.

The air quality impact modeling described in Appendix N, Air Emissions Modeling (California Water Board, 2020) for the Lower Klamath Project is based on the information available in EIR Appendix B Definite Plan as well as conservative assumptions regarding construction-related activities (e.g., overlapping of construction phases, equipment horsepower ratings).

J.3.1 Quantification of Criteria Air Pollutants

Quantification of air pollutant emissions was conducted using a combination of methods, including the use of emission factors from the EPA's published AP-42: Compilation of Air Emissions Factors, exhaust emission factors from the Sacramento Metropolitan Air Quality Management District's (SMAQMD) Road Construction Emissions Model (RCEM), conservative assumptions regarding project activities (e.g., overlapping of construction phases, equipment horsepower ratings), and the California Emissions Estimator Model (CalEEMod) version 2016.3.2. Although the RCEM model was created by SMAQMD, this model is recommended for use throughout California for California Environmental Quality Act (CEQA) analyses.

Exhaust emissions from construction equipment were estimated using SMAQMD RCEM, version 9.0. Although the model was developed by SMAQMD, emission rates and engine usage factors for construction equipment are based on the same CARB-approved model (i.e., OFFROAD 2011) used in CalEEMod and statewide for conducting emissions modeling and is therefore appropriate for use in this analysis (SMAQMD, 2019). Exhaust emissions from supplemental construction equipment such as lawnmowers, chippers, and chainsaws were estimated using OFFROAD 2007 because these equipment types are not included in the SMAQMD's RCEM. Additional supplemental construction equipment including worker boats and helicopters were estimated using EPA and the Federal Office of Civil Aviation emissions factors, respectively. Rock blasting activity emissions were also estimated using AP-42 emissions factors for explosive detonation. The CARB EMFAC 2017 model was used to estimate emissions from on-road vehicles from worker commute trips and truck hauling trips. Fugitive dust emissions from construction activity (e.g., grading, earthmoving, stockpiling of material), travel on roads for truck haul trips, and worker commute trips were estimated using AP-42.

The proposed action schedule was used to determine when the maximum construction activity would occur, based on anticipated activity phasing, for comparison of emissions to maximum daily thresholds of significance. Overall, the construction phasing was determined based on Appendix B: Definite Plan – Section 8.6 Construction Schedule. Generally, the dates associated with construction phases in the Definite Plan were pushed forward one year to acknowledge KRRC's recent proposed schedule adjustments (KRRC, 2019b); the overall duration of each phase/subphase remained approximately the same.

Equipment activity data (e.g., type, quantity, hours/day) were associated with the appropriate major construction phase (e.g., pre-dam removal, dam and powerhouse removal, restoration). However, after a review of the anticipated construction phasing presented in the Definite Plan, activity hours were further split into subphases for Copco

No. 1 and Iron Gate Dams to isolate activities that would occur prior to the major dam removal activities. For Copco No. 1 Dam demolition, activities were sub-divided into three subphases; dam modification, powerhouse demolition, and dam demolition. For Iron Gate Dam removal, activities were also sub-divided into three subphases; dam modification, fish hatchery at dam toe demolition, and dam demolition. For this analysis, it was assumed that the recreational facilities removal and the supporting construction or pre-dam removal construction phases would occur prior to major dam removal activity. Because these phases would occur prior to dam removal, they are not included in the calculation of the maximum daily emissions scenario. The maximum daily emissions scenario would occur during dam removal.

In determining the potential maximum daily emissions, the main dam demolition phases for Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle were all assumed to overlap by at least one day. Activities associated with blasting would also potentially occur during each of the main dam demolition phases. Lastly, restoration of all four dams would overlap with the four dam demolitions and blasting activities. Appendix N, table RE-N-3 (California Water Board, 2020) provides the overall anticipated construction schedule and general phasing. Maximum daily emissions were estimated by reviewing the overall project schedule in the Definite Plan and determining which phases would overlap to generate the highest emissions.

Since issuance of the Draft EIR in 2018, KRRC has proposed and agreed to implement mitigation measures to reduce emissions of NOx and PM, including Mitigation Measures Air Quality (AQ)-1 (Off-road construction equipment), AQ-2 (On-road construction equipment), AQ-3 (Trucks used to transport materials), AQ-4 (Blasting-related dust control measures) (KRRC, 2019c), and AQ-5 (General construction dust control measures) (KRRC, 2019d) (see section J.4 in this appendix). Mitigation Measure AQ-1 requires the use of off-road construction equipment (50 horsepower or greater) to meet EPA Tier 4 Final emissions standards, or Tier 3 and Tier 4 interim emissions standards if adequately documented that no Tier 4 Final equipment is available or feasible. Mitigation Measures AQ-2 and AQ-3 require on-road construction equipment and heavy-duty trucks to be equipped with engines that meet the 2010 model year or newer emissions standards. Mitigation Measure AQ-4 requires dust control measures to minimize fugitive dust emissions during blasting operations at Copco No. 1 Dam. Mitigation Measure AQ-5 requires dust control measures during general construction activity to minimize fugitive dust emissions from exposed surfaces and track-out onto paved roads. Appendix N (California Water Board, 2020) provides estimates of emissions without Mitigation Measures AQ-1 through AQ-5, as well as an estimate of the percent reduction in emissions that would occur after implementation of Mitigation Measures AQ-1 through AQ-5. These estimates primarily focus on the reductions in NOx that would occur from the implementation of Mitigation Measure AQ-1 and the reduction in PM10 that would occur from the implementation of Mitigation Measure AQ-5.

