Chapter 4
Cumulative Effects

This chapter describes the cumulative effects of the Proposed Action and alternatives. Included here are descriptions of the regulatory requirements, methods, and past, present, and reasonably foreseeable future actions considered as part of the analysis.

4.1 Cumulative Effects Overview

Cumulative effects are those environmental effects that, on their own, may not be "significant" (National Environmental Policy Act [NEPA]) or "considerable" (California Environmental Quality Act [CEQA]), but when combined with similar effects over time, result in "significant" (NEPA) or "considerable" (CEQA) effects. Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects, and any resulting environmental degradation, that should be the focus of cumulative impact analysis. While impacts can be differentiated by direct, indirect, and cumulative, the concept of cumulative impacts takes into account all disturbances since cumulative impacts result in the compounding of the effects of all actions over time. Thus the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource no matter what entity (Federal, non-Federal, or private) is taking the actions (EPA 315-R-99-002/May 1999). Cumulative effects are an important part of the environmental analysis because they allow decisionmakers to look not only at the impacts of an individual proposed project, but the overall impacts on a specific resource, ecosystem, or human community over time from several different projects.

4.1.1 Regulatory Requirements

Both the NEPA and the CEQA require consideration of cumulative effects in an Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The National Historic Preservation Act (NHPA) requires consideration of cumulative effects to historic properties.

4.1.1.1 National Environmental Policy Act

Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions (40 CFR Section 1508.7)."

NEPA regulations require an analysis of direct, indirect, and cumulative effects and define "effects" as "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative (40 CFR Section 1508.8)." In addition, the NEPA regulations state that when determining the scope of an EIS, both connected and cumulative actions must be discussed in the same document as the Proposed Action (40 CFR Section 1508.25(a)(1) and (2)).

4.1.1.2 National Historic Preservation Act

The regulations for Section 106 of the NHPA define "adverse effect" as an undertaking that "may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association." (36 CFR Section 800.5(a)(1)). "Adverse effects" explicitly include "reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative." (36 CFR Section 800.5(a)(1)). Cumulative effect under Section 106 of the NHPA applies only to those resources that are listed in or eligible for the National Register. Much of the analysis regarding potential cumulative adverse effects to historic properties, including proposed mitigation measures, is discussed in Chapter 3.13, Cultural Resources.

4.1.1.3 California Environmental Quality Act

Cumulative effects are defined in the CEQA Guidelines as:

> "Two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.
>
> (a) The individual effects may be changes resulting from a single project or a number of separate projects.
>
> (b) The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time (CEQA Guidelines Section 15355)."

According to the CEQA Guidelines, a Lead Agency must discuss the cumulative impacts of a project when the cumulative effect is significant and the project's incremental contribution to the cumulative effect would be "cumulatively considerable," that is, when the incremental effects of a project would be significant when viewed in connection with the effects of past, present, and probable future projects (CEQA Guidelines Section 15065(a)(3); Section 15130(a)).

If the combined cumulative impact associated with the project's incremental effect and the effects of other projects would not be significant, an EIR should briefly indicate why the cumulative impact is not significant (CEQA Guidelines Section 15130(a)(2)).

Additionally, an EIR can determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and therefore not significant. A project's contribution can also be less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The Lead Agency must identify facts supporting this conclusion (CEQA Guidelines Section 15130(a)(3)).

4.2 Cumulative Effects Methods

The Lead Agencies began analyzing cumulative effects in the Klamath Facilities Removal EIS/EIR by reviewing the impacts of the Proposed Action and alternatives on the specific environmental resources presented in Chapter 3. The Lead Agencies then identified past, present, and reasonably foreseeable future actions that could contribute to cumulative effects on each resource, and defined an area of analysis and timeframe for the potential cumulative effects for each resource. The Lead Agencies determined the significance of identified cumulative effects in accordance with CEQA requirements. As noted above, NEPA and CEQA have differing definitions of significance for cumulative effects; in most cases NEPA does not require a specific determination of significance, while CEQA does. If the Lead Agencies determined that a cumulative effect would be significant, feasible mitigation measures are proposed in this chapter. If no feasible mitigation would be possible (i.e., the technology does not exist), the cumulative effect is considered significant and unavoidable.

4.2.1 Identifying Past, Present, and Future Actions Contributing to Cumulative Effects

CEQA Section 15130(b)(1) identifies two methods that may be used to analyze cumulative impacts:

1. “A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency,” and/or

2. “A summary of projections contained in an adopted local, regional, or Statewide plan or related planning document, that describes or evaluates conditions contributing to the cumulative effect. Such plans may include: a general plan, regional transportation plan, or plans for the reduction of greenhouse gas emissions. A summary of projections may also be contained in an adopted or certified prior environmental document for such a plan. Such projections may be supplemented with additional information such as a

> regional modeling program. Any such document shall be referenced and made available to the public at a location specified by the lead agency."

The Lead Agencies analyzed cumulative impacts using both CEQA methods identified above. Some resources use a combination of both methods, when applicable. Table 4-1 lists the method used to evaluate the cumulative impacts for each resource, either the project method (#1) above, the projection method (#2) above, or a combination of both.

Table 4-1. Method for Developing the Cumulative Condition

Resource	Method for Developing the Cumulative Condition
Water Quality	(1) Project Method, and (2) Projection Method
Aquatic Resources	(1) Project Method, and (2) Projection Method
Algae	(1) Project Method, and (2) Projection Method
Terrestrial Resources	(1) Project Method
Flood Hydrology	(1) Project Method, and (2) Projection Method
Ground water	(1) Project Method, and (2) Projection Method
Water Supply/Water Rights	(1) Project Method
Air Quality	(1) Project Method, and (2) Projection Method
Greenhouse Gases/Global Climate Change	(2) Projection Method
Geology, Soils and Geologic Hazards	(1) Project Method
Tribal Trust	(1) Project Method
Cultural and Historic Resources	(1) Project Method
Land Use, Agricultural and Forest Resources	(1) Project Method
Socioeconomics	(1) Project Method, and (2) Projection Method
Environmental Justice	1) Project Method
Population and Housing	(2) Projection Method
Public Health and Safety, Utilities and Public Services, Solid Waste, Power	(1) Project Method, and (2) Projection Method
Scenic Quality	(2) Projection Method
Recreation	(1) Project Method
Toxic/Hazardous Materials	(1) Project Method
Traffic and Transportation	(1) Project Method
Noise and Vibration	(1) Project Method, and (2) Projection Method

The methods described above for CEQA are considered to be sufficient to identify past, present, and future actions for the NEPA cumulative analysis.

The Lead Agencies used a variety of Federal, tribal, State, county, and local government sources to identify and collect information on past, present, and reasonably foreseeable actions in the project area that could contribute to cumulative effects (see Table 4-2). These include:

- City and County General Plans
- Biological Management Plans
- Population, housing, traffic, and other projections found in existing city and county general plans
- Scoping comments
- Consultation with Federal and State agencies
- Published reports, documents, and plans
- Existing environmental documents

In addition to the documents reviewed above, the Lead Agencies mailed a formal request to the following transportation, city, and county planning departments on January 21, 2010, requesting information on past, present, and future actions in the area of analysis:

- Siskiyou County, California
- Klamath County, Oregon
- City of Yreka
- City of Chiloquin
- California Department of Transportation (Caltrans), District 2
- Oregon Department of Transportation, Region 4

Relevant information collected as part of this effort is presented Section 4.3 and was considered in this cumulative analysis.

4.2.2 Cumulative Effects Area of Analysis

Both NEPA and CEQA require a defined geographic scope for a cumulative effects analysis (Council of Environmental Quality [CEQ] 1997; CEQA Guidelines 15130(b)(3)). For NHPA, the Area of Potential Effects for the cumulative analysis is the same as the one defined in Section 3.13, Cultural and Historical Resources. The cumulative area of analysis for each resource in this EIS/EIR varies depending on the type of impacts that could occur and the nature of those impacts. The areas of analysis for some resource areas have clearly defined cumulative boundaries while others are more general in nature. Table 4-2 lists the area of analysis for each resource area's cumulative impacts related to the Klamath Hydroelectric Settlement Agreement (KHSA). The general cumulative effects area of analysis for the KBRA includes the Klamath Basin and its tributaries. Generally, fisheries programs proposed in the KBRA apply to

the entire basin, while programs related to water use apply mostly to the Upper Klamath Basin upstream of J.C. Boyle Dam. County and tribal programs apply to the relevant jurisdictions throughout the entire basin.

Table 4-2. Cumulative Effects Area of Analysis by Resource for Removal of the Four Facilities (KHSA)

Resource	Area of Analysis	Justification
Water Quality	Rivers, streams and reservoirs within the Upper and Lower Klamath Basins including Wood, Williamson and Sprague Rivers; Upper Klamath Lake; the Klamath River to the Klamath River Estuary; the Klamath River watershed; and the nearshore environment	This is the extent of physical and operational changes affecting water quality
Aquatic Resources	Surface waters within the Klamath Basin affected by dam removal activities excluding the Lost River watershed, Tule Lake basin, and Trinity River. The Klamath River to the Pacific Ocean and the nearshore environment	This is the extent of physical changes affecting water quality, habitat, and flows
Algae	Surface waters within the Klamath Basin affected by dam removal activities excluding the Lost River watershed, Tule Lake basin, and Trinity River. The Klamath River to the Pacific Ocean and the nearshore environment	This is the extent of physical changes affecting water quality, habitat, and flows
Terrestrial Resources	Klamath River channel and riparian habitat adjacent to the channel from Keno Dam downstream to the Pacific Ocean; the dam sites and construction areas, including equipment staging and access areas	This is the extent of physical changes affecting habitat
Flood Hydrology	The Klamath River watershed starting at J.C. Boyle reservoir and continuing downstream from the deconstruction area of the four dams to the Pacific Ocean	This is the extent of potential changes in surface water elevation
Ground water	Ground water supply wells adjacent to J.C. Boyle, Copco1, Copco 2, and Iron Gate reservoirs	This is the extent of physical changes affecting ground water
Water Supply/Water Rights	An area surrounding the Klamath River main stem between Upper Klamath Lake and Seiad Valley.	This is the extent of physical and operation changes affecting water supply and water rights
Air Quality	Klamath and Jackson Counties in Oregon and Siskiyou and Shasta Counties in California	Air quality impacts would occur within Siskiyou County, California and Klamath County, Oregon for Facility removal activities, while additional impacts could occur in Jackson County, Oregon and Shasta County, California from truck or construction worker travel
Greenhouse Gases/Global Climate Change	Greenhouse Gases geographic scope includes the entire State of California and Oregon	Total greenhouse gas emissions are available for the State of California; therefore this analysis examines cumulative greenhouse gas emission targets for the entire State

Table 4-2. Cumulative Effects Area of Analysis by Resource for Removal of the Four Facilities (KHSA)

Resource	Area of Analysis	Justification
Geology, Soils and Geologic Hazards	The reservoir bed and banks at the sites of the reservoirs impounded by J.C. Boyle Dam, Copco 1, Copco 2, and Iron Gate Dams, as well as the riverbed and adjacent banks along the Klamath River downstream from Iron Gate dam to its mouth at the Pacific Ocean	This is the extent of physical changes affecting geology, soils and geologic hazards
Tribal Trust	The area of analysis includes the entire 263 miles of the Klamath River and the Klamath Basin. The federally recognized tribes within this area of analysis include the Klamath Tribes, Quartz Valley Community, Karuk Tribe, Hoopa Valley Tribe, Yurok Tribe, and Resighini Rancheria	This is the geographic extent of the tribal trust resources that could be affected by the project are located
Cultural and Historic Resources	Known and unknown cultural and historic resources in the vicinity of the Four Facilities and the Klamath Basin where construction or land disturbance could occur	This is the extent of where cultural and historic resources could be affected
Land Use, Agricultural and Forest Resources	All lands directly adjacent to the Four Facilities	This is the extent of physical and operational changes affecting land use
Socioeconomics	Regional economies with Siskiyou, Humboldt, Del Norte, and Modoc counties in California and Klamath and Jackson counties in Oregon. For commercial fishing, regional economies also include San Mateo, San Francisco, Marin, Sonoma and Mendocino (as well as Humboldt and Del Norte) counties in California, and Curry, Coos, Douglas and Lane counties in Oregon.	This is the extent of the counties that could experience socioeconomic effects
Environmental Justice	Siskiyou, Humboldt, Del Norte, Shasta, Modoc and Mendocino counties in California and Klamath, Jackson and Curry counties in Oregon	These are the counties that contain environmental justice populations that could be affected by the project
Population and Housing	The area of analysis includes a combination of urban and rural communities: Hornbrook and Yreka in California and Klamath Falls and Medford in Oregon. The area of analysis also includes the residential rural areas immediately near the Copco 1 and 2 Dams and just upstream of the J. C. Boyle Dam	These are the communities with the potential to house temporary construction workers
Utilities and Public Services, Solid Waste, Public Health and Safety, Power	Utilities and Public Services: Existing utilities and public services supplying Siskiyou and Klamath Counties	These are the two counties that could experience utility and service effects from construction
	Solid Waste: Existing landfills in Siskiyou and Klamath Counties	Waste generated by the project would be sent to waste facilities in these two counties
	Public Health and Safety: The proposed dam deconstruction areas surrounding the Four Facilities (for deconstruction related safety issues), downstream from the dams (for flooding impacts), and the associated reservoirs (for impacts related to wildfires and public health issues)	This is the extent of construction activities that could affect public health and safety

Table 4-2. Cumulative Effects Area of Analysis by Resource for Removal of the Four Facilities (KHSA)

Resource	Area of Analysis	Justification
	Power: Existing generator facilities, employees and local customer base in Siskiyou and Klamath Counties and other potential power supply sources used to service the existing customer base	This is the extent of hydroelectric power service that would be affected by the Proposed Action. Other sources of power will be needed to replace lost service
Scenic Quality	All areas surrounding the Four Facilities that would have views of the four reservoirs or the Klamath River from J.C. Boyle to Iron Gate Dam	This is the extent of physical changes affecting aesthetics and visual resources
Recreation	Recreation areas at the lakes/reservoirs, the Klamath River and applicable tributaries within the Klamath Basin. Wildlife refuges and other regional recreation areas affected by changes at some reservoirs are included	This is the extent of physical and operational changes that could affect recreation
Toxic/Hazardous Materials	The proposed deconstruction areas surrounding the Four Facilities, transportation routes and disposal points for toxic hazardous materials	This is the area where exposure to toxic or hazardous materials could occur during deconstruction, transport and/or disposal activities
Traffic and Transportation	Roadways within Klamath and Jackson Counties in Oregon and within Siskiyou County in California	These are the roadways that would be used by construction vehicles and workers
Noise and Vibration	The region surrounding the Four Facilities and the haul routes in Klamath and Jackson Counties, Oregon and Siskiyou and Shasta Counties, California	This is the extent of where deconstruction and restoration activities would produce noise and vibration

4.2.3 Timeframe

Cumulative effects consider the timeframe for the project-specific analysis as well as how long the effects of the project are expected to last. There may be instances when the timeframe for cumulative effects must be expanded to encompass cumulative effects occurring further into the future (Council on Environmental Quality 1997). The Proposed Action and alternatives would not be implemented until 2020; however this cumulative analysis must rely on information available at the time of this document.

The timeframe for this cumulative effects analysis varies by environmental resource and is described for each resource area in this chapter. For several resources, impacts would occur only for the duration of deconstruction; for these resources, the cumulative effects analysis timeframe includes only the duration of deconstruction (May 2019 through December 2021). For other resources, long-term effects could occur even after deconstruction, so the Lead Agencies examined a longer timeframe. The timeframe for cumulative effects analysis also depends on the type of information available. Many general plans or other documents that are used to obtain relevant projections only have forecasts for 10 or 20 years from the date of the document. The timelines identified for long-term cumulative effects are based on the best available existing information. The cumulative effects analysis also accounts for past and present projects to the extent feasible.

4.2.4 Mitigation

4.2.4.1 National Environmental Policy Act

According to NEPA, a discussion on mitigation for adverse environmental effects is required in an EIS (40 Section Part 1502.16(h), 40 CFR Section 1502.14(f)); however, a final set of mitigation measures that are selected for implementation are adopted in a Record of Decision (ROD). If mitigation measures presented in the EIS are not adopted, the reasons why must be explained in the ROD (40 CFR Section 1505.2(c)). This cumulative effects analysis will identify potential mitigation for significant cumulative effects; the ROD will present the final mitigation measures adopted as part of the project that will be completed with the respective alternative selected for implementation.

4.2.4.2 National Historic Preservation Act

The United States Department of the Interior (DOI) is required to develop appropriate measures to avoid, minimize, or mitigate adverse effects to historic properties under Section 106 of the NHPA (36 CFR Sections 800.6, 800.8(c)(1)(v)). Such measures were identified and described in Chapter 3.13. These measures will be incorporated into the ROD and will become binding terms for addressing potential adverse effects to historic properties, including such effects identified as cumulative.

4.2.4.3 California Environmental Quality Act

Mitigation requirements of CEQA differ from those of NEPA. An EIR must examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects (CEQA Guidelines Section 15130). In addition, no public agency can approve or carry out a project with an EIR that identifies significant impacts unless the public agency makes one or more written findings for each of those significant effects (CEQA Guidelines Section 15091). Therefore, CEQA requires each public agency to mitigate or avoid the significant effects of projects that it carries out or approves whenever it is feasible to do so. (Pub. Res. Code § 21002.1(b)). This cumulative effects analysis will identify all feasible mitigation measures for effects of the project determined to be “cumulatively considerable.” The certification of the EIR and subsequent CEQA findings will contain the feasible mitigation measures adopted as part of the project.

4.3 Actions and Projects Considered in Cumulative Effects Analysis

This section outlines all the past, present, and reasonably foreseeable actions or projects that could contribute to cumulative effects and that were considered in the analysis.

4.3.1 Documents Reviewed

The Lead Agencies consulted many documents as part of this cumulative effects analysis to identify projects, plans, programs, and projections. Table 4-3 lists the documents considered in this analysis.

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
Federal					
Reclamation, U.S. Fish and Wildlife Service, Hoopa Valley Tribe, and Trinity County	Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement and Record of Decision	Trinity River	Aquatic Resources	2000	Undefined
U.S. Environmental Protection Agency	Trinity River Total Maximum Daily Load for Sediment	Trinity River	Aquatic Resources, Water Quality	2001	Undefined
Department of the Interior	Long Range Plan for the Klamath Basin Conservation Area Fishery Restoration Program (Klamath River Basin Fisheries Task Force 1991)	Klamath Basin	Aquatic Resources, Water Quality	1991	1986 to 2006
National Oceanic and Atmospheric Administration Fisheries Service	Final Environmental Assessment: Authorization for Incidental Take and Implementation of the PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for coho Salmon	PacifiCorp's existing Project facilities and the adjacent water and land areas potentially influenced by Project maintenance and operations, including the mainstem Klamath River and reservoirs from Link River dam at the outlet of Upper Klamath Lake down to the Klamath River estuary	Aquatic Resources	2012	10 years
National Oceanic and Atmospheric Administration Fisheries Service Southwest Region	Biological Opinion for Klamath River Project - Operation of the Klamath Project between 2010 and 2018 and its Effects on South Oregon/Northern California Coast coho Salmon	Klamath Project Area - Klamath County, Oregon, Siskiyou and Modoc Counties, California	Aquatic Resources	2010	2010 to 2018
National Oceanic and Atmospheric Administration Fisheries Service	Draft Central California Coast coho Salmon Recovery Plan	West Coast from British Columbia to California	Aquatic Resources	2010	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	Critical Habitat for the Southern Distinct Population Segment of Eulachon	California	Aquatic Resources	2010	Undefined

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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
National Oceanic and Atmospheric Administration Fisheries Service and United States Fish and Wildlife Service	Draft Environmental Impact Statement for Authorization for Incidental Take and Implementation of Fruit Growers Supply Company's Multispecies Habitat Conservation Plan	The Klamath River and Scott Valley management units are located west of Interstate 5, adjacent to and intermixed with Klamath National Forest lands	Aquatic Resources, Terrestrial Resources	2009	50 Years
National Oceanic and Atmospheric Administration Fisheries Service	2007 Federal Recovery Outline Southern Oregon/Northern California Coast coho Salmon	California and Oregon	Aquatic Resources	2007	Undefined
National Oceanic and Atmospheric Administration Fisheries Service	Biological Opinion for the Klamath Hydroelectric Project License[1]	Klamath River, Klamath County, Oregon and Siskiyou County, California	Aquatic Resources	2007	50 Years
U.S. Fish and Wildlife Service	Klamath Marsh National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment	Klamath Marsh National Wildlife Refuge	Terrestrial Resources, Water Quality	2010	2025 and beyond
U.S. Fish and Wildlife Service	Biological/Conference Opinion Regarding the Effects of the U.S. Bureau of Reclamation's Proposed 10-Year Operation Plan (April 1, 2008 – March 31, 2018) for the Klamath Project and its Effects on the Endangered Lost River and Shortnose Suckers	Klamath Project (Project) in Klamath County, Oregon and Modoc and Siskiyou Counties	Aquatic Resources	2008	2008 to 2018
U.S. Fish and Wildlife Service	Biological Opinion on the Proposed Relicensing of the Klamath Hydroelectric Project[2]	Klamath River, Klamath County, Oregon and Siskiyou County, California	Aquatic Resources	2007	50 Years
National Oceanic and Atmospheric Administration Fisheries Service	Pacific Coast Management Plan Amendment 14 Appendix A: Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon	Washington, Oregon, California	Aquatic Resources	1999	Undefined

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
U.S. Fish and Wildlife Service	Recovery Plan for Bull Trout	Columbia River/Klamath	Aquatic Resources	2002	Undefined
Redwood National and State Parks	General Management Plan/General Plans	Redwood National and State Parks	Land Use, Agriculture and Forest Resources/Soils/Water Quality/ Aquatic Resources	2000	2020
Bureau of Land Management	Cascade-Siskiyou National Monument Record of Decision and Resource Management Plan	Cascade-Siskiyou National Monument	Land Use, Agriculture and Forest Resources/Soils/Water Quality/ Aquatic Resources/Recreation	2008	2008-2023
National Park Service	Lava Beds National Monument Draft General Management Plan and Environmental Assessment	Lava Beds National Monument	Land Use, Agriculture and Forest Resources/Soils/Water Quality/ Aquatic Resources/Recreation	2010	2010-2025
U.S. Forest Service Pacific Northwest Region	Land and Resource Management Plan, Fremont National Forest and Amendments (and associated Planning Documents)	Fremont National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1989 for the original plan and 36 Amendments to the Plan are also listed starting in year 1992 and ending in July of 2010	1989-2004
U.S. Forest Service Pacific Northwest Region	Land and Resource Management Plan, Wineman National Forest and Amendments (and associated Planning Documents)	Wineman National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1990 with Amendments up to 2010	1990-2005
U.S. Forest Service Pacific Southwest Region	Shasta-Trinity National Forest, Land and Resource Management Plan	Shasta-Trinity National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995	Management Actions 1995-2010 Planning horizon 1995-2045
U.S. Forest Service Pacific Southwest Region	Six Rivers National Forest, Land and Resource Management Plan and Amendment	Six Rivers National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995 with Amendment in 2008	1995-2010

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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
U.S. Forest Service Pacific Southwest Region	Klamath National Forest, Land and Resource Management Plan and Amendments (and associated Planning Documents)	Klamath National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1995 with Amendments up to 2001	Management Direction Planning Period 1995-2010 Long Range Planning 1995-2045
U.S. Forest Service Pacific Southwest Region	Modoc National Forest, Land and Resource Management Plan and Amendments (and associated Planning Documents)	Modoc National Forest	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1991	1991-2006
U.S. Forest Service	Northwest Forest Plan Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl	Federal lands including U.S. Forest Service and Bureau of Land Management (BLM) lands within the range of the northern spotted owl in Oregon, Washington and northern California.	Land Use, Agriculture and Forest Resources /Soils/Water Quality/ Aquatic Resources/Recreation	1994	Undefined
U.S. Forest Service	Northwest Forest Plan Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl	Federal lands including U.S. Forest Service and BLM lands within the range of the northern spotted owl in Oregon, Washington and northern California.	Land Use, Agriculture and Forest Resources /Tribal Trust/Forest Resources/ Terrestrial Resources/ Water Quality	Undated	Undefined
U.S. Forest Service	Northwest Forest Plan—The First 10 Years (1994–2003): Socioeconomic Monitoring of the Klamath National Forest and Three Local Communities	Scott Valley, Butte Valley, and Mid-Klamath corridor	Land Use, Agriculture and Forest Resources / Socioeconomics	2008	1994-2003
U.S. Forest Service	Sierra Nevada Forest Plan Amendment	Sierra Nevada including Modoc Plateau	Land Use, Agriculture and Forest Resources / Socioeconomics	2003	2004 - 2104

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Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
Bureau of Land Management	Record of Decision and Resource Management Plan Klamath Falls Resource Area December 2008	BLM Land within Klamath Falls Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	2008	Undefined
Bureau of Land Management	Klamath Falls Resource Area Upper Klamath Basin and Wood River Wetland Record of Decision and Resource Management Plan	BLM Land within the Upper Klamath Basin and Wood River Wetland Project	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	1996	Undefined
Bureau of Land Management	Redding Resource Management Plan and Record of Decision	BLM Land within the Redding Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	1993	1993-2008
Bureau of Land Management	Record of Decision Alturas Resource Management Plan	BLM Land within the Alturas Resource Area	Land Use, Agriculture and Forest Resources / Socioeconomics/ Aquatic Resources /Water Quality	2008	2008-2023
Bureau of Land Management	Klamath River Gravel Placement and Bypass Barrier Removal Environmental Assessment and FONSI	BLM Land within the Hydroelectric Reach	Aquatic Resources, Water Quality	2011	2011 to 2020
National Research Council	Hydrology, Ecology, and Fishes of the Klamath Basin	Klamath Basin	Aquatic Resources	2008	2008
Federal Energy Regulatory Commission	Final Environmental Impact Statement for License, Klamath Hydroelectric Project Federal Energy Regulatory Commission Project No. 2082-027	Klamath Hydroelectric Project	Aquatic Resources	2007	30 to 50 years after license issued
Tribal					
Hoopa Valley Tribe	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan	Hoopa Valley Indian Reservation	Water Quality	2008	2008-2018
Yurok Tribe	Water Quality Control Plan	Yurok Lands	Water Quality	2004	Undefined
Klamath Tribes, Yurok Tribe	Reintroduction of Anadromous Fish to the Upper Klamath Basin: An Evaluation and Conceptual Plan	Upper Klamath Basin	Aquatic Resources	2006	Undefined
Karuk Tribe Department of Natural Resources	Draft Eco-Cultural Resources Management Plan	Tribal Trust properties along the Klamath River between Yreka and Orleans, California	Cultural Resources	2010	Undefined

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
State					
California State Parks	California Recreational Trails Plan	Designated trails in California including Klamath Basin	Recreation	2002	Undefined
California Department of Water Resources	California Water Plan and 2009 Update	California	Water Quality/Water Supply/Water Rights	2009	2050
California Department of Water Resources	Climate Change Characterization and Analysis in California Water Resources Planning Studies	California	Greenhouse Gasses/Global Climate Change	2010	Undefined
California Department of Transportation and California Department of Fish and Game	California Essential Habitat Connectivity Project, A Strategy for Conserving a Connected California	California including the North Coast and Modoc Plateau in area of analysis	Aquatic Resources/Terrestrial Resources	2010	Undefined
California Department of Transportation	California Transportation Plan 2025	California	Traffic and Transportation / Socioeconomics	2006	Through 2025
California Department of Fish and Game	California Wildlife Conservation Challenges, California's Wildlife Action Plan	California including the North Coast and the Modoc Plateau in the area of analysis	Aquatic Resources/Terrestrial Resources	2005	Update conservation actions every 5 to 10 years
California Department of Fish and Game	A Status Review of the Longfin Smelt (*Spirinchus thaleichthys*) in California	California	Aquatic Resources	2009	2009
California Department of Fish and Game	Suction Dredging Permit Program Draft Subsequent Environmental Impact Report	California	Socioeconomics/ Aquatic Resources	2011	Undefined
California Department of Fish and Game	Recovery Strategy for California coho Salmon	California	Aquatic Resources	2004	Undefined
California State Parks	California Outdoor Recreation Plan 2008	California	Recreation	2009	2009-2014
California Department of Housing and Community Development	2010-2015 Consolidated Plan and 2010-2011 Annual Plan for federally-Funded Community Development Programs Operated by the State of California	California	Population and Housing/ Socioeconomics	2010	2010-2015

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
Governor's Office of Emergency Services	State of California Emergency Plan	California	Public Health and Safety/ Flood Hydrology	2005	Undefined
Riparian Habitat Joint Venture	The Riparian Bird Conservation Plan	California	Terrestrial Resources	2004	Undefined
California, Oregon, Washington	West Coast Governors' Agreement on Ocean Health Action Plan	California, Oregon, Washington	Water Quality/Aquatic Resources/ Socioeconomics	2008	Undefined
North Coast Regional Water Quality Control Board	Action Plan for the Scott River Sediment and Temperature Total Maximum Daily Loads	Scott River	Water Quality/Aquatic Resources	2005	Undefined
North Coast Regional Water Quality Control Board	Salmon River Total Maximum Daily Load for Temperature and Implementation Plan	Salmon River	Water Quality/Aquatic Resources	2005	Undefined
North Coast Regional Water Quality Control Board	Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads	Shasta River	Water Quality/Aquatic Resources	2006	Undefined
North Coast Regional Water Quality Control Board	Water Quality Control Plan for the North Coast Region	The Klamath Basin within California and the North Coastal Basin within all of Del Norte, Humboldt, Trinity, and Mendocino Counties and major portions of Siskiyou and Sonoma Counties and small portions of Glenn, Lake and Marin counties.	Water Quality/Aquatic Resources	2011	Updated every 3 years
North Coast Regional Water Quality Control Board	Action Plan for the Klamath River Total Maximum Daily Loads Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in the Klamath River in California and the Lost River Implementation Plan	Klamath Basin in California	Water Quality/Aquatic Resources	2010	Undefined

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
North Coast Regional Water Quality Control Board	2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments Requiring Total Maximum Daily Loads	North Coast Region and Klamath Basin in California	Water Quality/Aquatic Resources	2007	2019
State Water Resources Control Board	2008 Notice of Preparation for an Environmental Impact Report for the Project entitled Long-Term Modification and Interim Operation of the Klamath Hydroelectric Project, and Continued Long-Term Operation of All or Part of the Klamath Hydroelectric Project, to Meet Conditions of Water Quality Certification and to Conform with Water Quality Standards.	PacifiCorp's Klamath Hydroelectric Project on Klamath River in California, and only to the extent that discharges from the Oregon facilities adversely impact the California environment.	Geology and soils. Water resources, Aquatic resources, • Terrestrial resources, Threatened and endangered species, Recreation, Land use and aesthetics, Socioeconomic impacts, Cultural impacts , Noise, Traffic , Air quality , Public services, Agricultural resources, Growth-inducing impacts, Climate change, Hazardous materials, Cumulative impacts, Mitigation measures	2008	Interim for 3 to 5 years; long term undefined.
State Water Resources Control Board	Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality	Applies to enclosed bays and estuaries only including Klamath estuary.	Water Quality/Aquatic Resources	2009	Undefined
State Water Resources Control Board	Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California	Applies to coastal and interstate waters and enclosed bays and estuaries of California including Klamath estuary	Water Quality/Aquatic Resources	Undated	Undefined
State Water Resources Control Board	Letter to FERC Docket P-2082 amending Resolution No. 2010-0024 issued May 18, 2010, accepting PacifiCorp's request that the Clean Water Act 401 certification process be held in abeyance in accordance with KHSA provision 6.5.	PacifiCorp's Klamath Hydroelectric Project on Klamath River in California, and only to the extent that discharges from the Oregon facilities adversely impact the California environment.	Water Quality/Aquatic Resources	2012	Through July 17, 2013

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
Oregon Department of Environmental Quality	A Plan for Maintaining The National Ambient Air Quality Standards for PM10 in Klamath Falls Urban Growth Boundary, Section 4.56 of the State Implementation Plan	Klamath Falls Urban Growth Boundary	Air Quality	2002	Through 2015
Oregon Department of Environmental Quality	Upper Klamath Lake Drainage Total Maximum Daily Load and Water Quality Management Plan	Upper Klamath Lake Drainage Area	Water Quality/Aquatic Resources	2002	Ongoing
Oregon Department of Environmental Quality	Final Upper Klamath and Lost River Subbasins Total Maximum Daily Load and Water Quality Management Plan	Upper Klamath and Lost River Subbasins	Water Quality/Aquatic Resources	2011	Undefined
Oregon Department of Environmental Quality	PacifiCorp's annual Date Stamped Copy of Section 401 Water Quality Certification Application Withdrawal and Resubmittal in accordance with KHSA provision 6.5.	PacifiCorp's Klamath Hydroelectric Project's J.C. Boyle reservoir on Klamath River in Oregon.	Water Quality/Aquatic Resources	2012	Until December 31, 2012
Oregon Parks and Recreation Department	The 2008-2012 Oregon Statewide Comprehensive Outdoor Recreation Plan	Oregon	Recreation	2008	2008-2012
Oregon Department of Fish and Wildlife	A Plan for the Re-Introduction of Anadromous Fish in the Upper Klamath Basin	Oregon portion of Klamath Basin	Aquatic Resources	2008	Undefined
County					
Modoc County	Modoc County General Plan	Modoc County, California	Traffic and Transportation/Noise	1988	1988 - 2008
Trinity County	Trinity County General Plan	Trinity County, California	Traffic and Transportation/Noise	Housing 2003 Open Space and Conservation 1973 Safety 2002	20 years
Trinity County	Trinity County Regional Transportation Plan - Final	Trinity County, California	Traffic and Transportation/Noise/ Air Quality/Greenhouse Gasses/ Global Climate Change/ Socioeconomics	2011	2011-2030

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
Humboldt County	Humboldt County General Plan Update Planning Commission Hearing Draft	Humboldt County, California	Traffic and Transportation/Noise/ Air Quality/Greenhouse Gasses/Global Climate Change/Socioeconomics	2008	2008-2028
Mendocino County	General Plan	Mendocino County, California	Traffic and Transportation/Noise/ Air Quality/Greenhouse Gasses/Global Climate Change/Socioeconomics	2009	Undefined
Mendocino County	General Plan Coast Element	Mendocino County Coastal Area, California	Aquatic Resources	Revised 1991	Undefined
Siskiyou County	General Plan	Siskiyou County, California	Traffic and Transportation/Public Utilities and Services/Population and Housing/ Land Use, Agriculture and Forest Resources /Noise/Socioeconomics/ Recreation/ Greenhouse Gasses/Global Climate Change	1970s, Housing Element was updated in 2008	Undefined
Siskiyou County	Siskiyou County Comprehensive Land & Resource Management Plan	Siskiyou County, California	Water Supply and Water Rights/Land Use, Agriculture and Forest Resources/ Socioeconomics/Recreation/ Cultural and Historic Resources/ Traffic and Transportation/ Geology, Soils, Geological Hazards	1996	Undefined
Del Norte County	General Plan	Del Norte County, California	Traffic and Transportation/Noise /Air Quality/Greenhouse Gasses/Global Climate Change	2003	2015
Shasta County Regional Transportation Planning Agency	Final Draft 2010 Regional Transportation Plan	Shasta County, California	Traffic and Transportation/Noise/ Air Quality/Greenhouse Gasses/Global Climate Change	2010	2010-2030
Shasta County Regional Transportation Planning Agency	Shasta Forward Final Report	Shasta County, California	Traffic and Transportation /Air Quality/Greenhouse Gasses/Global Climate Change	2010	Long range

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
Jackson County	Comprehensive Plan	Jackson County, Oregon	Traffic and Transportation /Air Quality/Socioeconomics	2004	Undefined
Jackson County	Transportation System Plan	Jackson County, Oregon	Traffic and Transportation /Air Quality	2005	2005-2025
Curry County	Comprehensive Plan	Curry County, Oregon	Land Use, Agriculture and Forest Resources/Population and Housing/Traffic and Transportation /Socioeconomics	Latest Amendment 2006	2009
Klamath County	Comprehensive Plan	Klamath County, Oregon	Land Use, Agriculture and Forest Resources /Scenic Quality /Cultural Resources /Recreation /Housing/Public Utilities and Services/ Traffic and Transportation/Recreation/ Greenhouse Gasses/Global Climate Change	2010	Undefined
Klamath County	Transportation System Plan	Klamath County, Oregon	Traffic and Transportation /Air Quality/Population and Housing	2010	2010-2030
Klamath County	Economic Opportunities Analysis and Long-Term Urban Land Needs Assessment	Klamath County, Oregon	Land Use, Agriculture and Forest Resources /Population and Housing/Socioeconomics/ Greenhouse Gasses/Global Climate Change	2009	2059
Del Norte, Humboldt, Mendocino, Siskiyou & Trinity Counties	Five Counties Salmonid Conservation Program	Del Norte, Humboldt, Mendocino, Siskiyou & Trinity Counties in California	Aquatic Resources	Undefined	Undefined
City					
City of Eureka	2009-2014 General Plan Housing Element	Eureka, California	Population and Housing	2010	2009-2014
City of Eureka	General Plan	Eureka, California	Land Use, Agriculture and Forest Resources / Housing/ Traffic and Transportation/Recreation	Adopted 1997, Amended 1999	1997-2022

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
City of Klamath Falls	Comprehensive Plan	Klamath Falls, Oregon	Cultural Resources/Recreation/ Traffic and Transportation/Land Use, Agriculture and Forest Resources	1981	Undefined
City of Klamath Falls	Economic Opportunities Analysis and Long-Term Urban Land Needs Assessment	Klamath County, Oregon	Land Use, Agriculture and Forest Resources /Population and Housing/Socioeconomics	2009	2059
City of Yreka	General Plan	Yreka, California	Land Use, Agriculture and Forest Resources / Housing/ Traffic and Transportation/Recreation	2002	2002-2022
City of Yreka	2009 Housing Element	Yreka, California	Population and Housing/ Socioeconomics	2009	2009-2014
City of Arcata	Draft Economic Development Strategic Plan 2010-2014	Arcata, California	Socioeconomics	2010	2010-2014
City of Arcata	Housing Element	Arcata, California	Population and Housing	2009	
City of Arcata	General Plan 2020	Arcata, California	Land Use, Agriculture and Forest Resources / Traffic and Transportation/ Population and Housing /Air Quality/Noise	2000	2000-2020
Crescent City	General Plan	Crescent City, California	Population and Housing	2001	2001-2020
Crescent City	Housing Element	Crescent City, California	Population and Housing	2003	2001-2020
City of Mt. Shasta	2007 General Plan Revision	Mt. Shasta, California	Land Use/ Traffic and Transportation /Public Utilities and Services/Noise	2007	2007-2025
City of Weed	General Plan	Weed, California	Land Use, Agriculture and Forest Resources/ Traffic and Transportation / Population and Housing/Noise	Undefined	Undefined
City of Weed	Draft Housing Element 2009-2014	Weed, California	Population and Housing/ Socioeconomics	2010	2009-2014
City of Brookings	Comprehensive Plan	Brookings, Oregon	Land Use, Agricultural and Forest Resources / Recreation/ Traffic and Transportation	2009	Undefined
City of Brookings	Public Facilities Plan for urban	Brookings, Oregon and	Public Utilities and Services	1999,	Undefined

Table 4-3. Plans, Programs, and Other Documents Considered in Cumulative Effects Analysis

Author	Document Title	Coverage Area	Resource Topic(s) Addressed	Date Published	Timeframe Covered
	Growth Expansion Brookings and Harbor Study Areas	Harbor, Oregon		Revised 2009	
City of Brookings and Oregon Department of Transportation	City of Brookings Transportation System Plan	Brookings, Oregon	Traffic and Transportation	2006	2006-2026
City of Port Orford	Comprehensive Plan	Port Orford, Oregon	Traffic and Transportation	1975	Undefined
City of Ashland	Comprehensive Plan	Ashland, Oregon	Population and Housing / Traffic and Transportation	2005	Undefined
City of Medford	Comprehensive Plan	Medford, Oregon	Population and Housing/ Socioeconomics / Land Use, Agriculture and Forest Resources/ Traffic and Transportation	Undefined	Undefined
Private					
PacifiCorp	PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for coho Salmon	PacifiCorp's existing facilities and the adjacent water and land areas potentially influenced by Project maintenance and operations, including the mainstem Klamath River and reservoirs from Link River dam at the outlet of Upper Klamath Lake down to the Klamath River estuary	Aquatic Resources	2011	10 Years
Fruit Growers Supply Company	Fruit Growers Supply Company Multispecies Habitat Conservation Plan	Klamath River west of Interstate 5, adjacent to and intermixed with Klamath National Forest	Aquatic Resources, Terrestrial Resources	2009	50 Years

[1] If a new license is issued by the Federal Energy Regulatory Commission for the Klamath Hydroelectric Project, the Project would need to comply with the recommendations set forth in this Biological Opinion. Because the existing license expired in 2006, the Klamath Hydroelectric Project is currently operating under an annual license with the same terms and conditions of the prior, existing license.

[2] If a new license is issued by the Federal Energy Regulatory Commission for the Klamath Hydroelectric Project, the Project would need to comply with the recommendations set forth in this Biological Opinion. Because the existing license expired in 2006, the Klamath Hydroelectric Project is currently operating under an annual license with the same terms and conditions of the prior, expired license.

4.3.2 Cumulative Projects

The Lead Agencies reviewed past, present, and future projects in the geographically defined area as part of this cumulative effects analysis. Table 4-4 lists the projects considered in this analysis.

4.4 Cumulative Effects Analysis

This section describes, by resource, the cumulative effects of the KHSA and KBRA. For each resource category, the analysis is structured as follows:

- A summary of each resource's impacts and mitigation measures presented in Chapter 3;
- A discussion of potential cumulative effects utilizing either the project method, the projection method, or a combination of both (as described in Section 4.2.1);
- A discussion of the incremental contribution of the alternative to the cumulative effect and whether that contribution is cumulatively considerable; and
- A discussion of any mitigation measures.

With regard to the summary table of impacts specific to each resource, the delineation of applicable alternatives and conclusions of significance are abbreviated as follows:

<u>Alternatives</u>

- 1 = No Action/No Project
- 2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
- 3 = Partial Facilities Removal of Four Dams Alternative
- 4 = Fish Passage at Four Dams Alternative
- 5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

<u>Significance</u>

- NCFEC = No Change From Existing Conditions
- B = Beneficial
- LTS = Less than Significant
- S = Significant

Table 4-4. Projects Considered in Cumulative Effects Analysis

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
Tribal				
Hoopa Valley Tribe	Various Watershed Restoration Projects	Hoopa Valley Indian Reservation (Mill Creek, Tish Tang, Supply, and Pine Creek Watersheds)	Undefined (Ongoing)	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan
Hoopa Valley Tribe	Masonite Mill Creek Soil Remediation	Hoopa Valley Indian Reservation (Masonite Mill Creek)	Undefined (Ongoing)	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan
Hoopa Valley Tribe	Supply Creek Landfill Closure	Hoopa Valley Indian Reservation (Supply Creek)	Undefined (Ongoing)	Hoopa Valley Tribe Environmental Protection Agency Water Quality Control Plan
Federal				
Department of the Interior	Klamath Basin Conservation Area Restoration Program	Klamath Basin	1986 to 2006	Long Range Plan for the Klamath Basin Conservation Area Fishery Restoration Program (Klamath River Basin Fisheries Task Force 1991)
State				
California Department of Transportation	Siskiyou I-5/SR89 So Mount Shasta Blvd Interchange	City of Mount Shasta, Siskiyou County	Undefined (Environmental study scheduled for Oct 2011)	District 2 Projects in the Northstate
California Department of Transportation	Various regional transportation projects - Capacity Increasing	Shasta County, CA	Within 20 years	Shasta County Regional 2010 Transportation Plan
County				
Del Norte County	Sewage treatment upgrade	Crescent City, CA	Within 5 yrs.	Del Norte General Plan Policy Document
Del Norte County	Intersection improvements on hwy 101	Between Highway 199 and the Oregon border.	Within 5 yrs.	Del Norte General Plan Policy Document
Shasta County	Various regional transportation projects - Capacity Increase	Shasta County, CA	Within 20 years	Shasta County Regional 2010 Transportation Plan
Siskiyou County Public Works	Ash Creek Bridge Replacement	Intersection of Klamath River Rd and State Route 96	2011	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Guys Gulch Bridge Replacement	Intersection of Guys Gulch and Old Highway 99	2012	Greg Plucker, Deputy Director of Planning County of Siskiyou

Table 4-4. Projects Considered in Cumulative Effects Analysis

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
Siskiyou County Public Works	Schulmeyer Gulch Bridge Replacement	Intersection of Schulmeyer Gulch and Old Highway 99	2012	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Bridge Preventive Maintenance - Replace joint seals, deck rehab	30 Locations at river crossings in the County	2012	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Shasta River Bridge Replacement	Intersection of Louie Road and Shasta River	2017	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	McKinney Creek - Replace culverts with bridge	Intersection of Walker Road and McKinney Creek	2013	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Barr Road Bypass - Construct 1/4 mile of new road	Horse Creek Bridge along the Klamath River	2018	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Ager Road - Overlay/Reconstruct	Ager Road Montague to Klamathon	Unknown Pending Funding	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Copco Road widening - Widen 1/2 mile road	Copco Road	Unknown Pending Funding	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County Public Works	Big Springs Road - Overlay/Reconstruct	Between Highway 97 and A-12	Unknown Pending Funding	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Klamath River Country Estates – 5 Subdivisions of various sizes	South of Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Cascade Shores Subdivision	Northwest of Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Iron Gates Lake Estates – 5 Subdivisions of various sizes	Northeast of Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Seiad Creek Restoration - Proposal to restore about 4,000 lineal feet of stream	Where Seiad Creek intersects with the Klamath River	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou

Table 4-4. Projects Considered in Cumulative Effects Analysis

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
Siskiyou County	Klamath Ranch Quarry Use and Reclamation - 9 acre open pit surface mining operation	Located off Copco Road, 6 miles east from Interstate 5 and 1.25 miles west from Iron Gate Dam	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Siskiyou County	Triple Duty Mine and Reclamation - 12 acre surface mining operation with the removal of 1.5 million cubic yards of overburden	Bradley/Henley Road, 1000 feet south from Copco Road, in the Community of Hornbrook	Approved but timeframe unknown	Greg Plucker, Deputy Director of Planning County of Siskiyou
Humboldt, Del Norte, Trinity, Siskiyou and Mendocino Counties	Five Counties Road Maintenance Program	Humboldt, Del Norte, Trinity, Siskiyou and Mendocino Counties	1998 to Present	Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California 19 Watersheds
Jackson County	Various roadway improvements at intersections on Highway 101	Jackson County, OR	Undefined	Jackson County Transportation System Plan
Jackson County	Various pedestrian and bike lane improvements	Jackson County, OR	Undefined	Jackson County Transportation System Plan
Klamath County	Statewide Transportation Improvement Program Projects	Klamath County, OR	Within 20 years	2010-2030 Klamath County Transportation System Plan (Ch. 7)
City				
City of Eureka, CA	Greyhound Hotel Project/Jack Freeman	420 Third Street	As of 2009, the applicant is currently seeking a construction bid proposal	General Plan - Housing Element
City of Eureka, CA	Humboldt County Office of Education (Seventh Street Villa Condominiums)	Between 6th and 7th Street on Myrtle Avenue	July 2009	General Plan - Housing Element
City of Eureka, CA	North Coast Veterans Resource Center Veterans Transitional Housing Facility	Veterans Transitional Housing Facility	Due to the temporary postponement of one of the additional funding sources, the project funds remain frozen until notified of funding availability.	General Plan - Housing Element
City of Eureka, CA	CalHome Grant Program	Unknown	2010	General Plan - Housing Element

Table 4-4. Projects Considered in Cumulative Effects Analysis

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
City of Eureka, CA	Eureka Waterfront Revitalization Program	Waterfront	2007	General Plan - Land Use and Design, Eureka Redevelopment Final Program EIR 2005
City of Arcata, CA	Courtyard Phase II	Unknown	Unknown	General Plan - Housing Element
City of Arcata, CA	Courtyard Phase III	Unknown	Unknown	General Plan - Housing Element
City of Arcata, CA	Samoa Boulevard Revitalization Plan	Samoa Boulevard	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Conservation Easement in Arcata Forest for trails	Arcata Forest	Expected completion 2010	Economic Development Strategic Plan
City of Arcata, CA	Humboldt State University Enrollment Increase	Humboldt State University	Over next 30 to 40 years	Economic Development Strategic Plan
City of Arcata, CA	Humboldt State University College Creek Dormitories	Humboldt State University	Completed by Fall 2010	Economic Development Strategic Plan
City of Arcata, CA	Schatz Energy Research Center	Humboldt State University	Unknown	Economic Development Strategic Plan
City of Arcata, CA	BSS building	Humboldt State University	Fall 2007 completed	Economic Development Strategic Plan
City of Arcata, CA	Carlson Park	At Mad River	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Arcata-Eureka Airport Expansion and remodeling	Airport	2009	Economic Development Strategic Plan
City of Arcata, CA	Hampton Inn Hotel	Valley West	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Mad River Hospital Development and Master Plan	Mad River Hospital area	Unknown	Economic Development Strategic Plan
City of Arcata, CA	Fire Training Center	A parcel off of Sunset Avenue near Arcata skate park	Unknown	Economic Development Strategic Plan
Crescent City, CA	Wastewater Treatment Plant	Unknown	2008	General Plan Housing Element Update
City of Yreka, CA	Expand Fall Creek Pump Station	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Filter Pump Station/Primary Coagulant Facilities	City of Yreka	Unknown	Steven Baker, City Manager

Table 4-4. Projects Considered in Cumulative Effects Analysis

Implementing Agency	Project/Program Name	Location	Implementation Timeframe	Reference
City of Yreka, CA	Water Treatment Plant Upgrade	City of Yreka Water Treatment Plant	Unknown	Steven Baker, City Manager
City of Yreka, CA	2.5 Million Gallon Clear Well	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Backwash Pond Improvements	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Zone 1 and 3 Supply Mains	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Rehabilitation of Butcher Hill Reservoir	City of Yreka	Unknown	Steven Baker, City Manager
City of Yreka, CA	Upgrading existing distribution system telemetry system	Distribution system	Unknown	Steven Baker, City Manager
City of Ashland, OR	Bear Creek Greenway and Bear Creek Trail	Mountain Ave to Ashland City Limits in the western portion of city	Unknown	Comprehensive Plan, Parks, Open Space, and Aesthetics
Klamath Falls, OR	Castle Ridge Destination Resort	West Side (West of Highway 97)	2004	Klamath Falls Westside Refinement Plan 2006
Klamath Falls, OR	Pine Valley Planned Unit Development	West Side	Approved April 2006	Klamath Falls Westside Refinement Plan 2006
Klamath Falls, OR	Southview Planned Unit Development	West Side	Preliminary plan approved 2002	Klamath Falls Westside Refinement Plan 2006
Private				
Ruby Pipeline L.L.C.	Ruby Natural Gas Pipeline	Klamath County, OR	July 2010 to June 2011	http://www.rubypipeline.com/
Klamath Falls Bioenergy L.L.C.	Klamath Falls Bioenergy Facility - electric generating facility burning biomass (wood waste), 38.5 mega-watts	Klamath Falls, Klamath County, OR	Unknown	http://www.oregon.gov/ENERGY/SITING/docs/KBE-PublicNotice.pdf

This cumulative analysis considers adverse effects of the project identified in Chapter 3 that are less than significant or significant. It also considers beneficial effects. If an impact has been determined to have no effect, then it would not contribute to any cumulative effects and it is not discussed in this section. This cumulative analysis does not evaluate the No Action/No Project Alternative because it already includes reasonably foreseeable past, present, and future projects.

Three resource categories, Environmental Justice, Socioeconomics, and Tribal Trust are NEPA requirements and are analyzed according to NEPA; therefore they do not require a specific determination of significance. The cumulative effects analysis for each of these resource categories describes potential cumulative effects but does not make a determination of whether or not they would be cumulatively considerable or significant (i.e., for all other resource categories, CEQA conclusions, shown in bold type, are presented at the end of each impact discussion).