J.3.2 Significance Criteria

For the purposes of this analysis, an air quality impact would be significant if one or more of the following criteria are met:

- Substantially conflict with or obstruct implementation of the California Regional Haze Plan.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the SCAPCD is in 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 toxic air contaminant concentrations.
- Create objectionable odors adversely affecting a substantial number of people.
- Cause release of emissions that exceed 250 pounds per day for NOx, volatile organic compounds (VOC), PM10, PM2.5, or sulfur oxides (SOx); or 2,500 pounds per day for CO (SCAPCD Rule 6.1).
- Activities or emissions considered inconsistent with Oregon's Regional Haze Plan (Oregon DEQ, 2009).

The proposed action would also occur within 100 kilometers of several mandatory Federal Class I areas, which are areas in which visibility was declared by Congress to be an important value (Clean Air Act, Section 169A). The following Class I areas could be affected by the proposed action or its alternatives.

- Crater Lake National Park (Oregon)
- Gearhart Mountain Wilderness (Oregon)
- Lava Beds National Monument (California)
- Marble Mountain Wilderness (California)
- Mountain Lakes Wilderness (Oregon)

Oregon's Regional Haze Plan (Oregon DEQ 2009) indicates that the current rules addressing construction-related activities in Oregon are sufficient to prevent visibility impairment in Oregon Class I areas. Rules that address construction activities include Oregon Administrative Rule (OAR) 340-208-0110, which sets opacity limits for visible emissions from any air contaminant source and OAR 340-208-0210, which addresses fugitive emissions from a variety of sources.

California's Regional Haze Plan (CARB, 2009) indicates that CARB's In-Use Off-Road Diesel Vehicle Regulation (adopted on July 26, 2007) will reduce PM and NOx emissions by 74 percent and 32 percent, respectively, from current levels. CARB expects this measure to be sufficient to mitigate visibility impacts from construction activities.

J.3.3 Air Quality Impacts

The following paragraphs describe potential impacts due to the implementation of the proposed action.

Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of VOC, NOx, CO, SO2, PM10, and PM2.5 to levels that could exceed Siskiyou County's thresholds of significance. Emission sources include exhaust emissions from off-road construction equipment, on-road trucks, construction worker employee commuting vehicles; and fugitive dust emissions from unpaved roads and general earth moving activities. General earth moving activities that could generate fugitive dust include the operation of construction equipment on the site and removal of excavated materials (cut/fill activities).

Table 2 summarizes predicted uncontrolled peak daily and annual emission rates for VOC, NOx, CO, SO2, PM10, and PM2.5 for the proposed action. This analysis uses the conservative assumption that the peak day of construction could occur at the same time for each dam; therefore, the peak daily emissions are additive. The analysis assumes that dust control measures like watering and erosion control fabrics would be required by the U.S. Department of the Interior (Interior). In addition, the calculations assume that all haul roads would be covered in gravel with minimal silt content. As a result, these measures are included as part of the project and are not considered to be mitigation measures.

Table 2. Proposed Action Maximum Daily Emissions by Construction (Source; California Water Board 2020, Appendix N).

	Peak Daily Emissions (pounds per day)					
Location	**VOC**	**CO**	**NOx**	**SO2**	**PM10**	**PM2.52**
Iron Gate	44	255	391	11	73	21
Copco No. 1	25	146	205	24	10	14
Copco No. 2	19	448	159	23	73	13
J.C. Boyle	62	354	542	14	92	28
Blasting	-	13	3	0	-	-
Restoration	45	200	222	19	24	10
Maximum Daily	196	1,415	1,520	92	272	86

Location	Peak Daily Emissions (pounds per day)					
	VOC	**CO**	**NOx**	**SO2**	**PM10**	**PM2.52**
Significance Criteria	250	2,500	250	250	250	250

Notes: Values shown in bold exceed the SCAPCD thresholds of significance in Rule 6.1 (Construction Permit Standards for Criteria Air Pollutants). Emissions calculations are provided in Appendix N cited above.

Key:

VOC = volatile organic compounds
CO = carbon monoxide
NOx = nitrogen oxides
SO2 = sulfur dioxide
PM10 = inhalable particulate matter
PM2.5 = fine particulate matter

Cofferdams would be constructed at the four facilities during deconstruction activities. Concrete rubble, rock, and earthen materials that would come from the dam removal activities would be used as possible to construct the cofferdams. Since the cofferdams would be constructed from materials salvaged from the dam demolition activities, emissions associated with construction would already be included in the emissions inventory. Additional emissions could occur when the cofferdams are later demolished, but this activity would not cause any changes to the significance determinations. Table 2 shows maximum daily emissions resulting from construction of the proposed action. Any adverse impacts would be temporary.

As shown in table 2, NOx and PM10 emissions exceed the threshold for the combined construction phase of dam removal, blasting, and restoration. These three phases were assumed to overlap in time, generating the maximum daily emissions. Pre-dam removal activities (Fall Creek Hatchery modification; access, road, bridge, and culvert improvements, recreation facility removal, flood improvements, Yreka water supply pipeline relocation, seed collection, and invasive exotic vegetation control) were assumed to occur before the major dam removal activities, and therefore, emissions associated with these activities did not contribute to the maximum daily emissions.