The KBRA is analyzed at a programmatic level of detail in this cumulative effects analysis because the specific locations, timeframes, and construction methods for KBRA actions are not yet known. Where adequate information on KBRA actions is available, general cumulative effects are discussed. Where information is not sufficient for a detailed cumulative effects analysis, or there is a high level of uncertainty as to what actions would occur and how they would affect resources, this is noted in the text and no attempt at speculation is made. As noted throughout this document, future environmental analysis will be completed as necessary.

4.4.1 Water Quality

Cumulative effects on water quality could be caused by short-term and long-term water quality impacts of the project, combined with other projects/actions in the Klamath Basin that could contribute to adverse water quality effects. The timeframe for short-term water quality effects related to reservoir drawdown is up to 2 years after reservoir drawdown begins, although modeling suggests most water quality effects would be negligible after a year (see Section 3.2.4.3, Water Quality). The timeframe for long-term cumulative water quality effects extends from 2 to 50 years, which includes the remainder of the Project analysis period and applies for the majority of the available numeric models of future water quality in the Klamath River.

The water quality modeling performed for the impact analysis in Chapter 3 already considers some cumulative actions such as implementation of the Total Maximum Daily Loads (TMDLs) in order to forecast future water conditions at the time the Proposed Action and alternatives would be implemented. This cumulative effects analysis focuses on additional projects not already considered in the water quality modeling.

Table 4-5 presents a summary of the water quality impacts identified in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Water Temperature				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable Oregon DEQ and California Basin Plan water quality objectives and adversely affect beneficial uses in the Hydroelectric Reach.	1	NCFEC	***None***	NCFEC
Dam removal and/or reduction or elimination of hydropower peaking operations at J.C. Boyle Powerhouse could cause short-term and long-term alterations in daily water temperatures and diel temperature variation in the J.C. Boyle bypass and peaking reaches.	2, 3, 4, 5	LTS for J.C. Boyle Bypass Reach in summer/fall B for J.C. Boyle Peaking Reach in summer/fall	***None***	LTS for J.C. Boyle Bypass Reach in summer/fall B for J.C. Boyle Peaking Reach in summer/fall
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term increases in spring time water temperatures and decreases in late summer/fall water temperatures in the Hydroelectric Reach downstream from Copco 1 Reservoir.	2, 3, 5	LTS for springtime B for late summer/fall	***None***	LTS for springtime B for late summer/fall
Lower Klamath Basin				
Draining the reservoirs and release of sediment could cause short-term and long-term increases in sediment deposition in the Klamath River or Estuary that could alter morphological characteristics and indirectly affect seasonal water temperatures.	2, 3, 5	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal water temperatures that are shifted from the natural thermal regime of the river and do not meet applicable California North Coast Basin Plan water quality objectives and adversely affect beneficial uses in the Klamath River downstream from Iron Gate Dam.	1, 4	NCFEC	None	NCFEC

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dam removal and conversion of the reservoir areas to a free flowing river could result in short-term and long-term increases in spring water temperatures and decreases in late summer/fall water temperatures in the Lower Klamath River.	2, 3, 5	LTS – Iron Gate Dam to Salmon River for springtime and B – in late summer/fall NCFEC – Klamath River downstream from Salmon River, the Klamath Estuary, and marine nearshore environment.	None	LTS – Iron Gate Dam to Salmon River for springtime and B – in late summer/fall NCFEC – Klamath River downstream from Salmon River, the Klamath Estuary, and marine nearshore environment.
Suspended Sediments				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could result in short-term and long-term interception and retention of mineral (inorganic) suspended material by the Klamath Hydroelectric Project dams.	1, 4	NCFEC	None	NCFEC
Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach.	1 ,2 ,3	LTS	None	LTS
Implementation of IM 8, J.C. Boyle Bypass Barrier Removal, could result in short-term increases in mineral suspended material in the Hydroelectric Reach due to deconstruction activities.	1	LTS	None	LTS
Implementation of IM 16, Water Diversions, could result in short-term increases in mineral (inorganic) suspended material in the Hydroelectric Reach due to diversion screening deconstruction and construction activities.	2 ,3	LTS	None	LTS
Continued impoundment of water in the reservoirs could cause short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the Hydroelectric Reach due to in-reservoir algal blooms.	1, 4	NCFEC	None	NCFEC

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Hydroelectric Reach downstream from J.C. Boyle Dam.	2, 3, 5	S	None	S
Construction/deconstruction activities could cause short-term increases in suspended material in the Hydroelectric Reach due to stormwater runoff from construction/deconstruction areas.	2, 3, 4, 5	LTS	None	LTS
Construction/deconstruction activities would include the demolition of various recreation facilities which could cause short-term increases in suspended material in the Hydroelectric Reach from stormwater runoff from the demolition areas.	2, 3, 5	LTS	None	LTS
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in slight long-term increases in suspended material in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Lower Klamath Basin				
Draining the reservoirs and release of sediment could cause short-term increases in suspended material in the Lower Klamath River and the Klamath Estuary.	2, 3, 5	S	None	S
Draining the reservoirs and release of sediment could cause short-term increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material and rates of deposition in the marine nearshore environment.	2, 3, 5	LTS	None	LTS

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water in the reservoirs could cause short-term and long-term interception and retention of mineral (inorganic) sediments by the dams and correspondingly low levels of suspended material immediately downstream from Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could result in short-term and long-term seasonal (April through October) increases in algal-derived (organic) suspended material in the KHP reservoirs and subsequent transport into the Klamath River downstream from Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Construction/deconstruction activities could cause short-term increases in suspended material in the Lower Klamath River, Klamath Estuary, and marine nearshore environment due to stormwater runoff from construction/ deconstruction areas.	2, 3, 5	LTS	None	LTS
Revegetation associated with management of the reservoir footprint area after dam removal could decrease the short-term erosion of fine sediments from exposed reservoir terraces into the Lower Klamath River and Klamath Estuary.	2, 3, 5	B	None	B
Dam removal could eliminate the interception and retention of mineral (inorganic) suspended material behind the dams and result in long-term increases in suspended material in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS
Dam removal could eliminate the interception and retention of algal-derived (organic) suspended material behind the dams and result in long-term increases in suspended material in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Nutrients				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could result in long-term interception and retention of TP and TN in the Hydroelectric Reach on an annual basis but release (export) of TP and TN from reservoir sediments on a seasonal basis.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in sediment- associated nutrients in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Lower Klamath Basin				
Continued impoundment of water in the reservoirs could cause long-term interception and retention of TP on an annual basis but release (export) of TP and TN on a seasonal basis.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment to the Lower Klamath River could cause short-term increases in sediment-associated nutrients in the river and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	LTS	None	LTS

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dissolved Oxygen				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could cause long-term seasonal and daily variability in dissolved oxygen concentrations in the Hydroelectric Reach, such that levels do not meet ODEQ and California North Coast Basin Plan water quality objectives and adversely affect beneficial uses.	1, 4	NCFEC	None	NCFEC
Draining the reservoirs and release of sediment could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Hydroelectric Reach downstream from J.C. Boyle Reservoir.	2, 3, 5	S	None	S
Dam removal and conversion of reservoir areas to free-flowing river conditions could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach.	2, 3, 5	B	None	B
Lower Klamath Basin				
Continued impoundment of water at the Four Facilities could result in continued release of water with low dissolved oxygen concentrations from Iron Gate Dam into the Klamath River immediately downstream from the dam.	1, 4	NCFEC	None	NCFEC
Dam removal and sediment release could cause short-term increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD]) and reductions in dissolved oxygen in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment.	2, 3, 5	S – Lower Klamath River from Iron Gate Dam to Clear Creek NCFEC – Klamath Estuary or Marine Nearshore Environment	None	S – Lower Klamath River from Iron Gate Dam to Clear Creek NCFEC – Klamath Estuary or Marine Nearshore Environment

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dam removal and conversion of reservoir areas to a free-flowing river could cause long-term increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Lower Klamath River, particularly for the reach immediately downstream from Iron Gate Dam.	2, 3, 5	B	None	B
pH				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term slight increases in pH and daily pH fluctuations in riverine reaches in the Hydroelectric Reach.	2, 3, 5	LTS (short term and long term)	None	LTS (short-term and long term)
Dam removal and conversion of the reservoir areas to a free-flowing river could cause short-term and long-term decreases in high summertime daily pH fluctuations in the free-flowing reaches of the river that replace Copco 1 and Iron Gate Reservoirs in the Hydroelectric Reach.	2, 3, 5	B	None	B
Lower Klamath Basin				
Continued impoundment of water in the reservoirs could cause long-term elevated seasonal pH and daily variability in pH in the Lower Klamath River downstream from Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term summertime increases in pH in the Lower Klamath River downstream from Iron Gate Dam.	2, 3, 5	LTS – Lower Klamath River from Iron Gate Dam to confluence with the Scott River) NCFEC – Klamath River downstream from the Scott River, the Klamath Estuary, and the Marine Nearshore Environment	None	LTS – Lower Klamath River from Iron Gate Dam to confluence with the Scott River NCFEC – Klamath River downstream from the Scott River, the Klamath Estuary, and the Marine Nearshore Environment

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Chlorophyll-a and Algal Toxins				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa*, resulting in high seasonal concentrations of chlorophyll-a and algal toxins (i.e., microcystin) in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and substantially reduce or eliminate algal toxins (i.e., microcystin) in the Hydroelectric Reach.	2, 3, 5	B	None	B
Lower Klamath Basin				
Continued impoundment of water in the reservoirs could support long-term growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa*, resulting in high seasonal concentrations of chlorophyll-a and algal toxins (i.e., microcystin) transported into the Klamath River from downstream from Iron Gate Dam to the Klamath Estuary, and potentially to the marine nearshore environment.	1, 4	NCFEC	None	NCFEC
Dam removal and conversion of the reservoir areas to a free-flowing river would cause short-term and long-term decreases in levels of chlorophyll-a and substantially reduce or eliminate algal toxins (i.e., microcystin) in the Lower Klamath River and the Klamath Estuary.	2, 3, 5	B	None	B

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Inorganic and Organic Contaminants				
Upper Klamath Basin				
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants for freshwater aquatic species in the Hydroelectric Reach.	1, 4, 5	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs and associated interception and retention of sediments behind the dams could cause long-term low-level exposure to inorganic and organic contaminants in the Hydroelectric Reach through human consumption of resident fish tissue.	1, 4, 5	NCFEC	None	NCFEC
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 in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed reservoir terraces and river banks within the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Construction/deconstruction activities could cause short-term increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation equipment in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS
Reservoir area restoration activities could include herbicide application which could cause short-term levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach.	2, 3, 5	LTS	None	LTS

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Lower Klamath Basin				
Dam removal and sediment release could cause short-term and long-term increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the Lower Klamath River and the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Draining the reservoirs and sediment release could cause short-term human exposure to contaminants from contact with deposited sediments on exposed downstream river terraces and downstream river banks following reservoir drawdown.	2, **3**, 5	LTS	None	LTS
Construction/deconstruction activities could cause short-term increases in suspended sediments and the potential for inorganic and organic contaminants from hazardous materials associated with construction equipment to be transported into the Lower Klamath River, Klamath Estuary, and the marine nearshore environment.	2, 3, 4, 5	LTS	None	LTS
Keno Transfer				
Implementation of the Keno Transfer could cause adverse water quality effects.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities could result in slight decreases in ammonia levels in the Keno Impoundment/Lake Ewauna.	2, 3	B	None	B
Trap and Haul Operations – Programmatic Measure				
Implementation of the trap and haul operations may affect water quality during construction.	4, 5	LTS	None	LTS

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period.	2, 3, 5	LTS	None	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Implementation of the Phase I Fisheries Restoration Plan could result in short-term construction-related increases in suspended materials and long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels.	2, 3	LTS (short term) B (long term)	None	LTS (short term) B (long term)
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I.	2, 3	LTS (short term) B (long term)	None	LTS (short term) B (long term)
Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction	2, 3	LTS	None	LTS
Implementation of Wood River Wetland Restoration could result in short-term construction-related increases in suspended materials and long-term warmer spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake.	2, 3	LTS (short term) B (long term)	None	LTS (short term) B (long term)
Implementation of Water Diversion Limitations could result in decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach.	2, 3	NCFEC (short term) B (long term)	None	NCFEC (short term) B (long term)

Table 4-5. Summary of Water Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Implementation of the Water Use Retirement Program could result in decreases in summer water temperature, nutrients, and pesticide and herbicide inputs to Upper Klamath Lake.	2, 3	NCFEC (short term) B (long term)	None	NCFEC (short term) B (long term)
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2, 3	NCFEC (short term) B (long term)	None	NCFEC (short term) B (long term)

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
TMDL=total maximum daily load
TN = total nitrogen
TP = total phosphorus

Water quality in multiple locations in the Klamath River is characterized by seasonally high concentrations of algal-derived (organic) suspended material, high water temperatures, low dissolved oxygen, and high pH levels (North Coast Regional Water Quality Control Board [NCRWQCB] 2010a). A lack of carbonate rock sources in the basin results in generally low alkalinity waters and during the daytime when photosynthesis is occurring, high pH levels can exceed Oregon, California, and Hoopa Valley Tribe water quality objectives (see Section 3.2.3, Water Quality). The export of nutrients and organic matter from Upper Klamath Lake has contributed to water quality issues in the downstream Klamath River, including high levels of biological productivity and respiration (NCRWQCB 2010a). The stable lacustrine environment created at the Four Facilities, particularly in the larger Copco 1 and Iron Gate Reservoirs, coupled with high nutrient availability and high water temperatures in summer to fall, provides ideal conditions for phytoplankton growth**.** Within the Klamath Basin, blue-green algal productivity is locally and seasonally associated with extreme daily fluctuations in DO levels (high during the day and low at night), and elevated pH and free ammonia concentrations, which do not meet Oregon water quality standards during the summer months (See Section 3.2.2.3). Nuisance algal blooms that occur in the Klamath Basin are primarily composed of three species of blue-green algae: *Aphanizomenon flos-aquae*, *Anabaena flos-aquae*, and *M. aeruginosa*. Large blooms of *Aphanizomenon flos-aquae and Anabaena flos-aquae* can strongly influence pH, free ammonia, and DO concentrations.

Many past and present cumulative actions and projects have contributed to the Klamath River's adverse water quality conditions, including the establishment and operation of the Klamath Hydroelectric Project (KHP) and Reclamation's Klamath Project, large-scale conversion of wetlands in the Upper Klamath Basin to irrigated agricultural lands, grazing, road construction and related run-off, timber harvesting, mining, water diversions, and development (see also Section 3.2.3.1, Water Quality).

Future actions that could cumulatively affect water quality in the Klamath Basin include proposed new subdivisions and road improvements in or near the Klamath River. There are also many ongoing restoration actions and projects in the Klamath Basin (identified in Tables 4-3 and 4-4) that have or will contribute to future water quality improvements in the Klamath River.

4.4.1.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.1.1.1 Temperature

Removal of the Four Facilities under the Proposed Action and elimination of hydropower peaking operations at J.C. Boyle Powerhouse could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) alterations in overall water temperatures and diel water temperature fluctuations in the J.C. Boyle Bypass and Peaking Reaches. Klamath TMDL model results indicate that under the Proposed Action, water temperatures in the Bypass Reach immediately downstream from J.C. Boyle Dam would be similar to those under the No Action/No Project Alternative, but there would be relatively greater diel water temperature variation during June through September due to the absence of the thermal mass in J.C. Boyle Reservoir. Greater diel variation would also occur further downstream in the J.C. Boyle Bypass Reach. The anticipated increases in summer/fall water temperatures and daily diel temperature variation in the J.C. Boyle Bypass Reach due to the removal of J.C. Boyle Reservoir and elimination of bypass hydropower peaking operations would be a less than significant impact.

In the J.C. Boyle Peaking Reach model results indicate that water temperatures under the Proposed Action would exhibit slightly lower daily maximum values (0.0–2 °C [0–3.6 °F]) as compared to those predicted under the No Action/No Project Alternative and would exhibit *lower* diel water temperature variation during June through September. The anticipated slight decreases in long-term maximum summer/fall water temperatures and less artificial water temperature swings in the J.C. Boyle Peaking Reach would be beneficial.

In the J.C. Boyle Bypass Reach, the Proposed Action's contribution to this cumulative effect would not be cumulatively considerable for the area directly downstream from J.C. Boyle Dam. Water temperatures in this short river reach (i.e., downstream from the cold springs) would increase during summer months due to the elimination of bypass operations; however, areas adjacent to the coldwater springs in the Bypass Reach would continue to serve as thermal refugia for aquatic species because the springs themselves would not be affected by the Proposed Action. Further, a shift in water temperatures toward natural diel variation would increase daily maximum temperatures, but would also

increase nighttime minimum water temperatures providing regular thermal relief, time for repair of proteins damaged by thermal stress, and significant bioenergetic benefits for salmonids.

In the J.C. Boyle Peaking Reach, temperature changes would be cumulatively beneficial. In the J.C. Boyle Peaking Reach model results indicate that water temperatures under the Proposed Action would exhibit slightly lower daily maximum values as compared to those predicted under the No Action/No Project and would exhibit *lower* diel water temperature variation during June through September, moving toward the natural thermal regime (Figure 3.2-3) (NCRWQCB 2010a, data from electronic appendices of Asarian and Kann 2006b). At these locations the relative difference in diel water temperature variation between the Proposed Action and the No Action/No Project Alternative is due to the elimination of peaking operations and the associated large artificial temperature swings. Overall, the TMDL model results indicate that June through October riverine water temperatures from J.C. Boyle Reservoir to the Oregon-California State line would meet the Oregon narrative natural conditions criterion that supersedes the numeric objective (i.e., 20°C [68°F], see Table 3.2-3) for support of coolwater habitat.

The Proposed Action's incremental contribution to the short-term and long-term cumulative effects on summer/fall water temperatures and diel temperature variation in the J.C. Boyle Bypass Reach would not be cumulatively considerable. The Proposed Action's incremental contribution to the significant cumulative effects associated with decreases in long-term maximum summer/fall water temperatures and less artificial water temperature swings in the J.C. Boyle Peaking Reach would be beneficial.

Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in spring water temperatures and decreases in late summer/fall water temperatures and increase diel temperature variation in the Hydroelectric Reach downstream from Copco 1 Reservoir and in the Lower Klamath River. In the California portion of the Hydroelectric Reach, removal of the Four Facilities under the Proposed Action would eliminate the seasonal temperature shift caused by the Four Facilities in the Hydroelectric Reach such that spring water temperatures would increase and late summer/fall temperatures would decrease. Additionally, the Proposed Action could result in short-term and long-term increases in spring water temperatures, decreases in late summer/fall water temperatures, and increased diel temperature variation in the Lower Klamath River.

Water temperatures in the Klamath Hydroelectric Reach are influenced by the presence of the Four Facilities. As noted in Section 3.2, Water Quality, the large thermal mass of the stored water in the reservoirs delays the natural warming and cooling of riverine water temperatures on a seasonal basis such that spring water temperatures in the Klamath Hydroelectric Reach are generally cooler than would be expected under natural conditions, and summer and fall water temperatures are generally warmer (NCRWQCB 2010a). The temporal water temperature pattern of the Hydroelectric Reach is repeated

in the Klamath River immediately downstream from Iron Gate Dam, where water released from the reservoirs is 1–2.5°C (1.8–4.5°F) cooler in the spring and 2–10°C (3.6–18°F) warmer in the summer and fall as compared to modeled conditions without the dams (PacifiCorp 2004a, Dunsmoor and Huntington 2006, NCRWQCB 2010a). Immediately downstream from Iron Gate Dam (RM 190.1), water temperatures are also less variable than those documented farther downstream in the Klamath River (Karuk Tribe of California 2009, 2010).

Farther downstream, the presence of the Four Facilities exerts less influence and water temperatures are more influenced by the natural heating and cooling regime of ambient air temperatures and tributary inputs of surface water. Meteorological control of water temperatures result in increasing temperature with distance downstream from Iron Gate Dam. By the Salmon River (RM 66), the effects of the dams on water temperature are not discernable.

Besides the influence of the reservoirs, the other major factor that could contribute to cumulative effects on water quality is climate change. Climate change is expected to increase summer and fall water temperatures in the Klamath Basin on the order of 1–3°C (1.8–5.4°F) (Bartholow 2005, Perry et al. 2011). The Upper Klamath River from the Oregon-California State line to Iron Gate Dam, the Middle Klamath River from Iron Gate Dam to Scott River, and the Lower Klamath River from Scott River to the mouth are all listed as impaired for water temperature according to the CWA Section 303d list. Water temperature is therefore a significant cumulative effect for the Klamath River in the Hydroelectric Reach downstream from Copco 1 Reservoir and the Lower Klamath River.

The Proposed Action's incremental contribution to the short-term and long-term cumulative effects on water temperatures would not be cumulatively considerable for spring water temperatures in the Hydroelectric Reach from Copco 1 Reservoir to Iron Gate Reservoir in May and June. Cooler fall water temperatures would likely lead to earlier fall-run Chinook spawning in the mainstem (reducing pre-spawn mortality) and a temperature regime more in sync with historical spawning timing. Earlier spawning and warmer spring temperatures would likely result in fry emerging earlier and growing faster, which could encourage earlier emigration downstream, reducing stress and disease (Bartholow 2005, FERC 2007). Diel temperature variations in the Hydroelectric Reach would not be cumulatively considerable. Downstream from Copco 1 and Copco 2 Reservoirs (≈RM 198), the Proposed Action would increase daily maximum temperatures that are currently up to 7 °C (13 °F) lower than modeled natural conditions in spring (May and June) and would decrease temperatures that are up to roughly 4°C (7°F) greater than modeled natural

conditions in late summer/fall (August through October), due to the presence of the reservoirs. However, the Proposed Action would also decrease temperatures in this same reach in August and October, contributing to cumulative beneficial effects.

In the Lower Klamath River, the Proposed Action's incremental contribution to the cumulative effects on spring water temperatures and diel temperature variations would

not be cumulatively considerable, as discussed above. The Proposed Action's contribution to the cumulative effects on temperature would be beneficial in late summer/fall by resulting in cooler water temperatures. These impacts would decrease in magnitude with distance downstream from Iron Gate Dam, and would not be expected to result in temperature changes in the lower river downstream from the confluence with the Salmon River, including the Klamath Estuary and the marine nearshore environment**. The Proposed Action's incremental contribution to the short-term (<2 years following dam removal) and long-term (2-50 years following dam removal) cumulative effects on increased spring water temperatures and diel water temperature variations would not be cumulatively considerable for the Hydroelectric Reach and the Lower Klamath River to the confluence with the Salmon River. The Proposed Action's incremental contribution to the cumulative effects on water temperatures would be beneficial in the fall in the Hydroelectric Reach and the Lower Klamath River to the confluence with the Salmon River.**

4.4.1.1.2 Suspended Sediments

Suspended sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in suspended material in the Hydroelectric Reach downstream from J.C. Boyle Dam, the Lower Klamath River and the Klamath Estuary due to the release of sediments currently trapped behind the dams at the Four Facilities. Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term increases in sediment loads from the Klamath River to the Pacific Ocean and corresponding increases in concentrations of suspended material in the marine nearshore environment. Stormwater runoff from deconstruction activities under the Proposed Action could cause short-term increases in suspended material in the Hydroelectric Reach during the deconstruction period. Interim Measures (IMs) would cause short-term increases in suspended sediment associated with construction activities. Construction of the Yreka Water Supply Pipeline under the Proposed Action could cause short-term increases in suspended material in the Hydroelectric Reach during the construction period. Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs will be removed following drawdown, and could release suspended sediment into the Klamath River. Under the Proposed Action, revegetation associated with management of the reservoir footprint area could decrease the erosion of fine sediments from exposed reservoir terraces in the Hydroelectric Reach. The Proposed Action would increase short-term suspended sediment concentrations through the release of sediment trapped behind the dams. Within the general uncertainty of the model predictions, suspended sediment concentrations (SSCs) at J.C. Boyle Reservoir across the three water year types would have peak values of 2,000–3,000 mg/L and occurring within 1–2 months of reservoir drawdown. Predicted SSCs quickly decrease to less than 100 mg/L for 5–7 months following drawdown, and concentrations less than 10 mg/L for 6–10 months following drawdown.

Sediment transport modeling of the impacts of dam removal on suspended sediment in the Lower Klamath River indicates high short-term loads immediately downstream from Iron Gate Dam under the Proposed Action (Reclamation 2012, Stillwater Sciences 2008).

Overall, and within the general uncertainty of the model predictions, SSCs across the three water year types would have peak values of 7,000–14,000 mg/L and would occur within 2–3 months of reservoir drawdown. SSCs in excess of 1,000 mg/L would occur on a timescale of weeks to months, as compared to SSCs greater than 1,000 mg/L that can occur during winter storm events on a timescale of days to weeks under existing conditions in the Klamath River downstream from Iron Gate Dam. Predicted SSCs would remain greater than or equal to 100 mg/L for 5–7 months following drawdown, and concentrations would remain greater than or equal to 30 mg/L for 6–10 months following drawdown. Model results also indicate that while dilution in the lower river would decrease SSCs to 60–70 percent of their initial value downstream from Seiad Valley and to 40 percent of their initial value downstream from Orleans, within a factor of 2 uncertainty for the model results it can be conservatively assumed that SSCs in the Lower Klamath River would be sufficient (≥30 mg/L) to substantially adversely affect beneficial uses throughout the lower River and the Klamath Estuary for 6–10 months following drawdown (Reclamation 2012).

The results of model predictions for sediment transport following dam removal under the Proposed Action indicate that dam removal would cause a release of less than 3 million tons of fine sediment to the Lower Klamath River downstream from Iron Gate Dam. While estimates of long-term average annual sediment discharge to the Klamath Estuary vary considerably, they are generally well above the projected 3 million tons. Due to the relatively small magnitude of SSCs released to the nearshore environment, the anticipated rapid dilution of the sediment plume as it expands in the ocean, and the relatively short duration of high SSCs, the short-term increases in SSCs in the marine nearshore environment under the Proposed Action would not be substantial.

Stormwater runoff from deconstruction activities, relocation of recreation facilities, implementation of Interim Measures 7 and 16, and the relocation of the Yreka pipeline could also contribute to erosion and runoff of sediments into the waterway. However, the potential for sediments to enter the water from deconstruction site runoff or in-water deconstruction work could be minimized or eliminated through the implementation of Best Management Practices (BMPs) for deconstruction activities that would occur in or adjacent to the Klamath River. Establishment of herbaceous vegetation in drained reservoir areas would be undertaken to stabilize the surface of the sediment and minimize erosion from exposed terrace surfaces following drawdown.

Several of the cumulative actions and projects identified in Table 4-4 above have the potential to increase erosion and the release of sediment into the Klamath River, including the transportation improvement project in Siskiyou County, construction of approved new subdivisions in Siskiyou County, and any other proposed developments that could involve ground disturbance. Other more general projects and activities that are not easily identifiable but likely to occur, such as timber harvesting, mining, and agriculture, livestock grazing, and road-related erosion, could also contribute to cumulative effects associated with suspended sediment. Climate change could also affect suspended sediment by increasing the number of heavy precipitation events each year.

As described in Section 3.10, Greenhouse Gases/Global Climate Change, increases in heavy precipitation may result in a variety of general consequences for the Pacific Northwest:

- Increased fine sediment in streams may result in negative effects on the spawning of native fish that build their nests in the areas of clean rocks and gravel (Barr et al. 2010).
- Increased frequency and severity of flooding may occur.
- Increased runoff may lead to surface water quality changes including increased turbidity, increased organic content, color changes, and alkalinity changes.

The Lower Klamath River from the Trinity River to the mouth is listed as impaired under CWA Section 303(d) for sedimentation/siltation impairment. Suspended sediment is therefore a significant cumulative effect.

The Proposed Action's contribution to the cumulative effects associated with suspended sediment would be short term but would remain high for several months after reservoir drawdown in the Hydroelectric Reach, the Lower Klamath River, and in the Klamath Estuary and would exceed water quality objectives. **Therefore, the Proposed Action's incremental contribution to the short-term significant cumulative effects associated with suspended sediment concentrations during reservoir drawdown and dam deconstruction would be cumulatively considerable for the Hydroelectric Reach, Lower Klamath River, and the Klamath Estuary. No feasible mitigation is available to reduce these impacts; therefore they remain cumulatively considerable.**

Under the Proposed Action, the lack of continued interception and retention of mineral (inorganic) and algal-derived (organic) suspended material by the dams at the Four Facilities could result in long-term (2–50 years following dam removal) increases in suspended material in the Hydroelectric Reach, Lower Klamath River, Klamath Estuary, and marine nearshore environment. As noted above, short-term sediment release results in a significant cumulative water quality effect for the Klamath River. The Proposed Action's contribution to the long-term cumulative effects associated with lack of continued interception and retention of inorganic and organic material would be minor. Peak concentrations of mineral (inorganic) suspended material in the Hydroelectric Reach and Lower Klamath Basin during the winter/early spring (November through April) would likely remain associated with high-flow events and any increases due to the lack of interception by the dams would not be large.

Episodic increases (10–20 mg/L) in algal-derived (organic) suspended material resulting from in-reservoir algal productivity are not expected to occur in the Hydroelectric Reach following dam removal. SSCs in the Hydroelectric Reach may attain levels similar to those observed upstream of J.C. Boyle Dam under existing conditions during May through October (>15 mg/L; see Appendix C), as algal-dominated suspended material is transported downstream from Upper Klamath Lake. If slight long-term increases in suspended materials did occur, they would likely be offset by the loss of algal-derived suspended material previously produced in Copco 1 and Iron Gate Reservoirs and would

not exceed levels that would substantially adversely affect the cold freshwater habitat (COLD) beneficial uses. **Therefore, the Proposed Action's incremental contribution to the long-term significant cumulative effects associated with suspended material would not be cumulatively considerable.**

4.4.1.1.3 Nutrients

Sediment release associated with the removal of the Four Facilities under the Proposed Action could cause short-term (<2 years following dam removal) increases in sediment-associated nutrients. Short-term increases in total nitrogen (TN) and total phosphorus (TP) concentrations in the Lower Klamath River would occur because particulate (primarily organic) nutrients contained in reservoir sediment deposits would be transported along with the sediments themselves.

While no specific projects, including the projects reviewed for purposes of this analysis of cumulative effects, have been identified that would increase nutrient levels during reservoir drawdown, general activities that are not easily identifiable but likely to occur, such as grazing and agriculture, could contribute to this cumulative effect. The entire middle and lower reaches of the Klamath River, beginning at State line (RM 208.7) and moving downstream, are currently listed as impaired under California's Section 303(d) list for nutrients (State Water Resources Control Board [SWRCB] 2010). Therefore nutrients represent a significant cumulative water quality effect.

The Proposed Action's contribution to the cumulative effect would minimal. Minimal deposition of fine suspended sediments, including associated nutrients, would occur in the river channel (Reclamation 2012, Stillwater Sciences 2008). Further, reservoir drawdown under the Proposed Action would occur during winter months when rates of primary productivity and microbially mediated nutrient cycling (e.g., nitrification, denitrification) are also expected to be low. Light limitation for primary producers that do persist during winter months is also likely to occur, further decreasing the potential for uptake of TN and TP released along with reservoir sediment deposits. Therefore, particulate nutrients released along with sediment deposits are not expected to be bioavailable and should be well-conserved during transport through the Hydroelectric Reach. **The Proposed Action's incremental contribution to the short-term significant cumulative effects associated with increases in nutrients would not be cumulatively considerable.**

Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause long-term (2–50 years following dam removal) increases in nutrient levels. Under the Proposed Action, nutrients otherwise trapped by the dams would be transported downstream and potentially be available for uptake (e.g., by nuisance algae species).

Primary nutrients including nitrogen and phosphorus are affected by the geology of the surrounding watershed of the Klamath River, upland productivity and land uses, as well as a number of physical processes affecting aquatic productivity within reservoir and riverine reaches. The relatively low relief, volcanic terrain of the Upper Klamath Basin

supports large, shallow natural lakes (Upper Klamath Lake, Agency Lake, Tule Lake, Lower Klamath Lake) and wetlands, with soils that are naturally high in phosphorus. Human activities in the Upper Klamath Basin, including wetland draining, agriculture, ranching, timber harvesting, and water diversions have increased concentrations of nutrients (nitrogen and phosphorus) in waterways.

Nitrogen arriving in Upper Klamath Lake has been attributed to upland soil erosion, runoff and irrigation return flows from agriculture, as well as *in situ* nitrogen fixation by cyanobacteria (Oregon Department of Environmental Quality [ODEQ] 2002). Although the relatively high levels of phosphorus present in the Upper Klamath Basin's volcanic rocks and soils have been identified as a major contributing factor to phosphorus loading to the lake (ODEQ 2002), land use activities in the Upper Klamath Basin have also been linked to increased nutrient loading, subsequent changes in its trophic status, and associated degradation of water quality. Extensive monitoring and research has been conducted for development of the Upper Klamath Lake TMDLs (ODEQ 2002) that shows the lake is a major source of nitrogen and phosphorus loading to the Klamath River.

While no specific cumulative projects have been identified that would increase nutrient levels, general activities that are not easily identifiable but likely to occur, such as timber harvesting, grazing, and other agricultural activities, could contribute to this cumulative effect. The entire middle and lower reaches of the Klamath River, beginning at State line RM 208.7) and moving downstream, are currently listed as impaired under California's Section 303(d) list for nutrients (SWRCB 2010a). Therefore nutrients represent a significant cumulative water quality effect for the Klamath River. The implementation Klamath Basin TMDLs for nutrients would help to reduce nutrient levels over time, but for the purposes of analysis this remains a significant cumulative effect.

The Proposed Action's contribution to the cumulative effect would minimal. Modeling conducted for development of the California Klamath River TMDLs (NCRWQCB 2010a) indicates that under the Proposed Action (similar to the TMDL TOD2RN scenario, which includes Oregon TMDL allocations), TP and TN in the Hydroelectric Reach immediately downstream from J.C. Boyle Dam would increase slightly (<0.015 mg/L and <0.05 mg/L, respectively) during summer months compared to those of the No Action/No Project Alternative (similar to the TMDL T4BSRN scenario) due to the absence of nutrient interception and retention in both Keno Impoundment/Lake Ewauna and J.C. Boyle Reservoir (the former because the TMDL model TOD2RN scenario includes the historic Keno Reef instead of Keno Dam [Appendix D]). At the Oregon-California State line, the situation would be much the same, although the lack of hydropower peaking operations under the Proposed Action may result in decreased daily variation in TP and ortho-phosphorus, as well as nitrate and ammonium (NCRWQCB 2010a). Concentrations of both nutrients are high enough in the river from Iron Gate Dam (RM 190.1) to approximately Seiad Valley (RM 129.4) (and potentially further downstream) that nutrients are not likely to be limiting primary productivity (i.e., periphyton growth) in this portion of the Klamath River (FERC 2007, HVTEPA 2008, Asarian et al. 2010). Overall, the increases would not be expected to

result in exceedances of either Oregon water quality objectives for nuisance algae growth, or California North Coast Basin Plan water quality objectives for biostimulatory substances, beyond levels experienced under the No Action/No Project Alternative. Further, the lacustrine environment that supports the growth of nuisance algae blooms of such as *M. aeruginosa* or other cyanobacteria would be eliminated under the Proposed Action (see Section 3.4, Algae), reducing the likelihood of uptake of the slightly increased nutrient concentrations by nuisance algae species. This is mainly relevant for Copco 1 and Iron Gate Reservoirs, where the longer residence times support seasonal nuisance algae blooms (see Section 3.4, Algae). Modeling results indicate small increases in TP and relatively larger increases in TN concentrations downstream from the Hydroelectric Reach under the Proposed Action, which diminish with distance downstream due to both tributary dilution and nutrient retention (i.e., uptake of nutrients). **The Proposed Action's incremental contribution to the significant cumulative effect associated long-term increases in nutrients in the Lower Klamath River and the Klamath River Estuary after dam removal would not be cumulatively considerable.**

4.4.1.1.4 Dissolved Oxygen

Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) increases in oxygen demand (Immediate Oxygen Demand [IOD] and Biological Oxygen Demand [BOD])and reductions in dissolved oxygen in the Hydroelectric Reach downstream from J.C. Boyle Reservoir, the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment. Under the Proposed Action, high SSCs are expected in the middle and Lower Klamath River immediately following dam removal. The high fraction of organic carbon present in the reservoir sediments (see Section 3.2.3.1, Water Quality) allows for the possibility of oxygen demand generated by microbial oxidation of organic matter exposed to the water column from deep within the sediment profile and mobilized during dam removal.

The entire middle and lower reaches of the Klamath River, beginning at State line (RM 208.7) and moving downstream, are currently listed as impaired under California's Section 303(d) list for dissolved oxygen (SWRCB 2010a). Therefore, dissolved oxygen levels represent a significant cumulative effect for the Klamath River. Other cumulative projects or actions within the Klamath Basin that could decrease dissolved oxygen levels would include any that would increase suspended sediments, such as those noted above under suspended sediments. In addition, climate change impacts in the future could increase average ambient air and water temperatures, thus resulting in decreased and fluctuating dissolved oxygen content.

The Proposed Action's contribution to the cumulative effect on dissolved oxygen would be cumulatively considerable in the short term in the Hydroelectric Reach from J.C. Boyle Reservoir to Iron Gate Reservoir and in the Klamath River from Iron Gate Dam to the confluence with Clear Creek. While predicted short-term increases in oxygen demand under the Proposed Action generally result in dissolved oxygen concentrations that would meet the acceptable level (5 mg/L) for salmonids, exceptions to this would occur 4 to 8 weeks following drawdown of J.C. Boyle and Iron Gate reservoirs (i.e., in

February 2020), when dissolved oxygen would remain below 5 mg/L[1] from Iron Gate Dam to near the confluence with the Shasta River (RM 176.7), or for a distance approximately 20–25 km downstream from the dam. This analysis assumes that the effects of sediment release on short-term oxygen demand (and reductions in dissolved oxygen) in the Hydroelectric Reach downstream from J.C. Boyle Dam would be the same as those for the Lower Klamath River. Recovery to the North Coast Basin Plan water quality objective of 90 percent saturation (i.e., 10–11 mg/L) would occur within a distance of 100–150 km (62–93 mi) downstream from Iron Gate Dam, or generally in the reach from Seiad Valley to the mainstem confluence with Clear Creek, and would therefore not effect dissolved oxygen in the estuary or the nearshore environment. **The Proposed Action's incremental contribution to the short-term significant cumulative effect associated with reductions in dissolved oxygen in the Klamath River downstream from J.C. Boyle Dam to the Oregon-California State line and the Lower Klamath River from Iron Gate Dam to Clear Creek during reservoir drawdown would be cumulatively considerable. No feasible mitigation is available to reduce this impact; therefore it remains cumulatively considerable.**

Removal of the Four Facilities under the Proposed Action could cause long-term (2–50 years following dam removal) increases in dissolved oxygen, as well as increased daily variability in dissolved oxygen, in the Hydroelectric Reach and in the Lower Klamath River, particularly for the reach immediately downstream from Iron Gate Dam. Modeling conducted for development of the Oregon and California Klamath River TMDLs indicates that under the Proposed Action (similar to the TMDL TOD2RN scenario), dissolved oxygen concentrations in the Hydroelectric Reach downstream from J.C. Boyle Dam and at the Oregon-California State line would be slightly greater during July through October than those under the No Action/No Project (similar to the TMDL T4BSRN scenario), due to the removal of J.C. Boyle Reservoir (Figure 3.2-15 and Figure 3.2-16; NCRWQCB 2010a). The same pattern is predicted for 30-day mean minimum and 7-day mean minimum dissolved oxygen criteria. The Klamath TMDL model (see Appendix D) also predicts that daily fluctuations in dissolved oxygen immediately downstream from J.C. Boyle Dam during this same period would be greater under the Proposed Action (TCD2RN) than the No Action/No Project Alternative (T4BSRN) (Figure 3.2-16). The slight increases in summer and fall dissolved oxygen concentrations and daily fluctuations downstream from J.C. Boyle Dam would be beneficial.

[1] Minimum acceptable dissolved oxygen concentration for salmonids. Although the minimum acceptable water quality objective for dissolved oxygen in the Klamath River for warm freshwater, saline, and marine habitats was previously 5 mg/L (NCRWQCB 2006), recent Basin Plan amendments require 85-90% saturation (generally ranging from 6–11 mg/L) depending on location and month (NCRWQCB 2010). Section 3.3 (Aquatics) of this EIS/EIR references a threshold of 6 mg/L for migrating adult anadromous salmonids (USEPA 1986), which is also a useful benchmark for dissolved oxygen concentrations. Based on BOD/IOD model results, a return to 6 mg/L dissolved oxygen would occur further downstream than the results presented in Table 3.2-13, on the order of 5–15 miles (10–25 km) depending on hydrologic conditions.

In contrast, the TMDL model predicts somewhat reduced daily fluctuations in dissolved oxygen at State line (i.e., in the Peaking Reach) under the Proposed Action (TCD2RN) as compared to the No Action/No Project Alternative (T4BSRN) (Figure 3.2-17). The slight decreases in daily fluctuations at the California-Oregon State line would be less than significant.

Additionally, elimination of the seasonal extremes in dissolved oxygen (i.e., super-saturation in surface waters and oxygen depletion in bottom waters) in the riverine reaches replacing Copco 1 and Iron Gate Reservoirs in the Hydroelectric Reach would occur under the Proposed Action and would be beneficial. In the Lower Klamath River immediately downstream from Iron Gate Dam, the removal of the Four Facilities under the Proposed Action would cause long-term increases in summer and fall dissolved oxygen along with potentially increasing daily variability due to the lack of stratification and oxygen depletion in bottom waters in the upstream reservoirs as compared with a free-flowing river condition (see Figure 3.2-18). Effects would diminish with distance downstream from Iron Gate Dam, such that there would be no measurable effects on dissolved oxygen by the confluence with the Trinity River.

As noted above, dissolved oxygen is a significant cumulative impact for the Klamath River. The Proposed Action's contribution to this cumulative effect would be beneficial as it would increase long-term dissolved oxygen concentrations in summer and fall and daily variability in dissolved oxygen and it would eliminate seasonal extremes in the riverine reaches replace Copco 1 and Iron Gate Reservoirs. **The Proposed Action's incremental contribution to the long-term significant cumulative effect associated with increases in summer and fall dissolved oxygen concentrations in the Hydroelectric Reach and immediately downstream from Iron Gate Dam would be beneficial.**

4.4.1.1.5 pH

Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in summertime pH in the Hydroelectric Reach. Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could result in long-term (2–50 years following dam removal) summertime increases in pH in the Lower Klamath River, the Klamath Estuary, and the marine nearshore environment. Klamath TMDL model results indicate that under the Proposed Action, pH in the Hydroelectric Reach immediately downstream from J.C. Boyle Dam would be the same as pH levels modeled under the No Action/No Project, with the potential for small decreases in minimum daily values. At the Oregon-California State line, pH levels under the Proposed Action would exhibit less daily variability during spring (March–May) and fall (October–November) while daily variability in the river during the period June-September would be similar or somewhat greater under the Proposed Action, likely due to enhanced periphyton growth in the free-flowing river reaches previously occupied by the upstream J.C. Boyle Reservoir.

Currently, reaches upstream of the Hydroelectric Reach (i.e., from RM 231 to RM 251, Upper Klamath Lake, Agency Lake, and the Sprague River) are included on Oregon's 303(d) list for pH, but the Hydropower Reach itself is not identified as impaired. A variety of different cumulative actions could contribute to changes in pH in this reach. Increased snowmelt or increased large storm events with heavy precipitation due to climate change, agricultural runoff, and acid rain could change pH in the Lower Klamath River. As the newly restored river erodes the river channel, the geology of the materials being eroded could alter the pH. Increases in pH could also occur from enhanced periphyton growth and increased rates of photosynthesis. These actions, considered together with the Proposed Action, could substantially change pH levels and result in significant cumulative water quality effects associated with pH.

The Proposed Action's contribution to the cumulative effect would be minimal. In the Hydroelectric Reach, there would be less daily variability of pH, and this would be beneficial. The modeled increases at the Oregon-California State line would consistently meet the Oregon water quality objective of 9.0 units for support of beneficial uses and would therefore be less than significant. While there are no TMDL model results for riverine locations upstream of Copco 1 or Iron Gate Reservoirs, these locations would be expected to exhibit similar patterns as those predicted for the Klamath River at the Oregon-California State line.

The Proposed Action would also eliminate the occurrence of high pH (> 9 pH units) and large (0.5–1.5 pH units) daily fluctuations occurring in the surface waters of Copco 1 and Iron Gate Reservoirs during periods of intense algal blooms. pH in the free-flowing reaches of the river replacing these reservoirs would not exhibit such extremes, instead possessing the riverine signal described above.

Modeling results indicate there would be large daily variation in pH and generally high pH levels in the Klamath River downstream from Iron Gate Dam under the Proposed action. Predicted differences in pH between the Proposed Action and No Action/No Project Alternative decrease in magnitude with distance downstream from Iron Gate Dam, and are considerably dampened by the Scott River confluence (RM 143.0). The Hoopa Valley Tribe water quality objective for pH (7.0-8.5) is met at all times under the Proposed Action (similar to the TMDL TCD2RN scenario) for the Klamath River at the reach of Hoopa jurisdiction (≈45–46).

Although the California Klamath River TMDL model predicts long-term increases in pH due to enhanced periphyton growth and increased rates of photosynthesis immediately downstream from Iron Gate Dam, this condition may be counteracted by increased scour and lack of nutrient availability at this location under the Proposed Action (see Section 3.4, Algae). Given the uncertainty in the model output from Iron Gate Dam to the Shasta River, and given the localized and instantaneous nature of the predicted high pH levels during summer months, these long-term pH increases would not be substantial. **The Proposed Action's incremental contribution to the significant short-term and long-term cumulative effect associated with slight summertime increases pH and daily pH fluctuations at the Oregon-California State line and upstream and**

downstream reaches that are currently riverine would not be cumulatively considerable. The Proposed Action's incremental contribution to the significant cumulative effect associated with decrease in high summertime daily pH fluctuations in the free-flowing reaches of the river that replace Copco 1 and Iron Gate Reservoirs in the Hydroelectric Reach would be beneficial. The Proposed Action's incremental contribution to the significant short-term and long-term cumulative effect associated with pH would not be cumulatively considerable from Iron Gate Dam to the Scott River. There would be no significant cumulative pH effects for the Klamath River downstream from the Scott River, the Klamath River Estuary and marine nearshore environment.

4.4.1.1.6 Chlorophyll-a and Algal Toxins

Removal of the Four Facilities under the Proposed Action and conversion of the reservoir areas to a free-flowing river could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) decreases in levels of chlorophyll-a and algal toxins in the Hydroelectric Reach, the Lower Klamath River, and potentially the Klamath Estuary. Elimination of the lacustrine (reservoir) environment that currently supports growth conditions for toxin-producing nuisance algal species such as *M. aeruginosa* would result in decreases in high seasonal concentrations of chlorophyll-*a* (>10 µg/L) and periodically high levels of algal toxins (> 8 µg/L microcystin) generated by suspended blue-green algae. Additionally, growth of *M. aeruginosa* in reaches of the Klamath River downstream from Iron Gate Dam would be reduced in the absence of significant reservoir blooms.

In the past, chlorophyll-a and algal toxins have resulted in a significant cumulative water quality impact in the Klamath River and have adversely affected aquatic species and human health. The main cumulative actions/projects contributing to chlorophyll-a and algal toxins are the construction of the KHP, which created reservoirs with conditions that promote nuisance algal growth, and nutrient loading from Upper Klamath Lake, as described above for nutrients. The Proposed Action's contribution to this cumulative effect would be beneficial. The Proposed Action would eliminate conditions promoting algal growth through reservoir drawdown and dam removal. **The Proposed Action's incremental contribution to the short-term and long-term significant cumulative water quality effect associated with a decrease in chlorophyll-*a* and a substantial decrease or elimination of algal toxins in the Hydroelectric Reach and subsequent transport into the Lower Klamath River and the potentially the Klamath Estuary would be beneficial**.

4.4.1.1.7 Inorganic and Organic Contaminants

Sediment release associated with the Proposed Action could cause short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) increases in concentrations of inorganic and organic contaminants and result in low-level exposure for freshwater aquatic species in the Hydroelectric Reach, Lower Klamath River, Klamath Estuary, and marine nearshore environment. The Proposed Action could result in short-term (<2 years following dam removal) and long-term (2–50 years following dam removal) human exposure to contaminants from contact with deposited sediments on

exposed reservoir terraces, river banks in the Hydroelectric Reach, and downstream river banks following reservoir drawdown. Dam deconstruction and revegetation (i.e., hydroseeding) activities could cause short-term (<2 years following dam removal) increases in inorganic and organic contaminants from hazardous materials associated with construction and revegetation (i.e., hydroseeding) equipment in the Hydroelectric Reach, Lower Klamath River, Klamath Estuary, and marine nearshore environment. Under the Proposed Action, herbicide application associated with management of the reservoir footprint area could result in short-term (<2 years following dam removal) levels of organic contaminants in runoff that are toxic to aquatic biota in the Hydroelectric Reach. The Proposed Action would result in the release of organic and inorganic contaminants through reservoir drawdown and the release of sediment, use of hazardous materials associated with construction and revegetation, and the application of herbicides. Short-term pathways of contaminant exposure for freshwater aquatic species include exposure during sediment transit through the Lower Klamath Basin river reaches and the estuary, as well as exposure following initial deposition of sediments in the river and the estuary. Potential human health risks could occur with exposure to sediments deposited on exposed reservoir terraces and river banks within the Hydroelectric Reach.

In general, information regarding contaminants in the Upper Klamath Basin upstream of the Hydroelectric Reach is very limited. Human activities such as illegal dumping may be a source of inorganic and organic contaminants to the lower Sprague and Williamson river sub-basins (Rabe and Calonje 2009). Natural geologic sources of arsenic may be causing relatively high levels of this chemical element in the Upper Klamath Basin (see Appendix C.7.1 for more detail). Other ongoing actions such as agricultural activities that result in the use of herbicides or pesticides, or large forest fires, may contribute to an increase in inorganic and organic contaminants in the Klamath River through surface water runoff or atmospheric deposition. Together, these actions could combine to result in significant cumulative effects associated with inorganic and organic contaminants.

The Proposed Action's incremental contribution to the significant cumulative effects associated with inorganic and organic contaminants would be minimal. Results from the 2009–2010 Secretarial Determination sediment chemistry analyses indicate that sediment deposits associated with the Proposed Action show that one or more chemicals are present, but at levels unlikely to cause adverse effects based on the lines of evidence (CDM 2011). Previous studies and the 2009–2010 Secretarial Determination study (CDM 2011) indicate that in the short term (<2 years following dam removal), one or more chemicals would be present at levels with potential to cause minor or limited adverse effects on freshwater aquatic species. In the long term, one or more chemicals would be present, but at levels unlikely to cause adverse effects based on the lines of evidence. Implementation of BMPs for deconstruction and revegetation activities that would occur in or adjacent to the Klamath River would minimize the potential for chemicals in sediment to enter the water. With respect to bioaccumulation potential, there are no detected chemicals that exceeded applicable marine bioaccumulation screening levels (CDM 2011). Elutriate chemistry results (prior to consideration for mixing and dilution) do not indicate likely toxicity in the marine nearshore environment

under the Proposed Action (CDM 2011). **The Proposed Action's incremental contribution to the significant cumulative effects associated with inorganic and organic contaminants would not be cumulatively considerable.**

KBRA - Programmatic Measures

Implementation of the Phase I Fisheries Restoration Plan could result in long-term reductions in fine sediment inputs, reduced summer water temperatures, improved nutrient interception, and increased dissolved oxygen levels. Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same short-term (i.e., during construction activities) and long-term impacts as Phase I. Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could affect water quality during construction. Implementation of Wood River Wetland Restoration could result in warmer long-term spring water temperatures and reduced fine sediment and nutrient inputs to Upper Klamath Lake. Implementation of Water Diversion Limitations could result in long-term decreased summer water temperatures in the Klamath River upstream of the Hydroelectric Reach. Implementation of the WURP could result in long-term decreases in summer water temperature and nutrient inputs to Upper Klamath Lake. Implementation of the Interim Flow and Lake Level Program could result in long-term decreases in summer water temperature and nutrient inputs to Upper Klamath Lake. Implementation of the Upper Klamath Lake and Keno Nutrient Reduction Program could result in long-term decreases in nutrient inputs, increases in seasonal dissolved oxygen, and decreases in concentrations of nuisance algal species in these waterbodies. Many KBRA actions have the potential to affect water quality conditions in the various waterways of the Klamath Basin.