Demolition of Copco No. 1 Dam could generate concrete dust, which has a high pH. Dust control measures as described in the mitigation measures identified in section J.4 below, would be used to control concrete dust to the maximum extent feasible. **The impact on air quality from emissions of NOx and PM10 from the construction of the proposed action would be a significant impact. Implementation of mitigation measures identified in section J.4 below, may reduce emissions of NOx to a less than significant level; however, emissions of PM10 would remain significant and unavoidable, and it is likely that NOx emission would also remain significant and unavoidable.**

Restoration actions could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust from the use of helicopters, trucks, and barges. Barges may be used to actively promote erosion of reservoir deposits during drawdown. Following drawdown of the reservoirs, revegetation efforts would be initiated to support establishment of native wetland and riparian species on newly exposed river-side sediment. Aerial application, using helicopters, drones, or fixed-wing aircraft, would be necessary for precision applications of material near sensitive areas and the newly established river channel. Trucks would also be used as necessary to provide seeding. Additional fall seeding may be necessary to supplement areas where spring seeding was unsuccessful.

A combination of techniques was used to estimate emissions from reservoir restoration activities. Emissions from aerial application were estimated using the Federal Aviation Administration's Emissions and Dispersion Modeling System. Emissions from barges were estimated using the following sources:

- Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data (EPA, 2000)
- AP-42, Chapter 3.3: Gasoline and Diesel Industrial Emissions (EPA, 1996)
- Title 17 California Code of Regulations, Section 93115.7: Air Toxic Control Measure for Stationary Compression-Ignition Engines – Stationary Prime Diesel-Fueled Compression-Ignition Engine (>50 bhp) Emission Standards
- Title 13 California Code of Regulations, Section 2423: Exhaust Emission Standards and Test Procedures—Off-Road Compression-Ignition Engines

Emissions from ground support equipment were estimated using the emission factors for off-road engines identified above and EMFAC for on-road motor vehicle emissions. As shown in table 3.9-4, *Klamath Facilities Removal, Final Environmental Impact Statement/Environmental Impact Report* (Interior and California DFG, 2012) emissions from reservoir restoration would not exceed significance criteria. **The impact on air quality from reservoir restoration activities would be less than significant.**

Relocation and demolition of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust. The demolition of the facilities would change recreational opportunities from lake-based recreation to river-based recreation. This change would require several recreation facilities to be reconstructed or demolished. On- and off-road construction equipment would be used to complete these activities, which would occur after the dam demolition actions. As shown in table 3.9-5 of the 2012 EIR (Interior and California DFG, 2012), emissions from the relocation and demolition of recreation facilities would not exceed significance criteria. **The impact on air quality from the relocation and demolition of the various recreation facilities would be less than significant.**

Vehicle exhaust and fugitive dust emissions from dam removal activities could exceed the de minimis thresholds in 40 CFR 93.153 that would require the development of a general conformity determination. Emissions from trucks and employee commuting could occur within the Klamath Falls UGB, the Klamath Falls non-attainment area (PM2.5), or the Medford-Ashland AQMA; therefore, emissions that would occur within these areas are subject to the requirements of general conformity. If the total of direct and indirect emissions is below the general conformity de minimis thresholds in 40 CFR 93.153, then no further action is warranted, and a general conformity determination is not required.

While only emissions that would occur within the designated non-attainment or maintenance areas would be subject to general conformity, it is not possible to separate those emissions from the project total. As a result, total emissions from haul trucks and employee commuting were compared to the general conformity de minimis thresholds as a conservative analysis. Emissions from trucks and employee commuting are less than the general conformity de minimis thresholds identified in tables 3.9-3 through 3.9-5, Interior and California DFG 2012. Therefore, a conformity determination is not necessary for any of the maintenance or non-attainment areas. **As a result, a general conformity determination is not required.**

Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas. Demolition activities would be conducted in compliance with Oregon and California regulations related to fugitive dust emissions. In addition, any fugitive dust emissions would be short term and temporary and would not have long-term effects related to visibility. **Impacts related to visibility would be less than significant.**

Short-term exposure of sensitive receptors to substantial toxic air contaminant concentrations. The areas surrounding Iron Gate Dam, Copco No. 1 Dam, and Copco No. 2 Dam is sparsely populated with few sensitive land uses. The nearest sensitive land uses to the major construction activities are recreational facilities located at Copco No. 1 and Iron Gate Reservoirs, along with hiking trails around the Fall Creek development. The next closest sensitive land uses include scattered residences that are located along the Klamath River. The closest homes to construction sites are located over 2,000 feet from Copco No. 1 Dam, over 2,700 feet from J.C. Boyle Dam, over 3,500 feet from Copco No. 2 Dam, and over 4,000 feet from Iron Gate Dam. As noted above, there are also several modular homes located at Copco Village that are currently occupied by PacifiCorp staff. These homes are located within the Limits of Work and range from 850 feet to 2,200 feet west of the Copco No. 2 Powerhouse. Prior to the beginning of dam deconstruction activities, it is anticipated that these homes would be vacated. However, for the purposes of this analysis, it is conservatively assumed that the homes at Copco Village would be occupied.

This section evaluates the proposed action's potential to create a significant hazard to sensitive receptors (e.g., residents and recreationists) near the construction sites through exposure to substantial TAC concentrations during construction activities.

According to CARB, the majority of the estimated health risk from TAC can be attributed to relatively few compounds, the most important being particulate matter from diesel-fueled engines (diesel PM) (CARB, 2013). Diesel PM differs from other TAC in that it is not a single substance but rather a complex mixture of hundreds of substances. Although diesel PM 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.

With regards to exposure of diesel PM, the dose to which receptors are exposed is the primary factor used to determine health risk. Dose is a function of the concentration of a substance or substances in the environment and the duration of exposure to the substance. Dose is positively correlated with time, meaning that a longer exposure period would result in a higher level of health risk for many exposed receptors. Thus, the risks estimated for an exposed individual are higher if a fixed exposure occurs over a longer period.

Construction-related activities would result in temporary, intermittent emissions of diesel PM from the exhaust of off-road, heavy-duty diesel equipment. On-road diesel-powered haul trucks traveling to and from the construction areas are less of a concern because they would not stay on site for long period of time. Sensitive receptors in the vicinity of the construction sites would potentially be exposed to diesel PM from heavy equipment and vehicle emission diesel exhaust during construction. However, even during the most intensive construction phases, there would not be substantial TAC concentrations, except in the immediate vicinity of the active construction sites, because concentrations of mobile-source diesel PM disperse rapidly with distance. Concentrations of mobile-source emissions of diesel PM are typically reduced by 60 percent at a distance of approximately 300 feet (Zhu et al., 2002) and 70 percent at a distance of approximately 500 feet (CARB, 2005). Construction activities for the proposed action and associated emissions would vary by construction phase and the emissions to which nearby receptors would be exposed would also vary throughout the construction period. As construction activities would take place at several construction sites, the concentration of diesel PM in any one location would be limited.

Since the recreation facilities near the construction sites would be closed during dam removal activities, it is not anticipated that recreationists would be exposed to substantial TAC concentrations during construction activity. As noted above, the closest residences are located approximately 850 feet away from the construction sites where the major construction activity associated with the proposed action would occur. Due to the short-term nature of the proposed construction activity and the fact that the nearest residences are located approximately 850 feet from where the major construction activity will occur, it is not anticipated that sensitive receptors residing at the closest residences would be exposed to substantial TAC concentrations during construction activities. Therefore, impacts from the major construction activity associated with the proposed action would be less than significant.

Some of the pre-dam removal activities may be located closer in proximity to sensitive land uses than the major construction activities associated with the proposed action. However, due to the limited scale and duration of these activities it is not anticipated that they would expose sensitive receptors to substantial TAC concentrations. Based on the emissions modeling conducted, maximum daily emissions of diesel PM (modeled by PM10 which is conservatively considered a surrogate for diesel PM), would not exceed 5 lb/day for all pre-dam removal activities, combined. This maximum daily emission level represents all pre-dam removal activities; however, individual subphases (Fall Creek hatchery modification; access, road, bridge, and culvert improvements; recreation facility removal; flood improvements; Yreka water supply pipeline relocation; seed collection and invasive exotic vegetation control; and Iron Gate Hatchery removal) would result individually in fewer emissions. Thus, due to the dispersive properties of diesel PM, concentrations from individual construction sites would be lower, resulting in less exposure to any one receptor. In addition, the use of off-road heavy-duty diesel equipment associated with pre-dam removal activities would be limited to the construction duration of less than two years but with each individual subphase being shorter (i.e., one month to six months). As construction progresses, activity intensity and duration would vary throughout the various geographic locations. As such, no single receptor would be exposed to substantial construction-related emissions of diesel PM for extended periods of time. Thus, given the temporary and intermittent nature of construction activities associated with the pre-dam removal activities, the dose of diesel PM to any one receptor would be limited. Therefore, impacts from the pre-dam removal activities would be less than significant.

As discussed earlier, an investigation was conducted of the potential for naturally occurring asbestos to occur both in the bedrock of the Lower Klamath Project boundary, as well as in the concrete used to construction the dams. An investigation was also conducted of the potential for asbestos-containing materials to occur in the structures proposed for demolition (KRRC, 2019a).

Naturally occurring asbestos has also been identified as a TAC. The naturally occurring asbestos investigation concluded that it is unlikely that the bedrock in the Lower Klamath Project boundary and the concrete used to construct the dams contain naturally occurring asbestos. Therefore, impacts related to the handling of naturally occurring asbestos would be less than significant. Although unlikely, if naturally occurring asbestos is encountered either during bedrock-disturbing activities, or in concrete during demolition activities, KRRC or its representatives will handle the naturally occurring asbestos in accordance with, as relevant, the federal EPA's fact sheet, Naturally Occurring Asbestos: Approaches for Reducing Exposure (March 2008) and the Guide to Normal Demolition Practices Under the Asbestos NESHAP (September 1992) (KRRC, 2019a).

As discussed earlier, detectable asbestos above 0.1 percent was identified in several materials in the structures proposed for demolition (e.g., surfacing materials, thermal system insulation, and miscellaneous materials) that could become airborne during project activities. Asbestos-related work (i.e., abatement and disposal of asbestos-containing materials) will be performed by KRRC and its representatives in compliance with, as relevant, local, state, and federal regulations including California Division of Occupational Safety and those implemented by the SCAPCD (KRRC, 2019a). Implementation of mitigation measures will reduce potential impacts to workers and the closest sensitive receptors from airborne asbestos to less than significant levels.