As noted above, temperature, sediment, nutrients, and dissolved oxygen continue to represent significant adverse cumulative water quality effects for the Klamath River. A variety of actions, mainly human-related activities, have contributed to these cumulative impacts. There are also many ongoing actions in the Klamath Basin to improve water quality, including the implementation of TMDLs on the Scott, Salmon, Shasta, and Klamath Rivers as noted in Table 4-3, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004), and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, and the Five Counties Road Maintenance Program. Additionally, the Northwest Forest Plan contains provisions for reducing water quality impacts from timber harvesting and road construction. Together these cumulative actions and programs would contribute to improving water quality in the Klamath Basin. Removal of the Four Facilities is also expected to help improve water quality by restoring the reservoirs to a more natural river system and reducing conditions that promote algal growth.

The KBRA's incremental contribution to the cumulative effects on water quality would be minimal in the short term and would generally be beneficial in the long term. In the short term, some of the KBRA actions could require construction activities that would have the potential to adversely affect water quality. However, best management practices would be implemented to reduce or avoid water quality impacts. In the long term, the KBRA actions are intended to be beneficial to water quality by improving water temperatures, reducing fine sediment and nutrient inputs, and increasing dissolved oxygen levels. **The KBRA's incremental contribution to the significant cumulative effects on water quality would not be cumulatively considerable in the short term and would be beneficial in the long term.**

4.4.1.2 Alternatives 3, 4, and 5

Alternatives 3 and 5 would have similar cumulative short-term and long-term effects on water quality (i.e., water temperature, suspended sediments, nutrients, dissolved oxygen, pH, chlorophyll-a, algal toxins, and inorganic and organic contaminants) as the Proposed Action. Although only two reservoirs are removed under Alternative 5, they are the two largest reservoirs in the Hydroelectric Reach and are responsible for the majority of water quality impacts under existing conditions. Alternative 4 would leave all four reservoirs in place. No short-term cumulative effects associated with high suspended sediment concentrations and low dissolved oxygen due to reservoir drawdown would occur under Alternative 4; however, long-term water quality would not improve and therefore there would be no cumulative benefits. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

4.4.1.3 Mitigation Measures

There would be short-term cumulatively considerable impacts associated with suspended sediment and decreased dissolved oxygen levels during drawdown under the Proposed Action, the Partial Facilities Removal of Four Dams Alternative, and the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative. No feasible mitigation is possible to reduce the impacts during reservoir drawdown. Suspended sediment concentrations would remain a cumulatively considerable water quality impact for up to 6-10 months following reservoir drawdown. Dissolved oxygen levels would remain a cumulatively considerable impact for up to 2 years after reservoir drawdown.

4.4.2 Aquatic Resources

Cumulative effects on aquatic resources could be caused by short-term and long-term effects on water and quality and habitat associated with the project, combined with other projects/actions in the Klamath Basin that could contribute to adverse aquatic resources effects. The timeframe for short-term construction related cumulative effects analysis is the duration of deconstruction and up to 10 months after reservoir drawdown, as suspended sediments are expected to remain elevated. The timeframe for long-term cumulative effects is indefinitely after construction as conditions for aquatic species would be permanently altered with implementation of any of the proposed alternatives.

Table 4-6 presents a summary of the aquatic resources impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

4.4.2.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.2.1.1 Critical Habitat

The Proposed Action could alter the availability and quality of critical habitat, which could affect aquatic species.

Coho Salmon Critical Habitat

Under the Proposed Action, elevated levels of suspended sediment concentrations occurring during 3 to 4 months of drawdown would degrade critical habitat for coho salmon in the short term.

Agricultural water diversions, timber harvesting, man-made barriers such as the Four Hydroelectric dams, mining, road building, livestock grazing, and streambed alteration have contributed to the degradation of coho salmon critical habitat (64 Federal Register 24049). While no specific activities have been identified that would affect coho salmon critical habitat during reservoir drawdown, ongoing activities such as agriculture, water diversions, and mining, and poor water quality could all contribute to the degradation of critical habitat. Degradation of critical habitat is therefore a significant cumulative impact in the short term.

The Proposed Action's contribution to the significant cumulative effect on critical habitat would be substantial. There would be 3 to 4 months of high suspended sediment concentrations that would degrade critical habitat for coho salmon.

However, in the long term, the Proposed Action would increase the amount of habitat available to coho salmon upstream of currently designated critical habitat and improve habitat quality within current critical habitat. Bedload movement following dam removal would cause substantial aggradation and increase supply of gravel below the dam as far downstream as Cottonwood Creek. This effect would potentially improve critical habitat for coho salmon by reducing median substrate to a size more favorable for spawning (Reclamation 2012). Other cumulative actions and programs that could benefit critical habitat for coho salmon include the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River.

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Critical Habitat				
Continued impoundment of water within the reservoirs could alter the water quality and habitat suitability within critical habitat.	1	NCFEC (coho, Bull Trout and Southern Resident Killer Whale, and Eulachon	None	NCFEC coho, Bull Trout, Southern Resident Killer Whale, and Eulachon
	4	NCFEC - coho, Bull Trout, Southern Resident Killer Whale	None	NCFEC - coho, Bull Trout, Southern Resident Killer Whale
Reservoir drawdown associated with dam removal could alter the quality of critical habitat.	2, 3	S - coho and eulachon LTS - Bull Trout and Southern Resident Killer Whale	None	S - coho and eulachon LTS - Bull Trout and Southern Resident Killer Whale
	5	S - coho LTS - Bull Trout and Southern Resident Killer Whale	None	S - coho LTS - Bull Trout and Southern Resident Killer Whale
The removal of dams and reservoirs could alter the availability and quality of critical habitat.	2,3	B (coho and eulachon) LTS (Bull Trout and Southern Resident Killer Whale)	None	B (coho and eulachon) LTS (Bull Trout, Southern Resident Killer Whale)
	5	B (coho) LTS (Bull Trout and Southern Resident Killer Whale)	None	B (coho) LTS (Bull Trout and Southern Resident Killer Whale)
Essential Fish Habitat				
Continued impoundment of water within the reservoirs could alter the availability and suitability of Essential Fish Habitat (EFH).	1, 4	NCFEC (Chinook and coho salmon EFH) NCFEC (Groundfish EFH, Pelagic Fish)	None	NCFEC (Chinook and coho salmon EFH) NCFEC (Groundfish EFH, Pelagic Fish)

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Reservoir drawdown associated with dam removal could alter the quality of EFH.	2, 3, 5	S (short term for Chinook and coho) B (long term) Chinook salmon and coho LTS (groundfish and pelagic fish)	None	S (short term for Chinook and coho) B (long term) Chinook salmon and coho LTS (groundfish and pelagic fish)
The removal of dams and reservoirs could alter the availability and quality of EFH.	2, 3, 5	B (Chinook and coho) LTS (groundfish and pelagic fish)	None	B (Chinook and coho) LTS (groundfish and pelagic fish)
Construction-Related Impacts				
Disturbance to the river channel during construction could affect aquatic species.	2, 3, 4, 5	LTS	None	LTS
Species Impacts				
Fall-Run Chinook				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect fall-run Chinook salmon.	2, 3, 5	S	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	LTS
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect fall-run Chinook salmon.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect fall-run Chinook salmon.	4	B	None	B

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Spring-Run Chinook				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCEFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect spring-run Chinook salmon.	2, 3, 5	LTS	AR-2: Protection of outmigrating juveniles	LTS
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect spring-run Chinook salmon.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect spring-run Chinook salmon.	4	B	None	B
Coho Salmon				
Continued impoundment of water within reservoirs at the Four Facilities could alter habitat suitability affecting aquatic species.	1	NCFEC (for all population units)	None	NCFEC (for all population units)
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC (for all population units)	None	NCFEC (for all population units)
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect coho salmon.	2, 3, 5	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units) LTS (Trinity River, Salmon River, and Lower Klamath River population units)	AR-1: Protection of mainstem spawning; AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses; AR-4: Hatchery management	S (Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units) LTS (Trinity River, Salmon River, and Lower Klamath River population units)

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect coho salmon.	2, 3, 5	B (Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River population units) LTS (Trinity River population units)	None	B (Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River population units) LTS (Trinity River population units)
Fish ladders could result in alterations in habitat availability which could affect coho salmon.	4	B (Upper Klamath River population unit) NCFEC (Mid-Klamath River, Shasta River, Scott River, Salmon River, Trinity River, and Lower Klamath River population units)	None	B (Upper Klamath River population unit) NCFEC (Mid-Klamath River, Shasta River, Scott River, Salmon River, Trinity River, and Lower Klamath River population units)
Steelhead				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect steelhead in the short term.	2, 3, 5	S	AR-2: Protection of outmigrating juveniles; AR-3: Fall flow pulses	S
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect steelhead.	2, 3, 5	B (summer and winter steelhead)	None	B (summer and winter steelhead)
Fish passage provisions could result in alterations in habitat availability which could affect steelhead.	4	B	None	B

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Pacific Lamprey				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting Pacific lamprey.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect Pacific lamprey in the short term.	2, 3, 5	S	AR-2: Protection of outmigrating juveniles; AR-5: Pacific lamprey capture and relocation	S
Removal of Project dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation, which could affect Pacific lamprey.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect Pacific lamprey.	4	B	None	B
Green Sturgeon				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect green sturgeon.	2, 3, 5	S	AR-3: Fall flow pulses	S
Removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins which could affect green sturgeon.	2, 3, 5	LTS	None	LTS

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Fish passage provisions could result in alterations in habitat availability which could affect green sturgeon.	4	NCFEC	None	NCFEC
Lost River and Shortnose Sucker				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir removal associated with dam removal could alter habitat availability and affect lost river and shortnose suckers	2, 3, 5	S (short term)	AR-6: Sucker rescue and relocation	LTS
Restoration action associated with KBRA implementation could alter habitat availability and suitability and affect lost river and shortnose suckers.	2	B	None	B
Continued impoundment of water in the reservoirs could affect shortnose and Lost River Sucker populations by continuing poor water quality and high rates of predation.	4	LTS	None	LTS
Redband Trout				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect redband trout.	2, 3, 5	LTS	None	LTS

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal would restore connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the Upper Klamath Basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect redband trout.	4	B	None	B
Bull Trout				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Dam removal and/or fish passage could alter habitat access for anadromous fish, which could affect bull trout.	2, 3, 4, 5	LTS	None	LTS
Eulachon				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1, 4	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect eulachon.	2, 3, 5	LTS	None	LTS
Longfin Smelt				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1, 4	NCFEC	None	NCFEC

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect longfin smelt.	2, 3, 5	LTS	None	LTS
Introduced Resident Species				
Continued impoundment of water within the reservoirs could alter habitat suitability affecting aquatic species.	1, 4	NCFEC	None	NCFEC
Continued blockage of habitat access at the Four Facilities could alter habitat availability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal would eliminate habitat for introduced resident species in the Hydroelectric Reach.	2	LTS[1]	None	LTS
Fish passage provisions could result in alterations in habitat availability which could affect introduced resident species.	4	NCFEC	None	NCFEC
Mandatory conditions and provisions for continued hydroelectric operations could alter habitat suitability affecting introduced resident species.	4	LTS	None	LTS
Freshwater Mussels				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect freshwater mussels in the short term.	2, 3, 5	S	AR-7: Freshwater mussel relocation	S

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Dam removal would restore connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the Upper Klamath Basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach.	4	B	None	B
Continued impoundment of water within the reservoirs would result in no change in suspended sediments.	4	NCFEC	None	NCFEC
Benthic Macroinvertebrates				
Continued impoundment of water within the reservoirs and blockage of habitat could alter habitat suitability affecting aquatic species.	1	NCFEC	None	NCFEC
Reservoir drawdown associated with dam removal could alter SSCs and bedload sediment transport and deposition and affect macroinvertebrates.	2, 3, 5	S	None	S
Dam removal would restore connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the Upper Klamath Basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach.	2, 3, 5	B	None	B
Fish passage provisions could result in alterations in habitat availability which could affect macroinvertebrates.	4	NCFEC	None	NCFEC
Trap and Haul Operations – Programmatic Measure				
Implementation of trap and haul measures could affect aquatic species.	4, 5	B (fall-run Chinook)	None	B (fall-run Chinook)

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Interim Measures				
IM 7, implementation of J.C. Boyle Gravel Placement and/or Habitat Enhancement could result in alterations to habitat quality and affect aquatic species.	1, 2, 3	B – Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. coho Salmon (Upper Klamath River population units) LTS – all other coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers. NCFEC – green sturgeon, eulachon, and southern Resident Killer Whales	None	B – Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. coho Salmon (Upper Klamath River population units) LTS – all other coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, and southern Resident Killer Whales
IM 8, implementation of J.C. Boyle Bypass Barrier removal could result in alterations to habitat availability, and affect aquatic species.	1, 2	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. coho Salmon (Upper Klamath River population units) LTS – all other coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers. NCFEC – macroinvertebrates, freshwater muscles, green sturgeon, eulachon, Southern Resident Killer Whales	None	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, and redband trout. coho Salmon (Upper Klamath River population units) LTS – all other coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers. NCFEC – macroinvertebrates, freshwater muscles, green sturgeon, eulachon, Southern Resident Killer Whales

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
IM 16, implementation of the interim measure Water Diversions could result in alterations to habitat availability and habitat quality and affect aquatic species.	3	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates.. coho Salmon (Upper Klamath River population units) LTS – all other coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, southern Resident Killer Whales	None	B-Fall-run Chinook, spring-run Chinook, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. coho Salmon (Upper Klamath River population units) LTS – all other coho population units, bull trout, freshwater mussels, shortnose and Lost River suckers NCFEC – green sturgeon, eulachon, southern Resident Killer Whales
Keno Transfer				
Implementation of the Keno Transfer could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities could cause adverse aquatic resource effects.	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
The Proposed Action will require the relocation of the Yreka Water Supply Pipeline.	2, 3, 5	LTS	None	LTS

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Klamath Basin Restoration Agreement –Programmatic Measures				
Implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could result in alterations to water quantity, water quality, habitat availability and habitat quality, and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers, coho salmon except for the Trinity River Populations); NCFEC (green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels); LTS (coho Trinity River)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers, coho salmon except for the Trinity River Populations); NCFEC (green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, and freshwater mussels); LTS (coho Trinity River)
Implementation of Phase I of the Fisheries Reintroduction and Management Plan could result in alterations to habitat availability (fish access), and could affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, benthic macroinvertebrates, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, and freshwater mussels); LTS (redband trout)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, Southern Resident Killer Whales, benthic macroinvertebrates, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, and freshwater mussels); LTS (redband trout)

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of Water Diversion Limitations could result in reducing uncertainties associated with maintaining adequate ecological flows for aquatic species and their habitats, especially in low-flow years, and could alter water quality and water temperatures in certain seasons and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)
Implementation of On-Project Plan could result in alterations to water quantity and water quality and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
The Water Use Retirement Program could alter water quantity and water quality, and affect aquatic species.	2, 3	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, shortnose and Lost River suckers, coho except those Trinity River population units); NCFEC (coho Trinity River Population Units; green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)
Implementation of the Fish Entrainment Reduction could result in alterations to potential alterations to mortality risk and affect aquatic species.	2, 3	B (shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey, coho salmon from the Upper Klamath River population unit); NCFEC (all other coho salmon population units, green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)	None	B (shortnose and Lost River suckers, redband trout, fall-run Chinook salmon, spring-run Chinook salmon, steelhead, and Pacific lamprey, coho salmon from the Upper Klamath River population unit); NCFEC (all other coho salmon population units, green sturgeon, bull trout, eulachon, Southern Resident Killer Whales, freshwater mussels, and benthic macroinvertebrates)

Table 4-6. Summary of Aquatic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Klamath Tribes Interim Fishing Site could result in alterations to managed harvest mortality of fish species that are culturally important to the Klamath River Tribes,	2, 3	NCFEC	None	NCFEC
Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake.	2,3	N/B	None	B

[1] Because these species were introduced and they occur in other nearby water bodies, their loss would not be considered significant from a biological perspective, and would benefit native species. From a recreational fishing perspective, their loss would be considered less-than-significant given the presence of regional lakes and reservoirs providing similar recreational opportunities (see Section 3.20, Recreation).

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
SSC = suspended sediment concentrations

The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat and may benefit coho salmon critical habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve critical habitat for coho salmon. Together, these actions and the Proposed Action would result in cumulatively beneficial effects on coho salmon critical habitat. **The Proposed Action's incremental contribution to the significant cumulative effect on coho salmon critical habitat would be cumulatively considerable in the short term during reservoir drawdown, and would be beneficial in the long term. No feasible mitigation is available to reduce the short-term significant cumulative impacts; therefore they remain cumulatively considerable.**

Bull Trout Critical Habitat

Implementation of the Proposed Action would not affect the physical or chemical components of bull trout critical habitat, but would allow Chinook salmon and steelhead to access areas they have not been able to access since the completion of the Copco 1 Development in 1918. These species would potentially compete with and prey upon bull trout fry and juveniles; however, bull trout would also be expected to consume the eggs and fry of Chinook salmon and steelhead. These species co-evolved in the watershed together, and it is anticipated that they would be able to co-exist in the future.

Past and present threats to bull trout critical habitat include channelization, water withdrawals, removal of streamside vegetation, elevated water temperatures, and increased sedimentation (United States Fish and Wildlife Service [USFWS] 2002). Degradation of bull trout critical habitat is a significant cumulative impact.

The Proposed Action would not physically alter the bull trout critical habitat. **The Proposed Action's incremental contribution to the significant cumulative effect on bull trout critical habitat would not be cumulatively considerable in the short or long term.**

Southern Resident Killer Whale Critical Habitat

The Klamath River contributes to critical habitat for Southern Resident Killer Whales through its contribution of Chinook salmon to their food supply. The Proposed Action would not affect the geographic extent of critical habitat for this species, as it is located in the State of Washington. The Proposed Action is expected to increase wild populations of anadromous salmonids, which could increase food supply for Southern Resident Killer Whale.

One of the Primary Constituent Elements for the Southern Resident Killer Whale critical habitat is "Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth" (National Oceanic and Atmospheric Administration [NOAA] Fisheries Service 2006). The Southern Resident Killer Whale population has declined substantially since the mid- to late 1800s. The declining population is partially attributed to a decline in food

sources, including stocks of fish, whales, and pinnipeds (NOAA Fisheries Service 2006). Changes to salmon populations, one of their main food sources, are therefore considered a significant cumulative effect on critical habitat.

The Proposed Action's contribution to the cumulative effect would be minimal. While the Proposed Action is anticipated to increase salmon populations, the Klamath River salmon are anticipated to provide less than 1 percent of the diet of Southern Resident Killer Whale in most months. **The Proposed Action's incremental contribution to the significant cumulative effect on Southern Resident killer whale critical habitat would not be cumulatively considerable.**

Eulachon Critical Habitat

Under the Proposed Action, PCEs of critical habitat supporting eulachon would be degraded in the short term, including short-term adverse affects of suspended sediment on spawning and egg incubation habitat, and adult and larval migration habitat for southern Distinct Population Segment eulachon.

Eulachon populations have declined substantially since the 1960s. Past and ongoing habitat and other protective efforts have contributed to the conservation of the southern DPS, but these efforts have not sufficiently reduced the extinction risks. Past and present actions affecting eulachon critical habitat include the presence of the four hydroelectric dams (Iron Gate, J.C. Boyle and Copco 1 and Copco 2), which have affected and continue to affect water flow, water quality, substrate quality, and depth. Timber harvesting and road building actions have also affected critical habitat by increasing sediment loading to aquatic environments (National Marine Fisheries Service [NMFS] 2011). Changes to water quality therefore considered significant cumulative effects on critical habitat.

The Proposed Action's contribution to the short-term significant cumulative effects would be cumulatively considerable during reservoir drawdown because it would increase suspended sediments. Over the long term, the Proposed Action's contribution to the significant cumulative effect is expected to be beneficial. Under the Proposed Action it is anticipated that water quality would improve throughout the Klamath River, including the estuary (WQST 2011) and that habitat restoration effort under KBRA would improve estuary habitat. **The Proposed Action's incremental contribution to the significant cumulative effect on eulachon critical habitat would be cumulatively considerable in the short term during reservoir drawdown, and would be beneficial in the long term. No feasible mitigation is available to reduce the short-term significant cumulative impacts; therefore they remain cumulatively considerable.**

4.4.2.1.2 Essential Fish Habitat

The Proposed Action would alter the availability of Essential Fish Habitat (EFH), which could affect aquatic species.

Chinook and Coho Salmon EFH

The release of sediment from reservoirs under the Proposed Action would adversely affect Chinook and coho salmon EFH in the short term during the months when suspended sediment concentrations are elevated. Over the long term, the Proposed Action would benefit EFH.

Past and present actions have also affected Chinook and coho salmon EFH. Agricultural water diversions, man-made barriers, including the four hydroelectric dams, sedimentation from erosion and runoff, and alteration of stream channels have affected water quality, fish passage, and food sources for salmon. While no other specific activities have been identified that would affect salmon EFH during reservoir drawdown, existing practices such as agriculture, water diversions, mining, and dredging could all contribute to the degradation of essential habitat. Together these actions have had significant cumulative effects on Chinook and coho salmon EFH.

The Proposed Action's contribution to the short-term cumulative effect would be substantial. There would be 3 to 4 months of high suspended sediment concentrations that would degrade Chinook and coho salmon EFH.

In the long term the Proposed Action would increase habitat for Chinook and coho salmon (upstream of currently designated EFH) by providing access to habitats upstream of Iron Gate Dam, improved water quality, and decrease prevalence of disease would provide a benefit to EFH for Chinook and coho salmon. Other cumulative actions and programs that could benefit Chinook and coho salmon EFH include the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat and may benefit Chinook and coho salmon EFH. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve critical habitat for Chinook and coho salmon EFH. Together, these actions and the Proposed Action would result in cumulatively beneficial effects on Chinook and coho salmon EFH. **Overall, the Proposed Action's incremental contribution to the significant cumulative effect on Chinook and coho salmon EFH would be cumulatively considerable in the short term and would be beneficial in the long term. No feasible mitigation is available to reduce the short-term significant cumulative impacts; therefore they remain cumulatively considerable.**

Groundfish EFH

Under the Proposed Action, EFH in the estuary could be affected by elevated turbidity from sediment releases during dam removal for about 3 months. After this time, suspended sediment concentrations would return to levels similar to existing conditions. Suspended sediment concentrations in the estuary would be less than 40 percent of the peak concentrations that are anticipated to occur immediately downstream from Iron Gate

Dam. These peaks would still be substantial, and would be higher than the extreme values estimated by the sediment transport model for existing conditions (see Section 3.3.4.5, Aquatic Resources).

Groundfish EFH continues to be adversely affected by commercial fishing. Certain types of common fishing gear, such as trawls, have degraded groundfish EFH. Non-fishing activities that have degraded EFH include mining, dredging, fill, impoundment, discharge, water diversions, thermal additions, actions that contribute to non-point source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH (Pacific Fishery Management Council 2005). Together these actions have resulted in significant cumulative effects on groundfish EFH.
The Proposed Action's contribution to the significant cumulative effects would be short term. Under the Proposed Project under the most likely to occur scenario, suspended sediment concentrations would be elevated relative to existing conditions, but would last a short duration. In the long term, suspended sediment concentrations would be similar to that under existing conditions. **The Proposed Action's contribution to the significant cumulative effect on EFH would not be cumulatively considerable.**

Pelagic Fish EFH

The cumulative effects on pelagic fish EFH would be similar to those described for groundfish EFH. **The Proposed Action's contribution to the significant cumulative effect on EFH would not be cumulatively considerable.**

4.4.2.1.3 Construction-Related Impacts

Disturbance to the river channel during construction could affect aquatic species. These effects could include shockwaves associated with breaking down the dam structure using explosives or heavy equipment, potential crushing of aquatic species from operation of heavy equipment in the river, sedimentation, and release of oil, gasoline, or other toxic substances from construction sites.

Other cumulative actions that could affect aquatic species during construction include agricultural activities, timber harvesting, new road construction, and mining that could increase suspended sediments, and construction projects in the surrounding area such as new subdivisions and road improvements planned in Siskiyou County that could introduce sediments or toxic materials into the river. Together these actions could result in cumulative effects on aquatic species.

The Proposed Action's contribution to the cumulative effect would not be cumulatively considerable. To reduce these potential construction impacts, construction areas would be isolated from the active river where possible, and water would be routed around the construction area, allowing the flow to move down the other portion of the river, while the isolated portion of the dam is removed. After a work area is isolated, fish rescues to remove any native fish trapped in the work area would be conducted. Fish would be relocated to an area of suitable habitat within the Klamath River. Implementation of soil erosion and sedimentation control and stormwater pollution prevention would minimize

soil erosion and water quality effects on anadromous fish downstream from the work area, during and after construction. **The Proposed Action's incremental contribution to the significant cumulative effects on aquatic resources during deconstruction would not be cumulatively considerable.**

4.4.2.1.4 Species-Specific Impacts

The Proposed Action could affect aquatic species.

Fall-Run Chinook Salmon

Reservoir drawdown associated with dam removal under the Proposed Action could alter SSCs and bedload sediment transport and deposition and affect fall-run Chinook salmon. Overall, the effect of the Proposed Action on the fall-run Chinook salmon population, under both most-likely and worst-case scenarios, is expected to be relatively minor. Effects would be distributed over three year-classes, rather than a single year-class. Direct mortality is predicted for 2,100 redds (around 8 percent of total redds in the basin), and for around 669 Type III smolts (< 1 percent of production). In addition, sublethal effects on Type I and Type II outmigrants are predicted.

Significant cumulative effects have occurred to fall-run Chinook salmon in the Klamath Basin. Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting fall-run Chinook salmon include the construction of the KHP and other dams, which have severely reduced access to habitat, altered water quality, adversely affected channel morphology, and created conditions for toxic algal blooms. Downstream from Iron Gate Dam, the mainstem Klamath River experiences occasional blooms of *Microcystis aeruginosa*. During outmigration, in some years juvenile Chinook salmon are subject to elevated disease levels that persist due to continued reduced flow variability (as compared to more natural flow conditions) below Iron Gate Dam and limited dispersal of salmonid carcasses due to the presence of Iron Gate Dam and the Iron Gate Hatchery. These pathogens include myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta*. Dams have affected the quality of habitat downstream by preventing spawning gravel from traveling downstream (Moyle et al. 2008), releasing limited, warm, and sometimes toxic water, and dictating unnatural stream morphology or structure. It is also important to note that bedload sediment movement and transport are vital to create and maintain functional aquatic habitat. Bedload sediment, in the form of sand, gravels, cobbles and boulders is naturally delivered to and transported in undammed streams and rivers. Natural sediment pulses that result from heavy rainfall and snowmelt events are incorporated by stream and river processes into spawning beds, gravel bars, side channels, pools, riffles and floodplains that provide habitat and support food chains of aquatic species. These periodic inputs of bedload sediments are necessary for the long-term maintenance of aquatic habitats.

Salmonids evolved with sediment and depend on continued bedload sediment delivery to provide substrate suitable for spawning and early rearing in streams and rivers. These

processes have been disrupted by the dams. Other cumulative activities that have affected Chinook salmon include agriculture, grazing, water diversions, timber harvesting, mining, suction dredging, discharge of toxic substances such as fertilizers or pesticides into the river, overfishing, disease, and predation. There are also many ongoing cumulative actions and programs that are intended to reduce impacts or benefit Chinook salmon and habitat in the long term. The implementation of the Klamath Basin TMDLs would improve water quality. The Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program would also help to improve water quality and aquatic habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for Chinook salmon.

The Proposed Action's incremental contribution to the short-term significant cumulative effect on fall-run Chinook salmon would be cumulatively considerable. The Proposed Action's contribution to the cumulative effects would be reduced by implementing Mitigation Measures AR-1 through AR-4 to reduce the short-term impacts of suspended sediment concentrations on fall-run Chinook salmon incubating eggs, and smolts. Additionally, Type-II and Type-III progeny of adults that successfully spawn in tributaries during 2020 would produce smolts that outmigrate to the ocean a year after the spring pulse of suspended sediment in 2020 and should not be noticeably affected by the Proposed Action. However, because of the reduced growth, stress, and high reported mortality for Chinook salmon smolts, the suspended sediment concentrations would still have a substantial cumulative effect in the short term. **The Proposed Action's incremental contribution to the short-term significant cumulative effect on fall-run Chinook salmon would be cumulatively considerable, even with mitigation. No other feasible mitigation is possible to reduce this impact; therefore this impact remains cumulatively considerable.**

Under the Proposed Action, removal of dams could alter habitat availability, flow regime, water quality, temperature variation, fish disease incidence, and algal toxins, all of which could affect fall-run Chinook salmon in the long term. Dam removal would restore connectivity to hundreds of miles of historical habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach currently under reservoirs and of exceptional value to anadromous salmonids. The presence of the dams prevents anadromous salmonids from occupying this habitat. Access to habitat is essential to restore salmonid populations. It is anticipated that as a result of the Proposed Action, the fall-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. Restored migration to habitat above the dams is likely to enable a greater diversity of life history strategies and habitat utilization, with some of those strategies more likely to avoid periods of poor water quality, parasite exposure, and adverse effects of climate change than under current conditions. Dam removal would also cause water temperatures to become warmer earlier in the spring and summer and cooler earlier in the late summer and fall, and to have diurnal variations

more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for salmonids in the mainstem. Dam removal would maximize the recruitment of gravel within and downstream from the Hydroelectric Reach, which would benefit fish spawning in the entire mainstem Klamath River from at least the current site of Copco Reservoir to Cottonwood Creek. Additionally, more variable flows patterns under Alternatives 2 and 3 would more frequently mobilize bedload sediment such as sand, gravel, and cobbles, and restore more natural sediment transport processes. These conditions are likely to reduce the occurrence of juvenile salmon disease and create better conditions for migration, rearing, and spawning.

The Proposed Action's contribution to the significant cumulative effects on fall-run Chinook salmon would be beneficial in the long term by providing access to habitat, improving water quality, minimizing disease, and generally contributing to an increase in abundance, productivity, population spatial structure, and genetic diversity. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on fall-run Chinook salmon would be beneficial**.

Spring-Run Chinook Salmon

Reservoir drawdown associated with dam removal under the Proposed Action could alter suspended sediment concentrations and bedload sediment transport and deposition and affect spring-run Chinook salmon. The overall effect of suspended sediment from the Proposed Action on the spring-run Chinook salmon population is not anticipated to differ much from existing conditions. There would be very little effect on adult migrants, and no effects are anticipated for the spawning, incubation, and fry stages. Type I and II outmigrants are expected to experience very similar conditions under the Proposed Action as under existing conditions and the No Action/No Project Alternative. However, direct mortality is predicted for around 16 to 28 Type III smolts (< 1 percent of production). In addition, sublethal effects on adult migrants and Type I and Type II outmigrants are predicted.

Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting spring-run Chinook salmon are similar to those described above for fall-run Chinook salmon.

The Proposed Action's incremental contribution to the significant cumulative effect on spring-run Chinook salmon would be cumulatively considerable. However, the cumulative impact would be reduced by implementing Mitigation Measure AR-2 to reduce the short-term impacts of suspended sediments on spring-run Chinook salmon Type III smolts. **With mitigation measures AR-2, the Proposed Action's incremental contribution to the short-term significant cumulative effect on spring-run Chinook salmon from sediment release would not be cumulatively considerable.**

Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect spring-run Chinook salmon in the long term. Dam removal would restore connectivity to hundreds of miles of potentially usable habitat in the Upper Klamath Basin and would create additional spawning and rearing habitat within the Hydroelectric Reach. Restored migration to habitat above the dams is likely to enable a greater diversity of life history strategies and habitat utilization, with some of those strategies more likely to avoid periods of poor water quality, parasite exposure, and adverse effects of climate change than under current conditions.

Significant cumulative effects have occurred to spring-run Chinook salmon in the Klamath Basin. Chinook salmon population levels have declined significantly over the last 100 years and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). Cumulative actions substantially affecting spring-run Chinook salmon are similar to those described above for fall-run Chinook salmon.

The Proposed Action's incremental contribution to significant cumulative effects on spring-run Chinook salmon would be beneficial. It is anticipated that as a result of the Proposed Action, the spring-run Chinook salmon population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity by providing access to additional habitat and improving water quality. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on spring-run Chinook salmon would be beneficial.**

Coho Salmon

Reservoir drawdown associated with dam removal under the Proposed Action could alter suspended sediment concentrations and bedload sediment transport and deposition and affect coho salmon. In general, the wide distribution and use of tributaries by both juvenile and adult coho salmon would likely protect the population from the worst effects of the Proposed Action. However, direct mortality is anticipated for around 13 redds, or 0.7–26 percent of Upper Klamath River Population unit natural escapement. Direct mortality is also anticipated for 2,668 smolts under the most-likely to occur scenario, or 6,536 smolts under a worst-case scenario. This equates to no mortality for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios, and 9 percent of the production from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units, or 22 percent under a worst-case scenario. Sublethal effects are anticipated for all other life-stages. All population units would be expected to recover from these losses within one or two generations, given the long-term benefits described below. Although no single year-class is expected to be completely lost, mortality of a portion of the smolt outmigration from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units may affect the strength of the 2018 year class, requiring two or three generations to recover from losses.

Significant cumulative effects have occurred to coho salmon in the Klamath Basin. coho salmon population levels have declined significantly over the last 100 years, and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). A large variety of actions have contributed to significant cumulative adverse effects on coho salmon, including the Klamath Hydroelectric Project. Additionally, alterations of the natural flow regimes have increased water temperatures, depleted flows necessary for migration, spawning, rearing, flushing of sediments from spawning gravels, gravel recruitment and transport of bedload and large woody debris. Land use activities in the Klamath Basin such as logging, road construction, urban development, mining, agriculture, and recreation have altered habitat quantity and quality, resulting in increased stream bank erosion, increased sedimentation input and loss of channel complexity (NOAA Fisheries Service Undated). Some ongoing actions that would also benefit coho salmon in the long term include implementation of Klamath Basin TMDLs to improve water quality, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Several anadromous fish reintroduction and conservation plans developed by the Tribes and the Oregon Department of Fish and Wildlife would help to conserve coho salmon and their habitat and support restoration efforts. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for coho salmon.

The Proposed Action's incremental contribution to the cumulative effect would be cumulatively considerable; however it would be lessened by implementing Mitigation Measures AR-1 through AR-4 to reduce the short-term impacts of suspended sediment concentrations on coho salmon adults, incubating eggs, and smolts. With implementation of mitigation measures there would still be short term effects for coho salmon including direct mortality to as high as 18 percent of the smolts from some population units under a worst-case scenario. **The Proposed Action's incremental contribution to the short-term significant cumulative effect on coho salmon would remain cumulatively considerable even with mitigation AR-1 through AR-4. No additional feasible mitigation is available to further reduce this cumulative impact; therefore it remains cumulatively considerable.**

Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and fish disease incidence, and algal toxins which could affect coho salmon in the long term. Dam removal would restore connectivity to habitat on the mainstem Klamath River up to and including Spencer Creek and would create additional habitat within the Hydroelectric Reach. Dam removal would also cause water temperatures to become warmer earlier in the spring and early summer and cooler earlier in the late summer and fall, and to have diurnal variations more in sync with historical migration and spawning periods (Hamilton et al. 2011). These changes would result in water temperature more favorable for

salmonids in the mainstem. It is anticipated that as a result of the Proposed Action the Upper Klamath River, Mid-Klamath River, Shasta River, Scott River, Salmon River, and Lower Klamath River coho salmon population units would have an increase in abundance, productivity, population spatial structure, and genetic diversity. It is anticipated that as a result of the Proposed Action the three Trinity River population units would have increased productivity.

Significant cumulative effects have occurred to coho salmon in the Klamath Basin. coho salmon population levels have declined significantly over the last 100 years, and currently a substantial number of Chinook salmon and coho salmon that return to spawn in the Klamath Basin were spawned in hatcheries (NOAA Fisheries Service 2009). A large variety of actions have contributed to significant cumulative adverse effects on coho salmon, including the Klamath Hydroelectric Project. Additionally, alterations of the natural flow regimes have increased water temperatures, depleted flows necessary for migration, spawning, rearing, flushing of sediments from spawning gravels, gravel recruitment and transport of bedload and large woody debris. Land use activities in the Klamath Basin such as logging, road construction, urban development, mining, agriculture, and recreation have altered habitat quantity and quality, resulting in increased stream bank erosion, increased sedimentation input and loss of channel complexity (NOAA Fisheries Service Undated). Some ongoing actions would also benefit coho salmon in the long term include implementation of Klamath Basin TMDLs to improve water quality, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program, which would improve water quality and habitat in the Klamath River. The Northwest Forest Plan would reduce impacts from timber harvesting and road construction on aquatic species and habitat. Several anadromous fish reintroduction and conservation plans developed by the Tribes and the Oregon Department of Fish and Wildlife would help to conserve coho salmon and their habitat and support restoration efforts. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) could also improve habitat for coho salmon.

Based on increased habitat availability and improved habitat quality, **the Proposed Action's incremental contribution to the significant long-term cumulative effects on coho salmon would be beneficial for the coho salmon from the Upper Klamath River, Mid-Klamath River, Lower Klamath River, Shasta River, Scott River, and Salmon River population units in the long term and would not be cumulatively considerable for coho salmon from the three Trinity River population units in the long term.**

Steelhead

Reservoir drawdown associated with dam removal under the Proposed Action could alter suspended sediment concentrations and bedload sediment transport and deposition and affect steelhead. Effects of suspended sediment resulting from the Proposed Action on steelhead are likely to be high, particularly for the portion of the population that spawns

in tributaries upstream of the Trinity River. For that portion of the population, effects are anticipated on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and outmigrating smolts.

Significant cumulative effects have occurred on steelhead populations in the Klamath River, including degraded habitat, decreased habitat access, fish passage, predation, and competition (Moyle et al. 2008). Steelhead populations are generally believed to have decreased since the early 1900's. This is likely due to degraded habitat and blocked tributaries (National Research Council 2004).

The Proposed Action's incremental contribution to the cumulative effect on steelhead would be cumulatively considerable; however it would be reduced by the implementation of Mitigation Measures AR-2 and AR-3. These measures would reduce the short-term impacts of suspended sediment concentrations on steelhead adults and outmigrating juveniles. Additionally, the broad spatial distribution of steelhead in the Klamath basin and their flexible life history suggests that some would avoid the most serious effects of the Proposed Action by (1) remaining in tributaries for extended rearing, (2) rearing farther downstream where SSC should be lower due to dilution (e.g., the progeny of the adults that spawn in the Trinity River basin or tributaries downstream from the Trinity River), and/or (3) moving out of the mainstem into tributaries and off-channel habitats during winter. In addition, the life-history variability observed in steelhead means that, although numerous year classes would be affected, not all individuals in any given year class would be exposed to the effects of the Proposed Action. In addition, some portion of the progeny of those adults that spawn successfully would rear in tributaries long enough to not only avoid the most serious impacts of the Proposed Action in 2020, but may also not return to spawn for up to two years, when any suspended sediment resulting from the Proposed Action should be greatly reduced. The high incidence of repeat spawning among summer-run steelhead (ranging from 40 to 64 percent, Hopelain 1998) should also increase that population's resilience (including all year classes) to effects of the Proposed Action. However, because of the potential for reduction in the abundance of a year class in the short term, **the Proposed Action's incremental contribution to the significant cumulative effects on summer and winter steelhead would be cumulatively considerable even with mitigation measures AR-2 and AR-3. No other feasible mitigation is available to reduce this impact; therefore it remains cumulatively considerable.**

Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, temperature variation, and algal toxins which could affect steelhead in the long term. Dam removal would restore connectivity to hundreds of miles of historical habitat in the Upper Klamath Basin and would create additional habitat within the Hydroelectric Reach. It is anticipated that as a result of the Proposed Action the summer and winter steelhead within the Klamath River watershed would have an increase in abundance, productivity, genetic diversity and the opportunity for variable life histories and use of new habitats.

Other cumulative actions that would also benefit steelhead in the long term include implementation of Klamath Basin TMDLs to improve water quality. Several anadromous fish reintroduction and conservation plans developed by the Tribes and the Oregon Department of Fish and Wildlife would help to conserve steelhead and their habitat and support recovery efforts. Together, these actions could benefit steelhead in the long term. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on steelhead would be beneficial.**

Pacific Lamprey

Reservoir drawdown associated with dam removal under the Proposed Action could alter suspended sediment concentrations and bedload sediment transport and deposition and affect Pacific lamprey. .The elevated suspended sediment concentrations under the Proposed Action could adversely affect the Lamprey population. Because multiple year classes of lamprey rear in the mainstem Klamath River at any given time, and since adults would migrate upstream over the entire year, including January 2020 when effects from the Proposed Action would be most pronounced, effects on Pacific lamprey adults and ammocoetes could be high in the mainstem Klamath River. However, most of the population would likely avoid the most severe suspended sediment pulses resulting from the Proposed Action. In addition, Pacific lamprey are considered to have low fidelity to their natal streams, and may not enter the mainstem Klamath River if environmental conditions are unfavorable in 2020. Migration into the Trinity River and other Lower Klamath River tributaries may also increase during 2020 because of poor water quality. Low fidelity also increases the potential that lamprey can recolonize mainstem habitat if ammocoetes rearing there suffer high mortality.

Significant cumulative effects have occurred on various life history stages of the Pacific lamprey, including manmade barriers to migration, water quality, predation, stream and floodplain degradation, dredging, and disease (USFWS 2009). The Proposed Action's incremental contribution to the short-term cumulative effect on pacific lamprey would be cumulatively considerable based on substantial reduction in the abundance of a year class in the short term. Implementation of Mitigation Measures AR-2 and AR-5 would be implemented to reduce the short-term impacts of suspended sediment concentrations on lamprey ammocoetes. However, with implementation of mitigation measures there could still be short-term effects for lamprey including sublethal and lethal effects. **The Proposed Action's incremental contribution to the short-term significant cumulative effect on lamprey would remain cumulatively considerable even with mitigation measures AR-2 and AR-5. No other feasible mitigation is available to reduce this impact; therefore it would be cumulatively considerable.**

Under the Proposed Action, removal of dams could result in alterations in habitat availability, flow regime, water quality, and temperature variation which could affect Pacific lamprey in the long term. The Proposed Action would provide access to habitat in the Hydroelectric Reach and tributaries to this reach. It is anticipated that as a result of the Proposed Action the Pacific lamprey population within the Klamath River watershed would have an increase in abundance, productivity, population spatial structure, and genetic diversity. Other cumulative actions that could also contribute benefits to this

species include several anadromous fish reintroduction and conservation plans developed by the Tribes and the Oregon Department of Fish and Wildlife would help to conserve Pacific lamprey and their habitat and support recovery efforts, and water quality improvements as described under salmon and steelhead. Together, these actions would have cumulative benefits on Pacific lamprey. **The Proposed Action's incremental contribution to the long-term significant cumulative effect on Pacific lamprey would be beneficial.**

Green Sturgeon

Reservoir drawdown associated with dam removal under the Proposed Action could alter suspended sediment concentrations and affect green sturgeon. Up to 100 percent mortality is predicted for incubating eggs and larval life stages, and up to 20 percent mortality is predicted for rearing juveniles under a most-likely-to-occur scenario, or up to 40 percent mortality under a worst-case scenario. Overall, the effects of the Proposed Action are most likely to include physiological stress, inhibited growth, and high mortality for some portion of the age-0 2020 cohort and age 1 2019 cohort. Green sturgeon populations have severely decreased over time, and while little information is available on the cumulative impacts to green sturgeon, because of their small population, it is assumed that green sturgeon have experienced significant adverse cumulative effects.

The Proposed Action's incremental contribution to the short-term cumulative effect on green sturgeon would be cumulatively considerable. Mitigation Measure AR-3 would be implemented to reduce the short-term impacts of suspended sediment concentrations on green sturgeon adults post-spawning; however, there would still be short-term impacts to green sturgeon including lethal and sublethal effects. **The Proposed Action's incremental contribution to the short-term significant cumulative effects on green sturgeon would remain cumulatively considerable even with mitigation measure AR-3. No other mitigation is available to reduce suspended sediment concentrations; therefore this impact remains cumulatively considerable.**

Under the Proposed Action, removal of dams could result in alterations in flow regime, water quality, temperature variation, and algal toxins which could affect green sturgeon in the long term. It is anticipated that as a result of the Proposed Action the green sturgeon population within the Klamath River watershed would have an increased productivity based on improved habitat conditions. As noted above, significant cumulative effects on green sturgeon exist due to their small population. **The Proposed Action's incremental contribution to the long-term significant cumulative effects on green sturgeon would not be cumulatively considerable.**

Lost River and Shortnose Sucker

Reservoir removal associated with dam removal under the Proposed Action could alter habitat availability and affect Lost River and shortnose suckers. The Proposed Action would eliminate reservoir habitat for the Lost River and shortnose suckers. However, this habitat is of little or no significance in restoring these species. Lost River and shortnose suckers have experienced significant cumulative effects from loss of habitat and decline in general water quality. Toxic algal blooms have also resulted in large fish

kills. Water reclamation projects that have removed a substantial number of wetlands in the Upper Klamath Basin have severely affected the quantity and quality of sucker habitat. Water diversions, dredging of Upper Klamath Lake, and the draining of marshes have also contributed to cumulative effects on suckers.

The Proposed Action's incremental contribution to cumulative effects on Lost River and shortnose suckers would be cumulatively considerable. Impacts to these suckers would be minimized by implementing Mitigation Measure AR-6 and removing individuals prior to reservoir drawdown. Based on the small number of individuals affected after mitigation, t**he Proposed Action's incremental contribution to significant short-term significant cumulative effects on Lost River and shortnose suckers would not be cumulatively considerable with implementation of mitigation measure AR-6.**

Redband Trout

The Proposed Action would have short-term effects related to suspended sediment concentrations and bed load movement that could affect redband trout. Redband trout in riverine reaches between the reservoirs in the Hydroelectric Reach would be vulnerable to sublethal and lethal effects of sediment released during dam removal and bed load deposition. However, in the long term, bedload sediment movement and transport are vital to create and maintain functional aquatic habitat. Bedload sediment, in the form of sand, gravels, cobbles and boulders is naturally delivered to and transported in undammed streams and rivers. Natural sediment pulses that result from heavy rainfall and snowmelt events are incorporated by stream and river processes into spawning beds, gravel bars, side channels, pools, riffles and floodplains that provide habitat and support food chains of aquatic species. These periodic inputs of bedload sediments are necessary for the long-term maintenance of aquatic habitats.

Salmonids evolved with sediment and depend on continued bedload sediment delivery to provide substrate suitable for spawning and early rearing in streams and rivers. These processes have been disrupted by the dams.

Redband trout in the Klamath River have experienced significant adverse cumulative effects as a result of existing conditions. The construction of the Klamath Hydroelectric Project has obstructed passage and reduced habitat, and has also adversely altered stream flows and water quality. Redband trout in the Klamath Hydroelectric Project reach are subject to ongoing entrainment into hydroelectric generation facilities and effect to habitat due to peaking. Other past and present cumulative impacts to Redband trout in the Klamath River include agricultural and timber harvesting practices which have degraded stream habitat, channelization and sedimentation of the river, irrigation, and water diversions. As a result of these impacts, some streams and populations are fragmented and have lost connection to lakes and marshes (Oregon Department of Fish and Wildlife 2010).

The Proposed Action's contribution to cumulative effects on redband trout would be short term and minimal. While the release of suspended sediment could affect this

species, a large proportion of the adult population should be already spawning in Spencer or Shovel creeks during the dam removal. Juvenile redband trout outmigrating from Spencer Creek would be expected to recolonize the mainstem by late spring or summer when water conditions become suitable. Those in the affected area could move to tributaries for refuge. The initial movement of coarse and fine sediment after drawdown would likely create adverse conditions for redband trout within the mainstem Klamath River, but these conditions would be short term. **Therefore, the Proposed Action's incremental contribution to significant cumulative effects on redband trout would not be cumulatively considerable in the short term.**

Dam removal would restore connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the upper basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach. As noted above, significant cumulative effects as a result of existing conditions have occurred to redband trout. Salmonids, including redband trout, have depend on continued bedload sediment delivery to provide substrate suitable for spawning and early rearing in streams and rivers. These processes have been disrupted by the dams. Based on increased habitat availability, restored migration, and improved habitat quality, the effect of the Proposed Action would be beneficial for redband trout in the long term. **The Proposed Action's incremental contribution to the significant cumulative impact on redband trout would be beneficial in the long term.**

Bull Trout

Dam removal associated with the Proposed Action could alter habitat availability for anadromous fish, which could affect bull trout. Bull trout upstream of Upper Klamath Lake could be affected by increased predation from reintroduced salmonids, but this loss might be offset by an increase in available food sources (e.g., eggs, fry, and juveniles of reintroduced salmonids) (Hamilton et al. 2010).

Bull trout have experienced significant cumulative adverse impacts. Bull trout populations in the Klamath Basin have been severely reduced and fragmented. Cumulative actions and projects that have contributed to their decline include channelization, water withdrawals, removal of streamside vegetation, timber harvesting practices, and other actions that have degraded the aquatic environment by elevating water temperatures, reducing water quantity and quality, and increasing sedimentation. Klamath Basin bull trout face a high risk of extirpation and continue to be threatened by habitat degradation, past and present land use management practices, agricultural water diversions, and competition or hybridization from nonnative brown and brook trout (USFWS 2002).

The Proposed Action's contribution to the significant cumulative effects on predation of bull trout would be counteracted by the increase in food source that would become available from eggs, fry, and juveniles of reintroduced salmonids. Additionally, Buchanan et al. (2011) states that the Proposed Action provides promise for preventing

extinction of bull trout and for increasing overall population abundance and distribution. **Therefore, the Proposed Action's incremental contribution to the significant cumulative effect on bull trout would not be cumulatively considerable in the short term or the long term.**

Eulachon

The Proposed Action would have short term effects related to suspended sediment concentrations and bedload movement. The Proposed Action would release dam-stored sediment downstream to the Lower Klamath River. Adults entering the Klamath River in the winter and spring of 2020 may be exposed to high suspended sediment concentrations for a portion of their migration period. Although no analysis of the effects of suspended sediment concentrations on eulachon is available, based on application of the Newcombe and Jensen (1996) approach using studies of the effects on other estuary species, it is predicted that under a most-likely or worst-case scenario mortality would be higher under the Proposed Action than under existing conditions. Mortality is also predicted to be higher for spawning, incubation, and larval life stages under the Proposed Action than under existing condition.

Significant cumulative adverse effects have occurred to eulachon populations in the Klamath River. Eulachon abundance in the Klamath River is in decline and eulachon spawning populations have severely declined and may become endangered in the future. The main cumulative impacts that threaten eulachon are identified by NOAA Fisheries Service as climate change impacts and ocean conditions, eulachon bycatch, dams/water diversions, water quality, dredging, and predation (NOAA Fisheries Service 2010). Other substantial cumulative impacts include in-water construction or alterations, including channel modifications, shoreline stabilization, sand and gravel mining, and road building and maintenance and pollution and runoff from industrial activities, urbanization, grazing, agriculture, and forestry operations (NOAA Fisheries Service 2010).