Therefore, the exposure of sensitive receptors to TAC concentrations during construction activity is less than significant with mitigation. **Impacts related to TAC would be less than significant.**

J.4 PROPOSED MITIGATION MEASURES

Article III. A Construction Emissions Mitigation Plan, to include the following air quality (AQ) mitigation measures, would be developed and implemented prior to construction activities associated with the proposed action. In addition to all applicable local, state, or federal requirements, the following control measures (Fugitive Dust, Mobile and Stationary Source and Administrative) would be included in the Construction Emissions Mitigation Plan to reduce impacts associated with emissions of PM and other toxics from construction-related activities.

AQ-1 Off-Road Construction Equipment Engine Tier:

For the construction activities occurring within California, any off-road construction equipment (e.g., loaders, excavators) that are 50 horsepower or greater must be equipped with engines that meet the EPA Tier 4 Final emissions standards for off-road compression-ignition (diesel) engines, unless such an engine is not available for a particular item of equipment. To the extent allowed by CARB off-road diesel-fueled fleets regulations, Tier 3 and Tier 4 interim engines will be allowed when the contractor has documented, with appropriate evidence, that no Tier 4 Final equipment or emissions equivalent retrofit equipment is available or feasible (CARB, 2016). Documentation may consist of signed statements from at least two construction equipment rental firms.

AQ-2 On-Road Construction Equipment Engine Model Year

Any heavy-duty on-road construction equipment must be equipped with engines that meet the model year (MY) 2010 or newer on-road emission standards.

AQ-3 Heavy-Duty Trucks Engine Model Year

Any heavy-duty trucks used to transport materials to or from the construction sites must be equipped with engines that meet the MY 2010 or later emission standards for on-road heavy-duty engines and vehicles. Older model engines may also be used if they are retrofitted with control devices to reduce emissions to the applicable emission standards.

AQ-4 Blasting-Related Dust Control Measures

Dust control measures will be incorporated to the maximum extent feasible during blasting operations at Copco No. 1 Dam. The following control measures will be used during blasting activities as applicable; Conduct blasting on calm days to the extent feasible. Wind direction with respect to nearby residences must be considered. Design blast stemming to minimize dust and to control fly rock.

AQ-5 General Construction Dust Control Measures

To reduce fugitive dust emissions, the following additional measures will be implemented:

- Water all exposed surfaces as appropriate to control fugitive dust through sufficient soil moisture. Under normal dry-season conditions this is generally a minimum of two times daily. Watering of exposed surfaces is not necessary when soils are already sufficiently wetted (e.g., during rain). Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.

- Install stabilized construction entrances where appropriate, to include geotextile fabric and/or coarse rock to manage the amount of soil tracked onto paved roadways by motor vehicle equipment, and suspended in runoff, from the active construction sites.

J.5 MITIGATED AIR QUALITY IMPACTS

The use of EPA Tier 4 engines, as proposed by Air Quality Mitigation Measure AQ-1, can reduce diesel exhaust (i.e., PM10) and NOx emissions by up to 90 percent over Tier 1 engines (SMAQMD, 2016a). However, construction fleets in California comprise a combination of engines, ranging from Tier 1 to Tier 4, and as older equipment are rebuilt or replaced, the composition of higher tiered engines will increase. At this time, the ratio of Tier 4 or Tier 3 engines the construction fleet will have cannot be determined. Further, certain equipment types/sizes are not always available in Tier 4 engines, so it cannot be guaranteed that the entire fleet can be composed of Tier 4 engines (California Water Board, 2020, Appendix N). As shown above in table 2 (table RE-N-6, California Water Board, 2020, Appendix N), maximum daily emissions of NOx were estimated to be as high as 1,520 lb/day, and therefore, an 84 percent reduction in emissions would be needed to achieve the 250 lb/day threshold. Considering that statewide average construction fleet emissions continue to improve, and the unlikeliness that Tier 4 engines would be available for all equipment types, the needed 84 percent reduction in NOx emissions would not be achieved and emissions would remain above the 250 lb/day threshold for NOx (California Water Board, 2020, Appendix N).

The use of on-road construction equipment and heavy-duty trucks that meet MY 2010 or newer emissions standards, as proposed by Mitigation Measures AQ-2 and AQ-3, can also reduce diesel exhaust (i.e., PM10) and NOx emissions. However, due to the uncertainty of the specific model year emissions standards that will be met by the construction fleet for the proposed action, providing an accurate quantification of these reductions was not feasible. Therefore, it is estimated that the needed 84 percent reduction in NOx emissions would not be achieved and emissions would remain above the 250 lb/day threshold for NOx (California Water Board 2020, Appendix N).

Implementation of the dust control measures in Mitigation Measures AQ-4 and AQ-5 can reduce fugitive dust by up to 50 percent. As noted above, the implementation of Mitigation Measure AQ-1 could also significantly reduce exhaust emissions (i.e., PM10). As shown above in table 2, maximum daily emissions of PM10 were estimated to be as high as 272 lb/day, and approximately 77 percent of these emissions would be from fugitive dust and 23 percent would be from exhaust. Therefore, a 50 percent or greater reduction in fugitive dust and exhaust emissions would reduce PM10 emissions well below the 250 lb/day threshold.

With the implementation of Mitigation Measures AQ-1 through AQ-5, construction emissions from the proposed action would still result in significant and unavoidable impacts from NOx.