The Proposed Action would have short-term impacts on eulachon from increased suspended sediment concentrations during reservoir drawdown. However, there are two key factors that reduce the likelihood that substantial numbers of individuals will be exposed. First, eulachon are very rare in the Klamath River, and thus there is a very low probability that any individuals will be in the Klamath River during implementation of the Proposed Action. Second, eulachon have a relatively long period of the year when they could potentially spawn in the Klamath River (January through April; Larson and Belchik 1998), and a relatively short duration of occurrence within freshwater (around one month), increasing the probability that most of the population would migrate and spawn either before or after the largest pulses of suspended sediment concentrations (predicted to be two weeks in duration or less). Because there would be no substantial reduction in the abundance of a year class, and there would be only a short duration of poor water quality during reservoir drawdown in the estuary, **the Proposed Action's incremental contribution to the significant cumulative effect would not be cumulatively considerable in the short term or the long term.**

Longfin Smelt

The Proposed Action would have short term effects related to suspended sediment concentrations and bedload movement. The Proposed Action would release dam-stored sediment downstream to the Lower Klamath River. Longfin smelt entering the Klamath River in the winter and spring of 2020 might be exposed to elevated suspended sediment concentrations for a portion of their migration period.

The overall abundance of longfin smelt has declined to very low levels. Significant adverse cumulative effects on longfin smelt have occurred from diversion of surface water, predation, and bycatch in a commercial fishery. They have also been adversely affected by dredging and sand mining, and are susceptible to adverse effects from toxic substances in the water and in the plankton upon which the fish feed.

The Proposed Action would have short-term impacts on longfin smelt from increased suspended sediment concentrations during reservoir drawdown. However, as described for eulachon above, the protracted migration season for longfin smelt (throughout the year), and relatively short duration of occurrence in the estuary (<2 months), increasing the probability that most of the population would migrate and spawn either before or after the largest pulses of suspended sediment concentrations (predicted to be two weeks in duration or less). Based on the short-term nature of the water quality effects, the long term impacts would not be cumulatively considerable. **The Proposed Action's incremental contribution to the significant cumulative effects on longfin smelt would not be cumulatively considerable in the short term and long term.**

Introduced Resident Species

The Proposed Action would eliminate habitat for introduced resident species in the Hydroelectric Reach. Because these species were introduced and they occur in other nearby water bodies, their loss would not be considered significant from a biological perspective, and would benefit native species. No other cumulative actions or programs would eliminate a substantial amount of habitat in the Klamath River for introduced resident species. **There would be no significant cumulative effects associated with the loss of habitat for introduced resident species.**

Freshwater Mussels

The Proposed Action would have short term effects related to suspended sediment concentrations and bedload movement. The Proposed Action could affect freshwater mussels through the release of sediments during reservoir drawdown. Very little information exists on population trends in the Klamath River; therefore, it is difficult to determine if other cumulative actions or projects have contributed to significant cumulative effects on freshwater mussels. For the purposes of this analysis, it is assumed that significant cumulative effects have occurred to freshwater mussels from ongoing activities that have increased suspended sediments in the Klamath River, such as timber harvesting, road construction, mining, and agricultural activities.

The Proposed Action's incremental contribution to this short-term significant cumulative effect would be substantial. The suspended sediment concentrations would cause major

physiological stress to freshwater mussels and might result in substantial mortality. The most significant impacts would occur downstream from Iron Gate Reservoir, especially to those individual freshwater mussels or freshwater mussel beds upstream of Orleans and closest to Iron Gate Dam. While it is anticipated that mainstem Klamath freshwater mussel populations would rebound, due to the extended time it takes for freshwater mussels to reach sexual maturity (4 years or more, depending on the species), the reestablishment of freshwater mussel populations within affected reaches might be slow and might not be readily noticeable for some time, possibly a decade or more. Implementation of Mitigation Measure AR-7 could be implemented to reduce the short- and long-term impacts of the Proposed Action on freshwater mussels. With implementation of mitigation measures there would still be impacts to a portion of the freshwater mussel population, and there could still be a substantial reduction in the abundance of at least one year class. **The Proposed Action's incremental contribution to the short-term significant cumulative effects on freshwater mussels would be cumulatively considerable even with mitigation.**

Dam removal would restore connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the Upper Klamath Basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach. Based on increased habitat availability and habitat quality in the long term, the effect of the Proposed Action would be beneficial for mussels in the long term. It is assumed that significant cumulative effects have occurred to freshwater mussels from ongoing activities that have increased suspended sediments in the Klamath River, such as timber harvesting, road construction, mining, and agricultural activities. Several ongoing or planned activities in the basin to address water quality and sediment (listed in Table 4-3), together with the Proposed Action, would likely contribute to beneficial cumulative effects. **The Proposed Action's incremental contribution to the long-term cumulative effects on freshwater mussels would be beneficial.**

Benthic Macroinvertebrates

The Proposed Action would have short term effects related to suspended sediment concentrations and bedload movement. Under the Proposed Action, increased suspended-sediment concentrations would be expected to result in cumulative effects on filter-feeding benthic macroinvertebrates similar to that as described for freshwater mussels. Cumulative effects on benthic macroinvertebrates are assumed to be similar to those described above for freshwater mussels. While a large proportion of macroinvertebrate populations in the Hydroelectric Reach and in the mainstem Klamath River downstream from Iron Gate Dam would be affected in the short term by the Proposed Action, their populations would be expected to recover quickly because of the many sources for recolonization and their rapid dispersion through drift or aerial movement of adults. **The Proposed Action's incremental contribution to the short-term significant cumulative effects on benthic macroinvertebrates would be cumulatively considerable. No feasible mitigation is available to reduce this impact; therefore it remains cumulatively considerable.**

Dam removal would restore connectivity among the Lower Klamath Basin, the Hydroelectric Reach and its tributaries, and the upper basin, and would rehabilitate and increase availability of riverine habitat within the Hydroelectric Reach. The impacts of hydropower peaking on benthic macroinvertebrates would be eliminated. The reformation of river channels in the reservoir reaches upstream of Iron Gate Dam under the Proposed Action would benefit benthic macroinvertebrates by providing more suitable substrates than currently exist. As a result, suitable habitats formed upstream of Iron Gate Dam might be opened to additional colonization by benthic macroinvertebrates through rapid dispersal by drift from upstream populations within current riverine reaches and/or dispersion of adult life stages. In addition, recolonization would occur rapidly from established benthic macroinvertebrate populations within the many tributary rivers and streams of the Klamath River. Several ongoing or planned activities in the basin to address water quality and sediment (listed in Table 4-3), together with the Proposed Action, would likely contribute to beneficial cumulative effects. **The Proposed Action's incremental contribution to the long-term cumulative effects on benthic macroinvertebrates would be beneficial.**

4.4.2.1.5 Interim Measures

Implementation of IMs 7 (J.C. Boyle Gravel Placement and/or Habitat Enhancement) and 16 (Water Diversions) could result in alterations to habitat availability and habitat quality, and affect aquatic species. These IMs would increase spawning gravel or habitat upstream of Copco Reservoir and would increase flows in Shovel and Negro Creeks. As described above, past and present cumulative projects have resulted in significant cumulative effects to resident and anadromous fish species. These IMs would provide improvements in habitat quantity and quality for resident fish prior to dam removal, and for resident and anadromous species following dam removal. Other cumulative ongoing and planned restoration and habitat improvement activities listed in Table 4-3 above would also contribute to cumulative benefits on habitat quantity and quality. **Therefore, the Proposed Action's incremental contribution to the significant cumulative effects would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and benthic macroinvertebrates. These actions would also be cumulatively beneficial for coho salmon from the Upper Klamath River Population Unit. Cumulative effects on bull trout, freshwater mussels, shortnose and Lost River suckers would not be cumulatively considerable.**

4.4.2.1.6 KBRA

Implementation of Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plan could result in alterations to water quantity, water quality, habitat availability and habitat quality, and affect aquatic species. Implementation of Phase I of the Fisheries Reintroduction and Management Plan could result in alterations to habitat availability (fish access), and could affect aquatic species. The Phases I and 2 Fisheries Restoration Plans and Fisheries Monitoring Plans are designed to improve habitat for aquatic species. The Phase I Fisheries Reintroduction and Management Plan is intended to support the reintroduction and management of fish in the upper basin during and after implementation of the KHSA.

As described above, significant cumulative effects have occurred to many fish species and habitat in the Klamath Basin as a result of the existing conditions. However, there are several ongoing cumulative actions or programs that are intended to improve fisheries in the Klamath River and its tributaries, including the removal of the Four Facilities as part of the KHSA, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. With implementation of the KBRA, ongoing habitat restoration would be better funded, better coordinated and monitored to ensure effective implementation.

The Northwest Forest Plan contains provisions to reduce impacts from timber harvesting on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4), would also improve fisheries.

The KBRA's incremental contribution to the significant cumulative effects on fisheries would be beneficial. These KBRA actions would improve habitat and potentially increase the number of anadromous fish. Increased anadromous fish abundance, especially Chinook salmon, would result in more prey availability for Southern Resident Killer Whales when the whales are near the Oregon and California coasts. Based on anticipated improvements in water quantity, water quality, habitat availability and habitat quality, these actions would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, benthic macroinvertebrates, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units. **The incremental contribution of the Fisheries Restoration Plans, Fisheries Monitoring Plans, and Fisheries Reintroduction and Management Plan to the significant cumulative effects on Klamath Basin fisheries would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

Implementation of Water Diversion Limitations could result in reducing uncertainties associated with maintaining adequate ecological flows for aquatic species and their habitats, especially in low-flow years, and could alter water quality and water temperatures in certain seasons and affect aquatic species. Implementation of the On-Project Plan could result in alterations to water quantity and water quality and affect aquatic species. This component of the KBRA would establish limits on specific diversions within Reclamation's Klamath Project to protect flows in the mainstem and ensure that adequate water supply is available for allocation to the wildlife refuges.

The KBRA's incremental contribution to the significant cumulative effects on fisheries would be beneficial and go beyond these current programs and recovery of listed species, advancing salmonid fisheries to greater levels.. Based on anticipated improvements in water quantity and water quality, implementation of Water Diversion Limitations under the Proposed Action would be beneficial for fall-run Chinook salmon, spring-run Chinook salmon, steelhead, Pacific lamprey, redband trout, and shortnose and Lost River suckers. These actions would also be beneficial for coho salmon, except those in the Trinity River population units. **The incremental contribution of Water Diversion**

Limitations to the significant cumulative effects on fisheries would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.

Implementation of the Fish Entrainment Reduction could result in potential alterations to mortality risk and affect aquatic species. This KBRA action would involve designing and installing fish screens at Project Diversions, including the Lost River Diversion Channel and associated diversion points, North Canal, Ady Canal, and other Reclamation and Reclamation Contractor diversions.

As noted above, significant cumulative impacts have occurred to Klamath Basin fisheries. Additionally, there are many other cumulative actions and programs that would also restore fisheries and habitat in the Klamath Basin. The Proposed Action's incremental contribution to the significant cumulative effect on fisheries would be beneficial. The Fish Entrainment Reduction would reduce mortality caused by entrainment of fish at these diversions, to the benefit of endangered shortnose and Lost River suckers, as well as to redband trout. Steelhead and fall- and spring-run Chinook salmon, steelhead, Pacific lamprey, and coho salmon would also benefit from this action once they recolonize areas upstream of Keno Dam. **The incremental contribution of Fish Entrainment Reduction to the cumulative effect would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

Implementation of the Interim Flow and Lake Level Program could result in decreases in summer water temperature and nutrient inputs to Upper Klamath Lake. The KBRA includes a program to study and reduce nutrient concentrations in the Keno Impoundment/Lake Ewuana and Upper Klamath Lake in order to reduce dissolved oxygen problems and algal problems in both water bodies. Restoration actions to control nutrients have not been developed, and there are many diverse possibilities that could require construction of treatment wetlands, construction of facilities, or chemical treatments of bottom sediment, among other possibilities. A nutrient reduction program in the Keno Impoundment/Lake Ewuana and Upper Klamath Lake would be designed to improve water quality (increasing dissolved oxygen and reducing algal concentration) and to provide fish passage through the Keno Impoundment/Lake Ewuana in summer and fall months; however, implementation of this nutrient reduction program will require future environmental compliance investigations and a determination on the significance of cumulative effects cannot be made at this time. Implementation of the KBRA will require future environmental compliance as appropriate.

4.4.2.2 Alternatives 3, 4, and 5

Alternative 3 and 5 would have similar cumulative effects on aquatic resources as the Proposed Action; however, two dams would remain in place under Alternative 5, reducing the amount of habitat and resulting in fewer water quality improvements. Alternative 4 would involve the creation of fish passage facilities but all four dams would remain in place. No short-term cumulative effects associated with suspended sediment concentrations from reservoir drawdown would occur to aquatic species; however, water

quality issues would not improve and therefore there would be no cumulative benefits from improved water quality. Because all four dams would remain in place, some habitat would still be blocked by the presence of the reservoirs. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

4.4.2.3 Mitigation Measures

While there would be cumulatively considerable impacts on aquatic species from Alternatives 2, 3, and 5 even with mitigation, no additional feasible mitigation is available to reduce these impacts. These impacts would remain cumulatively considerable.

4.4.3 Algae

Potential cumulative effects on the phytoplankton and periphyton communities would occur mainly through changes in temperature, light, and nutrient levels in the Klamath River. The timeframe for the cumulative effects analysis associated with reservoir drawdown is the length of deconstruction. The timeframe for long-term cumulative effects after deconstruction is indefinite, as conditions promoting algae growth would be permanently altered with implementation of any of the proposed alternatives.

Table 4-7 presents a summary of the algae impacts described in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-7. Summary of Algae Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Upper Klamath Basin Upstream of the Influence of J.C. Boyle Reservoir				
Dam removal activities would not affect phytoplankton in the Klamath River upstream of J.C. Boyle Reservoir.	2, 3, 5	NCFEC	None	NCFEC
Dam removal activities would not affect periphyton in the Klamath River upstream of J.C. Boyle Reservoir.	2, 3, 5	NCFEC	None	NCFEC
Hydroelectric Reach				
Continued impoundment of water in the reservoirs could support the long-term growth of seasonal nuisance and/or noxious phytoplankton such as *M. aeruginosa* in the Hydroelectric Reach.	1, 4	NCFEC	None	NCFEC
Sediment release associated with dam removal could cause short-term increases in sediment-associated nutrients downstream from J.C. Boyle Dam that could stimulate nuisance and/or noxious phytoplankton	2, 3	NCFEC	None	NCFEC

Table 4-7. Summary of Algae Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
growth in the Hydroelectric Reach.				
Removal of the reservoirs would eliminate lacustrine habitat behind the dams and could decrease or eliminate the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms in the Hydroelectric Reach and subsequent transport to the Klamath River from downstream from Iron Gate Dam to the Klamath Estuary.	2, 3, 5	B	None	B
Sediment release associated with the Proposed Action could cause short-term increases in sediment-associated nutrients downstream from J.C. Boyle Dam that could stimulate nuisance periphyton growth in the Hydroelectric Reach.	2, 3	NCFEC	None	NCFEC
Dam removal, conversion of the reservoir areas to a free-flowing river, and the elimination or reduction of hydropower peaking operations could cause long-term increases in nuisance periphyton growth due to increases in available habitat along low-gradient channel margin areas downstream from J.C. Boyle Dam.	2, 3, 5	S	None	S
Increased water temperatures and decreased peaking flows could result in long-term small amounts of nuisance periphyton colonization in the Klamath River downstream from J.C. Boyle Reservoir and upstream of Copco 1 Reservoir.	4	LTS	None	LTS
Implementation of IM 7, J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in increased bedload mobility and the potential for increased scour of nuisance periphyton in the Hydroelectric Reach.	1 ,2 ,3	B	None	B
Klamath River Downstream from Iron Gate Dam				
Continued impoundment of water in the reservoirs could support long-term growth of seasonal nuisance and/or noxious phytoplankton blooms *such as M. aeruginosa* in the Hydroelectric Reach and subsequent transport into the Klamath River downstream from Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities could support long-term growth of nuisance periphyton such as *Cladophora spp.* downstream from Iron Gate Dam.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams and could substantially reduce or eliminate the long-	2, 3, 5	B	None	B

Table 4-7. Summary of Algae Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
term transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream from Iron Gate Dam.				
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and biomass of nuisance periphyton in the Klamath River downstream from Iron Gate Dam.	2, 3, 5	LTS	None	LTS
Construction and deconstruction activities would include the demolition of various recreation facilities that could affect algae downstream from Iron Gate Dam.	2, 3, 5	NCFEC	None	NCFEC
Klamath River Estuary				
Continued impoundment of water in the reservoirs could support long-term growth of nuisance and/or noxious phytoplankton blooms in the Hydroelectric Reach and subsequent transport into the Klamath Estuary.	1, 4	NCFEC	None	NCFEC
Removal of the reservoirs would eliminate lacustrine habitat behind the dams and could substantially reduce or eliminate the long-term transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath Estuary.	2, 3, 5	B	None	B
Dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the Klamath Estuary.	2, 3, 5	LTS	None	LTS
Keno Transfer				
Implementation of the Keno Transfer could cause adverse algae effects.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities could cause adverse algae effects.	2. 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could impact algae.	2, 3, 5	NCFEC	None	NCFEC

Table 4-7. Summary of Algae Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Klamath Basin Restoration Agreement – Programmatic Measures				
Implementation of restoration actions, programs, and/or plans presented in the KBRA would accelerate restoration actions currently underway throughout the Klamath Basin and reduce nuisance and/or noxious phytoplankton blooms through their beneficial effects on flow and water quality.	2, 3	B	None	B
Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms.	2, 3	B	None	B
Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same impacts as Phase I.	2, 3	B	None	B
Implementation of Wood River Wetland Restoration could result in reduced nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B
Implementation of the Water Use Retirement Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B
Implementation of the Interim Flow and Lake Level Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	B	None	B

Table 4-7. Summary of Algae Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Implementation of the Upper Klamath Lake and Keno Nutrient Reduction Program could result in decreases in nutrient inputs to Upper Klamath Lake and Keno Impoundment/Lake Ewuana and associated decreases in nuisance and/or noxious phytoplankton blooms.	2, 3	N/A[1]	N/A	N/A

A nutrient reduction program in the Keno Impoundment/Lake Ewauna and Upper Klamath Lake would be designed to improve water quality (increasing seasonally low dissolved oxygen and reducing seasonal algal blooms) and fish passage through the Keno Impoundment/Lake Ewauna in summer and fall months, however implementation of this nutrient reduction program will require future environmental compliance investigations and a determination on significance cannot be made at this time.

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
LTS = Less than Significant

The main cumulative action affecting algae growth is the construction and operation of the KHP. The stable lacustrine environment created at the Four Facilities, particularly in the larger Copco 1 and Iron Gate Reservoirs, coupled with high nutrient availability and high water temperatures in summer to fall, provides ideal conditions for phytoplankton growth. Past and present actions potentially contributing to algal growth include agricultural activities, grazing, and sedimentation, which have increased nutrient loading in the Klamath River. Future cumulative actions with the potential to affect algae include implementation of the Klamath Basin TMDLs.

4.4.3.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.3.1.1 Phytoplankton

Sediment release associated with the Proposed Action could cause short-term *increases in sediment-associated nutrients downstream from J.C. Boyle Dam* that could stimulate nuisance and/or noxious phytoplankton growth *in the Hydroelectric Reach.* Under the Proposed Action, the short-term increase in nutrients due to the mobilization of sediment-associated nitrogen and phosphorus in the Hydroelectric Reach would have a minimal impact on phytoplankton due to the timing of reservoir drawdown.

Blue-green algae reach very high densities in the summer months in the Klamath Basin. Some blue-green algae produce toxins that are harmful to fish, mammals and humans (see Section 3.2.3.7, Water Quality). The Klamath River from Copco 1 Reservoir (RM 203.1) to Iron Gate Dam (RM 190.1) is listed as impaired for toxicity due to the

presence of microcystin in the reservoirs (see Section 3.2.2.3, Water Quality). Blue-green algae growth therefore represents a significant cumulative effect.

The Proposed Action's contribution to the short-term cumulative effects associated with nuisance and/or noxious phytoplankton growth would not be cumulatively considerable. By mid-to late- spring when phytoplankton begin to bloom again, reservoir drawdown would be nearly complete and little to no quiescent habitat would remain in the Hydroelectric Reach. Thus, phytoplankton blooms, and in particular nuisance and/or noxious phytoplankton blooms, would be very limited if not absent from the Hydroelectric Reach. **The Proposed Action's incremental contribution to the significant cumulative effects on nuisance and/or noxious phytoplankton growth in the short term would not be cumulatively considerable.**

Under the Proposed Action, removal of the reservoirs at the Four Facilities would eliminate lacustrine habitat behind the dams and could decrease the long-term spatial extent, temporal duration, or concentration of nuisance and/or noxious phytoplankton blooms. Under the Proposed Action, removal of the reservoirs would eliminate lacustrine habitat behind the dams and could substantially reduce or eliminate the long-term transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath River downstream from Iron Gate Dam. Under the Proposed Action, removal of the reservoirs would eliminate lacustrine habitat behind the dams and could substantially reduce or eliminate the long-term transport of nuisance and/or noxious phytoplankton blooms and concentrations of algal toxins into the Klamath Estuary. In the long term, dam removal, particularly within the larger Copco 1 and Iron Gate Reservoirs, would decrease or eliminate the system's support for excessive growth of blue-green algae by eliminating large areas of quiescent habitat where these algal species currently thrive. This dramatic decrease in the amount of optimal habitat available for nuisance and/or noxious phytoplankton species would occur even if relatively high nutrient concentrations were to remain in the Klamath River system. This would substantially reduce seasonal phytoplankton bloom occurrence and the associated production of algal toxins in these reservoirs that are potentially harmful to animals and humans. Additionally, because it is evident that large seasonal blue-green algae blooms (i.e., M. aeruginosa) and associated algal toxins (i.e., microcystin) in Copco 1 and Iron Gate Reservoirs and the Klamath River downstream from Iron Gate Dam originate in the two largest Project reservoirs and are transported to Klamath River sites downstream from Iron Gate Dam, the overall occurrence of nuisance and/or noxious phytoplankton and associated toxins in the Klamath River downstream from Iron Gate Dam would be substantially reduced or eliminated under the Proposed Action. Because removal of the Four Facilities would reduce or eliminate elevated M. aeruginosa levels in the lower Klamath River (see prior section), levels in the Klamath Estuary are also likely to be reduced or eliminated.

Blue-green algae reach very high densities in the summer months in the Klamath Basin. Some blue-green algae produce toxins that are harmful to fish, mammals and humans (see Section 3.2.3.7, Water Quality). The Klamath River from Copco 1 Reservoir (RM 203.1) to Iron Gate Dam (RM 190.1) is listed as impaired for toxicity due to the

presence of microcystin in the reservoirs (see Section 3.2.2.3, Water Quality). Blue-green algae growth represents a significant cumulative effect.

The Proposed Action's contribution to cumulative effects associated with blue-green algae would be beneficial by eliminating habitat through removal of the dams, and by reducing transport of nuisance blooms downstream. Other cumulative actions in the area that would reduce the potential for algal growth include implementation of the Klamath River TMDLs (and implementation of TMDLs on Klamath River tributaries) to reduce nutrients, and actions/programs identified in Table 4-3 to reduce sediment input into the Klamath River. Together, the Proposed Action and these cumulative actions would result in beneficial effects by reducing or eliminating conditions supporting blue-green algae. **The Proposed Action's incremental contribution to the significant cumulative effects on phytoplankton would be beneficial for the Hydroelectric Reach and the Klamath River downstream from Iron Gate Dam and the Klamath Estuary**.

4.4.3.1.2 Periphyton

Under the Proposed Action, conversion of the reservoir areas to a free-flowing river and the elimination of hydropower peaking operations could cause long-term increases in nutrient levels and biomass of nuisance periphyton in low-gradient channel margin areas in the Hydroelectric Reach downstream from J.C. Boyle Dam. Periphyton growth in low-gradient channel margin areas in the Hydroelectric Reach could increase on a seasonal basis following dam removal. Removal of the reservoirs and elimination of hydropower peaking operations in the J.C. Boyle Peaking Reach would immediately provide additional low-gradient habitat suitable for periphyton. The particular periphyton species that may become abundant in these areas are unknown.

Periphyton in the Klamath River plays an important role in nutrient dynamics, affecting nutrient fluxes and resulting in short-term changes in dissolved oxygen and pH. Excessive swings in dissolved oxygen and pH can be stressful to aquatic biota, thus too much periphyton can adversely affect water quality and aquatic resources. The growth of nuisance periphyton is therefore considered a significant cumulative effect. The Proposed Action's contribution to this cumulative effect could be substantial. The overall effect of the Proposed Action would likely be to increase periphyton in the re-exposed margins of low gradient river channels in the Hydroelectric Reach until full attainment of the Oregon and California TMDLs can be achieved. **The Proposed Action's incremental contribution to the long-term significant cumulative effect associated with nuisance periphyton growth due to increases in available habitat along channel margin areas of the Hydroelectric Reach downstream from J.C. Boyle Dam would be cumulatively considerable. No feasible mitigation is available to reduce this impact; therefore it remains cumulatively considerable.**

Under the Proposed Action, dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and biomass of nuisance periphyton in the Klamath River downstream from Iron Gate Dam. Under the Proposed Action, dam removal and conversion of the reservoir areas to a free-flowing river could cause long-term increases in nutrient levels and periphyton biomass in the

Klamath Estuary. Periphyton growth could continue to be relatively high downstream from Iron Gate Dam on a seasonal basis following dam removal because of continuing nutrient inputs from the Upper Klamath Basin, as described for the J.C. Boyle to Iron Gate Dam reach. Periphyton growth in the Klamath Estuary could also be affected by increased nutrient availability following dam removal.

As noted above, periphyton is a significant cumulative effect. The Proposed Action's incremental contribution to the cumulative effect would be minimal. Concentrations of both nutrients are high enough in the river from Iron Gate Dam (RM 190.1) to approximately Seiad Valley (RM 129.4) (and potentially further downstream) that algal growth is nutrient saturated, and nutrients are not likely to be limiting primary productivity (i.e., periphyton growth) in this portion of the Klamath River nitrogen-fixing species currently dominate the periphyton communities in the lower reaches of the Klamath River. Since these species can fix their own nitrogen from the atmosphere, increases in total nitrogen due to dam removal may alter the composition of the periphyton community but it may not substantially increase algal biomass in these reaches because it will be accompanied by only relatively minor increases in total phosphorous. In addition, overall total nitrogen and total phosphorous increases could be less than those predicted by existing models due to implementation of TMDLs and general nutrient reductions in the Klamath Basin. Long-term increase in nutrients in the Klamath Estuary would be relatively small due to the effects of tributary dilution and nutrient retention between Iron Gate Dam and the Estuary.

Because of these many competing factors, some that may favor enhanced periphyton growth downstream from Iron Gate Dam (i.e., increased nutrients transport and recycling), and some that counteract this response (increased uptake and retention of nutrients by periphyton in the Hydroelectric Reach, increased frequency and intensity of scouring events, decreasing nutrient concentrations due to TMDL implementation and KBRA nutrient reduction programs), it is likely that increases in periphyton growth below Iron Gate Dam would be minimal. **The Proposed Action's incremental contribution to the significant cumulative effects associated with long-term periphyton growth in the Klamath River downstream from Iron Gate Dam and in the Klamath Estuary would not be cumulatively considerable.**

4.4.3.1.3 KBRA – Programmatic Measures

Implementation of the Phase I Fisheries Restoration Plan could result in a long-term reduction in nutrients and associated decreases in nuisance and/or noxious phytoplankton and periphyton blooms. Implementation of the Phase II Fisheries Restoration Plan under the KBRA (KBRA Section 10.2) would include a continuation of the same types of resource management actions as under Phase I along with provisions for adaptive management of these actions and would therefore have the same impacts as Phase I. Implementation of Wood River Wetland Restoration could result in reduced nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. Implementation of the Water Use Retirement Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. Implementation of the

Interim Flow and Lake Level Program could result in decreases in nutrient inputs to Upper Klamath Lake and associated decreases in nuisance and/or noxious phytoplankton blooms. Many of these KBRA actions and programs would help to decrease nutrient levels through various measures such as decreasing irrigation and fallowing of cropland leading to a reduction in fertilizer inputs, restoration actions to reduce nutrient inputs to waterways, inundating wetland (peat) soils and creating anaerobic conditions that support nutrient retention, and cattle exclusion fencing in waterways. All these actions to reduce nutrients would help to reduce the prevalence of nuisance and/or noxious phytoplankton blooms. As noted above, phytoplankton and periphyton can adversely affect water quality and wildlife and are considered significant cumulative effects in the Klamath Basin. Other cumulative actions that could also improve nutrients and reduce nuisance and/or noxious phytoplankton and periphyton growth include implementation of the Klamath Basin TMDLs, the elimination of hydropower peaking, periphytic nutrient uptake, and implementation of the KHSA**. The Proposed Action's incremental contribution to the cumulative effects on nuisance and/or noxious phytoplankton and periphyton blooms in the Klamath Basin would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

4.4.3.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative effects on nuisance and/or noxious phytoplankton and periphyton growth as the Proposed Action. Alternative 5 would remove two reservoirs; however, two reservoirs would remain and therefore habitat for nuisance and/or noxious phytoplankton would remain and it would have less cumulative benefits than Alternatives 2 and 3. Alternative 4 would not result in any cumulative effects associated with nuisance and/or noxious phytoplankton and periphyton growth. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

4.4.3.3 Mitigation Measures

The Proposed Action's incremental contribution to the long-term significant cumulative effect associated with nuisance periphyton growth due to increases in available habitat along channel margin areas of the Hydroelectric Reach downstream from J.C. Boyle Dam would be cumulatively considerable. No feasible mitigation is available to reduce this impact; therefore it remains cumulatively considerable.

4.4.4 Terrestrial Resources

The timeframe for cumulative effects on terrestrial resources includes the duration of construction (May 2019 through December 2020), during which temporary impacts would occur, and extends for approximately three years following construction to 2023. Three years was selected as an approximate time during which residual longer term impacts would occur to terrestrial habitat and wildlife from loss of vegetation in construction areas. After three years, some grasses would be expected to regain structure and function with implementation of the planned restoration activities.

Table 4-8 presents a summary of terrestrial resources impacts identified in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Several past, present, and reasonably foreseeable future actions were considered during the cumulative effects analysis (see Table 4-3 and 4-4). Within the area of analysis, past, present and future cumulative actions such has timber harvesting, agriculture, recreation, residential developments, water diversions, and mining, have in the past, or have the potential in the future to adversely affect wildlife and alter habitat. Construction of the KHP and associated facilities has reduced some riparian habitat and may have blocked some wildlife corridors for species travelling along the Klamath River shoreline. Reclamation's Klamath Project and associated infrastructure has reduced and fragmented wetland and riparian habitat. Future developments, such as those proposed in Siskiyou County (see Table 4-4), may also contribute to some loss of habitat or impacts on wildlife species.

There are several cumulative plans and programs in place that seek to conserve terrestrial resources while allowing for certain land use activities. For instance, PacifiCorp's hydroelectric project activities must comply with Biological Opinions issued by the USFWS and NOAA Fisheries Service, and ongoing timber harvest activities must comply with the applicable agency land use plan.

Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water in the reservoirs could result in the continuance of various stressors in the area of analysis including habitat degradation, invasive species, barriers to movement of some terrestrial wildlife species, and uncertainties in water deliveries to the NWRs.	1	NCFEC	None	NCFEC
Construction activities could result in the loss of wetland and riparian vegetation communities and culturally important species including willows.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in direct mortality or harm to special-status invertebrate, amphibian and reptile species during construction.	2, 3, 4, 5	LTS	None	LTS

Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities could result in nest abandonment by birds, including special-status bird species, during construction.	2, 3, 4, 5	LTS	TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle Surveys	LTS
Construction activities could result in on the loss of special-status plants.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan TER-4**:** Surveys for Special Status Plants	LTS
Construction activities could result in adverse impacts on wildlife from riparian habitat loss.	2, 3, 4, 5	LTS	None	LTS
Removal of reservoirs and associated loss of habitat could result in impacts on wildlife.	2, 3, 5	LTS	None	LTS
Dam removal and the flushing of sediments could result in long-term impacts on riparian habitat from sedimentation in downstream reaches.	2, 3, 5	LTS	None	LTS
Removal of reservoirs could result in loss of reservoir wetlands.	2, 3, 5	S	TER-5: Permanent Loss of Wetlands at Reservoirs	LTS
Construction activities could result in the removal of trees and other vegetation and could result in long-term impacts on wildlife habitat, particularly for nesting birds.	2, 3, 4, 5	LTS	TER-1: Habitat Rehabilitation Plan TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle Surveys	LTS
Removal of dam facilities could result in long-term impacts on bats from loss of roosting habitat.	2, 3, 5	S	TER-6: Impacts on Special-Status Bats from Loss of Roosting Habitat	LTS
Dam removal and the flushing of sediments could result in long-term impacts on amphibians from changes in habitat due to sedimentation in downstream reaches.	2, 3, 5	LTS	None	LTS

Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Removal of the reservoirs could result in long-term impacts on special-status species from loss of aquatic habitat at reservoirs.	2, 3, 5	LTS (Special Status Birds; Special Status Plants)	TER-2: Nesting Bird Surveys TER-3: Bald and Golden Eagle TER-4: Surveys for Special Status Plants	LTS
Dam removal and associated sedimentation in downstream reaches could result in impacts on culturally important species.	2, 3, 5	LTS	None	LTS
Removal of reservoirs and associated facilities could result in long-term impacts on wildlife corridors.	2	B	None	B
Continued existence of the reservoirs and/or other facilities could present a barrier to movement of some terrestrial species.	1, 3, 4, 5	NCFEC	None	NCFEC
Exposed reservoir bottoms and other areas of construction disturbance could result in impacts from invasive plants.	2, 3, 4, 5	LTS	TER-1: Habitat Restoration Plan	LTS
Removal of various recreation facilities could result in impacts to terrestrial resources during construction.	2, 3, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special Status Plants	LTS
Keno Transfer				
Implementation of the Keno Transfer could cause impacts to terrestrial resources.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities could cause adverse effects to terrestrial resources.	2, 3	NCFEC	None	NCFEC

Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could result in impacts on terrestrial resources from construction activities and pipe alignment.	2, 3, 5	LTS	TER-1: Habitat Restoration Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special Status Plants	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction activities associated with the Fisheries Restoration Plan-Phase I and Phase II could result in impacts on terrestrial wildlife and/or habitat.	2,3	S	TER-1: Habitat Rehabilitation Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special-Status Plants TER-4: Permanent Loss of Wetlands at Reservoirs	LTS
Construction activities associated with Fish Entrainment Reduction could result in impacts on terrestrial wildlife and/or habitat	2,3	S	TER-1: Habitat Rehabilitation Plan TER-2: Nesting Bird Surveys TER-3: Surveys for Special-Status Plants TER-4: Permanent Loss of Wetlands at Reservoirs	LTS
Modification of aquatic habitat from the Wood River Wetland Restoration project could result in impacts on terrestrial wildlife and/or habitat.	2,3	LTS	None	LTS

Table 4-8. Summary of Terrestrial Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat.	2,3	B – Lower Klamath NWR, Tule Lake NWR. LTS – Upper Klamath NWR (waterfowl and non-game waterbirds) S – Upper Klamath Lake NWR ((juniper removal actions and effects on terrestrial wildlife including nesting migratory birds)	TER-2: Nesting Bird Surveys (for Juniper removal action effects)	B – Lower Klamath NWR, Tule Lake NWR. LTS – Upper Klamath NWR (waterfowl and non-game waterbirds) S – Upper Klamath Lake NWR ((juniper removal actions and effects on terrestrial wildlife including nesting migratory birds)
The Mazama Forest Project could result in adverse impacts on terrestrial resources.	2,3	NCFEC	None	NCFEC

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
WURP= Water Use Retirement Program

4.4.4.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.4.1.1 General Wildlife

Construction activities could result in adverse impacts on wildlife from riparian habitat loss. Some sedimentation from dam removal could decrease riparian habitat temporarily, and this could affect wildlife. Human activity in the Klamath Basin has decreased the abundance of riparian habitat, through development, agricultural activities, timber harvesting, mining, and other activities. Localized disturbance of riparian habitat

downstream due to sedimentation is expected to be short term, with colonization of riparian plant seedlings and subsequent re-vegetation of riparian areas within three years following implementation of the Proposed Action. Additionally, there would be gains in riparian habitat at the reservoirs following dam removal and restoration. **The Proposed Action's incremental contribution to the cumulative effects on wildlife from loss of riparian habitat would not be cumulatively considerable.**

The Proposed Action could result in impacts on wildlife from the permanent loss of aquatic habitat. The Proposed Action would result in the removal of four reservoirs that provide aquatic habitat for wildlife. No other cumulative actions or projects have been identified that would substantially decrease the amount of open water habitat in the Klamath Basin. **There would be no significant cumulative effects on wildlife from the permanent loss of open water habitat at the reservoirs.**

The Proposed Action could result in impacts on culturally important species. Willows, which are riparian-dependent plants, are culturally important to American Indians who use them for basket-making. Loss of historical wetland and riparian habitat, as noted above, residential development, and agricultural activities such as grazing, have affected the abundance of culturally important plant species such as willows in the Klamath Basin. This loss of culturally important species represents a significant cumulative effect. The Proposed Action's incremental contribution to this significant effect would be short term and minimal. Riparian habitat is expected to increase in the long term at the reservoirs, and any loss of riparian habitat from sedimentation downstream from the dams is anticipated to be short term in nature. Since willows are one of the first species to re-colonize following disturbance (Riparian Habitat Joint Venture 2009), impacts on these culturally important plants are not anticipated to be significant. **The Proposed Action's incremental contribution to the significant cumulative effect associated with loss of culturally important species would not be cumulatively considerable.**

The Proposed Action could result in construction-related impacts to terrestrial resources from relocation of the Yreka Water Supply Pipeline, replacement of the water supply pipeline to the Iron Gate Fish Hatchery, and relocation of existing recreation facilities, which would require the construction of new facilities along the river bank. Several actions, including relocation of the Yreka Water Supply Pipeline, the replacement of the water supply pipeline to the Iron Gate Fish Hatchery, and the relocation of existing recreation facilities, could adversely affect terrestrial resources during construction . Other cumulative actions or projects that may also disturb birds include ongoing agricultural activities, mining, road improvements, and new subdivisions approved in Siskiyou County near Iron Gate Dam. Together these actions, considered with past human development, represent significant cumulative effects on terrestrial resources. The Proposed Action's incremental contribution to the significant cumulative effect could be cumulatively considerable; however, several elements would be incorporated into the project to avoid or reduce adverse impacts on special-status species and common wildlife species, including mitigation measures TER-1 through TER-4. **The Proposed Action's incremental contribution to the significant cumulative effects on terrestrial resources would not be cumulatively considerable.**

4.4.4.1.2 Birds

Construction activities could result in adverse impacts on birds, including special-status bird species, during construction. The Proposed Action could adversely affect bird species through noise and disturbances from general construction activities. Other cumulative actions or projects that may also disturb birds include ongoing agricultural activities, mining, road improvements, and new subdivisions approved in Siskiyou County near Iron Gate Dam. If these actions occurred during construction in close proximity to the dams, there could be significant cumulative effects on bird species. However, the Proposed Action's contribution to this cumulative effect would be minimal, and specific mitigation (Mitigation Measure TER-2 and TER-3) and other species-specific measures would be incorporated into the project to avoid or minimize impacts to bird species, including protocol level surveys to identify nests, clearing and grubbing

during the non-nesting season, and establishment of buffer zones around nesting bird species. **With these measures, the Proposed Action's incremental contribution to cumulative effects on bird species would not be cumulatively considerable.**

4.4.4.1.3 Amphibians

Construction activities could result in direct mortality or harm to special-status invertebrate, amphibian and reptile species during construction. Construction would require heavy machinery to move through construction areas, staging areas, and haul roads where special-status invertebrate, amphibian and reptile species could occur. The past and present activities in the Klamath Basin such as agriculture, timber harvesting, road construction, and residential developments, considered with future developments noted in Table 4-4, have likely result in significant cumulative effects on amphibians. The Proposed Action's incremental contribution to the significant cumulative effects would not be cumulatively considerable, based on the specific measures have that been incorporated into the project to reduce or minimize impacts on special-status amphibians and reptiles. **The Proposed Action's incremental contribution to the significant cumulative effects on special-status amphibians and reptiles would not be cumulatively considerable.**

Dam removal could result in long-term impacts on amphibians from habitat degradation due to sedimentation in downstream reaches of the Klamath River. Amphibians are highly sensitive to alternations to their aquatic habitats. Sediment inputs in downstream reaches from dam removal would result in filling of riffle substrate necessary for larval phases of amphibian species. The past and present activities in the Klamath Basin such as agriculture, timber harvesting, road construction, and residential developments, combined with the Proposed Action and future developments noted in Table 4-3, could result in significant cumulative effects on amphibians from sedimentation of their habitat. The Proposed Action's contribution to the significant cumulative effects would be minimal. Most sediment is expected to be flushed out during subsequent high flow events (Stillwater 2008), and restoring a more natural sediment regime would be expected to benefit amphibian habitat in the long term. In addition, removal of reservoirs would reduce populations of non-native bullfrogs which prey on native amphibians. **The**

Proposed Action's incremental contribution to the significant long-term cumulative effects on amphibians from sedimentation would not be cumulatively considerable.

4.4.4.1.4 Bats

The Proposed Action could result in long-term impacts on bats from loss of roosting habitat. Bats have experienced significant cumulative effects associated with the loss of roosting habitat. This has occurred from past and present human activities in the Klamath Basin that have removed tree habitat, such as timber harvesting, agriculture, and road and residential developments. Proposed Action impacts on bats would occur from the loss of dam structures and associated facilities used as roosting habitat. The loss of a bat colony site or adverse effects to an active bat colony under the Proposed Action could contribute to these significant cumulative effects to bats. The Proposed Action's incremental contribution to the cumulative effect on bats could be cumulatively considerable because bats roost in all four dams or in their associated facilities and structures (FERC 2007) and these would be removed; however, the Proposed Action would provide mitigation for bats (TER-6) that would include bat surveys, exclusion measures, and the replacement of bat roosting structures that would minimize impacts on bats. **The Proposed Action's incremental contribution to the significant cumulative effects on bats would not be cumulatively considerable.**

4.4.4.1.5 Special-Status Species

Removal of reservoirs could result in impacts on wildlife from the permanent loss of aquatic habitat. The Proposed Action would result in impacts on special-status species from loss of aquatic habitat at reservoirs. Permanent loss of wetland and aquatic habitat at reservoirs would adversely affect wildlife and special-status species populations that use these habitats. No other known actions or projects are expected to substantially reduce the amount of open water habitat available in the Klamath Basin. **There would be no significant cumulative effects on special-status species from the loss of open water habitat.**

4.4.4.1.6 Habitat

Dam removal could result in long-term impacts on riparian habitat from sedimentation in downstream reaches. If the sediment is allowed to move downstream naturally, it is likely that some sedimentation would occur in deep pools or channel margins downstream during low-flow periods and cover wetland/riparian with a veneer of fine material (Bender Rosenthal, Inc. 2011). This short term wetland/riparian habitat alteration would be localized and would not be substantial. However, most sediment is expected to be flushed out during subsequent high flow events (see Section 3.11 Geology, Soils and Geologic Hazards), and restoring a more natural sediment regime would be expected to benefit amphibian habitat in the long term. No other cumulative actions or projects have been identified that would adversely affect riparian habitat in the downstream reaches after during drawdown. **There would be no significant cumulative effects associated with loss of riparian habitat.**

The Proposed Action could result in long-term impacts on wildlife habitat from tree and vegetation removal. During construction, some trees and other vegetation that provides

habitat for birds and other wildlife would be removed at construction areas, upland disposal sites, equipment staging areas, and access and haul roads.

Past, present and future cumulative actions such has timber harvesting, agriculture, recreation, residential developments, water diversions, and mining, have adversely affect wildlife and altered habitat. Construction of the KHP and associated facilities has reduced wildlife habitat. Reclamation's Klamath Project and associated infrastructure has reduced and fragmented wildlife habitat. Future developments, such as those proposed in Siskiyou County (see Table 4-4), may also contribute to some loss of habitat or impacts on wildlife species. Impacts on wildlife habitat are considered significant cumulative effects.

The Proposed Action's incremental contribution to the significant cumulative effects on wildlife habitat would not be cumulatively considerable. Specific measures have been incorporated into the Proposed Action to avoid or reduce impacts on specific bird species, such as bald eagles, if nesting trees are removed during construction. Following construction, restoration of this habitat would be conducted through the planting of native vegetation in accordance with a Habitat Rehabilitation Plan approved by the resource agencies. **The Proposed Action's incremental contribution to the significant cumulative effects on wildlife habitat would not be cumulatively considerable.**

4.4.4.1.7 Plant Species

Construction activities could result in the loss of special-status plants during construction. Construction activities such as the use of vehicles and equipment could result in the loss of special-status plant species. Past, present and future cumulative actions such has timber harvesting, agriculture, recreation, residential developments, water diversions, and mining, have adversely affect wildlife and altered habitat. Construction of the KHP and associated facilities has reduced wildlife habitat. Reclamation's Klamath Project and associated infrastructure has reduced and fragmented wildlife habitat. Future developments, such as those proposed in Siskiyou County (see Table 4-4), may also contribute to some loss of habitat or impacts on wildlife species.

The Proposed Action's incremental contribution to the significant cumulative effects on special-status plants would not be cumulatively considerable. Specific mitigation would be implemented (TER-1 and TER-4) to avoid or reduce impacts on special-status plants, including focused surveys and compensation measures, where necessary. **The Proposed Action's incremental contribution to the significant cumulative effects on special-status plants during construction would not be cumulatively considerable.**

The Proposed Action could result in impacts related to invasive plants. Invasive plants are found throughout the Klamath Basin and have adversely affected agriculture, wildlife, recreation areas, and native plant species. The spread of invasive plants is therefore a significant cumulative effect. The Proposed Action would not have a substantial contribution to this cumulative effect. Measures would be implemented to prevent the introduction of invasive plant species. All construction vehicles and equipment would be cleaned with compressed water or air within a designated containment area to remove

pathogens, invasive plant seeds, or plant parts, which would then be disposed of in an appropriate disposal facility. Implementation of the Reservoir Area Management Plan and the Habitat Rehabilitation Plan would include long-term maintenance and monitoring to control invasive species. Incorporation of these elements into the Proposed Action and implementation of Mitigation Measures TER-1 and TER-4 would avoid or reduce impacts on special-status plants during construction**. The Proposed Action's incremental contribution to the significant cumulative effects associated with the spread of invasive plants would not be cumulatively considerable.**

4.4.4.1.8 Wetlands

Construction of the Proposed Action could result in the loss of wetland and riparian vegetation communities. Dam removal could result in loss of reservoir wetlands.

Disturbances associated with construction areas and haul roads where clearing, grading, and staging of equipment would occur would have impacts on sensitive habitats, including wetlands and riparian vegetation along reservoirs and river reaches.

Under the Proposed Action, there would be unavoidable impacts on wetland habitat at the J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs (244.5 acres, see Table 3.5-2). However, much of these unavoidable impacts would be temporary, as wetlands would be expected to become reestablished in some areas along the new river channel with adequate hydrology, soils, and vegetation. As these areas would be prone to colonization by invasive plant species, management and control of invasives would occur as part of the Reservoir Area Management Plan and the Habitat Rehabilitation Plan.

A substantial amount of the historical wetlands of the Upper Klamath Basin have been lost to agricultural developments and water diversions (Larson and Brush 2010). As a result, there is less wetland habitat for waterfowl than there was prior to development, but abundant food for dabbling ducks and geese that feed on small grains in fields surrounding the wetlands (Jarvis 2002). Loss of wetland and riparian habitat is therefore a significant cumulative effect.

The Proposed Action's incremental contribution to the cumulative effect associated with loss of wetlands and riparian vegetation would be cumulatively considerable; however, there would also be gains in wetland and riparian habitat following restoration. Based on the Reservoir Area Management Plan, restoration of wetland/riparian habitat would occur at a total of 272 acres following reservoir drawdown. With implementation of the Reservoir Area Management Plan (DOI 2011a), permanent wetland loss at the reservoirs would be reduced. In contrast, wetlands would likely benefit from increased water availability under the Proposed Action, particularly in areas such as the J.C. Boyle bypass reach where water availability is currently limited. If it is determined that wetland losses would be greater than gains, a Compensatory Wetland Mitigation Plan would be developed and implemented in accordance with the requirements of the United States Army Corps of Engineers Section 404 Permit for impacts on Waters of the United States. Implementation of this mitigation (Mitigation Measure TER-5) would reduce the Proposed Action's contribution to the loss of wetland and riparian habitat. **The**

Proposed Action's incremental contribution to the significant cumulative effect associated with loss of wetlands and riparian vegetation would not be cumulatively considerable.

4.4.4.1.9 Wildlife Corridors

The Proposed Action could result in impacts on wildlife corridors. While there is little information on the extent of the loss of wildlife corridors, it is reasonable to assume that past actions such as residential developments, agriculture, timber harvesting, the KHP, and Reclamation's Klamath Project have all contributed to constructing infrastructure that has either blocked wildlife corridors or removed vegetation, causing a significant cumulative effect. The Proposed Action would have a beneficial contribution to this cumulative effect. The Proposed Action would remove the Four Facilities and infrastructure and would re-establish native vegetation at the Klamath River reservoir sites, allowing the establishment of wildlife corridors along the Klamath River. **The Proposed Action's incremental contribution to the significant cumulative effect associated with wildlife corridors would be beneficial.**

4.4.4.1.10 KBRA - Programmatic Measures

Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II could result in impacts on terrestrial wildlife and/or habitat. The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat. Construction activities associated with Fish Entrainment Reduction could result in impacts on terrestrial wildlife and/or habitat. The Fisheries Restoration Plan would include measures to restore riparian and floodplain vegetation throughout the Klamath Basin. While the overall intent of the Fisheries Restoration Plan is to benefit wildlife, there could be some temporary adverse impacts on terrestrial vegetation and wildlife during construction through ground disturbance and the use of construction equipment and vehicles. The WURP program could include juniper removal in order to increase inflow to Upper Klamath Lake. There could be adverse impacts on terrestrial wildlife, including nesting migratory birds, from removal of juniper trees. Fish Entrainment Reduction would entail the installation of fish screens at various water diversion structures for the Klamath Reclamation Project. There could be adverse impacts on riparian vegetation and wildlife habitat within these localized construction areas.