J.6 REFERENCES

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APPENDIX K—TRIBAL VIEWS ON DAM REMOVAL

APPENDIX K

TRIBAL VIEWS ON DAM REMOVAL

(as summarized by FERC staff)

This summary does not speak for the participating Tribes or provide their perspectives on the proposed Lower Klamath Project decommissioning and dam removal. Such perspectives have been provided by the Tribes in countless letters and meetings over the last two decades. Instead, this summary provides a very brief account of each participating Tribe's general position regarding the removal of the J.C. Boyle, Copco No. 1 and No. 2, and Iron Gate Dams as contained within the more recent (post-2017) public record filed with the Commission with the caveat that, throughout the process, the Tribes' voices have spoken for themselves.

From time immemorial, the Lower Klamath River has been the life spirit of the indigenous people who have resided on its shores and have relied on the resources that it provides. As mentioned by the Hoopa Valley Tribe[25] and later reiterated by the Yurok Tribe,[26] the fishery of the Klamath River was "not much less necessary to the existence of the Indians than the atmosphere they breathed" *Blake v. Arnett*, 663 F.2d 906, 909 (9th Cir. 1981) (quoting *United States v. Winans*, 198 U.S. 371, 381 (1905)).

The importance of the Klamath River to the regional Tribes is reflected in the extensive record of correspondence, interviews, and words spoken at project meetings during the proposed relicensing of the Klamath Hydroelectric Project (FERC No. 2082) by representatives of a number of Tribes, including, but not limited to, the Hoopa Valley Tribe, Karuk Tribe, Yurok Tribe, Klamath Tribes, Quartz Valley Indian Reservation, Shasta Indian Nation, Shasta Nation, and Resighini Rancheria. Subsequent comments received from the Tribes regarding the proposed removal of the four dams associated with the Lower Klamath Project have continued to evidence the ties that these Tribes have to the river and have further documented their strong views.

Section 4.2.15 of the California State Water Resources Control Board's (California Water Board) Scoping Report for the Lower Klamath Project License

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[25] Hoopa Valley Tribe. Motion to Intervene and Comments Regarding Notice of Application for Surrender of Project License. Filed on February 11, 2021 (20210211-5093).

[26] Yurok Tribe. Comments on the Notice of Intent to Prepare an Environmental Impact Statement for the Proposed Lower Klamath Project Surrender and Removal filed on August 20, 2021 (20210820-5045).

Surrender Environmental Impact Report (April 2017; filed April 9, 2020[27]) summarizes the perspectives and comments of a number of Tribal representatives on the proposed project. These comments include, but are not limited to:

- Concerns regarding the health of the river and water quality and a desire for river restoration.
- Potential benefits to recreational fishing and the desire for a traditional fishery to be reestablished.
- Concerns regarding potential effects of the removal of the dams on cultural resources and traditional cultural properties.
- Concerns regarding the potential effects of low river flows on Tribal ceremonies.

Since that time, consultation with Tribal organizations has continued, through written correspondence in response to Klamath River Renewal Corporation's (KRRC) application and also as expressed at numerous Cultural Resources Working Group, Tribal Caucus, and Federal Energy Regulatory Commission (FERC or Commission) consultation and scoping meetings. Tribal attendance at these meetings is documented in the KRRC's May 20, 2021, response to the Commission's April 26, 2021, request for additional information.[28] This consultation continues to reiterate many of these same comments and views identified in the Water Board's EIR.

In a January 16, 2018, scoping meeting,[29] members of the Hoopa Valley Tribe expressed support for removal of the Lower Klamath Project dams, but also concerns regarding potential effects on Tribal fishery rights and fishery management. In its subsequent Motions to Intervene filed on February 11, 2021,[1] and February 26, 2021,[30] the Hoopa Valley Tribe further explained that the location of the Hoopa Indian Reservation, which was established by the federal government in 1864, was selected

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[27] California State Water Resources Control Board. Final Environmental Impact Report for the Lower Klamath Project License Surrender, Volume II, Part 1. filed on April 9, 2020 (20200409-5054).

[28] KRRC. Response to April 26, 2021, Additional Information Request, Attachment 2, Response to AIR-2, National Historic Preservation Act Consultation Record (20210520-5129).

[29] FERC. Transcript of the January 16, 2018, Scoping Meeting, Hoopa Valley Tribe Neighborhood Facilities, Hoopa, CA (20180116-4007).

[30] Hoopa Tribe. Motion to Intervene and Comments Regarding Notice of Application for Transfer of License. Filed on February 26, 2021 (20210226-5312).

because it is located within the Tribe's traditional territory and also because of its location proximate to the Trinity and Klamath Rivers and to the natural resources these two rivers provide. The Tribe stated that one of the intents of the federal government in choosing this location for the reservation was to ensure that the Tribe would be "self-sufficient" and would be able to "achieve a moderate living based on fish." In its filings, the Tribe asserted that the decommissioning and removal of the four Lower Klamath River developments would be "necessary and appropriate to restore significant anadromous fish habitat and to mitigate and restore water quality in the Klamath River…such decommissioning and removal is necessary to open up additional habitat, improve water quality, reduce fish disease levels, and to provide other benefits that will help preserve and protect the Klamath River's anadromous fish populations that the Tribe depends on for its culture, subsistence, and economy."