The exact locations for many of the actions planned as part of the KBRA have not yet been identified; therefore, it is difficult to determine what cumulative actions or projects may be occurring that could contribute to cumulative terrestrial wildlife and habitat impacts. However, for the purposes of this analysis, it is assumed that ongoing activities such as timber harvesting, agriculture, livestock grazing, mining, road improvements, and recreation could all be contributing to adverse effects on terrestrial species and could have noise impacts but could also result in adverse changes to habitat or even direct mortality to some species. Therefore, depending on the locations, there could be significant cumulative effects on terrestrial resources. The KBRA's incremental contribution to this significant cumulative effect would be cumulatively considerable. Construction activities and vegetation removal could result in disturbance or mortality to

terrestrial wildlife and habitat. However, mitigation measures would be implemented to reduce or avoid these impacts (TER-1 through TER-4). **The KBRA's incremental contribution to the significant cumulative effects on terrestrial wildlife and/or habitat would not be cumulatively considerable**. **Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in impacts on terrestrial wildlife and/or habitat. In general, additional water supply would be expected to increase the numbers of waterfowl using the National Wildlife Refuges. As described in Section 3.15, Socioeconomics, there would be an additional 193,830 waterfowl, with corresponding increases in hunting trips and local revenue. As noted above, there has been a considerable amount of wetland and riparian habitat loss in the Klamath Basin over time, and that has resulted in less wetland habitat for waterfowl than there was prior to development. Impacts on waterfowl and habitat are therefore considered significant cumulative effects. The Proposed Action's incremental contribution to this cumulative effect would be beneficial as it would increase water supply at the National Wildlife Refuges and would therefore be expected to increase waterfowl habitat and the number of waterfowl visiting the refuges. **The KBRA's incremental contribution to the cumulative effects on waterfowl and their habitat at the National Wildlife Refuges would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Modification of aquatic habitat from the Wood River Wetland Restoration project could result in impacts on terrestrial wildlife and/or habitat. Implementation of the Wood River Wetland Restoration may reconnect subsided wetlands adjacent to Agency Lake to provide additional water storage. Therefore, these projects are anticipated to benefit waterfowl, water birds, and other species that utilize wetlands and aquatic habitat through increased reliability of water to wetland habitat. However, some adverse effects could also occur to some species, depending on whether habitats are managed as marsh or open water. There has been a considerable amount of wetland and riparian habitat loss in the Klamath Basin over time, and that has resulted in less wetland habitat for waterfowl than there was prior to development. Impacts on waterfowl and habitat are therefore considered significant cumulative effects. The Proposed Action's contribution to the significant cumulative effects associated with waterfowl and their habitat would be minimal. The KBRA actions would provide more open water and/or marsh habitat. **The KBRA's incremental contribution to the cumulative effects on terrestrial wildlife and habitat would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.4.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative effects as Alternative 2 as all dams would be removed. Alternative 4 would involve fish passage facilities and would not result in any cumulative effects as all wildlife impacts would be temporary and minimal; however no

new wildlife corridors would be created. Alternative 5 would have similar cumulative effects to Alternative 2 and 3; however less habitat would be lost during construction and two dam facilities would remain for bat roosting and aquatic habitat. Under Alternative 5, no new wildlife corridors would be created because two dams would still remain in place. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

4.4.4.3 Mitigation Measures

No cumulatively considerable adverse effects related to terrestrial resources would occur; hence, no mitigation measures are required.

4.4.5 Flood Hydrology

Cumulative effects associated with flood hydrology could occur through changes in flows on the Klamath River that could increase the flood risk. The timeline for short-term cumulative effects would be the duration of deconstruction. The timeline for long-term effects after dam removal would be indefinite. Table 4-9 presents a summary of flood hydrology impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued operation of the Klamath Hydroelectric Project and Reclamation's Klamath Project could alter river flows and result in changes to flood risks.	1	NCFEC	None	NCFEC
Ongoing restoration actions could affect flood hydrology.	1	NCFEC	None	NCFEC
Dam failure could inundate areas in the downstream watershed.	1	LTS	None	LTS
Drawdown of reservoirs could result in short-term increases in downstream surface water flows and could result in changes to flood risk.	2, 3, 5	LTS	None	LTS
Reservoir drawdown and resulting downstream sediment deposition could affect flood risk.	2, 3, 5	LTS	None	LTS

Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Changes in flows following dam removal could result in changes to the 100-year floodplain downstream from Iron Gate Dam between River Mile 190 and 171.	2, 3, 5	S	H-1: Emergency Response Plan H-2: Move or Relocate Structures	LTS
Removing the Four Facilities could reduce the risks associated with a dam failure.	2	B	None	B
Removing Copco 1 and Iron Gate Dams could reduce the risks associated with a dam failure	5	B	None	B
Removal of recreation facilities located on the banks of the existing reservoirs which could affect flood hydrology.	2, 3, 5	NCFEC	None	NCFEC
Changes in flows in the Hydroelectric Reach including the J.C. Boyle and Copco 2 Bypass Reaches could affect flood hydrology.	4, 5	LTS	None	LTS
Construction of a new gage within the 100-year floodplain at Copco 2 Dam or J.C. Boyle Dam to measure flows could affect flood hydrology.	5	LTS	None	LTS
Keno Transfer				
Implementation of the Keno Transfer could cause changes to operations affecting flows downstream from Keno Dam, which could cause changes to flood risks.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities could cause changed in flood risk downstream from the facilities.	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could affect flood risk.	2, 3, 5	NCFEC	None	NCFEC

Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Klamath Basin Restoration Agreement – Programmatic Measures				
Implementation of the Fisheries Restoration Plans could change flows downstream from Upper Klamath Lake, which could result in changes to flood risks	2,3	LTS	None	LTS
Implementation of Wood River Wetland Restoration by the Bureau of Land Management may change flows upstream and downstream from Upper Klamath Lake, which could result in changes to flood risks.	2,3	B	None	B
Implementation of Future Storage Opportunities by Reclamation may cause changes to flows upstream and down downstream from Upper Klamath Lake, which could result in changes to flood risks	2,3	B	None	B
Implementation of the On-Project Plan may change flows downstream from Upper Klamath Lake during dry years, which could result in changes to flood risks.	2,3	NCFEC	None	NCFEC
Implementation of the WURP would change flows upstream of Upper Klamath Lake, which could result in changes to flood risks.	2,3	NCFEC	None	NCFEC
Implementation of an Emergency Response Plan could result in changes to flood risks in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	NCFEC	None	NCFEC
Implementation of Climate Change Assessment and Adaptive Management may change flows upstream and downstream from Upper Klamath Lake, which could result in changes to flood risks.	2,3	B	None	B

Table 4-9. Summary of Flood Hydrology Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of Interim Flow and Lake Program during the interim period would change river flows, which could result in changes to flood risks.	2,3	NCFEC	None	NCFEC

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
WURP = Water Use Retirement Program

Physical changes within a watershed produce changes in runoff patterns and associated surface water hydrographs. Historically, the Klamath Basin has experienced a loss of wetland habitat and a conversion to agricultural areas in the upper watershed and along tributaries such as the Scott and Shasta Rivers. The lower watershed remains largely forested, although localized areas of timber harvest and development exist throughout.

In the future, county and city populations in the Klamath Basin are projected to grow throughout the watershed (see Table 4-10). Increases in population would likely spur development of additional housing and businesses to support this growth. Increased development creates additional impervious surfaces, which often channel precipitation into surface water bodies. Most roads and highways in mountainous regions such as the Klamath Basin are located adjacent to streams and rivers. Additionally, some timber harvest would continue into the future; the construction of logging roads to expand timber harvest could also channel sediment and water into surface water bodies. These actions could increase peak flows during storm events.

In addition to increasing populations and new development, climate change may also affect future surface water hydrology. The annual snow packs in the mountain ranges may be reduced, decreasing annual surface water supplies. Storm frequency and severity may increase, causing higher peak flows in rivers and their tributaries during storm events (California Department of Water Resources [CDWR] 2010).

Table 4-10. Population Projections for the Eight Klamath Basin Counties

	California Counties					Oregon Counties		
Year	Del Norte	Humboldt	Mendocino	Modoc	Siskiyou	Curry	Jackson	Klamath
2020	29,967	140,019	91,718	9,954	47,483	22,671	238,865	70,595
2030	31,252	143,811	95,355	10,282	49,989	22,225	268,385	74,924
2040	32,163	145,509	97,913	10,538	51,695	23,432	297,496	80,159
2050	33,191	146,120	101,684	10,976	53,506	N/A	N/A	N/A

Source: California Department of Finance 2010, Oregon Office of Economics 2004
N/A – not available

4.4.5.1 Alternative 2: Full Facilities Removal of Four Dams

Drawdown of reservoirs could result in short-term increases in downstream surface water flows and result in changes to flood risks. The Proposed Action would result in short-term increases in flows during reservoir drawdown. Because drawdown would not occur until 2019, population growth and associated increases in development, the creation of new impervious surfaces, and construction of new logging roads or other infrastructure that result in run-off and sediment deposition in waterways could all contribute to changes in peak flows in surface water bodies. Climate change could increase the frequency of large storm events, and could cause more snow melt earlier in the season. These changes have the potential to increase flows on the Klamath River and could result in significant cumulative effects associated with flood risks.

The long-term surface water flow changes associated with future climate change and the Proposed Action's increase in flows from reservoir drawdown could result in surface water changes such as increased peak flows during storms that could increase the potential flood risks during drawdown. Higher flows may also change the rates and locations of sediment deposition in the channel bed and banks. Flood risk during reservoir drawdown could be a significant cumulative effect.

The Proposed Action's incremental contribution to the cumulative effect associated with flood risks would be short term and minimal. The reservoir drawdown plans were made with consideration for minimizing flood risks downstream. The Dam Removal Entity (DRE) would carefully control drawdown to maintain flows that would not cause flood risks. Drawing down the reservoirs would increase storage availability in J.C. Boyle, Copco 1, and Iron Gate Reservoirs. If a flood event occurred during drawdown, the DRE would retain flood flows using the newly available storage capacity and continue drawdown after flood risks have ended. Current conditions do not allow these reservoirs to assist in flood prevention in this manner. While the controlled releases during reservoir drawdown would be higher than simulated No Action/No Project Alternative releases during the same time period, they would not be likely to increase flood risks because they would still be within the range of historic flows. **The Proposed Action's incremental contribution to the short-term cumulative effects on flood risks from reservoir drawdown would not be cumulatively considerable.**

The release of sediment stored behind the dams and resulting downstream sediment deposition under the Proposed Action could result in changes to flood risks.

Sedimentation would occur downstream from the Four Facilities, but the quantity would vary depending on year type. The magnitude of sediment deposition is relatively small compared to sediment loading from other existing sources along the Klamath River. The only measurable sedimentation will occur in the reach from Bogus Creek to Cottonwood Creek. From Willow Creek to Bogus Creek, there is about 1.5 feet of deposition and from Cottonwood to Willow Creeks there is less than 1 foot of deposition. Downstream from Cottonwood Creek, there is less than 0.25 feet of deposition expected. Additionally, the sedimentation will occur in primarily pool and not in the riffle and bedrock sections that tend to control surface elevations. Because the sediment deposition would be small in comparison with the No Action/No Project Alternative, it would not affect stream characteristics in a way that would substantively affect flood inundation or flood risks. Therefore, sediment deposition would have a less than significant effect on flood risk. However, even though its effect was considered less than significant, the increase in bed elevations due to sedimentation was included in the mapping of the 100-yr floodplain inundation areas downstream from Iron Gate Dam described below.

The 100-year floodplain inundation area downstream from Iron Gate Dam could change between River Mile 190 and 171 and result in changes to flood risks. Removal of the Four Facilities under the Proposed Action would change flow patterns and would cause some small changes to the 100 year flood plain. An additional six structures would fall within the current Federal Emergency Management Agency (FEMA) 100-year flood inundation area. In addition, the Proposed Action would release sediment stored behind the dams that could deposit downstream and change the river bed elevation.

While there may be slight changes in surface water elevation from annual variations in precipitation, or ongoing activities in the basin that could change sedimentation in the river channel, there are no projects or actions that have been identified that would substantially change the current flood risk.

4.4.5.1.1 KBRA - Programmatic Measures

Implementation of the Fisheries Restoration Plans could change flows downstream from Upper Klamath Lake, which could result in changes to flood risks. Actions within the floodplain and river channel could generate minor changes in flood risks in and around the specific restoration locations. There are no other known cumulative actions or projects that would change flood risks by placing structures within the floodplain and river channel. Additionally, the restoration actions are designed to improve aquatic and riparian habitat and the potential changes in river hydraulics are intended to improve the habitats' ability to support river fisheries. **There would be no significant cumulative effects associated with changes in flood risk. Implementation of specific plans and projects outlined in the Fisheries Restoration Plans will require the analysis of changes to flood risks in future environmental compliance investigations as appropriate. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of Wood River Wetland Restoration by the Bureau of Land Management may change flows upstream and downstream from Upper Klamath Lake, which could result in changes to flood risks. Implementation of Future Storage Opportunities by Reclamation may cause changes to flows upstream and down downstream from Upper Klamath Lake, which could result in changes to flood risks. The KBRA includes a study of Wood River Wetland area management options that could provide additional water storage for a total of 16,000 acre-feet of storage capacity at or adjacent to Agency Lake. Additionally, Reclamation plans to identify and study additional off-stream storage opportunities with a 10,000 acre-feet of storage milestone in implementation of KBRA. Additional storage upstream of Upper Klamath Lake is likely to decrease potential flood risks downstream from Upper Klamath Lake by potentially storing excess flows. No other cumulative actions or projects have been identified that would increase storage capacity and decrease flood risk**. There would be no significant cumulative effects associated with changes to flood risks. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of Climate Change Assessment and Adaptive Management may change flows upstream and downstream from Upper Klamath Lake, which could result in changes to flood risks. One of the main purposes of Climate Change Assessment and Adaptive Management would be to respond to and protect basin interests from the adverse affects of climate change. Flood risks could be adversely impacted due to climate changes which increase river flows and/or flooding frequency. Klamath Basin Parties including technical experts would be involved in the development of assessment and adaptive management strategies that would be implemented continuously to respond to predicted climate changes. No other known cumulative actions or projects would help to decrease flood risks from climate change. **There would be no significant cumulative effects associated with flood risks. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.5.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative flood hydrology effects as Alternative 2. Alternative 5 would involve removal of two dams, with two dams remaining in place and overall cumulative short-term and long-term effects on flood risks would be slightly less than Alternative 2, but changes in the 100-year floodplain would still occur. Alternative 4 would not remove any dams; cumulative flood hydrology effects would be minimal and would be associated with changes in flows to accommodate fish passage facilities. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.5.3 Mitigation Measures

No cumulatively considerable adverse effects related to flood hydrology would occur; hence, no mitigation measures are required.

4.4.6 Ground Water

Cumulative effects on ground water would occur if other projects or actions in the area of analysis and timeframe would result in changes to ground water levels. The timeframe for the ground water cumulative effects analysis is after 2020 when the dams would be removed, because ground water could be permanently changed. Table 4-11 presents a summary of ground water impacts described in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

Table 4-11. Summary of Ground Water Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Continued facility operations could result in impacts on ground water resources.	1, 4	NCFEC	None	NCFEC
Ongoing resource management actions could lead to increased ground water storage.	1, 4, 5	B	None	B
Draining of the reservoirs could lower ground water levels in the aquifer adjacent to the reservoirs, which could impact existing wells.	2, 3, 5	S	GW-1: Deepen or replace affected ground water wells	LTS
Removing the dams and eliminating the reservoirs could reduce ground water discharge to the Klamath River.	2, 3, 5	LTS	None	LTS
Dam removal activities would include the demolition of various recreation facilities which would affect ground water.	2, 3, 5	NCFEC	None	NCFEC
Keno Transfer				
Implementation of the Keno Transfer could cause adverse effects to local ground water.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities - Programmatic Measure				
Decommissioning the East and Westside Facilities could have adverse effects to local ground water.	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which would affect ground water.	2, 3, 5	NCFEC	None	NCFEC

Table 4-11. Summary of Ground Water Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Klamath Basin Restoration Agreement - Programmatic Measures				
The Water Diversion Limitations program could reduce irrigation water in the driest years.	2,3	LTS	None	LTS
Upland vegetation management under the WURP would increase inflow to Upper Klamath Lake.	2,3	B (long term)	None	B (long term)
The purchase and lease of water under the Interim Flow and Lake Level Program would increase water for fisheries.	2,3	LTS (short term) B (long term)	None	LTS (short term) B (long term
Implementation of an Emergency Response Plan could result in changes to ground water following the failure of a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	NCFEC – ground water resources B – reduction in ground water use	None	NCFEC – ground water resources B – reduction in ground water use

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
WURP = Water Use Retirement Program

Very little information exists on ground water levels in the area directly around the Four Facilities. The ground water wells for which existing data are available (and presented in Section 3.7, Ground Water) are almost all identified as domestic wells. Because of the lack of data, it is not possible to determine if significant cumulative effects have occurred or are presently occurring with respect to ground water levels around the Four Facilities. The only actions identified as potentially affecting ground water levels in the area are the construction of wells as part of past developments, and the potential for construction of new wells for the approved developments in Siskiyou County described in Table 4-4.

4.4.6.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.6.1.1 Ground Water Levels

Under the Proposed Action, ground water levels in existing wells adjacent to the reservoirs could decline in response to the drop in surface water elevation when the reservoirs are removed. The Proposed Action could result in a decline in ground water levels when the reservoirs are removed. Because of the lack of existing data, it is not possible to determine if there are existing significant cumulative ground water effects in the area around the Four Facilities. However, the approved developments noted in Table 4-4 in Siskiyou County around Iron Gate Reservoir, if constructed, may require development of new wells that could cause future declines in ground water levels. This new development, combined with the Proposed Action's declines in ground water levels directly adjacent to the reservoir, could result in a significant cumulative effect associated with declining ground water levels. The Proposed Action's incremental contribution to significant cumulative ground water effects would be cumulatively considerable; however, impacts would be minimized through mitigation measure GW-1, which would deepen or replace all existing wells that experience declining ground water levels as a result of the project. With this mitigation, **the Proposed Action's incremental contribution to any significant cumulative effects associated with a decline in ground water levels in existing wells adjacent to the reservoirs in response to the drop in surface water elevation when the reservoirs are removed would not be cumulatively considerable.**

4.4.6.1.2 Ground Water Recharge

The Proposed Action could cause a reduction in ground water discharge to the Klamath River. Removing the dams and eliminating the reservoirs could result in less percolation of surface water to the underlying ground water aquifer due to removal of the water bodies. Because of the lack of existing data, it is not possible to determine if there are existing significant cumulative effects associated with ground water recharge in the area around the Four Facilities. However, future development near the reservoir sites could, in conjunction with the Proposed Action, contribute to reduced potential for ground water recharge and declines in ground water levels after 2020 through an increase in impermeable surfaces and in increase in ground water use. Overall, a significant cumulative effect associated with declining ground water levels and reduced recharge could occur; however, the Proposed Action's contribution to this cumulative effect would be inconsequential. Current information indicates that the Klamath River reaches in the area of analysis are gaining (i.e., ground water discharges to the stream). Additionally, the Proposed Action would not alter the volume of water that would be flowing through the project area in the Klamath River. The change in ground water recharge would likely be small to negligible because the river would still be present. **The Proposed Action's incremental contribution to significant cumulative effects associated with ground water recharge would not be cumulatively considerable.**

4.4.6.1.3 KBRA - Programmatic Measures

The Water Diversion Limitations program and the On-Project Plan could reduce irrigation water in the driest years, which could increase ground water pumping. Implementation of the On-Project Plan and Water Diversion Limitations program has the

potential to generate significant short-term localized impacts through the increased use of ground water to replace surface water deliveries. It is assumed for the purposes of this analysis that there would be significant cumulative ground water effects because of ground water pumping in response to overall dry conditions. The Proposed Action's incremental contribution to the significant cumulative effects would be cumulatively considerable, but would be minimized through implementation of the Water Diversion Limitations program and On-Project Plan. As discussed in section 3.7.4.3, for Alternative 2, the KBRA would provide more surface water in the driest years. For example, if the KBRA applied in 2010, 145,000 acre feet more surface water would have been available and less ground water pumping would have been required. Also, the On-Project Plan is being developed to include several measures other than ground water pumping to meet water demand. The KBRA also provide increased monitoring and data collection, as well as funding related to ground water management. Moreover, the new USGS ground water model provides resource management agencies a robust tool for maximizing ground water use with the least amount of adverse effects as defined by KBRA, Klamath Water and Power Agency, and resource management agencies. As a result, implementation of the KBRA is expected to slow, halt, or reverse the declining trend in ground water levels over the past decade (i.e. since 2001). **Overall, the KBRA's incremental contribution to the significant cumulative effects on ground water would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

Upland vegetation management under the WURP would increase inflow to Upper Klamath Lake, which could increase ground water recharge. The WURP is intended to permanently increase the flow of water into Upper Klamath Lake by 30,000 acre-feet per year to support restoration of fish populations (KBRA Section 16.2.2). The KBRA action of implementing the WURP would increase ground water recharge and this could have beneficial effect on ground water levels. No other cumulative actions or projects have been identified that would increase ground water recharge in the Klamath Basin. **There would be no significant cumulative effects associated with ground water recharge. Implementation of the KBRA will require future environmental compliance as appropriate.**

The purchase and lease of water under the Interim Flow and Lake Level Program would increase water for fisheries, which could increase reliance on supplies. The Interim Flow and Lake Level Program (KBRA Section 20.4) would be an interim program of water purchase and lease to reduce surface water diversions and further the goals of the fisheries programs during the interim period prior to full implementation of the On-Project Allocation and WURP. This could increase the reliance on ground water sources. It is assumed for the purposes of this analysis that there would be significant cumulative ground water effects in the basin, given continued use of ground water substitution for surface water deliveries curtailed in drought years. The Interim Flow and Lake Level Program's incremental contribution to this cumulative ground water effect would be cumulatively considerable; however, that contribution would be mitigated through, water purchase and lease agreements, with a term greater than the interim period defined in

Section 20.4.2, that would be subject to a consistency requirement with the On-Project Plan. Reduced surface water diversions would not be expected to directly result in increased adverse ground water impacts given provisions developed to prevent impacts to ground water in the KBRA (see Section 15.2.4). With these measures, **the KBRA's incremental contribution to significant cumulative ground water effects would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

4.4.6.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative ground water effects as those described under Alternative 2, as all dams would be removed. Alternative 4 would not result in any cumulative ground water effects because it would involve construction of fish passage facilities and the dams would remain in place. Alternative 5 could have some similar cumulative ground water effects as Alternative 2; however two dams and associated reservoirs would remain in place. Any changes in ground water levels would likely be less than under Alternative 2, but because the remaining reservoirs would be the smallest of the four, the difference in cumulative ground water effects between Alternative 2 and Alternative 5 would likely be negligible. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.6.3 Mitigation Measures

No cumulatively considerable adverse effects related to ground water would occur; hence, no mitigation measures are required.

4.4.7 Water Supply/Water Rights

Cumulative effects on water supply and water rights would be associated with changes in Klamath River flow rates as a result of increased demands or diversions from new or existing water supply users. The timeframe for cumulative effects associated with reservoir drawdown impacts is May 2019 through December 2020. The timeframe for long-term cumulative effects is indefinite but would occur after deconstruction is complete (after 2020). Table 4-12 presents a summary of water supply/water rights impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

As described in Section 3.8, Water Supply/Water Rights, Oregon is currently undergoing an effort to adjudicate water rights on the Klamath River; this effort will define existing water rights. There are no other known past, present, or future actions or projects that would specifically affect existing water rights on the Klamath River. However, there are several projects described in Section 4.4.5, Flood Hydrology, that have the potential to alter surface water flows, which could affect water supply and the exercise of water rights.

Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Continued operation of the Four Facilities could affect water supply operations.	1, 4	NCFEC	None	NCFEC
Ongoing restoration actions would continue to be implemented and could affect water supply availability.	1	NCFEC	None	NCFEC
Removal of various recreation facilities located on the banks of the existing reservoirs which could affect water supply or water rights.	2, 3, 5	NCFEC	None	NCFEC
Flow changes downstream from Iron Gate Dam could affect water supply downstream from Seiad Valley.	2, 3, 5	LTS	None	LTS
Changes in flow downstream from Iron Gate Dam could affect water rights holders.	2, 3, 5	LTS	None	LTS
Sediment release during reservoir drawdown could affect Klamath River geomorphology and water intake pumps downstream from Iron Gate Dam.	2, 3, 5	S	WRWS-1: Modifications to intake points	LTS
Activities associated with Interim Measures could result in changes to PacifiCorp's water rights.	2,3	LTS	None	LTS
Keno Transfer				
Implementation of the Keno Transfer could cause changes to operations affecting water levels upstream of Keno Dam, which could cause changes to water supply or water rights.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities and eliminating water flows could affect water users reliant on a diversion from the West Canal.	2, 3	NCFEC	None	NCFEC

Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could affect water supply.	2, 3, 5	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement – Programmatic Measures				
Implementation of the trap and haul element of the Fisheries Reintroduction and Management would require water rights to divert water for the fish handling facilities.	2, 3	LTS	None	LTS
Implementation of Wood River Wetland Restoration by the Bureau of Land Management would result in changes to storage opportunities at Agency Lake, which could affect water supply.	2,3	LTS	None	LTS
Implementation of Water Diversion Limitations to Reclamation's Klamath Project could result in changes to water diversions, which may affect water rights and water supply.	2,3	LTS	None	LTS
Implementation of the On-Project Plan to allow for full implementation of Water Diversion Limitations to Reclamation's Klamath Project would result in changes to water diversions for irrigation in dry years, which could affect water rights or adjudicated rights.	2,3	B	None	B
The study of additional off-stream storage opportunities in the Upper Klamath Basin to identify new storage opportunities, could affect water supply.	2, 3	NCFEC	None	NCFEC

Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Implementation of the Water Use Retirement Program increases instream flow to Upper Klamath Lake which could affect water rights and water supply upstream of Upper Klamath Lake.	2,3	LTS(retired water rights)/NCFEC(downstream diverters)	None	LTS(retired water rights)/NCFEC(downstream diverters)
Implementation of Off-Project Water Settlement negotiations could affect water rights and adjudicated rights upstream of Upper Klamath Lake.	2,3	B (resolved water rights)/LTS (unresolved water rights)	None	B (resolved water rights)/LTS (unresolved water rights)
Implementation of Off-Project Reliance Program could change water deliveries for irrigation downstream from Upper Klamath Lake to Off-Project water users affecting water rights.	2,3	LTS	None	LTS
Implementation of an Emergency Response Plan could result in a change to water supply deliveries in the event of failure to a Klamath Reclamation Project facility or dike on Upper Klamath Lake or Lake Ewauna.	2,3	B	None	B
Implementation of Climate Change Assessment and Adaptive Management could result in changes to water deliveries depending on climatic changes	2,3	B	None	B
Implementation of Interim Flow and Lake Program during the interim period could change water deliveries affecting water supply	2,3	LTS	None	LTS
Implementation of Drought Plan water and resource management actions could result in changes to water supply deliveries for Klamath Basin interests during drought years.	2,3	B	None	B

Table 4-12. Summary of Water Rights/Water Supply Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Implementation of KBRA section 15.3 Water Rights Assurances Related to Tribal Water Rights could be beneficial to water rights and water supply.	2, 3	B	None	B

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

4.4.7.1 Alternative 2: Full Facilities Removal of Four Dams

Dam removal could change surface water flows available for diversion downstream from Iron Gate Dam. Dam removal could cause changes in water supply compared to the No Action/No Project Alternative. Modeling results show that the Proposed Action would change flows downstream from Iron Gate Dam, and this could affect water diversions and existing water rights. The modeling considers KBRA actions in addition to dam removal.

Water supply in the Klamath Basin has been affected by the construction of Reclamation's Klamath Project, the KHP, variations in annual precipitation throughout the Klamath Basin, drought, and regulatory requirements such as the recommendations in the Biological Opinions for Reclamation's Klamath Project and the KHP that contain specific stream flow requirements. Water demands for industries such as agricultural, timber harvesting, and mining also affect water supply. Changes in water supply therefore represent significant cumulative effects in the Klamath Basin.

The Proposed Action's contribution to this cumulative effect would be minimal. The modeling results showed either a slightly higher or slightly lower flow rate on the Klamath River downstream from Iron Gate Dam. These differences would diminish farther downstream from Iron Gate Dam. The modeling results show that at Seiad Valley, approximately 62 miles downstream from the Iron Gate Dam, the flow rates would have almost no change.

The Proposed Action would change the flows in the river downstream from Iron Gate Dam, but the flows available in the river would still be substantially greater than the peak diversion. The most conservative comparison is just downstream from Iron Gate Dam, where the flows would be the lowest in the potentially affected reach. Comparing the

peak potential diversion with low flow conditions, the diversions would be approximately 16 percent of the Klamath River flows during a dry year[2]. The flow rate of 824 cfs is the seasonal low during the month of July, when irrigation and livestock demands are the greatest. Because the amount of flow diverted for water right users between Iron Gate Dam and Seiad Valley would be less than 20 percent of the flow in the Klamath River in the upstream portions of this reach during dry year, low flow conditions, water right users are not likely to experience decreased supplies because of the changes in flows. **The Proposed Action's incremental contribution to the significant cumulative effect on water supply and water rights would not be cumulatively considerable.**

Release of stored sediment during drawdown of reservoirs could change Klamath River geomorphology and affect water intake pumps downstream from Iron Gate Dam. The release of sediment from the drawdown of the reservoirs could affect downstream water intake systems. Individual downstream intake facilities could be inundated with sediment deposits, causing operational problems.

Other cumulative actions that may increase sediment and could affect downstream water intake pumps include transportation improvement project identified in Table 4-4 for Siskiyou County, new subdivisions near Iron Gate Dam in Siskiyou County, and other proposed developments. Other more general projects and activities that are not easily identifiable but likely to occur, such as timber harvesting, mining, and agriculture, livestock grazing, and road-related erosion could also contribute to cumulative effects associated with sediment. Climate change could also affect sediment by increasing the number of heavy precipitation events each year.

Increased sediment in the Klamath River could result in significant cumulative effects on downstream water intake pumps. The Proposed Action's contribution to the significant cumulative impacts on water intake pumps from increased sediment would be cumulatively considerable; however, mitigation measure WRWS-1 would mitigate that contribution. The subject measure would provide for an investigation of potentially affected intake and pump sites at the request of the water user. If effects on water supply intakes occur as a result of dam removal, the DRE will complete modifications to intake points as necessary to reduce effects to a less-than-significant level. **With implementation of this mitigation, the Proposed Action's incremental contribution to the cumulative effects on water intake pumps from sedimentation associated with reservoir drawdown would not be cumulatively considerable.**

Activities associated with IMs could result in changes to PacifiCorp's water rights. Prior to construction, IM 16 (Water Diversions) would eliminate three screened diversions from Shovel and Negro Creeks and would seek to modify PacifiCorp's water rights to

[2] The increase during July and August is an average based on reported values on Statement Diversion and Use forms available on California Electronic Water Rights Information Management System for the Klamath River.

move the points of diversion to the mainstem Klamath River. As discussed above, water supply in the Klamath Basin has been adversely affected over time, and changes in water supply represent significant cumulative effects.

The Proposed Action's contribution to this cumulative effect through implementation of IMs would be minimal. While this measure would require a change to PacifiCorp's water rights, it would not affect the exercise of the water right (i.e., the quantity of water diversions) or flow in the Klamath River. **Therefore, the Proposed Action's incremental contribution to the significant cumulative effect on water supply and water rights would not be cumulatively considerable.**

4.4.7.1.1 KBRA - Programmatic Measures

Implementation of the trap and haul element of the Fisheries Reintroduction and Management Plan could require water rights to divert water for the fish handling facilities. Fish handling facilities to collect fish downstream from Keno Dam and at Link River Dam would require water sources. The facilities would not consumptively use the water; the water would pass through the facilities for release back into the system. Trap and haul is likely to be an exempt use under ORS 537.141(d) and OAR 340-0010(2)(c)(B) if it causes no injury to existing water rights and if it is found to be not harmful to fish or wildlife after consultation with Oregon Department of Fish and Wildlife. The geographic separation between this project and the hydroelectric facility removal actions analyzed above eliminate any potential for negative water supply effects generated by this program from contributing to water supply effects generated by facility removal. **The trap and haul element of the Fisheries Reintroduction and Management Plan would not contribute to the significant cumulative effects on water supply would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of the Wood River Wetland Restoration Project would result in changes to water storage opportunities at Agency Lake, which could affect water supply. The study of additional off-stream storage opportunities in the Upper Klamath Basin to identify new storage opportunities could affect water supply. A study of Wood River Wetland area management options would investigate the potential for providing additional water storage for a total of 16,000 acre-feet of storage capacity at or adjacent to Agency Lake. Additionally**,** Reclamation plans to identify and study additional off-stream storage opportunities. KBRA parties would support ongoing investigations and acquisition of additional storage. This additional storage would improve water supply reliability and assist with alleviating short-term impacts related to water supply delivery during Water Diversion Limitations (another KBRA program) helping to offset a portion of the deficiencies. No other cumulative actions or projects have been identified that would increase storage on the Klamath River. **There would be no significant cumulative effects on water supply from changes in water storage. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of Water Diversion Limitations to Reclamation's Klamath Project could result in changes to water diversions, which may affect the exercise of certain water rights and water supply. Water Diversion Limitations provide specific allocation of water for refuges and limitations on specific diversions for the Reclamation's Klamath Project intended to increase water availability for fisheries purposes. While reducing diversions during the driest years would affect water supply for irrigation, it would not affect what is needed for public health and safety. Water may not be available to fulfill some water rights or adjudication claims during dry years; however, the On-Project Plan, Drought Plan, and Future Storage Opportunities to be implemented as part of the KBRA would help to offset a portion of these deficiencies. No other cumulative actions or projects have been identified that would change water diversions and affect water rights and water supply. **There would be no significant cumulative effects associated with water supply and water rights. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of the On-Project Plan to allow for full implementation of Water Diversion Limitations to Reclamation's Klamath Project would result in changes to water diversions for irrigation in dry years, which could affect the exercise of certain water rights or adjudicated rights. The purpose of the On-Project Plan is to provide additional water supply or reduce the demand for Reclamation's Klamath Project to make up the differences between anticipated use and actual diversion. These actions include: land fallowing and shifting to dryland crop alternatives, efficiency and conservation measures (i.e. drip irrigation), development of ground water sources, or creation of additional storage. No other cumulative actions or projects have been identified that would affect water supply and water rights. **There would be no significant cumulative impacts associated with water supply and water rights. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of the WURP increases instream flow to Upper Klamath Lake which could affect water rights and water supply upstream of Upper Klamath Lake. The WURP is a voluntary program for the purpose of supporting fish populations restoration by permanently increasing inflow to Upper Klamath Lake by 30,000 acre-feet per year. Some measures include implementing water efficiency projects, increasing natural storage through wetland or improved riparian area performance, and purchase and retirement of water rights from willing sellers. This could affect water rights, although retirement of water rights would be voluntary. No other cumulative actions or projects have been identified that would result in the purchase or retirement of water rights from willing sellers. **The KBRA's incremental contribution to the significant cumulative effects on water supply would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of Off-Project Water Settlement (OPWAS) negotiations could affect the exercise of certain water rights and adjudicated rights upstream of Upper Klamath Lake. The intent of OPWAS is to negotiate a settlement of long-standing water disputes

between the Upper Klamath Water Users Association, Klamath Tribes, the Bureau of Indian Affairs, and potentially other water users in the Upper Basin. The negotiated settlements would resolve certain contests to significant major water right claims in the Upper Klamath Basin. Implementation of OPWAS would be a beneficial effect to resolve water rights and adjudicated rights and a less than significant impact to unresolved cases due to reciprocal assurances. There are no other cumulative actions or projects that have been identified that would resolve certain contests to major water rights claims that could affect water supply/water rights. **The KBRA's incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of Off-Project Reliance Program could change water deliveries for irrigation upstream of Upper Klamath Lake to Off-Project water users, affecting the water supply. The agreement establishes a program to avoid or mitigate the immediate effects of unexpected circumstances affecting water availability for irrigation in the Off-Project area. Activities under the Off-Project Reliance Program may include: funding water leasing to increase water supply availability for irrigation in the Upper Klamath Basin or mitigating the economic impacts of lost agricultural production by Off-Project irrigators. The program it is intended to provide additional water availability and help minimize reductions in water supply. No other cumulative actions or projects have been identified that would substantially change water supply availability. **The KBRA's incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of Drought Plan water and resource management actions could result in changes to water supply deliveries for Klamath Basin interests during drought years. Implementation of an Emergency Response Plan could result in a change to water supply deliveries in the event of failure to a facility in Reclamation's Klamath Project or dike on Upper Klamath Lake or Lake Ewauna. Implementation of Climate Change Assessment and Adaptive Management could result in changes to water deliveries depending on climatic changes. The Drought Plan would improve short-term water supply reliability during drought by releasing stored water, paid forbearance agreements, conservation, ground water substitution, or ground water sharing. The Emergency Response Plan would prepare water managers for an emergency affecting the storage and delivery of water needed for KBRA implementation. The Climate Change Assessment and Adaptive Management program would respond to and protect basin interests from the adverse affects of climate change by improving storage capabilities during the wet years and conservation during dry years. Implementation of these programs would be beneficial to water supply because they would help to reduce the effects of drought, climate change, and emergencies by increasing water supplies and/or improving water supply reliability. No other known cumulative actions or plans would increase water supply reliability or water supply during drought, climate change, or emergency situations. **The KBRA's incremental contribution to the significant cumulative effects on water supply and**

water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

Implementation of Interim Flow and Lake Program during the interim period could change water deliveries affecting water supply. The goal of the Interim Flow and Lake Level Program is to "further the goals of the Fisheries Program" through an interim program of water purchases and leases during the interim period prior to full implementation of the On-Project Plan and WURP. Leases and purchases of water under this interim program shall be from willing sellers and counted towards instream water supply. No other known cumulative actions or projects would result in the purchase or lease of water during the interim period. **The KBRA's incremental contribution to the significant cumulative effects on water supply and water rights would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Implementation of KBRA Section 15.3 Water Rights Assurances Related to Tribal Water Rights could affect tribal trust water rights and water supply. KBRA Section 15.3 and related provisions provide certain assurances related to Reclamation's Klamath Project operations in Oregon and directly tie into claims filed as part of the Oregon adjudication. The only tribal water rights being litigated there involve claims filed by the United States and the Klamath Tribes, not to any other Indian tribe in the Klamath Basin. Under the KBRA, these claims--to Upper Klamath Lake (Case 286 in the Oregon adjudication) and to the Klamath River from the Lake to the Oregon border (Case 282)--will be subordinated in relation to the Reclamation's Klamath Project as specified in the KBRA. In particular, Section 15.3.9 (the KBRA "no-call" provision) affects the ability of the United States or other parties to alter Reclamation's Klamath Project water budget in the future if the Secretary of the Interior were to make an Affirmative Determination regarding dam removal, the KBRA were implemented, dams were removed, and certain KBRA conditions were met.

Significant cumulative effects associated with water supply have occurred in the past, as described above. Therefore, tribal trust water rights and water supply represent a significant cumulative effect. However, overall, restoration would be consistent with any trust obligation to all Basin tribes, including those who currently oppose the KBRA and its authorizing legislation. Conversely, litigation or adjudication of these and other issues entails considerable risks and costs, takes years if not decades to resolve, and ultimately does not provide the opportunity, both in programs and appropriations, that the KBRA and related activities will if enacted. In fact, the Oregon adjudication originated in the mid-1970s, begun in earnest in the mid-1990s, and has yet to complete the first of two major phases. Implementation of KBRA Section 15.3 Assurances Related to Tribal Water Rights would be beneficial to water rights and water supply. **The Proposed Action's incremental contribution to the cumulative effects on tribal trust water rights and water supply would not be cumulatively considerable.**

4.4.7.2 Alternatives 3, 4, and 5

Alternatives 3 and 5 would have similar cumulative water supply and water rights impacts as described for Alternative 2 because both alternatives would involve dam removal. Alternatives 4 and 5 would require implementation of a trap and haul measure which would be functionally equivalent to the KBRA's trap and haul element of the Fisheries Reintroduction and Management. For the reasons discussed above for the KBRA's trap and haul element of the Fisheries Reintroduction and Management, the trap and haul measure for Alternatives 4 and 5 would also have a less than significant impact on water rights and water supply. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.7.3 Mitigation Measures

No cumulatively considerable adverse effects related to water supply and water rights would occur; hence, no mitigation measures are required.

4.4.8 Air Quality

Cumulative air quality effects occur when a variety of projects or sources contribute to emissions in the area of analysis. The timeframe for air quality impacts associated with deconstruction would be the length of the deconstruction/construction period. Deconstruction and construction activities would occur from May 2019 through December 2020 for Alternatives 2, 3, and 5. Table 4-13 presents a summary of air quality impacts described in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-13. Summary of Air Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Vehicle exhaust and fugitive dust emissions from dam removal activities and construction of fish passage could increase emissions of VOC, NOx, CO, SO_2, PM_{10}, and $PM_{2.5}$ to levels that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	S	AQ-1: MY 2015 or newer engines for offroad construction equipment AQ-2: MY 2000 or newer engines for on-road construction equipment AQ-3: MY 2010 or newer engines for haul trucks AQ-4: Dust control measures during blasting operations	S
	4	LTS	None	LTS

Table 4-13. Summary of Air Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Activities associated with interim measure (IM) 7 J.C. Boyle Gravel Placement and/or Habitat Enhancement, could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	1, 2, 3	LTS	None	LTS
Activities associated with IM 8 J.C. Boyle Bypass Barrier Removal could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	1	LTS	None	LTS
Activities associated with IM 16 Water Diversions could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	2, 3	LTS	None	LTS
Reservoir restoration actions could result in short-term and temporary increases in criteria pollutant emissions from the use of helicopters, trucks, and barges that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
Relocation and the demolition of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from the operation of construction equipment that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas.	2, 3, 4, 5	LTS	None	LTS
Keno Transfer				
Implementation of the Keno Transfer could have adverse effects on air quality.	2, 3	NCFEC	None	NCFEC

Table 4-13. Summary of Air Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
East and Westside Facilities – Programmatic Measure				
Decommissioning the East and Westside Facilities could cause adverse air quality effects.	2, 3	LTS	None	LTS
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Relocation of the Yreka Water Supply Pipeline could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance.	2, 3, 5	LTS	None	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust.	2, 3	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	S[3]
Activities associated with the implementation of the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap and haul activities.	2, 3	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	S[3]

[3] While Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce impacts to LTS, emissions from any construction actions completed in the same year as hydroelectric facility removal actions may not be reduced to a less than significant level. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

Table 4-13. Summary of Air Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Air Quality – Trap and Haul				
Implementation of trap and haul measures could result in temporary increases in air quality pollutant emissions from vehicle exhaust.	4, 5	S	AQ-1: Model Year 2015 Emissions Standards for Off-Road Construction Equipment AQ-2: Model Year 2000 or On-Road Emissions Standards for On-Road Construction Equipment AQ:3 Model Year 2010 Emissions Standards for On-Road Heavy Duty Vehicles	LTS

Key:
1 = No Action/No Project
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3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

4.4.8.1 Alternative 2: Full Facilities Removal of Four Dams

Vehicle exhaust and fugitive dust emissions from dam removal activities could increase emissions of volatile organic carbon (VOC), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), inhalable particulate matter < 10 microns (PM_{10}), and fine particulate matter < 2.5 microns ($PM_{2.5}$) to levels that could exceed Siskiyou County's thresholds of significance. Under the Proposed Action, total emissions of NOx, PM_{10}, and $PM_{2.5}$ exceed the significance criteria for the Four Facilities. The greatest source of NOx emissions from each of the dams would be off-road construction equipment, followed by on-road trucks, and then employee commuting vehicles. The major sources of PM_{10} and $PM_{2.5}$ emissions would be fugitive dust from unpaved roads and then cut/fill activities. Secondary formation of $PM_{2.5}$ could also occur from NOx and sulfur oxide (SOx) emissions; however, these pollutants are not emitted in sufficient quantities to affect the Klamath Falls Nonattainment Area. Any adverse impacts would be temporary.

The population in the affected counties is expected to increase in the future. Increases in population and housing could increase traffic, utility demands, and construction projects, which could all result in increased air pollution. Additionally, air pollutant emissions

associated with past and present development and activities have contributed to local and regional air pollution. As a result, the air quality emissions in the region create significant cumulative air quality effects. Dam removal would have an incremental contribution to the cumulative effect that would be cumulatively considerable. Dam removal would result in substantial, albeit temporary emissions, of construction-related air pollutants (i.e., equipment emissions and fugitive dust) and resultant air quality impacts near the project sites. Even with all feasible mitigation measures (AQ-1 through AQ-4), the Proposed Action would cause a substantial air quality impact associated with PM_{10} emissions because it would exceed Siskiyou County Air Pollution Control District Rule 6.1 permitting criteria. The Proposed Action's contribution to the cumulative effect would be significant**.** No additional feasible mitigation is available to adequately reduce project-related impacts below the criteria. **The incremental contribution to the significant cumulative effect on air quality from dam removal would be cumulatively considerable. No other feasible mitigation is available to reduce PM_{10} emissions; therefore, they remain cumulatively considerable.**

Construction of a new, elevated Yreka Water Supply Pipeline and steel pipeline bridge to support the pipe above the river could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance. Although criteria pollutant emissions are expected to be less than significant for the construction of the Yreka Water Supply Pipeline, air pollutant emissions associated with past and present development have contributed to local air pollution. As a result, the air quality emissions in the region are considered significant cumulative effects. The contribution to the significant cumulative air quality effect from construction of the water supply pipeline would not be cumulatively considerable. As shown in Table 3.9-4, the pipeline is expected to result in some air quality emissions from the use of equipment; however, the emissions would not exceed the significance criteria. No long-term effects air quality effects would occur. **The incremental contribution to significant cumulative air quality effects from construction of Yreka's Water Supply Pipeline would not be cumulatively considerable.**

Activities associated with several IMs could result in short-term and temporary increases in criteria pollutants from vehicle exhaust and fugitive dust that could exceed Siskiyou County's thresholds of significance. As discussed above, air pollutant emissions associated with past and present development and activities have contributed to local and regional air pollution; therefore, air quality emissions are considered significant cumulative effects. IMs would be implemented prior to facilities removal; therefore, they would not contribute to the emissions from those activities. IMs 7 and 16 would result in a small increase in emissions associated with construction vehicles, haul trucks, and construction workers. However, based on the limited amount of construction equipment expected to be used simultaneously, peak daily emissions are not expected to exceed the significance criteria described previously and would not result in long-term effects. **The incremental contribution to significant air quality effects from implementation of IMs would not be cumulatively considerable.**

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. As discussed above, air pollutant emissions associated with past and present development and activities have contributed to local and regional air pollution. As a result, the air quality emissions in the region are considered significant cumulative effects. Restoring the reservoir areas would not result in cumulatively considerable impacts. Restoration actions would result in temporary emissions, of construction-related air pollutants (i.e., equipment emissions and fugitive dust) but they would not exceed significance criteria (See Table 3.9-5). **The restoration actions' incremental contribution to the significant cumulative effect on air quality would not be cumulatively considerable.**

Demolition and reconstruction of various recreation facilities could result in short-term and temporary increases in criteria pollutant emissions from vehicle exhaust and fugitive dust. Air pollutant emissions associated with past and present development have contributed to local air pollution. As a result, the air quality emissions in the region are considered significant cumulative effects. Demolition and reconstruction of recreation facilities would result in contributions to the cumulative effect that would not be cumulatively considerable. On- and off-road construction equipment would be used to complete these activities, which would occur after the Facilities removal actions. Based on the number of recreation facilities that would be reconstructed or demolished, it is assumed that emissions would not exceed existing significance criteria (See Table 3.9-6). **The incremental contribution to the significant cumulative effect on air quality from relocation and demolition of recreation facilities would not be cumulatively considerable.**

Fugitive dust emissions from demolition activities could impair visibility in Federal Class I areas. Dam demolition activities would create fugitive dust and could temporarily impair visibility. No other known cumulative actions or projects would substantially increase dust and impair visibility during reservoir demolition because most of the area would be closed to outside traffic and restricted to construction worker use for safety concerns. There would be no significant cumulative fugitive dust effects that could impair visibility.

Decommissioning the East and Westside Facilities could cause adverse air quality effects. Decommissioning of the East and Westside canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA would eliminate the need to divert at Link River Dam into the two canals. Air quality emissions in the region are considered significant cumulative effects. However, incremental contribution of the decommissioning of the East and Westside Facilities to the significant cumulative effects would be minimal. These construction activities would be conducted in the years prior to Facilities Removal and would not overlap with other construction or demolition activities. Peak daily emissions would likely be minimal and are not expected to exceed the significance criteria. The incremental contribution to the significant cumulative effect on air quality from the East and Westside Facilities decommissioning would not be cumulatively considerable.

4.4.8.1.1 KBRA - Programmatic Measures

Construction activities associated with the KBRA programs could result in temporary increases in air quality pollutant emissions from vehicle exhaust and fugitive dust. Activities associated with the implementation of the Fisheries Reintroduction and Management Plan could result in temporary increases in air quality pollutant emissions from vehicle exhaust associated with trap and haul activities. Potential construction activities include channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. Several of these activities would require construction equipment with the potential to emit air quality pollutants. As noted above, the air quality emissions in the region are considered significant cumulative effects. Due to the potentially large amount of construction activities that would occur for the various KBRA programs, it is anticipated that the KBRA's incremental contribution to the significant cumulative air quality effects would be cumulatively considerable. Mitigation Measures AQ-1, 2, and 3 would be implemented to reduce these effects. **With mitigation, the KBRA's incremental contribution to the cumulative effects on air quality would not be cumulatively considerable; however, emissions from any construction actions completed in the same year as Facility Removal actions may remain cumulatively considerable even with all feasible mitigation. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.8.2 Alternatives 3, 4, and 5

Alternatives 3 and 5 would have similar cumulative effects to the Proposed Action as both of these alternatives would exceed existing criteria and would cause cumulatively considerable air quality impacts during construction. Alternative 4 would have less cumulative effects because no Facilities would be removed. Alternative 4 would not result in cumulatively considerable impacts from construction emissions. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; **therefore, there would be no cumulative effects associated with KBRA actions.**

4.4.8.3 Mitigation Measures

The Proposed Action, Alternative 3, and Alternative 5 would have cumulatively considerable impacts associated with construction emissions, even with implementation of all feasible mitigation. No other feasible mitigation is available to reduce these emissions; **therefore, the cumulative effects associated with on- and off-road construction equipment would remain cumulatively considerable for Alternatives 2, 3, and 5.**

4.4.9 Greenhouse Gases/Global Climate Change

By its very nature, climate change is a cumulative impact from various global sources of activities that incrementally contribute to global GHG concentrations. Individual projects provide a small addition to total concentrations, but contribute cumulatively to a global phenomenon. The goal of California Assembly Bill (AB) 32 and Oregon House Bill

3543 both require GHG emission reductions from existing conditions. As a result, cumulative GHG and climate change impacts must be analyzed from the perspective of whether they would impede each State's ability to meet its emission reduction goals. While it is not necessary to show zero or negative GHG emission impacts, the project must show a reduction in emissions from business-as-usual. The timeframe for short-term deconstruction/construction related effects is the duration of construction. The timeframe for the power replacement is indefinite as this would be a permanent change. Table 4-14 presents a summary of GHG/climate change impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

Table 4-14. Summary of Greenhouse Gases/Global Climate Change Impacts from Chapter 3

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Vehicle exhaust from dam removal activities and construction of fish passage could increase GHG emissions in the short term to levels that could exceed the designated significance criteria.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	LTS	None	LTS
Activities associated with interim measures (IM) 7 J.C. Boyle Gravel Placement and/or Habitat Enhancement could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	1,2,3	LTS	None	LTS
Activities associated with interim measures (IM) 8 J.C. Boyle Bypass Barrier Removal could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	1	LTS	None	LTS
Activities associated with interim measures (IM) 16 Water Divisions could result in short-term and temporary increases in GHG emissions from vehicle exhaust.	2,3	LTS	None	LTS
Reservoir restoration actions could result in short-term increases in GHG emissions from the use of helicopters, trucks, and barges.	1, 2, 3, 5	LTS	None	LTS
The demolition of various recreation facilities which could result in short-term increases in GHG emissions from vehicle exhaust.	2, 3, 5	LTS	None	LTS

Table 4-14. Summary of Greenhouse Gases/Global Climate Change Impacts from Chapter 3

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Removing or reducing generation of a renewable source of power could result in increased GHG emissions from possible non-renewable alternate sources of power.	1	NCFEC	None	NCFEC
	2, 3, 4, 5	S	CC-1: Market mechanisms CC-2: Energy audit program CC-3: Energy conservation plan	S
Trap and Haul Operations – Programmatic Measure				
Implementation of trap and haul measures could result in temporary increases in GHG emissions from vehicle exhaust	4, 5	LTS	None	LTS
Keno Transfer				
Implementation of the Keno Transfer could cause short-term and temporary increases in GHG emissions.	2, 3	NCFEC	None	NCFEC
East and Westside Facility Decommissioning – Programmatic Measure				
Decommissioning the East and Westside Facilities could cause short-term and temporary increases in GHG emissions.	2, 3	LTS	None	LTS
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Relocation of the Yreka Water Supply Pipeline could result in short-term increases in GHG emissions from vehicle exhaust.	2, 3, 5	LTS	None	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction activities associated with the KBRA programs involving construction could cause temporary increases in GHG emissions and climate change	2, 3	LTS	None	LTS
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in GHG emissions from vehicle exhaust associated with trap-and-haul activities.	2, 3	LTS	None	LTS
Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources which would provide affordable electricity to allow efficient use, distribution, and management of water.	2, 3	B	None	B

Table 4-14. Summary of Greenhouse Gases/Global Climate Change Impacts from Chapter 3

Potential Impact	Alternative(s)	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Implementation of the Drought Plan and the Climate Change Assessment and Adaptive Management Plan could affect climate change-related impacts.	2, 3	B	None	B

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

4.4.9.1 Alternative 2: Full Facilities Removal of Four Dams

Effects of the Proposed Action on Climate Change

Vehicle exhaust from dam removal activities could increase GHG emissions in the short term to levels that could exceed the significance criteria. Under the Proposed Action, there would be a net increase in GHG emissions from deconstruction of the facilities; however, these emissions would be temporary and would not contribute to long-term emissions. Construction related activities associated with decommissioning of the dams would contribute 8,558 $MTCO_2e$ to California's GHG emission for one year[4]. Amortizing these construction emissions over thirty years results in approximately 285 $MTCO_2e$ per year, well below the 10,000 $MTCO_2e$ threshold. Moreover, even without amortizing construction emissions over thirty years such emissions are 1,442 $MTCO_2e$ below the threshold. The 1990 GHG emissions level (and so the 2020 emissions target ascribed by AB 32) is 427 million metric tons of CO_2e ($MMTCO_2e$).

The emissions from dam removal would be 0.002 percent of the target emissions. In 1990, GHG emissions from construction were 0.67 $MMTCO_2e$; therefore, the Proposed Action would equal approximately 1 percent of allowable construction emissions.

[4] The value of 8,558 $MTCO_2e$ includes emissions from the J.C. Boyle Dam. Although J.C. Boyle Dam is located in Oregon, GHG emissions related to J.C. Boyle Dam could affect California because climate change is a global phenomenon. Therefore, and for purposes of full disclosure, emissions related to J.C. Boyle Dam are being analyzed under CEQA.

Climate change by nature is a result of cumulative emissions of GHG on a global scale. Worldwide, California[5] is the twelfth to sixteenth largest emitter of CO_2, and is responsible for approximately two percent of the world's CO_2 emissions (California Energy Commission [CEC] 2006). As shown in Figure 3.10-1, transportation is responsible for 37 percent of the State's GHG emissions, followed by electricity generation (24 percent), the industrial sector (19 percent), commercial and residential (9 percent), agriculture and forestry (6 percent) and other sources (5 percent). It is reasonable to expect that these sectors would continue to contribute to GHG emissions in the future. Climate change therefore represents a significant cumulative effect for the entire State and could have a variety of meteorological and hydrologic implications, described in Section 3.10.4.1, Greenhouse Gases/Global Climate Change.

The Proposed Action would generate GHG emissions only for the duration of construction; no long-term GHG emissions would be produced. Because emissions would represent 1 percent of allowable construction emissions at the 1990 level, **the incremental contribution to the significant cumulative effect on climate change from deconstruction would not be cumulatively considerable.**

Activities associated with several IMs could result in short-term and temporary increases in GHG emissions from vehicle exhaust. Restoration actions could result in short-term and temporary increases in GHG emissions from the use of helicopters, trucks, and barges. Relocation and demolition of various recreation facilities could result in short-term and temporary increases in GHG emissions from vehicle exhaust. Before deconstruction activities begin, IMs 7 and 16 would involve vehicle traffic that would temporarily increase GHG emissions. Following drawdown of the reservoirs, revegetation efforts would be initiated using helicopters, trucks, and barges that would produce emissions. Some recreation facilities would be relocated or demolished. These activities would produce GHG emissions and could contribute to climate change.

As noted above, climate change represents a significant cumulative effect for the entire State and could have a variety of meteorological and hydrologic implications, described in Section 3.10.4.1, Greenhouse Gases/Global Climate Change. Restoration actions and relocation or demolition of recreation facilities would have a minimal incremental contribution to significant cumulative climate change effects. Since dam demolition activities would be less than significant, and the scale of emissions expected from the IMs is expected to be substantially less than dam removal, it is likely that emissions from implementation of the IMs would also not exceed the significance criteria. For restoration actions, as shown in Table 3.10-5, total GHG emissions would not exceed 704 $MTCO_2e$ per year. Furthermore, the addition of new grassland and other vegetation would sequester CO_2 emissions in the long term, but the sequestered CO_2 would likely not offset all of the emissions occurring during restoration on an annual basis. Annual GHG emissions for relocation and demolition of various recreation facilities were

[5] Although the area of analysis for the project is restricted to portions of northern California and southern Oregon, GHG emissions data is not available at this level of detail; therefore, background emissions data (i.e., existing conditions) is presented at the State level for both California and Oregon.

estimated using information provided in the Detailed Plan for Dam Removal – Klamath River Dams (Reclamation 2012) and CalEEMod, Version 2011.1.1. Approximately 160 $MTCO_2e$ would be emitted during relocation and demolition of the recreation facilities. Since dam demolition activities would be less than significant and changes to the recreation facilities would not overlap, emissions from these activities would also not exceed the significance criteria. **The incremental contribution to the significant cumulative effects associated with GHG emissions from implementation of IMs, restoration actions, and recreation facility relocation or demolition would not be cumulatively considerable.**

4.4.9.1.1 Power Replacement

Removing a renewable source of power by removing the dams could result in increased GHG emissions from possible non-renewable alternate sources of power. As described above, climate change from GHG emissions represents a significant cumulative effect for the State. The emissions generated from power replacement would be permanent. The possible increase that may result from replacing the dam facilities with higher emitting power producing facilities would account for three percent of the expected emissions reduction. Under a business-as-usual scenario, which assumes that the Scoping Plan would not be implemented, this would impede California's ability to meet its emission reduction goal. The Proposed Action's incremental contribution to cumulative effects on climate change would be cumulatively considerable. Mitigation Measures CC-1 through CC-3 would be implemented to reduce emissions from power replacement. While these measures would lessen emissions, **the incremental contribution to the significant cumulative effect associated with GHG emissions and climate change from power replacement would remain cumulatively considerable until PacifiCorp adds new sources of renewable power that would replace the removed dams.**

Decommissioning the East and Westside Facilities could cause short-term and temporary increases in GHG emissions. Decommissioning of the East and Westside canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA would stop diversions of water flows at Link River Dam into the two canals, back into the Link River. Construction equipment used in the decommissioning action would be substantially less than the equipment required to complete dam demolition activities and the decommissioning action would be conducted in the years prior to 2020.

As described above, climate change from GHG emissions represents a significant cumulative effect for the State. Since dam demolition activities would be less than significant, it is likely that emissions from the decommissioning action would also not exceed the significance criteria. **The incremental contribution to the significant cumulative effect associated with GHG emissions and climate change from the East and Westside Facility Decommissioning would not be cumulatively considerable.**

4.4.9.1.2 KBRA - Programmatic Measures

Construction activities associated with the KBRA could cause temporary increases in GHG emissions and climate change. Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in GHG

emissions from vehicle exhaust associated with trap-and-haul activities. Several KBRA programs may cause some GHG emission impacts from the use of vehicles and heavy equipment. As described above, climate change from GHG emissions represents a significant cumulative effect for the State. The KBRA's incremental contribution to GHG emissions and climate change would be minimal and short term. Sufficient information is not currently available to quantify emissions; however, the quantity of equipment required to complete these activities is expected to be less than that required to complete the dam removal activities. Emissions are not expected to exceed the South Coast Air Quality Management District (SCAQMD)'s threshold of significance for industrial emissions (10,000 $MTCO_2e$ per year), especially when amortized over thirty years. **The incremental contribution to significant cumulative effects associated with GHG emissions and climate change from KBRA construction activities would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

Implementation of the Power for Water Management Program of the KBRA could create new renewable energy sources which would provide affordable electricity to allow efficient use, distribution, and management of water. Implementation of the Drought Plan and the Climate Change Assessment and Adaptive Management Plan could affect climate change-related impacts. KBRA actions could involve the development of renewable energy sources, which would provide green energy. The Drought Plan would identify water and resource management actions to minimize risk associated with drought, which is a projected climate change impact for the Klamath Basin and the Pacific Northwest. The Climate Change Assessment and Adaptive Management Plan includes early and frequent assessment of the existing and future impacts of climate change. Together, these actions and programs would have beneficial effects associated with climate change. One other project, the Klamath Falls Bioenergy Facility, is in the early stages of planning but has issued a Notice of Intent to file an application from the Oregon Department of Energy (ODE) (see Table 4-4). This facility would burn wood waste and would produce up to 38.5 megawatts (MW) of electrical power. Together these actions would result in beneficial cumulative effects on climate change by providing electricity produced by renewable resources. **The incremental contribution to the significant cumulative effects associated with climate change and GHG from the Power for Water Management Program, the Drought Plan, and the Climate Change Assessment and Adaptive Management Plan would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

4.4.9.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative effects to the Proposed Action as all Four Facilities would be removed. Alternative 5 would have similar construction related cumulative effects to the Proposed Action, although there would be less of a contribution to the cumulative GHG impacts because there would be less overall emissions as only two dams would be removed. Alternative 4 would have construction-related emissions but they would be less than Alternatives 2 and 3 because Alternative 4 would involve

fish passage facility construction rather than dam removal. The Proposed Action, Alternative 3, Alternative 4, and Alternative 5 would have cumulatively considerable impacts associated with the loss of hydropower and the replacement of the power with alternate sources. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions.

4.4.9.3 Mitigation Measures

The loss of hydropower and the possible replacement of that power with another energy source would have cumulatively considerable impacts associated with GHG emissions and climate change. No additional feasible mitigation is available to reduce these emissions; therefore, the impact remains cumulatively considerable for Alternatives 2, 3, 4, and 5.

4.4.10 Geology, Soils and Geologic Hazards

Cumulative effects on geology, soils, and geologic hazards would be associated with erosion and sedimentation downstream from Iron Gate Dam. The timeframe for the cumulative effects analysis includes the duration of construction and continues up to ten years afterwards (the expected duration for sand in the bed to return to equilibrium levels between Willow Creek and Cottonwood Creek).

Table 4-15 lists the impacts and mitigation presented in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-15. Summary of Geology, Soils and Geologic Hazards Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Continued impoundment of water in the reservoirs could continue to trap sediment at rates similar to historical rates.	1, 4	NCFEC	None	NCFEC
Continued impoundment of water in the reservoirs could continue to prevent access to the diatomite beds at Copco 1 Reservoir.	1, 4	NCFEC	None	NCFEC
Draining of the reservoirs could uncover diatomite beds at Copco 1 Reservoir; however the land would be transferred to a State agency which would not allow commercial use, access to the mineral resource would not be changed.	2, 3, 5	NCFEC	None	NCFEC

Table 4-15. Summary of Geology, Soils and Geologic Hazards Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Construction and deconstruction activities could change erosion patterns through heavy vehicle use, excavation, and grading which could result in soil erosion.	2, 3, 4, 5	LTS	None	LTS
Draining of the reservoirs could cause instability along the banks of the reservoirs	2, 3, 5	LTS	None	LTS
Draining of Copco 1 Reservoir could eliminate wave induced erosion thereby improving stability for upland hillsides and reducing the potential for erosion.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could cause river bank erosion downstream.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in short-term increases in sedimentation in slow-moving eddies and pools downstream from the reservoirs to the Klamath River estuary.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in changes to seismic or volcanic activity.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in long-term changes in the amount of erosion of the exposed reservoir bottom sediment remaining in the river channel.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could result in long-term changes to downstream sediment deposition from the erosion of remaining reservoir sediments.	2, 3, 5	LTS	None	LTS
Draining of the reservoirs could leave sediments that would dry out and could affect restoration activities and/or future road construction activities.	2, 3, 5	S	GEO-1: Geotechnical analysis of the site	LTS
Dam removal activities would include the removal of various recreation facilities which could affect geology and soils.	2, 3, 5	NCFEC	None	NCFEC
Keno Transfer				
The Keno Transfer could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC

Table 4-15. Summary of Geology, Soils and Geologic Hazards Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
East and Westside Facilities – Programmatic Measure				
The decommissioning of the East and Westside Facilities could have adverse effects to geology, soils, or geologic hazards.	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Removal of Iron Gate Dam would require relocation of the Yreka Water Supply Pipeline which could affect geology and soils.	2, 3,5	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement – Programmatic Measures				
Implementation of the Phase I Fisheries Restoration Plan could result in construction related sediment erosion.	2, 3	LTS (short term)/ B (long term)	None	LTS/B

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5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

The major past actions that have affected geology, soils, and geologic hazards in the area of analysis are the construction of the KHP and Reclamation's Klamath Project. These actions have permanently altered the natural erosion and deposition processes of the Klamath River, increased the potential for landslides and erosion in some areas, and restricted access to mineral resources through the presence of the reservoirs. These actions continue to affect geology, soils, and geologic hazards today. Past actions that have increased soil erosion or altered soils include timber harvesting, urban development, agriculture, and mining. Actions potentially benefitting soil erosion include soil erosion control measures required by the Five Counties Road Maintenance Program, and the Northwest Forest Plan, as well as existing water quality and stormwater regulations (CWA Section 401, and 402, TMDLs). In the future, proposed new subdivisions identified in Table 4-3 could increase soil erosion; however, they are expected to adhere to existing regulations and implement measures to minimize soil erosion and stormwater runoff.

4.4.10.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.10.1.1 Soil Erosion and Sedimentation during Deconstruction

Soil disturbance associated with heavy vehicle use, excavation, and grading could result in erosion during removal activities. Drawdown of reservoirs could cause bank erosion downstream. Drawdown of reservoirs and release of sediment would result in short-term increases in sedimentation in slow-moving eddies and pools downstream from the reservoirs and in the Klamath River estuary. Soil erosion has increased in the past due to human activity and has altered the Klamath River's banks. Increased sedimentation in the Klamath River has also adversely affect water quality and aquatic species. Other cumulative actions and projects that could contribute to soil erosion and sedimentation in the river include road improvement projects, new subdivisions, and other future developments. Other more general projects and activities that are likely to occur, such as timber harvesting, mining, agriculture, livestock grazing, and road-related erosion could also contribute to cumulative effects associated with sediment. Soil erosion and sedimentation represent significant cumulative effects.

Because soil disturbance from heavy vehicle use, excavation, and grading could result in erosion during deconstruction activities, the Proposed Action's incremental contribution to the cumulative effect associated with soil erosion would be cumulatively considerable; however, mitigation would be implemented to minimize these impacts. The Proposed Action would obtain coverage under the General Stormwater National Pollution Discharge Elimination System Permit (NPDES) for Construction Activities in both Oregon and California would be required as per Section 402 of the CWA. Coverage under this permit requires the development and implementation of an Erosion and Sediment Control Plan prior to deconstruction that describes BMPs to prevent erosion. Implementation of these BMPs would minimize the potential for erosion into the reservoir areas and would reduce the Proposed Action's contribution to the cumulative effect. Inasmuch as the requirements of the General Stormwater NPDES Permit for Construction Activities apply to all new construction, such BMPs would also be implemented in other projects, thereby reducing overall cumulative effects.

Drawdown of the Four Facilities would occur simultaneously beginning in January 2020, but is not expected to substantially increase soil erosion through landslides or declining water levels. Although some landslides and erosive areas have been identified in the lower river, based on the expected flow rates that are similar to existing flow rates, substantial amounts of additional erosion are not expected to occur downstream from any of the dams as a result of reservoir drawdown. The proposed drawdown rates are consistent with the historic discharge rates from the reservoirs and would be adjusted depending on the water year; therefore, flow rates downstream from the dams are not anticipated to increase substantially above median historic rates, if at all (discharges from the reservoirs would be similar to seasonal 10-year flood flows from the reservoirs). Additionally, existing erosion at Copco 1 Reservoir is largely the result of wave action, and emptying the reservoir would remove the source of shoreline erosion and future landslides and would ultimately result in improved stability for the upland hillsides and existing development.

During reservoir drawdown in 2020, the sediment behind the four dams would be released downstream. Since all reservoirs would be drawn down concurrently, sediment released from the upstream reservoirs would remain suspended and is not anticipated to settle within Iron Gate Reservoir. However, the released sediment would likely exceed the carrying capacity of the river during some water year types, and would result in sedimentation and particle settling downstream in eddies, pools, and the Klamath River estuary. Any settling or sedimentation of fine sediment in eddies or pools is expected to be minimal and short-lived. Little settling or sedimentation is expected to occur in the Klamath River estuary, particularly due to the location of its sandbar offshore (rather than within the mouth itself). Overall, the release of sediment downstream during reservoir drawdown would not exceed the existing sediment load added by any tributary, and as such the transport capacity of the river may be sufficient to transport the additional load, particularly since the river is supply-limited in regards to fine-grained material and sand. **The Proposed Action's incremental contribution to the short-term significant cumulative effects associated with soil erosion and sedimentation from deconstruction activities and reservoir drawdown would not be cumulatively considerable.**

4.4.10.1.2 Bank Stability and Landslides

Drawdown of the four reservoirs could cause instability along the banks of the reservoirs. Reservoir drawdown at Copco 1 would reduce the potential for erosion and future landslides. No large-scale landslides are anticipated in newly exposed areas during drawdown. In the long term with implementation of reservoir restoration actions including hydro seeding, landslides and erosion would not be expected at a higher frequency or of a larger size than what is currently contributed from the slopes currently adjacent to the reservoirs. Because existing erosion at Copco 1 Reservoir is largely the result of wave action, emptying the reservoir would remove this source of shoreline erosion. No other cumulative actions or projects would substantially change the stability of the banks or the potential for landslides during reservoir drawdown. **There would be no significant cumulative effects associated with bank stability and landslides during reservoir drawdown.**

4.4.10.1.3 Seismic Activity

Drawdown of reservoirs could result in changes to seismic or volcanic activity. Reservoir drawdown is not expected to result in substantial changes in seismic or volcanic activity in the area of analysis. No other known actions or projects in the area of analysis would have the potential to change the seismic or volcanic risk in the area of analysis. **There would be no significant cumulative effects.**

4.4.10.1.4 Soil Erosion and Sediment Deposition after Dam Removal

Following dam removal, reservoir sediment remaining could result in changes in the amount of erosion in the river channel. Following dam removal, reservoir sediments remaining could result in changes to downstream sediment deposition. As noted above, soil erosion and sediment deposition have adversely affected the Klamath River and are considered significant cumulative effects. The Proposed Action's contribution to these cumulative effects would be short term and minimal.

After dam removal, approximately 36 to 57 percent of sediment would be eroded, depending on the water year type. The remaining sediment would remain on the reservoir terraces and dry. Minimal erosion is expected following completion of reservoir drawdown and dam removal activities.

After it is dry, the remaining sediment would be unlikely to erode downstream except during storm and other high-flow events. As previously discussed, the Klamath River is supply-limited for fine-grained material. Further, based on the estimated settling velocity of the remaining sediment and average flows during wet years and storm events, it is expected that any eroded sediment would be transported as suspended sediment flushed downstream. There would be minimal erosion and sediment deposition from the remaining sediments after dam removal.

Additionally, many of the ongoing programs such as the TMDLs, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, the Northwest Forest Plan, and the Five Counties Road Maintenance Program may actually reduce soil erosion and sediment deposition in the Klamath River, and help to reduce the overall cumulative effect. **The Proposed Action's incremental contribution to the significant cumulative effect associated with erosion and downstream sediment deposition after reservoir drawdown would not be cumulatively considerable.**

4.4.10.1.5 Unstable Soils

Following dam removal, the reservoir sediment remaining would dry and could affect restoration activities and/or future road construction activities. After dam removal, an estimated 43 to 64 percent of the sediment in the reservoirs would remain and settle on the terraces of the new river channel. Initial sampling conducted on the sediment indicates that once dry, it has a tendency to crack and substantially decrease in porosity. This characteristic could limit future construction activities (e.g., access road construction, recreation facilities). No other known actions or projects would change the amount of unstable soils in the area of analysis. Additionally, implementation of mitigation measure GEO-1 would reduce potential impacts of the Proposed Action by requiring a geotechnical analysis to determine suitability for any planned developments. **No significant cumulative effects associated with unstable soils would occur.**

4.4.10.1.6 KBRA - Programmatic Measures

Implementation of the Phase I and Phase II Fisheries Restoration Plans could result in construction related sediment erosion. Construction actions including the operation of construction equipment and the associated soil disturbance could result in erosion into the active river channel and could cause new or exacerbate existing landslide areas. Additionally gravel augmentation could result in temporary sediment transport and deposition downstream from the construction site.

Soil erosion has increased in the past due to human activity and has altered the Klamath River's banks. Increased sedimentation in the Klamath River has also adversely affect water quality and aquatic species. Other cumulative actions and projects that could contribute to soil erosion and sedimentation in the river include road improvement projects, new subdivisions, and other future developments. Other more general projects and activities that are likely to occur, such as timber harvesting, mining, agriculture, livestock grazing, and road-related erosion could also contribute to cumulative effects associated with sediment. There are also several ongoing programs such as implementation of the Klamath Basin TMDLs, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, the Northwest Forest Plan, and the Five Counties Road Maintenance Program may actually reduce soil erosion and sediment deposition in the Klamath River.

The KBRA's contribution to the significant cumulative effects associated with soil erosion and landslides would be cumulatively considerable; however, BMPs would be implemented to minimize these impacts. Given these BMPs (see Appendix B), the short-term effects on sediment erosion and landslides would be reduced. Moreover, in the long-term implementation of the Phase I and II Fisheries Restoration Plans would be expected to generate a beneficial reduction in sediment erosion through improved river channel stability, and generate no change from existing conditions for landslides. **The KBRA's incremental contribution to cumulative effects on soil erosion and landslides would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.10.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative effects to the Proposed Action as all Four Facilities would be removed. Alternative 4 could have some erosion during construction, but would not involve reservoir drawdown or dam removal and would therefore contribute to fewer cumulative effects. Alternative 5 would have similar effects to those described for the Proposed Action; however, two dams would remain in place so less sediment would be released and less deconstruction would occur. This would reduce the amount of soil erosion and sedimentation. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.10.3 Mitigation Measures

No cumulatively considerable adverse effects related to geology, soils and geologic hazards would occur; hence, no mitigation measures are required.

4.4.11 Tribal Trust

A large number of past, present, and future actions have contributed to cumulative effects associated with Tribal Trusts. The timeframe for cumulative effects includes the duration of construction (May 2019 through December 2020), during which temporary impacts would occur, and extends indefinitely following construction for long-term effects associated with restoration of the Klamath River fisheries.

Several past, present, and future actions were considered during the cumulative effects analysis, including those identified by the tribes as having the greatest cumulative potential to adversely impact Tribal Trust Assets: hydroelectric energy production, mining, timber extraction, agricultural production, and cattle grazing. These actions have resulted in poor water quality, a decline in fisheries, and decline in culturally important plants and animals, and have affected tribal health, economies, cultural practices and traditional ceremonies. Impacts on Tribal Trust Assets from some of these land uses, particularly mining and timber extraction, have decreased in the last few decades due to better land management practices. In addition, restoration projects, including those being carried out by the tribes themselves, have mitigated some of these impacts. However, the KHP significantly affects the trust resources of the Klamath Basin tribes and, by extension, their cultural values. Therefore, this evaluation was based on the potential for the project alternatives to result in cumulative effects on Tribal Trust Assets when considered along with the past, present, and future activities.

4.4.11.1 Alternative 2: Full Facilities Removal of Four Dams

To the federally recognized Tribes in the Klamath Basin, the KHP dams and associated reservoirs, along with other actions identified above, represent a significant cumulative adverse effect on Tribal Trust Assets. Removal of the four dams under the Proposed Action would result in long-term benefits to Tribal Trust Assets through the restoration of salmon fisheries and traditional fishing sites, improved water quality, and restored riparian habitats that support culturally important plants and animals. The restoration of salmon fisheries would create an opportunity for tribal members to improve their diet , allow for cultural practices and traditional ceremonies to continue, and could provide a source of income for Tribes that participate in a commercial fishery.. Water quality, including temperature and toxic algal blooms, would improve with removal of the dams, benefitting culturally important plants and animals and allowing traditional practices and ceremonies that require bathing to resume. **Together, the Proposed Action's benefits, along with ongoing fisheries restoration and water quality actions identified in Table 4-4, and better mining and timber extraction land management practices, would result in cumulative benefits to Tribal Trust Assets.**

4.4.11.1.1 KBRA - Programmatic Measures

Implementation of the Tribal Fisheries and Conservation Management Program could result in impacts/effects to Trust Resources and other traditionally used resources. Implementation of the Mazama Forest Project could result in impacts/effects to Trust Resources and other traditionally used resources. Implementation of the Tribal Fisheries and Conservation Management Program would provide funding to assist the Klamath

Basin tribes in developing their capacity to participate in resource management activities within the basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. Actions associated with the Mazama Forest Project would help The Klamath Tribes gain back culturally important lands and become more economically self-reliant. The other main cumulative action that would benefit the Klamath Basin tribes would be the implementation of the KHSA and removal of the Four Facilities. This would help to restore fisheries and improve water quality. Other actions that would also contribute benefits include the implementation of the Klamath Basin TMDLs to improve water quality, various restoration projects noted in Table 4-4 above, and the Northwest Forest Plan, the Trinity River Restoration Program, and the Five Counties Road Maintenance Program which contain provisions for improving water quality and enhancing fisheries on the Klamath River. Together these would provide substantial cumulative benefits to the Klamath Basin tribes. **The KBRA's incremental contribution to the significant cumulative effects on Trust Resources and other traditionally used resources would be beneficial. Implementation of specific plans and projects associated with the KBRA will require future environmental compliance as appropriate.**

4.4.11.2 Alternatives 3, 4, and 5

Alternative 3 would result in cumulatively beneficial effects on Tribal Trust Assets similar to those described for Alternative 2. Alternative 5 would also result in some cumulative benefits, although these would be less than Alternative 2 and 3 because two dams would remain in place and could block some fish passage and would not substantially improve water quality conditions. Alternative 4 would have little cumulative benefits because water quality issues associated with the reservoirs would remain. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.11.3 Mitigation Measures

No cumulatively considerable adverse effects related to Tribal Trust Assets would occur; hence, no mitigation measures are required.

4.4.12 Cultural and Historic Resources

Cumulative effects would result from the loss or degradation of important historic and cultural resources in the Klamath Basin.

Table 4-16 lists the impacts and mitigation presented in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Current effects/impacts on historic properties/ historical resources, other cultural resources, and human remains would continue to occur.	1, 4	NCFEC	None	NCFEC
Dam removal and construction of fish passage would result in direct effects/impacts to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the KHHD considered eligible for inclusion on the National Register and California Register.	2, 3, 4,5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4:Treatment of Indian Human Remains	S
Reservoir drawdown could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Native American human remains.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4:Treatment of Indian Human Remains	LTS

Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction activities including use of haul roads and disposal sites for demolition debris could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register or California Register.	2, 3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4:Treatment of Indian Human Remains	LTS
Removal of the recreational facilities after reservoir drawdown may affect archaeological or historic sites that could be eligible for inclusion on the National Register or California Register or human remains.	2,3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4:Treatment of Indian Human Remains	LTS
Keno Transfer				
The Transfer of Keno Dam to the DOI could have adverse effects to historic properties or historic resources.	2, 3	B	None	B
East and Westside Facilities – Programmatic Measure				
The decommissioning of the East and Westside Facilities could have adverse effects on historic resources or historic properties.	2, 3	LTS	None	LTS

Table 4-16. Summary of Cultural and Historic Resources Impacts from Chapter 3

Potential Impacts	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Installation of the Yreka Water Supply Pipeline could affect/impact archaeological and historic sites that are eligible for inclusion on the National Register or California Register.	2, 3, 5	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4:Treatment of Indian Human Remains	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Implementation of the KBRA fisheries restoration program, Klamath Tribes Interim Fishing Site, and the Mazama Forest Project could result in impacts/effects to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains.	2,3	S	CHR-1: Update the Klamath Hydroelectric Project Request for Determination CHR-2: MOU Under Section 106 and Preparation of Monitoring and Cultural Resources Management Plan CHR-3: Respect and Maintain Confidentiality of Sensitive Information CHR-4:Treatment of Indian Human Remains	LTS

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

Table 4-4 presents the projects that were considered in the analysis, including the KHP, road improvements, and future proposed subdivisions around Iron Gate Dam. In addition to these projects, past, present, and future county, municipal, and private development in the region surrounding the reservoirs is also considered in this analysis.

4.4.12.1 Alternative 2: Full Facilities Removal of Four Dams

The Proposed Action would result in direct effects to J.C. Boyle Dam, Copco 1 Dam, Copco 2 Dam, and Iron Gate Dam, their associated hydroelectric facilities, and on the Klamath Hydroelectric Historic District (KHHD) considered eligible for inclusion on the National Register and California Register. The Four Facilities contribute to the KHHD, which is presumed eligible for inclusion on the National Register and on the California Register. Removal of the four dams and all associated facilities would adversely affect each dam's eligibility and the overall integrity of the KHHD because a large portion of this district would be removed.

The Proposed Action would result in adverse effects on an important and unique cultural resource. There are very few of these types of facilities in existence today. Other actions that are likely to occur and could adversely affect the KHHD include additions to buildings, replacement of equipment, internal reconfiguration of buildings, demolition of structures, or lack of maintenance of facilities. Adverse impacts on the KHHD would be considered significant regional and Statewide cumulative effects.

The Proposed Action's incremental contribution to the significant cumulative effects on the KHHD would be cumulatively considerable. The Proposed Action would remove the Four Facilities, eliminating a large portion of the district. Mitigation measure CHR-1 through CHR-4 would be implemented to reduce the impacts; however, even with this mitigation the incremental contribution to the significant cumulative effects would remain cumulatively considerable. No additional feasible mitigation is available to reduce these cumulative impacts. **The Proposed Action's incremental contribution to the significant cumulative effect on the KHHD would remain cumulatively considerable even with all feasible mitigation.**

Reservoir drawdown and construction activities, including use of haul roads and disposal sites for demolition debris, could affect archaeological and historic sites, Traditional Cultural Properties (TCPs), and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Native American human remains. Installation of the Yreka Water Supply Pipeline could affect archaeological and historic sites that are eligible for inclusion on the National Register or California Register. Construction activities including use of haul roads and disposal sites for demolition debris under the Proposed Action could affect/impact archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register or California Register. Removal of the recreational facilities after reservoir drawdown may affect archaeological or historic sites that could be eligible for inclusion on the National Register or California Register or human remains. Archaeological and historic sites, TCPs, and cultural landscapes in the vicinity of the Four Facilities and have been adversely affected through human activity, development, and construction of the KHP. Historically, the displacement of Indian Tribes by Euroamericans led to the loss of their traditional lands and culture. Economic pursuits such as mining, logging, ranching, and farming further contributed to these impacts. The construction of towns, roads, and other developments over time have likely disturbed or altered many sites in the area. The KHP, constructed in phases from 1918 through 1962,

brought power to region and has been recommended as eligible for inclusion on the National Register as the KHHD under criterion a for its association with the industrial and economic development of southern Oregon and northern California. However, the creation of the reservoirs has likely inundated some cultural sites and the build-up of sediment behind the reservoirs may have buried some of these sites. Artificial water fluctuations from the reservoirs have resulted in erosion along the lower terraces. Cultural resources have been impacted by these changing water levels. Known impacts include exposing cultural materials to the public, sometimes leading to illegal excavation of these sites. At least one site is known to have exposed human remains from these circumstances. Actions by a Federal agency resulted in the reburial of the exposed remains and temporary stabilization of the river bank. Therefore, significant cumulative effects have occurred to archaeological and historic sites, TCPs, and cultural landscapes within the Area of Potential Effect.

The Proposed Action's incremental contribution to the cumulative effects on archaeological and historic sites, TCPs, and cultural landscapes would be cumulatively considerable. The dam removal and reservoir drawdown could affect 32 known sites located along the current shores of the reservoirs, ten ethnographic village sites, an unknown number of sites that may be submerged in the reservoirs and human remains that may be isolated or associated with those sites. Also, several hundred sites along and near the Klamath River downstream from the dams and reservoirs may be exposed or damaged from temporary increase in flows during reservoir drawdowns. Associated riverscape sites could be adversely affected through erosion, exposure, and vandalism. Increased flows along the Klamath River could undercut, erode, or flood sites along or near the banks of the river, also affecting contributing elements of the riverscape. Drawdown of the reservoirs and the flushing of sediment would likely expose submerged sites around and under the reservoirs. After reservoir drawdown, any cultural sites that become exposed could be damaged through vandalism or natural processes, especially if they occur in areas proposed for public recreation.

Modifications of the proposed haul roads and use of disposal sites could affect/impact sites (including 17 sites previously identified during earlier survey coverage of the roads) that are located along the haul roads and/or at the disposal sites. In addition, the location of disposal sites at features associated with construction of the dams may contribute to the KHHD and be historic properties/historical resources.

The existing water supply pipeline for the City of Yreka passes under Iron Gate Reservoir and would have to be relocated. The pipeline itself may be a historic property or historical resource and would need to be evaluated for eligibility. Ground disturbance could result in the discovery of historic and/or archaeologically significant sites. The construction of footing to support the pipe bridge could uncover previously unknown sites.

Recreation facilities, such as campgrounds and boat ramps, currently located along the reservoir banks will need to be relocated down slope to be near the new river bed once the reservoir is removed. These facilities are not eligible for the National Register or

California Register, and were not known to impact archaeological sites when they were built. Additional ground disturbance from removal of these facilities may affect/impact previously unidentified historic properties/historical resources.

The Proposed Action's incremental contribution to the significant cumulative effects on cultural resources would be reduced through mitigation. Additional cultural resources surveys and monitoring of the drawdown zone would be conducted as land is exposed. Avoidance, minimization, and mitigation measures would be implemented, as appropriate. A cultural resources management plan would be developed, through consultations, to manage and protect endangered and exposed cultural resources. Mitigation measures CHR-1 through CHR-4 would be implemented to minimize or avoid impacts to these resources. **The Proposed Action's incremental contribution to the significant cumulative effect on archaeological and historic sites, TCPs, and cultural landscapes would not be cumulatively considerable.**

The decommissioning of the East and Westside Facilities could have adverse effects on historic resources or historic properties. Decommissioning of the East and Westside canals and hydropower facilities of the Link River Dam by PacifiCorp as a part of the KHSA will stop diversion of water flows at Link River Dam into the two canals, back in to Link River. Following decommissioning of the facilities there will be no change in outflow from Upper Klamath Lake or inflow into Lake Ewauna. As described above, significant cumulative effects have occurred to archaeological and historic sites, TCPs, and cultural landscapes within the Area of Potential Effect. The Proposed Action's incremental contribution to the significant cumulative effects would be minimal. Decommissioning does not typically involve deconstruction of the facilities. Instead, buildings and equipment that are too large to easily remove or are fixed in place are usually fenced to prevent entry. **The Proposed Action's incremental contribution to the significant cumulative effect on archaeological and historic sites, TCPs, and cultural landscapes would not be cumulatively considerable.**

4.4.12.1.1 KBRA - Programmatic Measures

Implementation of the KBRA actions could result in impacts to archaeological and historic sites, TCPs, and cultural landscapes that are eligible for inclusion on the National Register and/or California Register and possibly Indian human remains. Implementation of the KBRA could result in river restoration actions, ground disturbing activities, or forest management practices that could have a significant impact on cultural and historic resources that are eligible for inclusion on the National Register and/or California Register.

Given the past and present significant cumulative effects on cultural resources in the area, as described above for the Proposed Action, it is assumed that the KBRA's incremental contribution to cumulative effects on cultural resources would be cumulatively considerable; however, mitigation measures, including CHR-2, CHR-3, and CHR-4, as appropriate, would be implemented to reduce such contribution. **With mitigation, the KBRA's incremental contribution to significant cumulative effects on historic properties, historical resources, human remains, or archaeological and historic sites**

would not reduce these effects to a less than significant level; therefore, they would be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.

4.4.12.2 Alternatives 3, 4, and 5

All alternatives would have cumulatively considerable impacts on the KHHD. Alternatives 3 would have similar cumulative cultural resources effects as described for Alternative 2. Alternative 4 would not require relocation of the Yreka pipeline and would not contribute to cumulative effects associated with the pipeline relocation. Alternative 4 would likely affect a smaller overall area during construction and would therefore decrease the potential for disturbing previously unknown resources. Alternative 5 would leave two dams and reservoirs in place, and would expose less area that may contain cultural resources. Alternative 5 would likely require less overall general construction, roads, and ground disturbance than Alternatives 2 and 3; therefore it could result in fewer impacts to previously unknown resources. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.12.3 Mitigation Measures

While there would be cumulatively considerable impacts on the KHHD under Alternatives 2, 3, 4, and 5 even with mitigation, no additional feasible mitigation is available to substantially reduce or avoid these cumulative effects. They would remain cumulatively considerable.

4.4.13 Land Use, Agricultural and Forest Resources

Cumulative effects on land use, agriculture, and forest resources would be associated with changes in existing zoning, or conversion of agriculture and forest lands to non-agriculture and non-forest lands. The timeframe for agricultural and forest resources includes the duration of deconstruction (May 2019 through December 2020). Table 4-17 lists a summary of land use, agriculture, and forest resources impacts presented in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

While there are many different past, present, and potentially future cumulative activities that could affect land use, such as agriculture, timber harvesting, mining, and new subdivisions planned in Siskiyou County, there are no cumulative activities that have been identified that would specifically conflict with existing land use plans or zoning, or result in a conversion of agricultural lands to non-agricultural uses or forest lands to non-forest uses.

Table 4-17. Summary of Land Use, Agricultural and Forest Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
The continued operation of and impoundment of water at the Four Facilities could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	1	NCFEC	None	NCFEC
The exposure of the currently inundated lands from the removal of the Four Facilities could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	2, 3	NCFEC	None	NCFEC
The construction of fish passage at the Four Facilities, or the construction activities associated with the removal of Copco 1 and Iron Gate dams and the construction of fish passage at J.C. Boyle and Copco 2 could conflict with applicable land use plans, policies, or regulations adopted for the purpose of mitigating an environmental effect.	4, 5	NCFEC	None	NCFEC
The alternatives could result in the direct conversion of farmland to non-agricultural uses or conflict with Williamson Act land or agricultural zoning in the Upper Klamath Basin.	1,2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities associated with full or partial Facility removal, the construction of fish passage, or the continued impoundment of water at Copco 2 and J.C. Boyle dams could result in the conversion of forest lands to non-forest use or conflict with forest zoning.	1, 2,3,4,5	NCFEC	None	NCFEC
Continued impoundment of water at the Four Facilities and construction activities associated with the development of fish passage could indirectly convert farmland to non-agricultural use or forest land to non-forest use.	1, 4	NCFEC	None	NCFEC
Ongoing restoration actions could affect land use, agriculture, and forest resources.	1, 4	NCFEC	None	NCFEC
Construction activities associated with Facility removal and the draining of the reservoirs could result in changes in the existing physical environment that could convert farmland to non-agricultural use or convert forest land to non-forest use.	2, 3, 4, 5	LTS	None	LTS
Construction activities associated with dam removal could require new, permanent roads to be constructed to provide access to new recreation areas, which could constitute a change in the existing environment.	2, 3, 5	LTS	None	LTS

Table 4-17. Summary of Land Use, Agricultural and Forest Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
Construction and restoration activities associated with Facility removal would include the removal and reconstruction of recreation facilities which could affect land use.	2, 3, 5	NCFEC	None	NCFEC
The construction and development of fish passage facilities would require new permanent roads to be created to provide access to the Klamath Hydroelectric Project facilities which could change land use and create conflicts with applicable plans and policies or otherwise cause a significant land use impact due to existing zoning and land uses.	4, 5	LTS	None	LTS
Trap and Haul – Programmatic Measure				
Construction of fish handling facilities for trap and haul operations could change land use.	4, 5	LTS	None	LTS
Keno Transfer				
The transfer of ownership of Keno Facility from PacifiCorp to Reclamation could result in a change in land use.	2,3	NCFEC	None	NCFEC
East and Westside Facilities - Programmatic Measure				
The decommissioning of the East and Westside facilities could impact land use	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Dam removal would require the relocation of the Yreka Water Supply Pipeline and could result in a change in Land use	2,3,5	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement - Programmatic Measure				
The KBRA could conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect.	2,3	LTS	None	LTS
The implementation of the Water Diversion Limitation Program could convert farmland to non-agricultural uses.	2,3	LTS	None	LTS
The Water Use Retirement Program could result in the fallowing or conversion of agricultural land non agricultural uses, such as open space or wetland restoration areas.	2,3	B	None	B
The Power for Water Management Program could affect Land Use in the area of Reclamation's Klamath Project.	2,3	LTS	None	LTS

Table 4-17. Summary of Land Use, Agricultural and Forest Resources Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Proposed Mitigation	Significance After Mitigation
The KBRA's Mazama Forest Project could result in the conversion of forest land to non-forest use or conflict with forest zoning.	2,3	NCFEC	None	NCFEC

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

4.4.13.1 Alternative 2: Full Facilities Removal of Four Dams

The Proposed Action result in changes that result in conversion of farmland to non-agricultural use or conversion of forest land to non-forest use. New, permanent roads constructed to provide access to recreation areas could constitute a change in land use. The Proposed Action would require the use of land for temporary access roads, stockpiling, staging, and other general construction activities. These would generally be temporary and would occur on lands designated for industrial (dam) or open space use or on currently inundated lands, and could be returned to their original or alternate use following deconstruction. New, permanent roads associated with achieving public access to the river would be created. However, these roads would be constructed on formerly inundated lands and would not affect land use. There are no other cumulative actions or projects that would result in changes to land use in and around the reservoirs. **There would be no significant cumulative effects associated with land use, agriculture, and forest resources.**

4.4.13.1.1 KBRA - Programmatic Measures

The KBRA could conflict with applicable land use plans, policies, or regulations. The KBRA may conflict with applicable land use plans, policies or regulations because it is designed to enact policies at a regional (basin) level, and may not be consistent with local city or county plans and policies. However, Humboldt County in California and Klamath County in Oregon signed the KBRA, and any subsequent conflicts with their plans and policies would be handled by the county Board of Supervisors/Commissioners or other authorizing body. At this time, no other cumulative actions or projects have been identified that would conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect. However, additional analysis would be completed when locations and specific KBRA program

details are available. **There would be no significant cumulative effects. Implementation of the KBRA will require future environmental compliance as appropriate.**

Construction of fish handling facilities for trap and haul operations within the Fisheries Reintroduction and Management Plan could change land use. The Fisheries Reintroduction and Management Plan includes trap and haul operations that move fish around Keno Impoundment/Lake Ewuana and Link River during times of poor water quality. Trap and haul operations would require construction of new fish handling facilities near Keno Dam and Link River Dam. At this time, no other cumulative actions or projects have been identified that would conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect. However, additional analysis would be completed when locations and specific KBRA program details are available. Because these new facilities would likely be built on lands designated for industrial (dam) use, their construction would not likely conflict with applicable plans and policies or otherwise cause a significant land use impact. The potential land use conversions generated by development of trap and haul facilities would not be expected to contribute to any land use effects generated by the hydroelectric facility removal action analyzed above. **There would be no significant cumulative effects. Implementation of the KBRA will require future environmental compliance as appropriate.**

The implementation of the Water Diversion Limitation Program could convert farmland to non-agricultural uses. Implementation of the measures in the WURP could result in conversion of farmland to non-agricultural use in the Off Project areas. The Power for Water Management Program could affect land use in the area of Reclamation's Klamath Project. Several of the KBRA actions and programs have the potential to result in the conversion of agricultural land to non-agricultural uses. This could occur indirectly through the retirement of water rights or as a result of decreases in water diversions, or directly through crop fallowing, short-term water leasing, split season irrigation, natural storage improvement or sighting of renewable energy infrastructure on agricultural lands. Overall, the KBRA is intended to provide long-term benefits by ensuring sustainable agriculture. No other cumulative actions or programs have been identified that would convert agricultural lands to non-agricultural uses in the Klamath Basin; however additional analysis would be completed when specific locations and additional KBRA program details are available. **There would be no significant cumulative effects. Implementation of the KBRA will require future environmental compliance as appropriate.**

4.4.13.2 Alternatives 3, 4, and 5

Alternatives, 3, 4, and 5 would have similar cumulative land use impacts as those described for the Proposed Action. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; **therefore there would be no cumulative effects associated with KBRA actions.**

4.4.13.3 Mitigation Measures

No mitigation measures are required, therefore, **no cumulatively considerable adverse effects related to land use and agriculture would occur.**

4.4.14 Socioeconomics

Tables 4-3 and 4-4 identify local, State and Federal plans, programs and projects identified as potential contributors to the cumulative condition. These plans, as well as the decadal population projections described in Table 4-10, provide some information regarding the cumulative context within this project would occur. This section discusses (1) whether the plans, programs or projects identified in Tables 4-3 and 4-4 are sufficiently connected or similar to this project as to magnify or offset the economic impacts of this project, and (2) whether the individual positive and negative socioeconomic effects of this project would result in cumulatively considerable adverse effects.

County economic conditions fluctuate based on local, regional, and national economic conditions. The national economic recession, which started in December 2007, has affected county economies in the area of analysis and employment, income, and output have declined in some sectors. Section 3.15, Socioeconomics, and Appendix O, County Economic Descriptions, detail the existing economic conditions in the area of analysis[6].

Unemployment rates in 2009 and 2010 have been the highest in the past decade in the eight Klamath Basin counties in the area of analysis, as they have been for most of the counties in California and Oregon. California coastal counties, with the potential to experience marine fishery effects from the proposed alternatives, reflect similar trends. From 1997 to 2008, poverty trends in the eight counties were higher than California and Oregon State averages (U.S. Census Bureau [USCB] 2010a; 2010b).

Total industry earnings[7] increased from 2005 to 2008 for all counties in the Klamath Basin, but some sectors experienced decreased earnings. In all counties, except Modoc County, which had undisclosed data, earnings in the construction industry decreased from 2005 to 2008 (Bureau of Economic Analysis 2010). The manufacturing sector also had decreased earnings comparing 2005 and 2008 in most counties in the impacted region. This trend is similar to the trends occurring in the larger economy. In Siskiyou County, the quantity of timber harvested declined 2008 and 2009 relative to 2000 through 2007. Data presented in the existing conditions in Section 3.15, Socioeconomics, reflect these cumulative economic effects.

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[6] Data presented in this section and Section 3.15, Socioeconomics, was the most recent data available at the time of the Notice of Preparation. Based on a brief review of 2009 and 2010 data, now available, total industry earnings in the Klamath Basin counties decreased relative to 2008, which is expected based on the national recession.

[7] Industry earnings are defined as a measure of hourly and weekly earnings of wage and salary workers by occupation and by industry (Bureau of Labor Statistics 2012).

All else equal, the regional economy would likely experience fluctuations in employment and economic output similar to the previous decades. Housing, commercial, transportation, and other development projects under the cumulative condition would help generate activity in the local economy and result in long-term term improvements in overall economic conditions. However, publicly funded projects could face delays as budgets could be constrained at all levels of government. At the local level counties could have smaller operating budgets and tax revenues.

Population growth also helps to generate economic activity. As shown in Table 4-10, population is expected to increase in the area of analysis. As people move into the region, they purchase houses, food, fuel, and other goods and services in the region. As demands for goods and services increase, businesses move into the area and jobs are created. New residents also pay property taxes and sales taxes, typically the largest contributors to county revenues (Table 3.15-19 shows tax revenues for Siskiyou County).

Tables 3.15-65 and 3.15-66 in Section 3.15, Socioeconomics, summarize the regional economic impacts (jobs, labor income, output) of proposed alternatives on each affected sector; these impacts are described quantitatively for Alternatives 2 and 3 and qualitatively for Alternatives 4 and 5. Economic impacts vary in terms of time frame (based on the timing of the impact on a given resource) and affected region (based on where most of the spending associated with a given resource is expected to occur). The magnitude of regional effects is sensitive not only to the magnitude of the direct effect being analyzed but also the size and economic diversity of the affected region. Given the disparate regions used to define economic effects for the affected resources, summing economic effects across resources is not an appropriate way to determine the net economic impact of the alternatives, unless the impacts can be monetized so be readily compared. Simple addition of effects is not possible because the units of measurement are different for impacts on different resources. Absent a method to compare the impacts in a consistent manner using common metrics, it is not possible to compare the relative magnitude of positive and negative effects of each alternative.

Table 3.15-66 includes economic effects of the KBRA, including the Tribal Program on Klamath Basin tribes. Other tribal effects covered in Section 3.15 but not included in Table 3.15-66 are effects of fishery improvements on subsistence, ceremonial and commercial harvests and effects of water quality improvements on tribal cultural practices.

The following sections describe cumulative economic effects of the proposed alternatives. Positive economic effects are presented together as they would improve regional economies under the cumulative conditions. Potential adverse cumulative economic effects are presented separately; however, it is important to recognize that some positive economic effects of the proposed alternatives would be offset by adverse effects of proposed alternatives if they occur in the same economic region.

4.4.14.1 Alternative 2: Full Facilities Removal of Four Dams

Implementation of the Proposed Action under the cumulative condition could affect economic output, employment, and labor income in the short- and long-term. The introduction to this section describes the cumulative condition for regional economies in the area of analysis. The Proposed Action would have some positive effects, summarized in the bullet list below, on the regional economy. Positive economic effects would benefit economies under the cumulative condition and are not further discussed. Adverse effects, which would offset some positive effects, are discussed in more detail below to evaluate the cumulative economic effect. The following summary presents employment effects; regional economic effects pertaining to labor income and output follow the same direction as employment (see Tables 3.15-65 and 3.15-66).

- Short-term impacts pertaining to dam decommissioning would be positive for Klamath and Siskiyou Counties (+1400 jobs).

- Medium-term impacts (about 15 years) would be positive. Mitigation would have positive impacts in Klamath and Siskiyou counties (+220 jobs in total during 2018-2025). KBRA programs would have positive impacts in Klamath, Del Norte, Humboldt and Siskiyou Counties, which would experience total job increases during the 15-year KBRA implementation period as follows: Fisheries Program (+3,917 jobs), Water Resources Program (+243 jobs), Regulatory Assurances (+146 jobs), and Tribal Program (+122 jobs for the Karuk Tribe in Siskiyou County, +120 jobs for The Klamath Tribes in Klamath County, +144 jobs for the Yurok Tribe in Humboldt County). The KBRA County Program designates $3.2 million for Klamath County and $20 million for Siskiyou County (numbers of jobs contingent on how the counties would choose to expend these monies).

- Some long-term impacts would be positive: Jobs would increase periodically in Klamath, Siskiyou and Modoc Counties due to irrigated agriculture (+70 to +695 jobs in five modeled drought years, no change in remaining 45 modeled years). Commercial fishing would experience positive impacts, including +218 jobs in San Francisco Bay Area Counties, +69 jobs in Fort Bragg (Mendocino County), +19 jobs in KMZ-CA (Humboldt and Del Norte counties) , +11 jobs in KMZ-OR (Curry County), and +136 jobs in Central Oregon (Douglas, Lane and Lincoln Counties). Ocean recreational fishing would experience positive impacts, including +5 jobs in KMZ-CA and +1 job in KMZ-OR. Klamath, Del Norte, Humboldt and Siskiyou Counties would experience positive impacts due to in-river salmon fishing (+3 jobs); steelhead and redband trout impacts would also be positive but are not quantifiable. Impacts in Klamath and Siskiyou Counties would be positive for refuge recreation (+5 jobs).

The regional employment impacts described above include a mix of part-time, full-time and temporary jobs. The estimates are based on modeled results, using 2009 economic data for the counties that encompass each affected region (2009 being the most recent year for which data were available at the time of this analysis). The estimates are more

indicative of the economy's short-term response rather than long-term adjustment to an infusion of money. Regional economies are dynamic and changes in demographics, markets, technology, infrastructure, and other factors may affect how businesses respond over time to such infusions.