In a scoping meeting held on January 17, 2018,[31] representatives of the Karuk Tribe expressed concern regarding algae blooms, decreased salmon populations in the Klamath River, and correlations between a decrease in salmon consumption and Tribal health issues and that "the flavor of algae we have here is important because it's not only a problem for fish health but it's a human health risk." A Tribal member commented that "time is of the essence for dam removal." In its Motion to Intervene filed on February 12, 2021,[32] the Karuk Tribe explained that its ancestral homelands are based along the middle Klamath River and, despite historic hardships, Tribal members "remained in our traditional territory refusing to succumb to the violence and oppression" of others and that "Karuk fishermen continue to fish using traditional methods today as they have for time immemorial." The Tribe refers to the studies that have described the negative effects of the Lower Klamath Project dams on the river and asserts that that removal of the four dams "is key to restoring runs of salmon at-risk of extinction and dramatically improve water quality in a river basin plagued annually by massive blooms of toxic blue-green algae" and that the Tribe is "no longer able to access enough fish to meet even the needs of religious ceremonies much less subsistence needs."

These same concerns about the river have also been expressed by the Yurok Tribe. In a scoping meeting held with the Tribe on January 19, 2018,[33] a Tribal member commented that the Lower Klamath dams should be removed "so that the river can begin to heal, to be able to provide, and sustain the salmon runs which in turn feed many other animals, people, and give people joy." In the meeting, Tribal members affirmed their commitment to dam removal. In its Motion to Intervene filed on February 12, 2021, the

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[31] FERC. Transcript of the January 17, 2018, Scoping Meeting, Karuk Department of Natural Resources, Orleans, CA (20180117-4003).

[32] Karuk Tribe. Motion to Intervene (20210212-5116).

[33] FERC. Transcript of the January 19, 2018, Scoping Meeting, Yurok Tribe, Klamath Tribal Office, Klamath, CA (20180119-4008).

Tribe reiterated that it has occupied the lowest segment of the Klamath River since time immemorial. Like the Hoopa Valley Tribe, the Yurok Tribe explained that the Yurok Reservation was established in its current location so that the Tribe "could maintain its fishing and river-centric way of life, reserving to the Tribe fishing and water rights to support that lifestyle."[34] Further, in its comments on the Commission's Notice of Intent,[35] the Tribe refers to the 2012 Secretarial Determination Environmental Impact Statement (EIS)/Environmental Impact Report and states that, since that time, "the crisis has only worsened, and in no small part due to the dams, toxic algae effects to the river, record low salmon runs, a suicide epidemic and further entrenchment of poverty on the reservation, all of which can be tied to the continued damage to the River in part due to the presence of the dams" and that "the salmon are going extinct right before our eyes and another year delay could lead to the tipping point beyond which we can save Klamath River salmon." Finally, in a meeting between Commission staff and representatives of the Yurok Tribe held on October 11, 2021, a member of the Yurok Tribal Council shared that high algae levels in the Klamath River were discouraging individuals from swimming and recommended that prompt action be undertaken to ensure the health of the river.[36]

In November 2020, both the Karuk Tribe and the Yurok Tribe indicated their commitment to removal of the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams by signing a Memorandum of Agreement (MOA) with the State of Oregon and the State of California, PacifiCorp, and KRRC. The purpose of the MOA is to implement the amended Klamath Hydroelectric Settlement Agreement.

The Klamath Tribes of southern Oregon, consisting of the Klamath, Modoc, and Yahooskin-Paiute people,[37] have also actively participated in consultation. In a scoping meeting held on January 18, 2018,[38] Tribal representatives expressed concern regarding algae and the importance of reestablishing indigenous fish populations. According to its November 14, 2017, Motion to Intervene regarding the Lower Klamath Project and also

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[34] Yurok Tribe. Motion to Intervene (20210212-5017).

[35] Yurok Tribe. Comments on the Notice of Intent to Prepare an Environmental Impact Statement for the Proposed Lower Klamath Project Surrender and Removal filed on August 20, 2021 (20210820-5045).

[36] FERC Memo (20211013-4000).

[37] The Modoc Nation is based in Oklahoma, but the Klamath Tribes and Modoc Nation consider themselves related.

[38] FERC. Transcript of the January 18, 2018 Scoping Meeting, Klamath Tribes Administration Building, Chiloquin, OR (20180118-4007).

the Klamath Project (FERC No. 2062),[39] the Klamath Tribes reiterate that they retain Treaty-reserved hunting, fishing, and gathering rights along the Klamath River (*Kimball v. Callahan 493 F.2d 564 (9th Cir. 1974) ("Kimball I)(; Kimball v. Callahan, 590 F. 2d 768 (9th Cir. 1979)(Kimball II*)). Additionally, according to court decisions, the Tribes have "reserved water rights to sufficient water instream to support the populations of fish and wildlife on which those Treaty rights depend" (*United States v. Adair, 723 F.2d 1394 (9th Cir. 1983*)). In its motion, the Tribe states that it is "obligated by its constitution and culture to ensure that it supports every effort to remove the dams and re-open the Klamath River." At the January 18, 2018, scoping meeting,[13] a member of the Modoc Tribe commented that, when the Klamath River dams were constructed, "you took a big chunk out of this whole chain—the eco-system that now we are seeing the damages" to salmon and suggested that "we can maybe turn back the clock a little bit and make this area a little bit closer to what it was before." Additionally, at a subsequent February 5, 2018, Tribal consultation teleconference meeting,[40] a Tribal representative expressed concern regarding potential effects on inundated cultural resources, fish habitat, the elimination of the project reservoirs as a source of water for fire-fighting purposes, liability issues, and potential economic effects. The representative stated that "it would be premature of us to support this without further involvement of the Tribe."