In addition to the regional economic impacts summarized above, tribal harvest opportunities would increase under the Proposed Action. Removal of the reservoirs behind the dams would significantly reduce the incidence of late-summer, toxigenic phytoplankton blooms that have prompted postings of public health advisories in the Hydroelectric Reach and further downstream on the Klamath River. These water quality improvements would have beneficial effects on tribal cultural practices that involve water contact.

Long-term job losses in Siskiyou and Klamath Counties as a result of foregone O&M at the Four Facilities would adversely affect the regional economy under the cumulative condition. The introduction to this section describes the cumulative economic condition in the area of analysis, including trends in employment. Reduced employment has had an adverse effect on the regional economy in the cumulative condition. In the long term, counties would implement development projects to meet growth defined in general plans, which would be a positive cumulative effect on the economy. However, the recent economic recession and decreased county budgets may delay some of these projects and associated job opportunities. The Proposed Action would contribute to job losses by eliminating an estimated 49 jobs related to O&M at the Four Facilities. These would be long-term job losses and an adverse cumulative effect. As described above, the Proposed Action would create some jobs in the short- and medium-term that could offset some of these losses.

Decreases in recreational opportunities could affect the regional economy under the cumulative condition. Recreation is an important industry in the area of analysis to support economic activity and growth. In their general plans, counties emphasize the importance of maintaining and creating recreation opportunities in the area. No cumulative projects were identified that would further reduce reservoir/lake based recreation opportunities including reservoir-based fishing, flat water boating, and camping and day use facilities adjacent to a lake. The Proposed Action would permanently remove J.C. Boyle, Copco 1, and Iron Gate Reservoirs, which are frequently visited recreation sites and contribute to economic output, labor income, and jobs. Loss of recreation at the reservoirs would be an adverse cumulative effect to the economies of Siskiyou and Klamath Counties.

Proposed water diversion activities on tributaries (Scott River and Trinity River) to the Klamath River could affect flows and result in a decrease of available flows for recreational activities, namely whitewater boating and fishing. Lower flows could reduce boating opportunities and trips booked in the region, which would be an adverse cumulative economic effect. Loss of whitewater boating opportunities at Hell's Corner Reach under the Proposed Action would also adversely affect Klamath County's economy under the cumulative condition.

Removal of the Four Facilities, in combination with other cumulative projects, could result in increased energy rates for PacifiCorp customers. Under the cumulative condition, PacifiCorp would continue operations to meet customer demands, which may include projects to develop energy sources or changes to customer rates. PacifiCorp sets customer rates based on multiple factors, including energy prices, future demands, resource adequacy, overhead costs, and long-term investments. PacifiCorp's Integrated Resource Plan from 2008 and the 2010 update describes plans included in the cumulative condition to increase the percentage of renewable energy in the company's portfolio, establish new sources of energy to meet the increasing base load and higher peak demands, and upgrade or maintain existing power sources. These actions would affect PacifiCorp's decisions to change customer rates, which in turn are subject to OPUC and CPUC approval. Because of the many factors that PacifiCorp considers in setting customer rates, it is difficult to assess the size of potential rate effects under the cumulative condition. For the Proposed Action, PacifiCorp has added an approximately 2 percent surcharge to customer rates in Oregon and California to cover costs of dam removal, which was approved by the Oregon Public Utilities Commission (OPUC) and California Public Utilities Commission (CPUC). Under the KHSA, ratepayer liability is capped at $200 million, prorated between PacifiCorp's customers in Oregon (up to $184 million) and California (up to $16 million). The Proposed Action has affected customer rates under the Proposed Action; however, customer rates would not likely increase above the existing surcharges as a direct result of dam removal costs.

Removal of the Four Facilities could affect property values of parcels near Copco 1 and Iron Gate Reservoirs. Under the cumulative condition, land values would fluctuate with market conditions. The introduction to this section describes existing economic trends in the area of analysis that could affect property values. The recent economic recession has negatively affected land values. Some planned projects under the cumulative condition, such as those described in city or county planning documents, could increase economic development and lead to an upward trend of property values in the long term under the cumulative condition. In Siskiyou County, median home prices have declined since 2006 (See Real Estate Evaluation Report, Bender Rosenthal, Inc 2011 in Section 3.15, Socioeconomics). Land values have followed similar trends. However, it is speculative to predict how land values would change in the future under the cumulative condition. To the extent that dam removal has not been fully capitalized into property values, reservoir real estate values may continue to decline following a positive Secretarial Determination. This loss in value may be partially offset over the long term as barren landscape becomes revegetated open space. However, some of this loss may be permanent as a shift from reservoir view to no view or from reservoir frontage to river view may make a parcel less desirable. Riverine parcels in areas downstream from Iron Gate Dam that experience detectable improvements in water quality and/or fish availability may experience positive changes in value. Available data are insufficient to quantify such short- and long-term effects of the Proposed Action.

Removal of the Four Facilities could affect tax revenues to Siskiyou and Klamath Counties. The introduction to this section describes existing economic trends in the area of analysis that could affect tax revenues, including property and sales taxes, to local

governments under the cumulative condition. The recession resulted in declines in tax revenues. In the future, economic growth could increase revenues. It is difficult to predict how the economy would fluctuate under the cumulative condition, which generally has a direct effect on local government revenues.

In the short term, if property values decline further and there are no offsetting increases due to other factors, there would be adverse effects to property tax revenues to Siskiyou and Klamath Counties under the cumulative condition. The Proposed Action could contribute to these effects. PacifiCorp owns property around the reservoirs and pays property taxes annually to Siskiyou and Klamath Counties. Annually, PacifiCorp pays in the range of $290,000 to $305,000 in property taxes on land attributable to hydroelectric facilities at Copco and Iron Gate Dams and about $132,000 in property taxes for land attributable to hydroelectric facilities at J.C. Boyle Dam. Under the Proposed Action, the States would assume ownership of these lands and PacifiCorp would not pay property taxes on the relinquished land to the counties. The loss in tax revenue from PacifiCorp owned lands would impact the regional economy. However, if Siskiyou and Klamath Counties receive in-lieu payments of equal value to PacifiCorp property tax payment, there would be no net effect to county revenues under the Proposed Action. Decreased land values and associated property taxes would affect local government revenues. Combined with decreased budgets and revenues as a result of the recession that began in 2007, further reductions in property tax revenues to local governments would be an adverse cumulative effect. In the long term, Siskiyou and Klamath Counties are projecting increased need for housing to support population growth (See Section 4.4.16). Increased homeowners in the counties would increase property taxes to the counties that could offset some losses as a result of the Proposed Action under the cumulative condition in the long term.

The Proposed Action would increase sales tax revenues during the construction period. Construction crews for dam removal in Siskiyou County would purchase goods and services from local restaurants and stores, which would increase sales tax revenues for the counties. Similar to construction worker spending, increased visitation to the counties offering recreation activities would increase sale tax revenues within the counties. Any adverse effects on visitation expenditures would decrease sales tax revenues. Decreases in reservoir recreation in Siskiyou County could reduce sales tax revenues, which would be a and adverse effect. As noted above, under the cumulative condition, income and employment in Klamath and Siskiyou counties has declined between 1997 and 2008. Construction worker spending would be a temporary and positive effect to Siskiyou County under the Proposed Action. The net effect to sales tax revenues from changes in recreation expenditures is unknown. Cumulative effects on county economies would likely vary with some positive and negative effects.

4.4.14.2 Alternative 3: Partial Facilities Removal of Four Dams

Positive cumulative economic effects of Alternative 3 would be similar to the Proposed Action. As indicated in Tables 3.15-65 and 3.15-66, regional employment impacts associated with Alternative 3 would be similar to those for Alternative 2, with the

following exceptions of short-term impacts pertaining to dam decommissioning. Dam decommissioning would be positive but smaller under Alternative 3 (+1100 jobs) than Alternative 2 (+1400 jobs).

The negative impacts under Alternative 3 would be similar to those for Alternative 2 with the exception of O & M. Long-term job losses in Siskiyou and Klamath Counties as a result of foregone O&M at the Four Facilities would adversely affect the regional economy under the cumulative condition. Reduced employment has had an adverse effect on the regional economy in the cumulative condition. In the long term, counties would implement development projects to meet growth defined in general plans, which would be a positive cumulative effect on the economy. Alternative 3 would contribute to job losses by eliminating an estimated 47 jobs related to O&M at the Four Facilities, 2 less than jobs than Alternative 2. These would be long-term job losses and an adverse cumulative effect. Similarly to Alternative 2, Alternative 3 would create some jobs in the short- and medium-term that could offset some of these losses.

The same caveats and uncertainties that apply to Alternative 2 also apply to Alternative 3. As with Alternative 2, short- and medium-term impacts would be positive in all affected regions under Alternative 3. Long-term economic impacts would be positive for coastal counties but more modest and ambiguous for Klamath Basin counties due to the countervailing influence of job losses and gains. Effects on tribal harvests and cultural practices would be positive and similar to effects under Alternative 2.

4.4.14.3 Alternatives 4 and 5

Quantitative estimates of regional economic impacts are not available for Alternative 4 or 5. As indicated in Tables 3.15-65 and 3.15-66, regional impacts of these alternatives can be qualitatively characterized as follows:

- Short-term impacts of construction expenditures associated with fish passage and/or dam removal would be positive under the two alternatives.
- Mitigation would yield some positive medium-term impacts, but the absence of KBRA jobs would mean lower positive impacts relative to Alternatives 2 and 3.
- Long-term positive impacts on irrigated agriculture and refuge recreation attributable to the KBRA under Alternatives 2 and 3 would not occur under Alternatives 4 and 5.
- Commercial, ocean recreational and in-river recreational fisheries would experience positive long-term economic impacts under Alternatives 4 and 5 but to a lesser extent than they would under Alternatives 2 and 3. Positive long-term impacts associated with reservoir and whitewater recreation and operation and maintenance of the dams, which would be foregone under Alternatives 2 and 3, would continue at a diminished level under Alternatives 4 and 5.

In addition to the regional economic impacts cited above, effects of Alternatives 4 and 5 on tribal fish harvest would be positive relative to the No Action/No Project Alternative though of lesser magnitude than Alternatives 2 or 3. However some water quality benefits would occur under Alternative 5 with removal of the two largest dams. Therefore Alternative 5 would lead to some positive effects on tribal cultural practices.

4.4.15 Environmental Justice

Cumulative environmental justice effects would be associated primarily with effects on water quality, aquatic resources, air quality, traffic and noise, and socioeconomics from implementation of the project and other past, present and reasonably foreseeable actions.

The timeframe for environmental justice concerns includes both the duration of construction (May 2019 through December 2020), as some environmental justice issues would only occur during construction (air quality, traffic, noise, water quality, employment), and the years following completion of construction (water quality). The timeframe would extend beyond the construction period indefinitely because impacts on socioeconomics and county revenues would be long term and could continue to occur after construction.

4.4.15.1 Alternative 2: Full Facilities Removal of Four Dams

Dam removal activities could affect fisheries and disproportionately affect tribal people. Dam removal would improve anadromous fisheries in the Klamath River and help recovery of the endangered sucker fisheries. The construction of the Klamath Hydroelectric Facility has resulted in significant cumulative effects on fisheries that have disproportionately affected tribal people because it has blocked access to habitat, impaired water quality, and increased the potential for nuisance algae. The Proposed Action's contribution to this cumulative environmental justice effect would be beneficial. Restored fisheries would help reverse the environmental justice impacts to the tribes that the dams created. Other cumulative actions that would also contribute to restoring fisheries include ongoing restoration actions by the tribes (see Table 4-4), implementation of Klamath Basin TMDLs, the Trinity River Restoration Program, the Five Counties Road Maintenance Program, the Northwest Forest Plan, which contain provisions for improving water quality, restoring habitat, and reduce impacts on fisheries. Together these cumulative actions and the Proposed Action would have environmental justice benefits for tribal people by improving fisheries.

Increased air pollutants and noise associated with dam removal activities could disproportionately affect county residents and tribal people. The traffic on the associated haul roads could disproportionately affect tribal people. Temporary, short term air quality and noise impacts from deconstruction would occur (see Sections 3.9, Air Quality, and 3.23, Noise) that would disproportionately affect Siskiyou and Klamath County residents and tribal people, which as a whole are low income relative to California and Oregon. Implementation of mitigation measures in Sections 3.9, Air Quality, and 3.23, Noise, would reduce the severity of these short term construction impacts. Additionally, residents in Siskiyou and Klamath Counties would be

disproportionately affected by increased traffic on local roads during the construction period. Residents would be subject to short term impacts, such as increased congestion, potential traffic delays, slow moving trucks and potential safety hazards. Section 3.22, Traffic and Transportation identifies measures to be taken to reduce traffic effects of the Proposed Action.

New subdivisions approved for Siskiyou County, timber harvesting, mining, recreation, and agricultural activities could result in significant cumulative air quality, traffic, and noise effects. The Proposed Action's contribution to the cumulative effect would be minimized by implementation of mitigation measures in Sections 3.9, Air Quality, 3.22, Traffic and Transportation, and 3.23, Noise, to reduce the severity of these short-term impacts and would ensure impacts are not disproportionately adverse for tribal people. There would be no long-term cumulative environmental justice effects from construction.

Dam removal activities could provide jobs for county residents and tribal people that are low income and minority. Deconstruction activities would generate jobs in the area of analysis. Approximately 90 construction workers would be hired locally during peak deconstruction period and about 60 workers would be hired locally on average during the deconstruction period from Klamath or Siskiyou Counties. Increased employment would support low income individuals, resulting in a beneficial effect. Any loss in existing recreation or PacifiCorp jobs would be offset by the new jobs created during the decommissioning and deconstruction of the four dams. There are no other cumulative actions such as construction projects that have been identified that would generate a substantial number of local jobs in the area of analysis during the construction period; therefore, there would be no substantial cumulative effects associated with jobs for low income and minority people.

Release of sediment from reservoirs could cause disproportionate short term impacts on county residents and tribal people. The short-term sediment impacts that would occur from reservoir drawdown would be significant for 6-8 months. This could result in a significant cumulative environmental justice effect because of the tribes' dependency on the river for subsistence, cultural ceremonies, and a source of income. The short-term sediment impacts could hurt fisheries or other aquatic plants or animals the tribes rely on. Considering the current decline in fisheries, the high unemployment rates and high poverty rates of the tribes, this could result in cumulative economic and social environmental justice effects. However, the sediment release would be short term in duration. It would occur during the winter to minimize the impacts to fisheries. Because of the short-term nature of the impacts, any potential cumulative effects would be minimal.

Dam removal activities could cause disproportionate long-term water quality impacts on county residents and tribal people. As stated in Sections 3.2, Water Quality, and 3.3, Aquatic Resources, under the Proposed Action water quality would be expected to improve in the Hydroelectric Reach over the long term. Additionally, there would be long-term beneficial effects on dissolved oxygen concentrations and decreased water temperatures downstream from Iron Gate Dam. Ongoing programs and actions in the

Klamath Basin, including implementation of TMDLs to improve water quality, programs identified in Table 4-3 and 4-4 to improve water quality, and actions to improve water quality such as the Five Counties Road Maintenance Program and the Northwest Forest Plan, all have the potential to result in cumulative beneficial effects on water quality.

Therefore, the Proposed Action in addition to other ongoing programs and actions to improve water quality, would contribute to beneficial cumulative environmental justice impacts on water quality.

Changes in county revenues associated with dam removal could decrease county funding of social programs. As described in Section 3.15, Socioeconomics, the Proposed Action could cause a short- and long-term decline in tax revenue to the counties associated with a discontinuation of tax revenue from PacifiCorp and a decrease in property values near the reservoirs. It is speculative to quantify short- and long-term impacts on county social programs because many of these programs receive funding from the State and Federal governments, and would be unaffected by the Proposed Action. However, the recent economic recession and forthcoming budget cuts to Federal, State, and local governments could also result in a decrease in funding of social programs. Together these could create a cumulative effect associated with social program funding. It is not possible to quantify the Proposed Action's contribution to this cumulative effect. The Proposed Action would allow tribal people to gain increased self-reliance and self-sufficiency through increased subsistence and the restoration of the tribal commercial fishery. This might help offset cumulative environmental justice effects associated with social program funding decreases in the long term.

Dam removal activities could disproportionately impact tribal health and social wellbeing in the long term. Ongoing programs and actions in the Klamath Basin, including implementation of programs identified in Table 4-3 and 4-4 to improve fisheries and actions to improve water quality such as implementation of TMDLs, the Five Counties Road Maintenance Program, and the Northwest Forest Plan, all have the potential to result in cumulative beneficial effects on water quality and fisheries. Removal of the dam as part of the KHSA is expected to be beneficial to fall- and spring-run Chinook salmon, coho salmon, and summer and winter steelhead in the long term. Fish population increases would allow the tribes to increase subsistence fishing and once again make fish a larger component of their diet and ceremonies. The Proposed Action, in addition to other ongoing programs and actions to improve water quality and fisheries, would contribute to beneficial cumulative environmental justice impacts on tribal health.

4.4.15.1.1 KBRA - Programmatic Measures

Implementation of the WURP and Interim Flow and Lake Level Program could disproportionately affect low income and minority farm workers. The KBRA proposes voluntary land fallowing and permanent water right sales which could disproportionately affect farm workers in Klamath, Siskiyou, and Modoc Counties. Loss of farm labor jobs could disproportionately affect low-income, minority farm workers, who could lose a portion of their income if farms no longer required their labor. This would be a disproportionate effect on farm workers. Recent drought, regulatory requirements for

fish and stream flows and the resulting water supply unreliability, and the recent economic downturn have contributed to cumulative impacts on agriculture and farm workers in the Klamath Basin. The Proposed Action's contribution to this cumulative impact could be substantial because it could result in loss of jobs and income. However, land fallowing and permanent water rights sales would be voluntary. The impacts on farm workers would depend on the number of willing participants in the Programs. The core of the KBRA is to provide water reliability to farmers, which would ensure continuation of agricultural jobs in the area of analysis. In the long term, the KBRA has the potential to offset any loss of agricultural jobs because of increased water reliability.

Implementation of the Klamath County Economic Development Plan could disproportionately affect low income and minority people in Klamath County. Implementation of the California Water Bond Legislation could disproportionately affect low income and minority people in Siskiyou County. Both Klamath County and Siskiyou County have a larger percentage of persons and families living below the poverty line than their respective States. They also have lower per capita and median family incomes than their respective States. Significant cumulative environmental justice impacts have affected these counties, such as the decline in the timber industry, drought conditions that severely decreased agricultural production, and the recent economic downturn. The KBRA could help to provide some environmental justice benefits to these low income and minority groups in Klamath and Siskiyou Counties. The Klamath County Economic Development Plan would provide $3.2 million of funding to Klamath County. Funding would support long-term economic growth in Klamath County and could create new job opportunities and improve public programs for county residents. Depending on how funding is used within the county, this action could benefit low income and minority populations. If approved, bond funds would provide $20 million to Siskiyou County to use for economic development. It cannot be determined at this time how Siskiyou would distribute funds from the California Water Bond Legislation; this is a general discussion. The bond funds could assist Siskiyou County in addressing unemployment, poverty, bankruptcy, and social problems and continuing funding for other county programs. Programs could benefit low income and minority populations in Siskiyou County.

Implementation of the Phase I and Phase II Fisheries Restoration Plans, Tribal Fisheries and Conservation Management Program, Mazama Forest Project, Tribal Programs Economic Revitalization, Fisheries Reintroduction and Management Plan, and Fishery Monitoring Plan could disproportionately affect the tribes. As described in Section 3.16, Environmental Justice, adverse cumulative environmental justice effects on tribes have occurred through the decline in fisheries and the loss of subsistence fishing, including economic, cultural, and social impacts. The KBRA's contribution to this cumulative effect would be beneficial. Implementation of several KBRA programs and projects would have beneficial environmental justice impacts on tribes because they would restore anadromous fish species in the Klamath River and Upper Klamath Basin, return 90,000 acres of the Mazama Forest back to the Klamath Tribes, and provide funding for the Klamath, Karuk, and Yurok Tribes to develop economic revitalization

plans, programs and projects and to assist the tribes in developing their capacity to participate in resource management activities within the basin, particularly relating to tribal fishing and revitalization of tribal subsistence and other economic activities. These actions, and other ongoing river restoration actions, as well as implementation of the KHSA and removal of the Four Facilities, would have cumulative environmental justice benefits on the tribes.

4.4.15.2 Alternatives 3, 4, and 5

Alternatives 3, 4, and 5 would have similar construction-related environmental justice cumulative effects as Alternative 2. Under Alternatives 4 and 5, dams would still block fish passage and increase the potential for disease; therefore, there would be no cumulative benefits on tribes. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.15.3 Mitigation Measures

No cumulatively considerable adverse effects associated with environmental justice would occur; hence, no mitigation measures are required.

4.4.16 Population and Housing

Cumulative effects on population and housing would be associated with the cumulative need for housing that would result by including the influx of construction workers associated with dam removal and future population growth. The timeframe for population and housing includes the duration of construction (May 2019 through December 2020) because the impacts on population and housing would only occur during construction.

Table 4-18 presents a summary of the potential impacts on population and housing presented in Chapter 3. These impacts are analyzed for cumulative effects below the table.

The 2020 population projection for Siskiyou County is 51,283, an increase of 4,174 from 2010 (Siskiyou County Community Development Department 2010). The Siskiyou County General Plan (2010) states that based on current population and housing trends, there will be a need for an additional 720 new residential units in the county by the year 2014 (Siskiyou County 2010). The projections do not extend to 2020; however, the Lead Agencies assume that there would still be some housing needs within the Siskiyou County.

Klamath County's population is expected to increase from 66,243 in 2008 to 71,440 in 2020 (U.S. Census Bureau, 2006-2008 Community Survey; Klamath County Planning Department 2009). No housing estimates are available for the year 2020. The Klamath Falls urban growth boundary is expected to experience the most growth of all urban areas

Table 4-18. Summary of Population and Housing Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities could employ non-local workers, who would need housing for the duration of their employment.	1	NCFEC	None	NCFEC
	2,3,4,5	LTS	None	LTS
Construction, restoration, and monitoring activities associated with new programs could create new jobs and could employ non-local workers, who would need housing for the duration of their employment.	1	LTS	None	LTS
Removal of recreation facilities and related construction activities could result in an increase in construction workers requiring housing.	2,3,5	NCFEC	None	NCFEC
Keno Transfer				
The transfer of ownership of Keno Dam from PacifiCorp to Reclamation could affect population and housing.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
The decommissioning of the East and Westside Facilities could impact population and housing.	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Dam removal would require relocation of the Yreka Water Supply Pipeline and could result in an increase in construction workers requiring housing.	2,3,5	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction and monitoring activities associated with the KBRA programs could employ non-local workers who would need housing for the duration of their employment.	2,3	LTS	None	LTS

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

in Klamath County over the next 20 years. The forecasted range for the Klamath Falls urban growth boundary population in 2020 is 47,420 to 49,471, from 44,321 in 2007 (Klamath County Planning Department 2009**).** The Lead Agencies assume there would still be some housing needs in Klamath County.

In 2006, Jackson County's population was 198,615. The Jackson County Comprehensive Plan, Revised Population Element (2007) projects that Jackson County's 2020 population will be 238,865.[8] The majority of Jackson County's population growth from 1980 to 2005 was in the city of Medford. It is reasonable to assume that Medford will continue to account for a large share of Jackson County's growth in the future (Jackson County 2007). The Comprehensive Plan states that the County has been experiencing a scarcity of workforce housing (low- and middle-income housing), especially from 2002 to 2005 when housing prices rapidly increased. Much of the new housing in Jackson County has been for higher income retirees (Jackson County Undated). Therefore, the Lead Agencies assume there would still be some needs for housing in Jackson County.

4.4.16.1 Alternative 2: Full Facilities Removal of Four Dams

Construction activities could employ non-local workers, who would need housing for the duration of their employment. Implementation of the Proposed Action could create a temporary increase in population as non-local workers migrate to the area for deconstruction. During peak deconstruction periods, implementation of the Proposed Action would require up to 250 total workers with 195 working at the Copco and Iron Gate Facilities combined, and up to 55 workers at the J.C. Boyle Facility. Both of these numbers include administrative and management staff. At the Copco and Iron Gate Facilities, 78 workers would be provided from within the region and 117 would be required from outside of the region. At the J.C. Boyle Facility, 20 workers would come from within the region and 35 from outside of the region. Therefore, the housing need would be up to 117 housing units for the California facilities and 35 housing units for the Oregon facility. Peak worker needs would occur between November 2019 and September 2020.

Population increases are expected for all counties in the area of analysis by the year 2020, and many of the affected counties have noted that housing is needed in the future, especially workforce housing for low- to middle-income groups. The need for housing would be considered a significant cumulative effect. However, the Proposed Action would not have a cumulatively considerable contribution to the cumulative effect. The temporary work force needed for the Proposed Action would likely spread out to cities with available accommodations. It is also possible that some temporary workers would stay in hotels or motels in Klamath Falls or Yreka, local recreational vehicle parks, or available rentals in the rural areas surrounding the dam facilities. The Proposed Action would not require permanent new residences and most workers would leave the area

[8] The 238,865 projection was made in 2004. A forecast made in 1997 projected the 2020 population to be slightly less at 221,665. The Revised Population Element (Jackson County 2007) presents both projections.

after construction was complete. **The Proposed Action's incremental contribution to the significant cumulative effect associated with population and housing would not be cumulatively considerable.**

4.4.16.1.1 KBRA - Programmatic Measures

Construction and monitoring activities associated with KBRA programs could employ non-local workers who would need housing for the duration of their employment. The creation of jobs and potential need to employ non-local workers could strain local housing availability and result in short and long-term increases in population in communities with the potential to house workers migrating into the area.

Population increases are expected for all counties in the area of analysis by the year 2020, and many of the affected counties have noted that housing is needed in the future, especially workforce housing for low- to middle-income groups. The need for housing would be considered a significant cumulative effect.

The Proposed Action's incremental contribution to this significant cumulative effect would be temporary. It is anticipated that the majority of workers could be satisfied locally. The timing of, and specific locations where, these KBRA programs could be undertaken is not certain, but it is assumed that some of these actions could occur at the same time and in the vicinity of the hydroelectric facility removal actions analyzed above. However, as described in Section 3.17.3, Population and Housing, Existing Conditions/Affected Environment, it is assumed that there is sufficient housing supply in the current stock to temporarily accommodate non-local workers. **The KBRA's incremental contribution to the significant cumulative effect on housing would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

4.4.16.2 Alternatives 3, 4, and 5

Alternatives 3, 4, and 5 would have similar cumulative effects on population and housing as those described for Alternative 2. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.16.3 Mitigation Measures

There are no cumulatively considerable adverse effects associated with population and housing; therefore, no mitigation measures are required.

4.4.17 Public Health and Safety, Utilities and Public Services, Solid Waste, and Power

Cumulative effects on utilities and public services, solid waste, and public health and safety could occur through increasing the demand for utilities and services, increasing solid waste, and creating additional public health and safety risks. The timeframe for this analysis includes the duration of construction (May 2019 through December 2020).

Cumulative effects on hydropower would be associated with the cumulative demand for power that may exceed generation capabilities. The timeframe for this analysis includes the end of construction (December 2020) and beyond, as the demand for power is expected to be needed indefinitely into the future.

Table 4-19 presents a summary of utilities and public services, solid waste, and public health and safety, and power impacts presented in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water at the reservoirs under annual license renewals would allow hydropower generation to continue subject to the conditions of the Reclamation Biological Opinions, which would have the potential to decrease hydropower production.	1	NCFEC	None	NCFEC
Construction activities related to the ongoing restoration and management activities could impact public health and safety.	1	NCFEC	None	NCFEC
Construction activities from removal of the Four Facilities could result in public health and safety risks.	2, 3, 4, 5	S	PHS-1: Public Safety Management Plan	LTS
Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities.	2, 3, 4, 5	S	PHS-1: Public Safety Management Plan; PHS-2: Fire Management Plan	LTS
Construction and demolition activities could increase the risk of wildfires.	2, 3, 4, 5	S	PHS-2: Fire Management Plan	LTS
Removal of the dams would eliminate a water source for wildfire services in the Klamath Basin and could increase response times.	2, 3, 5	LTS	None	LTS
Dam removal would eliminate a water source for residential firefighting in and around Copco Village, and could increase the risk to homes from fire.	2, 3, 5	LTS	None	LTS

Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Construction activities could affect police services by temporarily increasing the population of construction workers, lengthening response times due to construction traffic on area roads, and exposing construction areas to theft and/or vandalism.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could require the use of electricity and natural gas supplies in the study area.	2, 3, 4, 5	NCFEC	None	NCFEC
The removal of recreational facilities currently located on the banks of the existing reservoirs could affect public health and safety	2, 3, 5	S	PS-1: Public Safety Management Plan PHS-2: Fire Management Plan	LTS
Construction activities could affect public services and utilities in the counties and cities in the study area.	2, 3, 4, 5	LTS	None	LTS
Construction activities could result in the need for new construction and access roads.	2, 3, 4, 5	LTS	None	LTS
Dam removal would require the construction of new access roads for recreation facilities which could affect public health and safety.	2, 3, 4, 5	LTS	None	LTS
Construction activities (including Signage and Construction Traffic Management BMP) could affect road conditions by increasing traffic from heavy construction vehicles which could affect public health and safety.	2, 3, 4, 5	LTS	None	LTS
Construction activities could generate a substantial amount of solid waste which could affect public services and utilities.	2, 3, 4, 5	LTS	None	LTS
Dam removal would remove existing hydropower facilities, resulting in a loss of hydropower generation which could affect the supply of electricity.	2, 3, 5	LTS	None	LTS
Development of fish passage would reduce power generation at the existing hydropower facilities due to bypass stream flow requirements which could affect the supply of electricity.	4, 5	LTS	None	LTS

Table 4-19. Summary of Public Health and Safety, Utilities and Public Services, Solid Waste, and Power Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Dam removal could increase available mosquito habitat and could increase the risk of disease transmission in the short term.	2, 3, 5	LTS	None	LTS
Leaving dam facilities and infrastructure in place could have the potential to result in public health and safety risks.	4	NCFEC	None	NCFEC
	3, 5	LTS	None	LTS
Keno Transfer				
The Keno Facility would be transferred to the DOI, which would not cause adverse effects to Public Health and Safety.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
The East and Westside Facilities would be decommissioned, resulting in the loss of generated power.	2, 3	LTS	None	LTS
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Construction activities could affect Yreka's municipal water supply by damaging or exposing the Yreka Water Supply Pipeline prior to its relocation.	2, 3, 5	LTS	None	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Prescribed burning and mechanical thinning under the Phase I and II Fisheries Restoration Plans could affect Public Services and Utilities.	2,3	S (short term) B (long term)	PHS-2: Fire Management Plan	LTS/B
Construction activities associated with the KBRA programs could result in public health and safety impacts	2,3	LTS (short term) B (long term)	None	LTS (short term) B (long term
Implementation of the Power for Water Management Program could create new renewable energy sources.	2,3	B	None	B
Completing the Emergency Response Plan could have beneficial effects on Public Services and Public Safety.	2,3	B	None	B

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

The 2020 population projection for Siskiyou County is 51,283, an increase of 4,174 from 2010 (Siskiyou County Community Development Department 2010). The Siskiyou County General Plan (2010) states that based on current population and housing trends, there will be a need for an additional 720 new residential units in the county by the year 2014 (Siskiyou County 2010). Klamath County's population is expected to increase to 71,440 in 2020 (Klamath County Planning Department 2009).

4.4.17.1 Alternative 2: Full Facilities Removal of Four Dams

Construction activities could result in public health and safety risks. Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities. Construction activities could increase public hazards by placing construction equipment in waterways, roadways, and other areas accessible by residents, recreational visitors, and potential spectators of the deconstruction activities. Earthwork, blasting, construction vehicles, and work within the waterway could have public safety risks. The placement of construction equipment in areas potentially accessible by residents and recreational visitors would be a safety hazard. Blockage of existing roadways and or use of the roadways for truck hauling of materials would also be a safety hazard**.** There are no other known actions or projects that would affect public health and safety directly at the reservoir sites during deconstruction. There could be construction of new subdivisions or road improvements adjacent to the reservoirs; however, the timeframe for these projects is not known. If these projects occurred at the same time as dam deconstruction, they could result in significant cumulative public health and safety effects. The Proposed Action's incremental contribution to the cumulative effects would be cumulatively considerable; however, mitigation measures would be implemented to reduce these impacts. A public safety plan (PHS-1) and a Fire Management Plan (PHS-2) would be developed that would ensure measures are taken to protect public safety during deconstruction. With mitigation, **the Proposed Action's incremental contribution to the significant cumulative effect would not be cumulatively considerable**.

Construction and demolition activities could increase the risk of wildfires. The fire threat in the areas surrounding the Four Facilities is categorized as high to very high. Deconstruction activities could further aggravate the risk of fire. Other future actions or projects in the vicinity of the facilities that could also increase the risk of fire include development of new subdivisions, road improvements, and even recreation activities such as camping with fires. A decline in the timber industry and a decrease in timber harvesting has also occurred in Siskiyou County and the surrounding counties. If this trend continues, it could leave more dry flammable brush that could increase the potential for wildfires. Together, these actions could result in significant cumulative risks associated with wildfires. The Proposed Action's incremental contribution to the cumulative effect associated with wildfires would be cumulatively considerable; however mitigation measures would be implemented to reduce these impacts. A Fire Management Plan (PHS-2) would be developed to reduce the risks of fires and ensure fire suppression

tools are on-site at all times. **With mitigation, the Proposed Action's incremental contribution to the significant cumulative effect would not be cumulatively considerable.**

Removal of the dams could eliminate a water source for wildfire services and could increase response times. Removal of the dams would eliminate a water source for wildfire services and could increase response times. Removal of the reservoirs would reduce accessibility to a water source for residential firefighting, including in and around Copco Village, potentially increasing the risk to homes from fire. Dam removal would reduce accessibility to a source of water for fire services and could therefore increase response times. The Klamath River would remain after dam removal, and surface water modeling (described in Section 3.6, Flood Hydrology, and Section 3.8, Water Supply/Water Rights) indicates that flows in the Klamath River downstream from the removed dams would remain unchanged. As such, helicopter fire crews could still obtain water from the Klamath River, Keno Impoundment/Lake Ewauna, or Upper Klamath Lake. The presence of the Klamath River, existing water systems, and existing fire fighting resources ensures that assets for firefighting are present in the area. No other known actions or projects in the area would substantially change response times or decrease water availability for fire services. **There would be no significant cumulative effects associated with increased response times for fire services or elimination of water sources for firefighting.**

Construction of the Proposed Action could affect the City of Yreka's municipal water supply. The Proposed Action would require relocating the City of Yreka's municipal water supply pipeline that is currently under Iron Gate Reservoir. No other known cumulative actions or projects would affect the City of Yreka's municipal water supply pipeline. **There would be no significant cumulative effects.**

Under the Proposed Action, recreational facilities currently located on the banks of the existing reservoirs would be removed following drawdown and could affect public health and safety. Once the reservoirs are drawn down, existing recreational facilities will be removed. The deconstruction could have health and safety impacts as a result of the construction equipment and work site safety issues. No other known cumulative actions are expected to occur that could affect the public during deconstruction of the recreational facilities. Additionally, Mitigation Measures REC-1 and REC-2 would be implemented to reduce health and safety impacts. **There would be no significant cumulative effects.**

Construction of the Proposed Action could affect public services and utilities in the counties and cities in the area of analysis. The large number of construction workers required for the project could increase the demand on existing services and utilities. Both Siskiyou County and Klamath County are projecting population increases in 2020, and this would also increase the demand for public services and utilities. Together these actions could result in significant cumulative effects associated with the demand for public services and utilities. However, the workers for the Proposed Action would likely stay in existing residences, hotels, or campgrounds with adequate existing utilities and

services. In addition, the workers and their associated utility and service demands would be temporary, and by December 2020 they would likely return to their city or county of origin. No new long-term utility or services demands would occur. **The Proposed Action's incremental contribution to the significant cumulative effect associated with increased demands for utilities and services would not be cumulatively considerable.**

Implementation of the Proposed Action could affect road conditions. Construction equipment could damage existing roads during deconstruction. Siskiyou County has had reduced budgets and has several existing roads that they cannot afford to maintain. Other proposed projects such as the new subdivisions around Iron Gate Dam, mining activities, and general wear and tear from seasonal traffic all contribute to degrade the current road system over time. Together these actions and the Proposed Action would result in significant cumulative effects on road conditions. However, the DRE would be responsible for repairing all damages to roads during deconstruction activities. The use of roads during deconstruction would be temporary and would be over after deconstruction is complete. No long-term use of the roads would occur. **The Proposed Action's incremental contribution to the significant cumulative effect associated with road conditions would not be cumulatively considerable.**

Activities associated with the Proposed Action could generate a substantial amount of solid waste. Deconstruction of the Four Facilities is expected to generate a substantial amount of solid waste. The population in Siskiyou and Klamath Counties is expected to increase in the future. As a consequence of this projected population growth, the generation of solid waste would also be expected to increase proportionally. Solid waste facilities have a finite amount of space and can only accept waste if space is available. The Proposed Action's generation of solid waste, combined with the expected increases in solid waste generation from population increases, and any future construction projects such as the proposed subdivisions described in Table 4-3 above, could create a significant cumulative solid waste impact. The Proposed Action's contribution to the cumulative effect would be less than cumulatively considerable. The earth, concrete, and rebar waste that would be removed from the facilities under the Proposed Action would be sent to local landfills. The selected landfills in the region have adequate capacity to absorb the debris from this temporary project. A portion of the waste would be sent to recycling facilities. The Proposed Action would not create a new permanent stream of solid waste generation; the solid waste impacts would be temporary and only last the duration of construction. **The Proposed Action's incremental contribution to the significant cumulative effects associated with solid waste would not be cumulatively considerable.**

The Proposed Action would remove existing hydropower facilities, resulting in a loss of hydropower. Under the Proposed Action, the East and Westside Facilities would be decommissioned, resulting in the loss of generated power. Under the Proposed Action, four of the seven power generating facilities of the KHP would be removed and the Eastside and Westside Facilities would be decommissioned. The combined output of the

Four Facilities that would be removed is approximately 169 MW, and FERC rates the project's dependable capacity as 42.7 MW[9] (M-Cubed 2006). The total combined power generating capacity of the Eastside and Westside Facilities is approximately 3.8 MW.

This accounts for less than 2 percent of PacifiCorp's power portfolio. While the loss of the power generated may have some impact to the local area, the effects of the loss to the Northwest Power Pool, in light of the scale of the additional generation needed to meet demand over the next 10 years, is minimal.

Significant cumulative effects have occurred associated with power supply and demand in the west. Declining power supply margins over the next 10 years will require an upgraded transmission system across the western interconnection in order to balance the surplus of generation in the northern and eastern portions with the higher demands in the western and southern areas of the region. Planning for these upgrades has already begun independently of the Proposed Action in order to meet the growing energy demand across the Western States, and construction on several of these projects is already underway. The need for these transmission upgrades was established independently of the Proposed Action and the impacts associated with them cannot be attributed to the potential loss of energy as a result of this project. Many of the major portions of the transmission upgrades will be completed by 2014, prior to the decommissioning of the hydropower facilities discussed in this EIS/EIR.

The need for new generation facilities to meet the needs of PacifiCorp customers has already been established as well. Increasing the percentage of renewable energy in the company's portfolio, establishing new sources of energy to meet the increasing base load demand as well as higher peak demand, and upgrading or maintaining existing power sources are all delineated in PacifiCorp's Integrated Resource Plan from 2008 and the 2010 update. These improvements have been outlined as necessary in order to continue to provide reliable service to their customers, and will occur regardless of the Proposed Action.

One cumulative project has been identified that could potentially supply electricity to the region. The Klamath Falls Bioenergy Facility is in the early stages of planning but has issued a Notice of Intent to file an application from the ODE for construction of a bioenergy facility. This facility would burn wood waste and would produce up to 38.5 MW of electrical power. This might help to offset lost power in the region from removal of the Four Facilities.

[9] Dependable capacity is the MW output of a generator of group of generators during a period of low water or other operational constraints that coincide with a peak electrical system load -- essentially a worst case generation capacity, where low water coincides with peak demand. The dependable capacity is the number of megawatts that can be produced for at least four to six hours under these conditions. This is generation based on real world operations at a hydropower generating facility, whereas nameplate capacity is the amount of power that the turbines are capable of generating with all other conditions being perfect (CEC 2003).

While the Proposed Action would result in the loss of approximately 173.8 MW of power, it would represent less than 2 percent of PacifiCorp's power portfolio. Independent of the Proposed Action, additional improvements are planned by PacifiCorp to increase power generation to meet growing demands. **The Proposed Action's incremental contribution to the significant cumulative effects associated with the loss of electrical generating capacity/hydropower would not be cumulatively considerable.**

The loss of the reservoirs could increase available mosquito habitat and the increase the risk of disease transmission. No other known actions or projects would affect standing water or increase mosquito habitat. **There would be no significant cumulative effects associated with mosquito habitat and increased risk of disease.**

4.4.17.1.1 KBRA - Programmatic Measures

Implementation of the Power for Water Management Program could create new renewable energy sources. Implementation of the Power for Water Management Program (KBRA Section 17) would provide affordable electricity to allow efficient use, distribution, and management of water. This could also involve the development of renewable energy sources, which would provide green energy. One other project, the Klamath Falls Bioenergy Facility, is in the early stages of planning but has issued a Notice of Intent to file an application from the ODE. This facility would burn wood waste and would produce up to 35 MW of electrical power. Together, these actions could provide new sources of power to the region. **The KBRA's incremental contribution to the cumulative effect on electricity would be beneficial. Implementation of the KBRA will require future environmental compliance as appropriate.**

Completing the Emergency Response Plan could have beneficial effects on Public Services and Public Safety. The Emergency Response Plan is intended to prepare water managers and emergency responders for potential failure of Reclamation's Klamath Project dikes or other facilities that affect the storage and delivery of water to Reclamation's Klamath Project irrigators. The plan would include a process to prepare for potential emergencies, identify available funding sources for responding to emergencies, a prioritization method for funding emergency responses, and a process to implement emergency responses. No other known cumulative actions would involve emergency response for Reclamation's Klamath Project. **There would be no significant cumulative impacts. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**.

Prescribed burning and mechanical thinning under the Phase I and II Fisheries Restoration Plans could affect Public Services and Utilities. Prescribed burning and mechanical thinning in forests could damage to utility lines from falling trees and branches, and could also require using public resources to monitor and manage burning which can leave other areas more vulnerable during the prescribed burn. There are no other cumulative actions or projects that have been identified that would specifically require the use of public resources such as firefighters or that could damage public

utilities in forests; however the risk of forest fires is high in many areas of the Klamath Basin. If forest fires occurred during prescribed burning, this could put stress on existing public resources such as firefighters. The KBRA's incremental contribution to this cumulative effect would be minimal. All prescribed burns would be scheduled so as to ensure firefighters remain available to assist with any wildfires. **The KBRA's incremental contribution to the cumulative effects on public services would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**.

Construction activities associated with the KBRA programs could result in public health and safety impacts. Potential construction activities could include a variety of restoration actions and habitat improvements. The Fisheries Reintroduction and Management Plan, the Agency Lake/Barnes Ranch project, the Wood River Wetland Restoration Program, and elements of the On-Project Plan contain construction components that could have health and safety issues related to the construction activities.

While the exact locations for some of these actions is not yet known, there could be significant cumulative health and safety impacts if the KBRA actions were to take place adjacent to other large construction projects or in areas with substantial public health and safety risks. The KBRA's incremental contribution to the significant cumulative public health and safety impacts would be minimal. Prior to implementing construction, an applicable public health and safety plan would be developed to ensure construction workers and the public would not be adversely affected during construction and operation. **The KBRA's incremental contribution to the significant cumulative effects associated with public health and safety impacts during construction would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**.

4.4.17.2 Alternatives 3, 4, and 5

Alternatives 3 and 5 would have similar cumulative public health and safety, utility, and services effects as those described for Alternative 2. Alternative 4 would have a smaller workforce and a smaller construction area and would therefore have less cumulative effects on public health and safety, utilities, and services. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.17.3 Mitigation Measures

There would be no cumulatively considerable adverse effects; therefore, no mitigation measures are required.

4.4.18 Scenic Quality

Cumulative effects on scenic quality could occur through changes in the existing visual character of the area or loss of scenic vistas. The timeframe for this analysis includes the

duration of construction (May 2019 through December 2020) and several months to several years after construction until some vegetation becomes established. Table 4-20 presents a summary of scenic quality impacts identified in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

Table 4-20. Summary of Scenic Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Continued impoundment of water at the Four Facilities could result in water quality impacts that could have long-term impacts on scenic quality.	1, 4	NCFEC	None	NCFEC
Continued existence of the buildings and other man-made structures could have the impact that they would remain inconsistent with the VRM classification of the surrounding area (where such inconsistency is defined as a criterion of significance).	1, 3, 4, 5	NCFEC	None	NCFEC
Ongoing fish habitat restoration actions could result in short-term and long-term impacts on scenic resources.	1	S (short term from construction); B (long term)	None	S (short term from construction); B (long term)
Dam removal could result in impacts on scenic resources from removal of dams and facilities.	2, 3, 5	B	None	B
The removal of historic properties could result in impacts on scenic resources.	2, 3, 5	S	None	S
Dam removal could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas.	2, 3, 5	S	None	S
Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities.	2, 3, 5	S (short term); B (long term)	None	S (short-term); B (long term)
Replacement of the existing wooden Lakeview Bridge just downstream from Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources.	2, 3	S (short term); LTS (long term)	None	S (short-term); LTS (long term)
Demolition of existing recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources.	2, 3	S (short term); LTS (long term)	None	S (short-term); LTS (long term)

Table 4-20. Summary of Scenic Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Deconstruction activities could create a new source of light or glare that could adversely affect nighttime views in the area.	2, 3, 4, 5	S	SQ-2: Measures to Reduce Nighttime Light and Glare	LTS
Sediment release during dam and reservoir removal could cause temporary changes in water quality and the appearance of the Klamath River in the area of the dams and downstream from Iron Gate Dam.	2, 3, 5	S (short-term)	None	S (short-term)
Removal of the dams and facilities could result in long-term impacts on scenic resources from changes to water quality.	2, 3, 5	B	None	B
Demolition, construction, and restoration activities for the fishways could cause short-term adverse effects on the scenic vistas in the immediate vicinity of the Four Facilities.	4, 5	S	None	S
Construction of fishways could cause changes in the appearance of the Klamath River in the area of the Four Facilities and downstream from Iron Gate Dam.	4, 5	LTS	None	LTS
Fishways could cause substantial long-term impacts on scenic resources.	4, 5	S	SQ-1: Measures to Minimize Scenery Disturbances	S
Keno Transfer				
Implementation of the Keno Transfer could affect scenic resources.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Decommissioning of the East and Westside canals and hydropower facilities could affect scenic resources.	2, 3	LTS	None	LTS
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Construction of a new, elevated Yreka Water Supply Pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources.	2, 3, 5	S	SQ-1: Measures to Minimize Scenery Disturbances	S

Table 4-20. Summary of Scenic Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction activities associated with the Fisheries Restoration Plan-Phase I and Phase II, the WURP, the Fish Entrainment Reduction, and the Klamath Tribes Interim Fishing Site could result in impacts on scenic resources.	2, 3	LTS	None	LTS
The Fisheries Restoration Plan-Phase I and Phase II could result in long-term impacts on scenic resources.	2, 3	B	None	B
The Wood River Wetland Restoration Project, the Fish Entrainment Reduction, and the Klamath Tribes Interim Fishing Site could result in long-term impacts on scenic resources.	2, 3	LTS	None	LTS
Construction activities associated with the WURP could result in impacts on scenic resources.	2, 3	LTS (short term)	None	LTS (short term)
The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in long-term impacts on scenic resources.	2, 3	LTS	None	LTS (short term)
Fish Entrainment Reduction could result in short-term and long-term impacts on scenic resources.	2, 3	LTS	None	LTS (short term and long term)
Construction activities associated with the Klamath Tribes Interim Fish Site could result in impacts on scenic resources.	2,3	LTS (short term)	None	LTS (short term)
The Klamath Tribes Interim Fish Site could result in long-term impacts on scenic resources.	2,3	LTS (long term)	None	LTS (long term)
Construction of fish management structures would introduce new features into the landscape.	2, 3	LTS (short term); S (long term)	SQ-1: Measures to Minimize Scenery Disturbances	LTS (short term); S (long-term)

Table 4-20. Summary of Scenic Quality Impacts from Chapter 3

Potential Impact	Alternatives	Significance	Mitigation	Significance after Mitigation
Trap and Haul – Programmatic Measure				
Construction activities associated with fish collection facilities would introduce new features into the landscape.	4, 5	LTS (short term); S (long term)	SQ-1: Measures to Minimize Scenery Disturbances	LTS (short term); S (long term)

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable
VRM = Visual Resource Management

4.4.18.1 Alternative 2: Full Facilities Removal of Four Dams

The Proposed Action would result in impacts on scenic resources from removal of the dams and facilities. Removal of all of four dam facilities would result in a change from a reservoir vista to a river vista. No other known cumulative actions or projects would visibly change the scenic character of the Klamath River at the Four Facilities. **There would be no significant cumulative scenic impacts.**

The Proposed Action would result in impacts on scenic resources from the removal of some historic properties. Removal of some properties that are considered historic would occur during dam deconstruction. No other known cumulative actions or projects would remove historic properties along the Klamath River near the Four Facilities. **There would be no significant cumulative scenic impacts associated with removal of historic properties.**

Removal of the Four Facilities could result in short and long-term impacts on scenic resources in formerly inundated reservoir areas. The Proposed Action would remove the dams' associated reservoirs, and substantial changes would occur in the former reservoir area during drawdown and until restoration is complete. The Klamath River in the vicinity of the reservoirs would be reduced in breadth to its historic channel width and depth, exposing all previously inundated areas except the historic river channel. The receding water would expose reservoir sediments at the bottom of the reservoir. No other known cumulative actions or projects would affect the scenic resources in the previously inundated areas during this time period. **There would be no significant cumulative scenic impacts associated with the exposed reservoir areas.**

Deconstruction and restoration activities could result in short-term impacts on scenic resources in the immediate vicinity of the Four Facilities. Deconstruction activities would have temporary impacts on existing scenic resources around the Four Facilities because of the presence of construction staging and stockpiling. No other known cumulative actions or projects would affect the scenic vistas at the dam sites during deconstruction because this area would be closed to the public. **There would be no significant cumulative scenic vista impacts associated during deconstruction.**

Construction of a new, elevated Yreka Water Supply Pipeline and steel pipeline bridge to support the pipe above the river could result in short and long-term impacts on scenic resources. The new prefabricated steel pipe bridge would likely be three spans with a center span of 200 feet and two end spans of 100 feet. The spans would be supported on concrete piers. The new pipeline would be connected to the existing buried pipeline at each end of the bridge. No other known actions or projects would affect scenic resources in the location of the proposed bridge. **There would be no significant cumulative scenic effects associated with the City of Yreka's elevated water supply pipeline.**

Replacement of the existing wooden Lakeview Bridge just downstream from Iron Gate Dam with a concrete bridge could result in short and long-term impacts on scenic resources. If the Lakeview Bridge is replaced with a concrete bridge in the same location, there would be short-term significant impacts on scenic quality during construction from the presence of construction equipment, and long-term impacts because the wooden bridge would be replaced with a concrete bridge. No other known actions or projects would affect scenic resources in the location of the existing bridge. **There would be no significant cumulative scenic effects associated with the replacement of the Lakeview Bridge.**

Deconstruction of existing recreation facilities and construction of new recreation facilities, such as campgrounds and boat ramps, from the reservoir banks to the new river shoreline would result in short and long-term impacts on scenic resources. The recreation areas located on the edges of the existing reservoirs would be removed once the reservoirs have been drawn down. Removal activities would include deconstruction and site restoration. No other known cumulative actions or projects would affect visual resources in the locations of the recreational facilities to be demolished. **There would be no significant cumulative scenic effects associated with the deconstruction of the recreational facilities along the reservoirs.**

Deconstruction could create a new source of light or glare that could adversely affect nighttime views in the area. Temporary lighting would be erected for nighttime activities, and security lighting might be required during deconstruction. No other known cumulative actions or projects would introduce light or glare at the Four Facilities during deconstruction. **There would be no significant cumulative scenic impacts associated with light or glare.**

Drawdown and removal of the four reservoirs could cause temporary changes in the appearance of the Klamath River in the area of the dams and downstream from Iron Gate

Dam. In the short term, water aesthetics (clarity, turbidity, depth of view, and color) in the receding reservoir and downstream river reaches would likely be affected as the sediment behind the dams erodes and washes downstream. Other projects and actions that could occur during reservoir drawdown and could alter the appearance of the Klamath River could include subdivision developments in Siskiyou County, timber harvesting, mining activities, and large storm events. These could contribute sediment and could change the clarity, turbidity, depth of view, and color of the Klamath River. If one or more of these actions occurred at the same time as reservoir drawdown, there could be significant cumulative effects associated with the visual appearance of the river. The Proposed Action's impacts would be temporary and would occur in the winter when the river may already have a changed appearance from runoff and increased turbidity. Because the Proposed Action's contribution would be temporary and would end after the reservoirs were drawn down, **the Proposed Action's incremental contribution to the significant cumulative effect on the appearance of the Klamath River in the short term would not be cumulatively considerable.**

Removal of the dams and facilities could result in long-term impacts on scenic resources from changes to water quality. As described in Section 3.2, Water Quality, removal of the dams at the Four Facilities is expected to improve water quality in the long term. The changes are expected to reduce the river's summer algae concentrations, resulting in changes in both water clarity and coloration. An improvement in water quality could result in some improvement in scenic resources, such as water clarity or fish viewing opportunities. These improvements would be most noticeable from on-river and riverside viewpoints, and much less noticeable from river canyon roadway and community viewpoints. Other cumulative actions and programs that could also improve water quality on the Klamath River include implementation of TMDLs on the Scott, Salmon, Shasta, and Klamath Rivers as noted in Table 4-3, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, and the Five Counties Road Maintenance Program. Additionally, the Northwest Forest Plan contains provisions for reducing water quality impacts from timber harvesting and road construction. Together these cumulative actions and programs would contribute to improving water quality in the Klamath Basin and could positively affect scenic resources. **The Proposed Action's incremental contribution to the significant cumulative effect on scenic resources would be beneficial.**

4.4.18.1.1 KBRA - Programmatic Measures

Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II, Fish Entrainment Reduction, the Klamath Tribes Interim Fishing Site, and the Fisheries Reintroduction and Management Plan could result in impacts on scenic resources or introduce new features into the landscape. Many of the KBRA actions and programs would likely require some type of construction. Construction equipment, vehicles, staging areas, and stockpiling areas could have temporary impacts on scenic resources within localized construction areas. No other cumulative actions or projects

have been identified that would cause significant cumulative effects on scenic resources. However, when specific locations and construction schedules are available, additional analysis would be completed. **There would be no significant cumulative effects on scenic resources. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

The Fisheries Restoration Plan- Phase I and Phase II, Wood River Wetland Restoration Project, Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in long-term impacts on scenic resources. The Fisheries Restoration Plan is intended to benefit fish populations and therefore increase fish viewing opportunities, which would result in beneficial effects to scenic resources. In addition, actions are anticipated to result in scenery more consistent with the naturally established, characteristic landscape**.** The Wood River Wetland Restoration Project is intended provide additional water storage which could potentially result in scenery more consistent with the naturally established, characteristic landscape. The Water Diversion Limitations, On-Project Plan, WURP, and Interim Flow and Lake Level Programs could result in changes to land uses, including changes from ranchland to water storage areas. These changes have the potential to be beneficial if they result in landscapes (wetlands) that are consistent with the naturally established, characteristic landscape. The only other main cumulative action that would have beneficial effects on scenic resources is the implementation of the KHSA, which would remove reservoirs and restore a portion of the Klamath River to its natural state. Together these actions would have beneficial effects on scenic resources. **The KBRA's incremental contribution to the cumulative effects on scenic resources would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Construction activities associated with fish collection facilities would introduce new features into the landscape. Trap and haul operations within the Fisheries Reintroduction and Management Plan would require construction of fish collection and handling facilities below Keno and near Link River Dams to seasonally move fish around Keno Impoundment/Lake Ewauna and Link River during times of poor water quality. Constructing these facilities would result in temporary impacts on scenic resources at Keno and Link River Dams, and the fish handling facilities would remain in the long term to change the visual landscape. The handling facilities would not be in the same visual area as the Four Facilities; therefore, construction of fish handling facilities would not compound the effects of facility removal actions. No other cumulative actions or projects have been identified that would affect scenic resources at Keno and Link River Dams. **There would be no significant cumulative effects associated with fish collection facilities. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

*Fish Entrainment Reduction could result in long-term impacts on scenic resources. Construction activities associated with fish collection facilities below Keno Dam and above Klamath Lake would introduce new features into the landscape***.** *Construction*

*activities associated with fish collection facilities below Keno Dam and above Klamath Lake would introduce new features into the landscape***.** The impact to scenic resources from the addition of the fish management and entrainment reduction structures would likely be inconsistent with the naturally established, characteristic landscape. No other cumulative actions or projects would introduce structures into the waterway at these locations. **There would be no significant cumulative effects on scenic resources. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.18.2 Alternatives 3, 4, and 5

Alternatives 3 and 5 would have similar cumulative scenic effects as those described above for Alternative 2. Alternative 4 would not have any cumulative scenic effects associated with reservoir drawdown or reservoir removal. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.18.3 Mitigation Measures

There would be no cumulatively considerable adverse effects; therefore, no mitigation is required.

4.4.19 Recreation

Cumulative effects on recreation would be associated with changes in the available recreational facilities and/or opportunities adjacent to the Klamath River, reservoirs, and within the Klamath Basin. The timeframe for recreation therefore includes the duration of construction (May 2019 through December 2020) and continues indefinitely afterwards because post-construction impacts would be permanent. No cumulative projects were identified that would further reduce reservoir/lake based recreation opportunities including reservoir-based fishing, flat water boating, and camping and day use facilities adjacent to a reservoir. This analysis does not include effects discussed as part of the Wild and Scenic Rivers analysis in Chapter 3. Table 4-21 presents a summary of the recreation impacts described in Chapter 3. These impacts are analyzed for cumulative effects below the table.

There are no known past, present, or future actions or projects that would substantially alter recreation facilities or recreation opportunities along the Klamath River. There are, however, a number of ongoing actions to improve fisheries, including the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. These would benefit recreational fishing.

Table 4-21. Summary of Recreation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued existence of the reservoirs could change existing recreation access and opportunities.	1,4	NCFEC	None	NCFEC
Construction activities associated with ongoing programs could temporarily restrict access to recreational opportunities.	1	LTS	None	LTS
Construction activities associated with ongoing programs could result in short-term water quality impacts which could affect recreational opportunities.	1	LTS	None	LTS
Ongoing actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	1	B	None	B
Construction activities would temporarily restrict recreational access on and in the vicinity of the reservoirs.	1, 4	NCFEC	None	NCFEC
	2, 3, 5	LTS	None	LTS
Construction activities, such as demolition, would generate temporary impacts (i.e., increased noise and dust) and could decrease the quality of recreational experiences in the vicinity of the reservoirs.	2, 3, 5	LTS	None	LTS
Reservoir removal could permanently decrease the availability of reservoir/lake-based recreational opportunities.	1, 4	NCFEC	None	NCFEC
	2, 3, 5	LTS	None	LTS
Removal of recreation facilities could limit access to recreational opportunities along and within the newly formed river channel.	2, 3, 5	S	REC-1: Prepare a plan to develop new recreational facilities and river access points	LTS

Table 4-21. Summary of Recreation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Changes in flow and water quality following Facility removal could impact developed recreational facilities upstream and downstream from the reservoirs.	2, 3, 5	LTS	None	LTS
Downstream sediment release during reservoir drawdown could decrease the quality of water-contact-based-recreation in the short term.	2, 3, 5	LTS	None	LTS
Removal of reservoirs improves water quality and could impact water-contact-based recreational opportunities.	2, 3, 5	B	None	B
	1, 4	NCFEC	None	NCFEC
Changes to the floodplain or river channel and removal of recreation facilities as a result of Facility removal could affect access to whitewater boating opportunities.	2, 3, 5	NCFEC (downstream from Iron Gate); LTS (Hydroelectric Reach)	None	NCFEC (downstream from Iron Gate); LTS (Hydroelectric Reach)
Changes in flows following Facility removal could increase the number of days with acceptable flows for whitewater boating and recreational fishing in the Keno Reach and reaches downstream from Iron Gate Dam.	2, 3, 5	LTS	None	LTS
Changes in flows could increase the number of days with acceptable flows for whitewater boating and recreational fishing in the J.C. Boyle and Copco 2 Bypass Reaches.	2, 3, 5	B	None	B
Changes in flows could decrease the number of days with acceptable flows for whitewater boating and recreational fishing in the Hells Corner Reach.	2, 3, 5	S (whitewater boating); LTS (fishing)	None	S (whitewater boating); LTS (fishing)
Loss of peaking flows in the J.C. Boyle Peaking Reach could affect whitewater boating opportunities in the Hell's Corner Reach.	4, 5	S	None	S

Table 4-21. Summary of Recreation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Improved habitat for anadromous fish species following Facility removal could affect recreational fishing opportunities in the long term.	2, 3, 4, 5	B	None	B
Implementation of Mitigation Measure REC-1 could permanently reduce recreational opportunities in the Klamath Basin.	2, 3, 5	LTS	None	LTS
Keno Transfer				
Transfer of the Keno Facility from PacifiCorp to DOI could affect recreational opportunities.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
The decommissioning of the East and Westside Facilities could have adverse effects on recreational resources.	2, 3	NCFEC	None	NCFEC
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
The Yreka Water Supply Pipeline, currently under the Iron Gate Reservoir, would need to be relocated to avoid damage after the reservoir is removed, which could change existing recreational resources.	2, 3	NCFEC	None	NCFEC
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction activities associated with the KBRA could temporarily restrict recreational access.	2,3	LTS	None	LTS
Construction activities associated with KBRA programs could result in short-term water quality impacts which could affect recreational opportunities.	2,3	LTS	None	LTS
Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin.	2,3	B	None	B

Table 4-21. Summary of Recreation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin.	2,3	B	None	B
KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin.	2,3	B	None	B
KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin.	2,3	B	None	B

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

There are no known past, present, or future actions or projects that would substantially alter recreation facilities or recreation opportunities along the Klamath River. There are, however, a number of ongoing actions to improve fisheries, including the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. These would benefit recreational fishing.

4.4.19.1 Alternative 2: Full Facilities Removal of Four Dams

Demolition activities could temporarily restrict recreational access in the vicinity of the reservoirs. Short-term demolition activities associated with dam removal would result in temporary loss of access to recreational facilities at the Four Facilities and associated reservoir-based recreational opportunities. No other known actions or projects from May 2019 through December 2020 would occur that would restrict recreation access along the Klamath River. **There would be no significant cumulative impacts associated with restricted recreation access during deconstruction.**

Temporary impacts from demolition activity (i.e., increased noise and dust) could decrease the quality of recreational experiences in the vicinity of the reservoirs. No other known actions or projects from May 2019 through December 2020 would occur that would restrict recreation access along the Klamath River. **There would be no significant cumulative impacts associated with a decrease in the quality of recreational experiences due to demolition activities.**

Facility removal would permanently decrease the availability of reservoir/lake-based recreational opportunities in the area of analysis. The removal of the Facilities would eliminate existing opportunities for reservoir-based recreation activities, such as power boating, waterskiing, lake swimming, and flat-water boat and shore angling, provided at J.C. Boyle, Copco 2, and Iron Gate Reservoirs. No other cumulative projects were identified that would further reduce reservoir/lake based recreation opportunities including reservoir-based fishing, flat-water boating, and camping and day use facilities adjacent to a lake in the Klamath Basin. **There would be no significant cumulative effects associated with the decrease of reservoir/lake based recreation.**

Facility removal could permanently remove recreational facilities associated with the reservoirs. Under the Proposed Action, the recreational facilities constructed to accommodate reservoir recreation, with the exception of Topsy Campground, Fall Creek and Jenny Creek Day Use Areas, and the Iron Gate Fish Hatchery Day Use Area, would be completely removed and the former recreation areas, parking areas, and access trails would be regraded and revegetated (O'Meira et al. 2010). No actions or projects were identified that would further reduce recreation opportunities along the Klamath River. **There would be no significant cumulative effects associated with the removal of the reservoir recreation facilities.**

Facility removal could adversely affect developed recreational facilities upstream and downstream from the subject reservoirs. No actions or projects were identified that would substantially change recreation facilities upstream or downstream from the reservoirs. **There would be no significant cumulative effects associated with recreation facilities upstream or downstream from the Four Facilities.**

Sediment release downstream during reservoir drawdown could decrease the quality of water-contact-based recreational opportunities. The increase in turbidity would reduce visibility and water clarity and this could affect recreation. Other actions that could occur in the Klamath Basin that could increase turbidity include construction of new subdivisions around Iron Gate Dam in Siskiyou County listed in Table 4-4, mining activities, timber harvesting, agricultural activities, road improvements, and large storm events. Together, these could result in high levels of turbidity that could cause significant cumulative water quality effects that could decrease the quality of water-based recreation. The Proposed Action's contribution to this effect would be minimal. The Proposed Action's effects on turbidity would be temporary and almost all the sediment would likely be flushed to the ocean in about two years or less. The Proposed Action would only affect turbidity levels downstream from Iron Gate Dam.

The Proposed Action's incremental contribution to the significant cumulative effect on the quality of water-contact based recreational opportunities in the short term would not be cumulatively considerable.

Changes in water quality associated with dam removal could positively affect water-contact-based recreational opportunities. Facility removal is expected to result in long-term improvements in water quality that could benefit water-contact-based recreational activities. Many other past, present, and future cumulative actions and programs are taking place or are planned to take place in the Klamath Basin to improve water quality, including the implementation of TMDLs on the Scott, Salmon, Shasta, and Klamath Rivers as noted in Table 4-3, the Hoopa Valley Tribe Water Quality Control Plan (Hoopa Valley Indian Reservation 2008), the Water Quality Control Plan by the Yurok Tribe (2004) and the Draft Eco-Cultural Resources Management Plan (2010) by the Karuk Tribe that contain measures and programs to improve water quality, various watershed and creek restoration projects by the Hoopa Valley Tribe and Siskiyou County noted in Table 4-4, and the Five Counties Road Maintenance Program. Additionally, the Northwest Forest Plan contains provisions for reducing water quality impacts from timber harvesting and road construction. Together these cumulative actions and programs would contribute to improving water quality in the Klamath Basin and could positively affect water-contacted based recreation. **The Proposed Action's incremental contribution to the cumulative effects on the quality of water-contact-based recreational opportunities in the long term would be beneficial.**

Facility removal could impede access for whitewater boating opportunities. In the reaches between the existing dams, particularly in the Hell's Corner reach, whitewater boating access would likely be affected due to dam removal activities and sedimentation. No cumulative actions or projects have been identified that would further reduce whitewater boating opportunities along the Klamath River during deconstruction. **There would be no significant cumulative effects associated with access for whitewater boating.**

Facility removal could increase the number of days with acceptable flows for various whitewater boating and recreational fishing in the Keno Reach and reaches downstream from Iron Gate Dam. Dam removal could increase the number of days with acceptable flows for whitewater boating and recreational fishing in the J.C. Boyle and Copco 2 Bypass Reaches.. Dam removal could decrease the number of days with acceptable flows for whitewater boating in the Hell's Corner Reach. No other known actions or projects would change the number of days with acceptable flows for water-based recreation on the Klamath River. **There would be no significant cumulative effects associated with reducing the number of days with acceptable flows for recreation activities.**

Facility removal would result in increased fisheries populations and abundance, which would improve recreational fishing along the river. Removal of the Facilities would improve habitat conditions for anadromous fish species and is expected to result in increased populations of these species. The increased fisheries populations and abundance would increase the opportunity for recreational fishing. Many other ongoing programs are intended to improve fisheries in the Klamath River and its tributaries,

including the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. Together, these actions and the Proposed Action could result in cumulatively beneficial effects on recreational fishing. **The Proposed Action's incremental contribution to the significant cumulative effect on recreational fishing would be beneficial.**

4.4.19.1.1 KBRA - Programmatic Measures

Construction activities associated with the Phase I Fisheries Restoration Plan could temporarily restrict recreational access. Although specific plans have not yet been developed, floodplain rehabilitation would likely involve the use of heavy equipment along floodplain and riparian areas and therefore could result in restrictions to public access for recreational activities. No other cumulative actions or projects have been identified that could potentially restrict recreation access on the Klamath River. **There would be no significant cumulative effects associated with restricted recreation access. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Construction activities associated with KBRA programs could result in short-term water quality impacts that could affect recreational opportunities. Erosion and sedimentation during construction activities has the potential to temporarily decrease water quality and reduce water visibility for boaters, swimmers, and fisherman. These short-term water quality impacts would be anticipated to occur throughout the basin where construction activities take place. Specific sections of the river could be affected for a period of time throughout implementation of the KBRA programs. BMPs would be implemented to reduce erosion and sedimentation during construction. Following implementation and related construction activities for KBRA programs including the Interim Flow and Lake Level Program, WURP, water quality and clarity would be expected to improve.

Other actions that could occur in the Klamath Basin that could increase turbidity include reservoir drawdown associated with the KHSA, construction of new subdivisions noted in Table 4-4, mining, timber harvesting, road improvements, recreation, and agricultural activities. Together, these could result in high levels of turbidity that could cause significant cumulative water quality effects that could decrease the quality of water-based recreation. The KBRA's contribution to this effect would be minimal. The KBRA's effects on turbidity would be temporary and would be controlled with best management practices. **The KBRA's incremental contribution to the significant cumulative effect on water quality that could decrease the quality of water-contact based recreational opportunities would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

Fire treatment proposed in the Fisheries Restoration Plan could alter the visual setting and result in decreased recreational visitors to the Klamath Basin. Implementation of the Fisheries Restoration Plan would likely include some sort of fire treatment throughout the basin. It is expected that large or severe burn treatments would result in a short-term adverse effect of the visual quality of the burned area, which could directly affect the

number of recreational visitors to the area (i.e., depending on the size and intensity of the burn, recreationalists may be less likely to visit an area immediately after a prescribed burn than an unburned area). However, long-term visual quality benefits typically result from burn treatments that are consistent with the historic range of the ecosystem. No other cumulative actions are projects have been identified that would substantially alter the visual setting of the basin through proscribed burning that could decrease recreational visitors to the basin. **There would be no significant cumulative impacts associated with altering the visual setting and decreasing recreational visitors to the Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

KBRA actions correcting fish passage issues, reintroducing and monitoring fish species, and restoring aquatic habitat could increase recreational fishing and wildlife viewing opportunities in the basin. It is expected that correction of fish passage issues throughout the basin would restore fish access to new and historic habitats and result in increased fish populations. The increased fish populations and abundance would beneficially affect recreational fishing opportunities. More specifically, the increased abundance would allow for increased catch limits and fewer catch and release requirements, as well as decrease the potential of closures of entire fishing seasons as those that occurred on the Klamath River in the recent past. Many other ongoing actions or programs are intended to improve fisheries in the Klamath River and its tributaries, including the removal of the Four Facilities as part of the KHSA, the Trinity River Restoration Program, the Five Counties Road Management Program, and the Klamath Basin Conservation Area Restoration Program. The Northwest Forest Plan contains provisions to reduce impacts from timber harvesting on aquatic species and habitat. Other stream and watershed restoration actions, such as those being completed by the Hoopa Valley Tribe and Siskiyou County (see Table 4-4) would also improve fisheries. Together, these actions and the Proposed Action could result in cumulatively beneficial effects on recreational fishing. **The Proposed Action's incremental contribution to the significant cumulative effect on recreational fishing would be beneficial. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

KBRA programs resulting in long-term water quality improvements could increase recreational opportunities throughout the Klamath Basin. KBRA programs including the Fisheries Restoration Plans Phase I and II, Fisheries Reintroduction and Management Plan Phase I and II, WURP, and Interim Flow and Lake Level Program would result in long-term benefits to water quality throughout the Klamath Basin. No other cumulative actions or projects have been identified that would increase recreational opportunities in the Klamath Basin. **There would be no significant cumulative effects associated with increased recreational opportunities in the Klamath Basin. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

KBRA programs that enhance terrestrial wildlife and plant resources could increase recreational opportunities throughout the Klamath Basin. KBRA programs would result

in long-term benefits to terrestrial species as a result of restored floodplain and riparian vegetation and habitat areas. It is anticipated that improvements and increases in terrestrial wildlife habitat would benefit recreational wildlife viewing and recreational hunting opportunities in the Klamath Basin**.** Other cumulative actions and programs identified in the Klamath Basin that would also contribute to enhancing wildlife and plant resources include California Wildlife: Conservation Challenges (California Department of Fish and Game [CDFG] 2005), which is California's Wildlife Action Plan and outlines measures for conservation of wildlife and habitat, the Riparian Bird Conservation Plan (Riparian Habitat Joint Venture 2004), which provides conservation guidance and implements various programs for riparian bird species in California, and the California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California (CDFG and Caltrans 2004), which provides information on wildlife corridors that will be used to help implement the Wildlife Action Plan, and will encourage consideration of wildlife corridors for transportation and land use planning projects. Together, these would have beneficial cumulative impacts on terrestrial vegetation and wildlife. **The KBRA's incremental contribution to the cumulative effects on terrestrial and wildlife species that could increase recreational opportunities throughout the Klamath Basin would be beneficial**. **Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.19.2 Alternatives 3, 4, and 5

Alternative 3 would have similar cumulative recreation effects as Alternative 2. Alternative 4 would not have any cumulative recreation effects, beyond potentially improving fish passage and therefore improving recreational fishing. Alternative 5 would have similar cumulative effects as Alternative 2 but because two dams would remain in place, cumulative benefits to water quality and fisheries would be less. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.19.3 Mitigation Measures

There are no cumulatively considerable recreation effects; therefore, no mitigation measures are required.

4.4.20 Toxic/Hazardous Materials

Cumulative toxic and hazardous materials effects could occur from future projects in the vicinity of the Four Facilities that could require the use, transport, or disposal of hazardous materials, or that could involve the accidental release of hazardous materials around the Four Facilities. The timeframe for cumulative effects associated with toxic and hazardous materials includes the duration of construction (May 2019 through December 2020). No permanent toxic or hazardous materials would occur after construction is complete. Table 4-22 presents a summary of the toxic and hazardous materials impacts presented in Chapter 3. These impacts are analyzed for cumulative effects below the table.

Table 4-22. Summary of Toxic/Hazardous Materials Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Continued operation of the Four Facilities could create a hazard to the public or the environment through the transport, use, or disposal of hazardous materials.	1, 4, 5	NCFEC	None	NCFEC
Construction activities could create a hazard to the public or the environment if they are located on a site which is included on a list of hazardous materials sites.	2, 3, 4, 5	NCFEC	None	NCFEC
Construction activities could create a hazard to the public or the environment through the transport, use, or disposal of HTRW.	2, 3, 4, 5	LTS	None	LTS
Construction activities could create a hazard to the public or the environment through the abatement and disposal of asbestos and lead-based paint.	2, 3, 5	LTS	None	LTS
Construction activities could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 4, 5	LTS	None	LTS
Removal of various recreation facilities could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment.	2, 3, 5	LTS	None	LTS
Keno Transfer				
The transfer of the Keno Facility to DOI could result in affects to HTRW.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
The decommissioning of the East and Westside Facilities could have adverse effects in terms of toxics and hazards.	2, 3	LTS	None	LTS
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Construction activities required to relocate the Yreka Water Supply Pipeline could create a hazard to the public or the environment through the accidental release of hazardous materials into the environment	2, 3, 5	LTS	None	LTS

Table 4-22. Summary of Toxic/Hazardous Materials Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Klamath Basin Restoration Agreement – Programmatic Measures				
Construction activities associated with the KBRA programs could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered during construction.	2,3	LTS	None	LTS
Construction activities associated with the KBRA programs could create a hazard to the public or the environment through the accidental release of hazardous materials during construction activities.	2,3	LTS	None	LTS

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

There are no known actions or projects that would occur directly at the Four Facilities that could contribute to cumulative hazardous or toxic materials impacts. There are several new subdivisions proposed around Iron Gate Dam and several road improvements proposed for Siskiyou County. If these actions occur at the same time as dam removal, they could contribute to cumulative hazardous and toxic materials impacts through the use, storage, disposal, and accidental release of hazardous materials.

4.4.20.1 Alternative 2: Full Facilities Removal of Four Dams (Proposed Action)

Facility deconstruction could create a hazard to the public or the environment through the transport, use, or disposal of hazardous materials during construction. Facility deconstruction could create a hazard to the public or the environment through the abatement and disposal of asbestos and lead-based paint during construction. Drawdown of the reservoirs would require removal of recreational facilities currently located on the banks of the existing reservoirs. The decommissioning of the East and Westside Facilities could have adverse effects in terms of toxics and hazards. The Proposed Action would involve the use, transport, and disposal of hazardous materials during deconstruction. In addition, deconstruction activities may uncover hazardous materials. Future development such as the proposed subdivisions near Iron Gate Dam or road improvements, mining, or agricultural activities could also involve the use,

transport, or disposal of hazardous materials in and around the dam sites. Together these projects and the Proposed Action could result in significant cumulative effects on the public or the environment if they occurred simultaneously. The Proposed Action's incremental contribution to the cumulative effect would not be cumulatively considerable. The Proposed Action's contribution to any toxic and hazardous materials cumulative effects would be minimized by a hazardous materials management plan that would contain measures for proper handling and transport to prevent hazardous materials effects on the public and environment. No schools exist within 3 miles of the project site; therefore, no schools would be exposed to hazardous materials. **The Proposed Action's incremental contribution to significant cumulative effects associated with toxic and hazardous materials would not be cumulatively considerable.**

Facility deconstruction could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction. Removal of Iron Gate Reservoir would require the relocation of the Yreka Water Supply Pipeline, which could create a significant hazard to the public or the environment through the accidental release of hazardous materials into the environment during construction. Some equipment and deconstruction activities may require the use and storage of hazardous materials on-site. An accidental release of these materials could pose a threat to the public and the environment. Future development such as the proposed subdivisions near Iron Gate Dam or road improvements could also accidentally uncover or release hazardous materials in and around the dam sites. Together these projects and the Proposed Action could result in significant cumulative effects on the public or the environment. The Proposed Action's incremental contribution to the cumulative effect would not be cumulatively considerable. The Proposed Action's contribution to any toxic and hazardous materials cumulative effects would be minimized by a health and safety plan and a hazardous materials management plan that would contain measures for proper handling, storage, and transport of hazardous materials, as well as spill prevention measures to be implemented on-site. Proper clean up equipment would be required to be kept on-site in the case of accidental spills or releases. **The Proposed Action's incremental contribution to the significant cumulative effects associated with the accidental release of toxic and hazardous materials would not be cumulatively considerable.**

4.4.20.1.1 KBRA - Programmatic Measures

Construction activities associated with the Fisheries Restoration Plan- Phase I and Phase II and Fish Entrainment Reduction could create a significant hazard to the public or the environment through the transport, use, or disposal of hazardous materials encountered or through the accidental release of hazardous materials during construction. The KBRA could require the transport, use, and disposal of hazardous materials and has the potential to result in accidental releases of such materials during construction. While the specific locations and schedules for KBRA actions are currently unknown, the KBRA actions could combine with other actions requiring the transport, use, or disposal of hazardous materials, such as road construction, mining, or agricultural activities, and could result in significant cumulative hazardous impacts. The KBRA's contribution to the significant cumulative effect would be minimal. A health and safety

plan and a hazardous materials management plan that would contain measures for proper handling, storage, and transport of hazardous materials, as well as spill prevention measures to be implemented on-site. Proper clean up equipment would be required to be kept on-site in the case of accidental spills or releases. **The KBRA's incremental contribution to the cumulative effect on hazardous materials would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate.**

4.4.20.2 Alternatives 3, 4, and 5

Alternatives 3, 4 and 5 would have similar cumulative hazardous effects as those described for Alternative 2; however, Alternative 4 would not require the removal of any dams and would therefore not contribute to cumulative effects associated with handling and disposal of hazardous materials from hydroelectric facilities and infrastructure. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; therefore there would be no cumulative effects associated with KBRA actions**.**

4.4.20.3 Mitigation Measures

There would be no cumulatively considerable effects; therefore, no mitigation measures are required.

4.4.21 Traffic and Transportation

Cumulative effects on transportation would be associated with the cumulative ambient background growth in traffic volumes that would result from traffic associated with the dam removal and future actions or projects that may temporarily or permanently increase traffic levels in the area of analysis. The traffic analysis presented in Section 3.22, Traffic and Transportation, in Chapter 3 already considers the dam removal traffic impacts and those of background growth in traffic volumes for the years of construction. For the transportation analysis in Chapter 3, ambient background growth was calculated and superimposed on baseline traffic volumes before applying additional "project related" traffic volumes to the roadways for analysis. This method ensures the accounting of traffic growth out to the planning timeframe.

Therefore, this cumulative analysis focuses on future projects or actions that could occur that might increase traffic levels in the area. This analysis is performed on a qualitative level rather than a quantitative level because the future timeframe for implementation of the Proposed Action and alternatives makes it difficult to accurately predict all actions or projects that could be implemented and contribute cumulative traffic impacts. The timeframe for this cumulative effects analysis includes the duration of construction as no permanent traffic impacts would occur from the Proposed Action or alternatives. Table 4-23 presents a summary of the traffic and transportation impacts described in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Traffic Flow Effects				
Construction vehicle trips could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 4, 5	LTS	None	LTS
	1	S	Traffic Management BMPs	LTS
Construction vehicle trips could result in temporary traffic flow effects on on-site roads.	2, 3, 4, 5	LTS	None	LTS
	1	NCFEC	None	NCFEC
Construction vehicle trips during removal of recreation facilities associated with dam removal could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 5	LTS	None	LTS
Implementation of the interim measures (IM's) 8 J.C. Boyle Bypass Barrier Removal and IM 16 Water Diversions could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	1 (IM 8); 2 (IM 8 and 16)	LTS	None	LTS
Traffic Safety Effects				
Construction vehicle trips could cause traffic safety effects associated with the creation of dust along gravel roads.	2, 3, 5	LTS	None	LTS
Construction vehicle trips could cause traffic safety effects associated with vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road and OR66.	2, 3, 4, 5	LTS	None	LTS
Construction vehicle trips could cause traffic safety effects associated with sharp curves along Copco Road and OR66.	2, 3, 5	LTS	None	LTS
The removal of existing recreation facilities from the banks of the existing reservoirs and replacement with new recreations facilities down slope to the new river bed could result in traffic impacts along adjacent roadways.	2	LTS	None	LTS

Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Changes in traffic safety could occur.	1	NCFEC	None	NCFEC
Implementation of IM 7 J.C. Boyle Gravel Placement could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	1,2,3	LTS	None	LTS
Implementation of IM's 8 J.C. Boyle Bypass Barrier Removal could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	1,2,3	LTS	None	LTS
Implementation of IM 16 Water Diversions could cause traffic safety effects associated with sharp turns along Copco Road and OR66.	2,3	LTS	None	LTS
Trap and Haul – Programmatic Measure				
Traffic associated with the implementation of haul operations would cause traffic safety effects on OR66 and US97, access roads, and onsite roads.	4,5	LTS	None	LTS
Road Condition Effects				
Increased traffic volumes from heavy construction vehicles during construction activities could degrade road conditions and exceed bridge weight capacities. As part of the development of the construction plan, an in depth analysis of bridge and road capacity and state of repair will be conducted by the dam removal entity (DRE), with remedial actions taken prior to the commencement of facility deconstruction.	2, 3, 4, 5	S	TR-1: Relocate Jenny Creek Bridge and Culverts	LTS
Changes in road conditions could occur.	1	NCFEC	None	NCFEC
Public Transit Effects				
Construction vehicle trip volumes and material hauling routes could affect regional transit service.	2, 3, 4, 5	LTS	None	LTS
Changes in public transit could occur.	1	NCFEC	None	NCFEC

Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Non-Motorized Transportation Effects				
The presence of construction vehicles along Copco and Topsy Grade/Ager-Beswick Roads could affect non-motorized transportation (i.e., bicyclists and pedestrians) due to high speeds and dust generation.	2, 3, 4, 5	LTS	None	LTS
Changes in non-motorized transportation could occur.	1	NCFEC	None	NCFEC
Keno Transfer				
The transfer of the Keno Facility could impact traffic and transportation.	2, 3	NCFEC	None	NCFEC
East and Westside Facilities – Programmatic Measure				
Activities associated with the decommissioning of the East and Westside Facilities could affect traffic and transportation.	2, 3	LTS	None	LTS
Yreka Water Supply Pipeline Relocation – Programmatic Measure				
Construction vehicle trips during the relocation of the Yreka Water Supply Pipeline could result in temporary traffic flow effects on I-5, OR66, US97, and access roads.	2, 3, 5	LTS	None	LTS
Construction vehicle trips during the relocation of the Yreka Water Supply Pipeline and removal of recreation facilities could cause traffic safety effects associated with sharp curves along Copco Road. The installation of signage at sharp corners would help to reduce this risk (See Appendix B).	2, 3, 5	LTS	None	LTS
Klamath Basin Restoration Agreement – Programmatic Measures				
Activities associated with the KBRA programs involving construction could cause temporary traffic effects.	2,3	LTS	None	LTS

Table 4-23. Summary of Traffic and Transportation Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Operational activities associated with the Fisheries Reintroduction and Management Plans could result in temporary traffic effects associated with trap and haul activities.	2,3	LTS	None	LTS

Key:
1 = No Action/No Project
2 = Full Facilities Removal of Four Dams Alternative (Proposed Action)
3 = Partial Facilities Removal of Four Dams Alternative
4 = Fish Passage at Four Dams Alternative
5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

Actions or projects that could contribute to cumulative traffic impacts include construction of new subdivisions in Siskiyou County, and road improvement projects planned by Siskiyou County Public Works, Klamath County, and Jackson County, as noted in Table 4-3 above. Ongoing mining, timber harvesting, recreation, and agricultural activities could also contribute to cumulative traffic impacts and are considered.

4.4.21.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.21.1.1 Traffic Flow Effects

Deconstruction activities associated with the Proposed Action would result in temporary traffic flow effects on Interstate-5 (I-5), OR66, US97, and access roads. Deconstruction activities would increase traffic on I-5, OR66, US97, and access roads to the Four Facilities. Several projects or actions in the area of analysis that would also likely increase traffic include various approved subdivisions in Siskiyou County noted in Table 4-4 and mining operations in Siskiyou County. Road improvement projects planned by Siskiyou County Public Works, Klamath County, and Jackson County could also affect traffic on access roads or highways by increasing the number of construction vehicles or diverting traffic onto other roads. However, current traffic does not exceed the existing Level of Service (LOS) or volume to capacity (v/c) ratios and future traffic with planned growth is not expected to exceed these. The Proposed Action's contribution to this cumulative effect would be minimal. None of the main roads in the area of analysis would experience volumes in excess of their planned LOS or volume to capacity (v/c) ratio due to traffic resulting from implementation of the Proposed Action. Additionally, the traffic impacts would only occur for the duration of deconstruction. No

permanent traffic effects would occur. **There would be no significant cumulative traffic flow effects on I-5, OR66, US97, or access roads.**

Deconstruction activities associated with the Proposed Action would result in temporary traffic flow effects on on-site roads. Construction activities associated with the demolition of recreation facilities would result in temporary traffic flow effects on I-5, OR66, US97, and access roads. Construction activities related to the relocation of the Yreka Water Supply Pipeline would result in temporary traffic flow effects on I-5, OR66, US97, and access roads. The Proposed Action would require the removal of existing recreation facilities from the banks of the reservoirs and construction of new recreation facilities down slope to the new river bed. The short but frequent heavy vehicle trips anticipated as part of dam deconstruction along on-site gravel roads could cause traffic flow concerns. Removal and replacement of recreation facilities and relocation of the Yreka Water Supply Pipeline would also increase traffic levels and could have construction traffic safety concerns associated with sharp curves. Cumulative projects that could also cause traffic flow and safety concerns include the widening of Copco Road by Siskiyou County Public Works, which currently does not have a date of implementation. The Proposed Action and the planned road widening could create significant cumulative traffic flow effects. The Proposed Action's incremental contribution to this significant cumulative effect would not be cumulatively considerable. The Lead Agencies would incorporate measures into the project to minimize such cumulative effects. Signage and construction traffic management would be implemented to maintain traffic flow. The Lead Agencies would coordinate with Siskiyou County Public Works to provide updates on the proposed deconstruction schedule and this could allow the planned Copco Road widening and other road improvements to be scheduled so as to help avoid cumulative effects. **The Proposed Action's incremental contribution to the significant cumulative traffic effects on on-site roads would not be cumulatively considerable.**

4.4.21.1.2 Traffic Safety Effects

Activities associated with the Proposed Action, would cause traffic safety effects associated with dust along gravel roads. High trip volumes would create a substantial amount of dust in dry conditions on Copco Road, Lakeview Road, Topsy Grade/Ager-Beswick Road, and the roads leading to and surrounding each dam. The dust could create a substantial visibility hazard for vehicles on the deconstruction sites throughout the area. Other future projects such as the planned subdivisions around Iron Gate Dam, mining activities, road improvements, and recreation could also increase dust along these roads and create significant cumulative dust impacts. The Proposed Action's contribution to the significant cumulative effects associated with dust would not be cumulatively considerable. The Proposed Action's dust impacts would be minimized with the incorporation of dust abatement measures. Additionally, the dust impacts would only last the duration of construction; no long term dust impacts would occur. **The Proposed Action's incremental contribution to the significant cumulative effects associated with dust from construction traffic would not be cumulatively considerable.**

Activities associated with the Proposed Action, would cause traffic safety effects associated with vehicle turnouts along Copco Road, Topsy Grade/Ager-Beswick Road and OR66. Slow moving construction traffic associated with the Proposed Action could have safety impacts when turning onto roads or merging onto freeways. A significant cumulative effect could occur if additional construction traffic was also present for roadway improvements, or if mining or other activities required the use of large construction vehicles in the same vicinity as the Proposed Action. The Proposed Action's incremental contribution to the cumulative effects would not be cumulatively considerable. The Proposed Action would implement appropriate signage and would coordinate with local agencies regarding road use during deconstruction to minimize cumulative effects. If conflicts are identified, the Lead Agencies would work with local agencies to re-route traffic, whenever feasible. **The Proposed Action's incremental contribution to the significant cumulative traffic effects associated with vehicle turnouts would not be cumulatively considerable.**

*Activities associated with the Proposed Action would cause traffic safety effects associated with sharp curves along Copco Road and OR66***.** *Activities associated with relocation of the Yreka's Water Supply Pipeline, implementation of the IMs, and relocation or demolition of recreation facilities would cause traffic safety effects associated with sharp curves along Copco Road and OR66***.** Sharp curves along Copco Road and OR66 could pose a safety risk for deconstruction traffic. All other projects using Copco Road or OR66 would be responsible for ensuring their own traffic safety; **therefore no significant cumulative effects are expected.**

4.4.21.1.3 Road Condition Effects

Under the Proposed Action, further analysis of road conditions and bridge weight capacities would be necessary. Bridges used for the Proposed Action deconstruction activities may not be capable of handling the heavy deconstruction vehicles. This impact is related solely to the Proposed Action; no other actions could contribute to this effect. **There would be no significant cumulative effects on road conditions and bridge weight capacities.**

4.4.21.1.4 Public Transit Effects

Under the Proposed Action, the trip volumes and routes of material hauling and worker trips could affect regional transit service. There are small overlaps between minor haul routes and public transit routes during deconstruction. No other known projects/actions in the area of analysis would affect regional transit service. **There would be no significant cumulative effects on regional transit service.**

4.4.21.1.5 Non-motorized Transportation Effects

Under the Proposed Action, heavy vehicle traffic could cause non-motorized transportation effects. Cyclists and pedestrians could travel along Copco and Topsy Grade/Ager-Beswick Roads because of the recreational nature of the area. These pedestrians and cyclists would have to travel along the road itself, and could encounter safety hazards when sharing the road with large hauling vehicles, which could occupy much of the available road width, generate dust, or vary speeds around corners. This

impact is related solely to the Proposed Action; no other actions could contribute to this effect. **There would be no significant cumulative effect on non-motorized transportation.**

4.4.21.1.6 KBRA - Programmatic Measures

Construction activities associated with the KBRA programs involving construction could cause temporary traffic effects. While several of the KBRA actions and programs would likely generate construction traffic, specific locations and construction, operation, and maintenance details are not available. For the purposes of this analysis, it is assumed that significant cumulative traffic impacts would occur. The KBRA would implement best management practices and would coordinate with local agencies to minimize or reduce traffic impacts. **Therefore, the KBRA's incremental contribution to the cumulative effects on traffic would not be cumulatively considerable. Implementation of the KBRA will require future environmental compliance as appropriate.**

Operational activities associated with the Fisheries Reintroduction and Management Plans could result in temporary traffic effects associated with trap and haul activities. Haul trucks would be required to relocate anadromous fish species around Keno Impoundment/Lake Ewauna and Link River. Haul trucks may travel on OR66, US97, access roads, and on-site roads. Seasonal trap and haul operations would occur during periods of poor water quality. Hauling activities would occur after the peak traffic-generating period of facility removal because fish cannot access Keno Dam until after removal of the Four Facilities; however, some construction traffic associated with completing removal activities and reservoir restoration may occur at the same time as hauling operations.

Other general cumulative actions or projects that could also contribute to increased traffic on these roads include the new residential subdivisions approved for Siskiyou County, mining, agricultural activities, recreation, and road improvements such as those planned in Siskiyou County. Together, these actions could increase the amount of traffic on existing roads and could cause temporary significant cumulative traffic impacts.

The KBRA's contribution to any cumulative traffic effects would be temporary and minimal. Seasonal trap and haul operations would occur at Keno Dam, but only until water quality conditions no longer require it. While construction traffic related to dam removal and hauling operations, taken together, could increase the severity of the traffic effects, the combined traffic would likely still be less than the peak traffic during dam deconstruction. **The KBRA's incremental contribution to the significant cumulative effects associated with traffic would not be cumulatively considerable. Implementation of specific plans and projects described in the KBRA will require future environmental compliance as appropriate**.

4.4.21.2 Alternatives 3, 4, and 5

Alternatives 3, 4, and 5 would have similar cumulative traffic effects as those described for Alternative 2 because they would require construction vehicles and equipment. Alternative 5 may contribute to fewer cumulative traffic effects because it would require

the removal of only two Facilities and therefore less roads would be used by construction vehicles and equipment. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; **therefore there would be no cumulative effects associated with KBRA actions.**

4.4.21.3 Mitigation Measures

No mitigation measures are required, **therefore, there would be no cumulatively considerable effects.**

4.4.22 Noise and Vibration

Cumulative noise impacts could occur from a variety of sources near the Four Facilities. Traffic, recreational activities, mining, agricultural activities, firefighting activities, and timber harvesting could all contribute to the cumulative background noise. The timeframe for noise and vibration impacts is during construction (May 2019 to December 2020).

Table 4-24 presents a summary of the noise and vibration impacts described in Chapter 3. These impacts are then analyzed for cumulative effects below the table.

Table 4-24. Summary of Noise and Vibration Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Construction and deconstruction activities at the Four Facilities could cause a temporary increase in noise levels at Copco 1 Dam that could affect residents in the area.	1	NCFEC	None	NCFEC
	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
	4	S	NV-1: Noise and Vibration Control Plan	LTS
Construction and deconstruction activities at the dam sites could cause a temporary increase in nighttime noise levels at Iron Gate Dam.	1	NCFEC	None	NCFEC
	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
	4	LTS	None	LTS
Reservoir restoration activities could result in short-term increases in noise levels in the vicinity of the reservoirs.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S

Table 4-24. Summary of Noise and Vibration Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Blasting activities at Copco 1 Dam could increase vibration levels.	2, 3, 5	S	NV-1: Noise and Vibration Control Plan	S
Construction activities at the Four Facilities could increase short-term vibration levels.	2, 3,5	S	NV-1: Noise and Vibration Control Plan	S
	4	LTS	None	LTS
Construction activities at the Four Facilities could require the transport of waste to off-site landfills and construction worker commutes which would cause increases in noise along haul routes.	2, 3, 4, 5	LTS	None	LTS
Trap and Haul – Programmatic Measure				
Trap and Haul operations could result in temporary increases in noise and vibration levels from vehicles used to relocate fish.	4, 5	S	NV-1: Noise and Vibration Control Plan	LTS
Keno Transfer				
The transfer of Keno Facility to the DOI could have adverse effects on noise and vibration.	2,3	NCFEC	None	NCFEC
East and Westside Facility Decommissioning – Programmatic Measure				
The decommissioning of the East and Westside Facilities could have adverse effects on noise and vibration.	2.3	LTS	None	LTS
Klamath Basin Restoration Agreement - Programmatic Measures				
Construction activities associated with the KBRA could cause temporary increases in noise and vibration levels.	2,3	S	NV-1: Noise and Vibration Control Plan	LTS

Table 4-24. Summary of Noise and Vibration Impacts from Chapter 3

Potential Impact	Alternatives	Significance Pursuant to CEQA	Proposed Mitigation	Significance After Mitigation Pursuant to CEQA
Operational activities associated with the Fisheries Reintroduction and Management Plan could result in temporary increases in noise and vibration levels from vehicles associated with trap-and-haul activities.	2,3	S	NV-1: Noise and Vibration Control Plan	LTS

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5 = Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative
NCFEC = No Change From Existing Conditions
B = Beneficial
LTS = Less than Significant
S = Significant
N/A = Not Applicable

Actions or projects that could contribute to cumulative noise effects include construction of the approved new subdivisions around Iron Gate Dam in Siskiyou County (see Table 4-4). Other more general activities that could contribute cumulative noise effects include road improvement projects, increases in traffic from population growth, and recreation activities.

4.4.22.1 Alternative 2: Full Facilities Removal of Four Dams

4.4.22.1.1 Construction Equipment Noise and Vibration

Deconstruction activities associated with the Proposed Action could cause a temporary increase in noise levels at Copco 1 that could affect residents in the area. Reservoir restoration activities could result in short-term increases in noise levels in the vicinity of Copco 1. Construction activities would result in significant noise impacts at Copco 1 during daytime construction activities and nighttime construction activities after 10:00 p.m. Helicopters and other equipment noise from embankment restoration would cause a temporary significant noise impact on the residential areas near Copco Lake. Mitigation measures would be implemented to reduce noise levels, but these would not reduce levels below significance criteria and noise would still be noticeable. At this time, there are no other known projects or actions are would be implemented in the same time frame near Copco 1 Reservoir that would result in a new source of noise and could contribute to cumulative noise effects. However, future residential development, mining, agricultural or recreation activities, firefighting practices, road improvements, and increased traffic levels from population increases could contribute to increased noise levels at Copco 1. If these activities occurred around Copco 1, they could result in significant cumulative noise effects. The Proposed Action's incremental contribution to

the significant cumulative noise effects would be cumulatively considerable. The Proposed Action would implement all feasible mitigation measures to reduce noise levels (Mitigation Measure NV-1); however, noise would remain high for the duration of deconstruction. **Therefore, the Proposed Action's incremental contribution to significant cumulative noise effects would be cumulatively considerable around Copco 1 for the duration of deconstruction**. **No other feasible mitigation measures are available to reduce these impacts; therefore they would remain cumulatively considerable.**

Deconstruction activities associated with the Proposed Action would cause a temporary increase in nighttime noise levels at Iron Gate Dam. Deconstruction noise would cause a temporary significant noise impact on the residential area near Iron Gate Dam at night. Helicopters and other equipment noise from embankment restoration would cause a temporary significant noise impact on the residential areas near Iron Gate Reservoir. Mitigation Measure NV-1 would be implemented but would not reduce nighttime outdoor noise impacts to less than significant levels at sensitive receptors**.** Several subdivisions have been approved around Iron Gate Dam in Siskiyou County, as noted above in Table 4-4. However, it is assumed that these construction activities associated with new subdivisions would not occur at night. No other cumulative actions have been identified that would result in increased nighttime noises around Iron Gate Dam. **There would be no significant cumulative nighttime noise effects at Iron Gate Dam during deconstruction.**

Blasting activities could increase vibration levels. Deconstruction activities could require some blasting to remove portions of the dams and associated infrastructure. Blasting would result in increased vibration levels around the Four Facilities.

Residential developments, increased traffic, mining, and recreation activities in the area around the dam sites could also cause increases in vibration. This could result in significant cumulative vibration impacts. However, the Proposed Action would implement measures to minimize or avoid vibration impacts (Mitigation Measure NV-1) and address potential vibration complaints. With these mitigation measures, the Proposed Action's **incremental contribution to the significant cumulative effect associated with vibration would not be cumulatively considerable.**

4.4.22.1.2 Deconstruction-Related Traffic Noise

Transporting waste to off-site landfills and construction worker commutes could cause increases in noise along haul routes. Under the Proposed Action, transporting waste to off-site landfills and construction worker commutes could cause increases in noise along haul routes. The transporting of construction wastes, as well as the construction workers commuting to and from the deconstruction sites would increase traffic-related noise levels. Construction of new residential developments, traffic, mining, timber harvesting, agricultural activities, and recreation activities in the area around the dam sites could also cause increases in traffic-related noise. Traffic-related noise would therefore be a significant cumulative effect. The Proposed Action would have minor increases in noise levels 50 feet from all haul roads, and would be barely noticeable 500 feet away from

haul roads. Additionally, the traffic-related noise would only last the duration of construction; no long-term noise would occur after dam removal and restoration actions are complete. **The Proposed Action's incremental contribution to the significant cumulative effect associated with traffic-related noise would not be cumulatively considerable.**

4.4.22.1.3 KBRA - Programmatic Measures

Construction activities associated with the KBRA could cause temporary increases in noise and vibration levels. Several KBRA programs may cause noise and vibration impacts from the use of heavy equipment, including channel construction, mechanical thinning of trees, road decommissioning, fish passage and facilities construction, breaching levees, and fish hauling. These KBRA actions would take place in different locations around the Klamath Basin, and could occur at different times. While the locations, equipment, and schedules for the KBRA actions are currently not known, it is reasonable to assume that significant short-term cumulative noise and vibration effects could occur from implementation of the KBRA actions and other on-going activities such as traffic, timber harvesting, agricultural activities, mining, and recreation. The KBRA's incremental contribution to the significant cumulative noise and vibration impacts could be cumulatively considerable. Mitigation Measure NV-1 would be implemented, when appropriate, to reduce or avoid noise and vibration impacts. **Because the noise and vibration impacts would be temporary and would be reduced or avoided with mitigation, the KBRA's contribution to the significant short-term cumulative noise and vibration impacts would not be cumulatively considerable**. **Implementation of the KBRA will require future environmental compliance as appropriate.**

4.4.22.2 Alternatives 3, 4, and 5

Cumulative noise and vibration effects under Alternatives 3 and 5 would be similar to those described for Alternative 2 as they would require dam removal, blasting, and hauling of waste for disposal. Alternative 4 would not involve any dam removal or restoration activities and therefore would not contribute to any cumulative noise or vibration impacts associated with those activities. Alternative 4 would still contribute construction-related noise and vibration impacts from equipment and blasting during creation of fish passage facilities. KBRA cumulative effects under Alternative 3 would be similar to those described for the Proposed Action. The KBRA would not be implemented under Alternatives 4 and 5; **therefore there would be no cumulative effects associated with KBRA actions.**

4.4.22.3 Mitigation Measures

Noise impacts at Copco 1 and Iron Gate Dam would be cumulatively considerable under all alternatives with the exception of Iron Gate Dam under the Fish Passage at Four Dams Alternative. All feasible noise mitigation (Mitigation Measure NV-1) would be implemented to reduce noise during deconstruction; **however, noise impacts would remain cumulatively considerable at these locations for the duration of deconstruction and no further mitigation is possible.**

4.5 References

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