On January 19, 2021, the Shasta Indian Nation filed its Notice of Intervention for the proposed decommissioning. In its notice, the Shasta Indian Nation comments that its aboriginal homelands include currently inundated lands at the Copco No. 1, Copco No. 2, and Iron Gate Reservoirs and states that "ancestors of the present-day membership of the Shasta Indian Nation had their lands taken by eminent domain during the construction of the Copco Dams."[41] Further, the Shasta Indian Nation expresses concern regarding submerged cultural, ceremonial, and burial sites that are located beneath these three reservoirs. Their views regarding the removal of the four dams are not provided in their written correspondence.

The Shasta Nation also participated in consultation and attended numerous meetings. During the prior Klamath Hydroelectric Project relicensing, the Shasta Nation filed a letter to Commission staff on April 27, 2004, stating that "the dams/structures in the Iron-Gate/Copco Complex must be decommissioned immediately and removed in their entirety from the river's riparian area and the area restored to its formal natural

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[39] Klamath Tribes. Motion to Intervene and Motion for Permission to File Motion to Intervene After Deadline. Filed November 14, 2017 (20171114-5012).

[40] FERC. Transcript of February 5, 2018, Modoc Tribal Consultation Meeting. (20180313-4001).

[41] Shasta Indian Nation. Motion to Intervene/Notice of Intervention for Federal Energy Regulatory Commission's Klamath (P-2082-062) and Lower Klamath (P-14803) Projects, Regarding Notice of Application for Surrender of License (20210119-5021).

condition." However, according to the notes from a November 16, 2018, Tribal Caucus meeting, the Shasta Nation had more recently expressed concerns regarding the removal of the four dams, and KRRC had sent them a letter "acknowledging their position of non-support" to dam removal and inviting their continued participation in the caucus meetings with the caveat that the meetings would be held with the assumption that the dams would be removed.[42] During the November 2018 meeting, the Shasta Nation expressed concerns regarding this letter, but the details regarding these concerns are not provided in the meeting notes. The Shasta Nation's current views on the proposed decommissioning and removal of the dams is not known.

The Quartz Valley Community of the Quartz Valley Indian Reservation in Scotts Valley is fed by Shackleford Creek, which receives salmon from the Klamath River via the Scott River. In a scoping meeting with the Tribe held on January 16, 2018,[43] Tribal representatives expressed concern about the timing of dam removal, fish migration, and a desire to see as many fish as possible in the Scott River prior to the initiation of work associated with decommissioning. At a subsequent June 4, 2019, Cultural Resources Working Group meeting, a representative of the Tribe stated that the Klamath River would "be beautiful once it's a free-flowing river again."

The U.S. Environmental Protection Agency recognizes the Resighini Rancheria as having water quality authority over water resources of the Rancheria and, because it borders the Klamath River, it maintains riparian water rights.[44] Representatives of the Rancheria participated in Klamath Hydroelectric Project relicensing consultation and provided comments on the Commission's Draft EIS for that project. The Rancheria was also invited to participate in the Lower Klamath River undertaking and meetings but has not actively responded. In a Cultural Resources Working Group meeting held on March 15, 2018, a representative of the California Office of Historic Preservation noted that the Rancheria may have opted to have the Yurok Tribe represent their interests regarding the project. However, in earlier letters to the Commission filed on January 18, 2005,[45] and

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[42] KRRC. Response to April 26, 2021 Additional Information Request, Attachment 2, Response to AIR-2, National Historic Preservation Act Consultation Record, pg. 693 (20210520-5129).

[43] FERC. Transcript of the January 16, 2018 Scoping Meeting, Quartz Valley Indian Reservation, Fort Jones, California. (20180116-4008).

[44] KRRC. Response to April 26, 2021, Additional Information Request, Attachment 5, Response to AIR-5, Phase II Archaeological Research Design and Testing Plan, pg. 113 (20210520-5129).

[45] Resighini Rancheria. Follow-up Comments Regarding December 16, 2004 Government-to-Government Meeting with FERC Representatives filed January 24, 2005 (20050124-5068).

November 29, 2006,[46] the Rancheria expressed its position regarding dam removal and stated that the Commission must "remedy the abridgement of our traditional rights as long recognized by the federal government and guide the river's return to good health and allow the restoration of the fish on which we and other Tribes rely. The Council believes that dam removal is the path you must follow to honor that commitment and that such actions must be taken expeditiously to avoid irretrievable and irreversible harm to both Public Trust and Tribal Trust resources."

A representative of the Confederated Tribes of the Siletz Indian Reservation also attended two consultation meetings (November 29, 2018, and June 4, 2019) and inquired about recreation closures, sedimentation and siltation, coldwater fish refuge areas, and cultural sites but did not express an opinion regarding the removal of the Lower Klamath dams.

Representatives of the Trinidad Rancheria have not attended any of the Cultural Resources Working Group or Tribal Caucus meetings associated with the Lower Klamath Project and have not forwarded an opinion regarding dam removal.

In summary, consultation with the participating Tribes indicates a strong support for the removal of the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Dams with the consensus being that removal is necessary to restore anadromous fish habitat and improve water quality in the Lower Klamath River. While many Tribes have also expressed concern regarding issues such as sediment passage, exposure and/or erosion of significant cultural resources, the record indicates that most Tribes have supported removal of the dams as quickly as possible.

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[46] Resighini Rancheria. Comments on the Draft Environmental Impact Statement (DEIS), Klamath Hydroelectric Project filed November 29, 2006 (20061129-5052).