RECLAMATION

Managing Water in the West

Environmental Assessment

Implementation of Klamath Project Operating Procedures 2019-2024

Oregon and California
2019-EA-007

U.S. Department of the Interior
Bureau of Reclamation
Klamath Basin Area Office

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Mission Statements

The **Department of the Interior** protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities

The mission of the **Bureau of Reclamation** is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Acronyms and Abbreviations

ACFFOD	Amended and Corrected Findings of Fact and Order of Determination
AF	Acre feet
Act	Reclamation Act
BA	Biological Assessment
BIA	U.S. Bureau of Indian Affairs
BLM	Bureau of Land Management
BMPs	Best management practices
CAA	Clean Air Act
CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources
CFS	Cubic feet per second
DO	Dissolved oxygen
DPS	Distinct Population Segment
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
EWA	Environmental Water Account
FASTA	Flow Account Scheduling Technical Advisory
FERC	Federal Energy Regulatory Commission
FONSI	Finding of No Significant Impact
GDP	Gross domestic product
IGD	Iron Gate Dam
ITA	Indian Trust Asset
KBPM	Klamath Basin Planning Model
KDD	Klamath Drainage District
Klamath ROC	Reclamation's Klamath Project reinitiation of consultation
KRRC	Klamath River Renewal Corporation
KSD	Klamath Straits Drain
KWAPA	Klamath Water and Power Agency
LKNWR	Lower Klamath National Wildlife Refuge
LRD	Link River Dam
LRDC	Lost River Diversion Channel
Magnuson-Stevens Act or MSA	Magnuson-Stevens Fishery Conservation and Management Act
Modified 2018 BA	The Effects of the Proposed Action to Operate the Klamath Project from April 1, 2019 through March 31, 2024 on Federally-Listed Threatened and Endangered Species

NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWRs	National Wildlife Refuge; Lower Klamath, Tule Lake, Clear Lake, and Upper Klamath National Wildlife Refuges
ODEQ	Oregon Department of Environmental Quality
ODSL	Oregon Department of State Lands
O&M	Operation and Maintenance
OWRD	Oregon Water Resources Department
PA	Proposed Action
PM	Particulate matter
POE	Probability of exceedance
POI	Prevalence of infection
POM	Prevalence of mortality
POR	Period of Record
Project	Bureau of Reclamation's Klamath Project
Program	Klamath River Coho Restoration Program
Reclamation	Bureau of Reclamation
Secretary	Secretary of the Interior
SIP	State Implementation Plan
SONCC	Southern Oregon Northern California Coast
SRKW	Southern Resident killer whale
TAF	Thousand acre-feet
T&Cs	Terms and conditions
TID	Tulelake Irrigation District
TLNWR	Tulelake National Wildlife Refuge
TLS1A	Tulelake Sump 1A
TMDLs	Total Maximum Daily Loads
UKL	Upper Klamath Lake
UKNWR	Upper Klamath National Wildlife Refuge
U.S.	United States
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WRIMS	*Water Resource Integrated Modeling System*
WSRA	Wild & Scenic Rivers Act
WUMP	Water Users Mitigation Program
2013 BiOp	Biological Opinions on the Effects of Proposed Klamath Project Operations from May 31, 2013 through March 31, 2023, on Five Federally Listed Threatened and Endangered Species
2019 BiOps	Coordinated 2019 Biological Opinions from U.S. Fish and Wildlife Service and National Marine Fisheries Service

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1. Introduction

In 2017, the Bureau of Reclamation (Reclamation) formally reinitiated consultation with the National Marine Fisheries Service (NMFS) and the United States (U.S.) Fish and Wildlife Service (USFWS; collectively the Services) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. §1531 et seq.) on the continued operation of the Klamath Project (Project) in response to consecutive years of drought and the 2014 and 2015 exceedance of incidental take of coho salmon – included in the 2013 Biological Opinions (2013 BiOp) incidental take statement. Reclamation's Klamath Project reinitiation of consultation (Klamath ROC) consists of analyzing Reclamation's proposed action to implement a modified water management approach for Project operations providing water supply reliability for Project irrigators, while addressing ESA requirements for listed species and/or designated Critical Habitat. Reclamation provided a *Final Biological Assessment on the Effects of the Proposed Action to Operate the Klamath Project from April 1, 2019, through March 31, 2024*, to the Services on December 21, 2018, and associated addenda dated February 15, 2019, and March 25, 2019, (modified 2018 Biological Assessment [BA]). The modified 2018 BA and all associated modifications and clarifications (i.e., addenda) referenced in this EA can be found at: https://www.usbr.gov/mp/kbao/programs/ops-planning.html

Reclamation's modified water management approach consists of four components (*see section* 2.4) that could result in a material change from the range of historic operations previously exempt from compliance with the National Environmental Policy Act (NEPA; 42 U.S.C. §4321 et seq.)[1]. Reclamation has prepared this environmental assessment (EA) to determine whether implementing the modified water management approach for the Project as described below and in the modified 2018 BA may significantly affect the quality of the human environment.

1.1. Need for Proposal

There is a need for certainty regarding operation of the Project consistent with contractual and/or water right delivery obligations while complying with Federal laws, including the ESA. The Proposed Action defines how Project operations would be conducted, consistent with Reclamation's responsibilities and obligations, with an April 1 determination of available Project Supply (*defined below in section 2.2*). Implementation of the Proposed Action also defines how Reclamation will manage Upper Klamath Lake (UKL) elevations and Klamath River flows below Iron Gate Dam (IGD).

In development of the Proposed Action, Reclamation's legal requirements and obligations were considered, which include:

[1]Reclamation has been operating the Project since 1905 and prior to the enactment of NEPA in 1969. As such, operations of the Project are considered ongoing operations and not subject to NEPA until such time that all or part of the operations are outside of historic operations.

• The ESA
• Trust responsibility to Klamath Basin Indian tribes
• Klamath Project contract water users and/or water rights beneficiaries
• The Klamath Basin National Wildlife Refuges

1.2. Geographic Scope

The geographic scope of the modified water management approach extends throughout the Klamath River Basin *(see map in Appendix A*). The Klamath River Basin is commonly divided into two basins – the Upper Klamath Basin being the portion of Klamath River upstream of IGD and the Lower Klamath Basin being the portion downstream of IGD. Elevations in the Upper Klamath Basin range from approximately 2,500 feet to a high of 9,000 feet above sea level. The mean annual precipitation at the Klamath Falls airport from 1981 to 2010 was 14.96 inches. Precipitation occurs mainly in the winter months in the form of snow, which provides the majority of the water available for the Project; winter and spring runoff is stored in Project reservoirs for release during the spring/summer and fall/winter operating periods.

<u>Klamath Project</u>
The Project is located in Klamath County in Oregon, and Siskiyou and Modoc counties in California (*see map in Appendix A*). As constructed, the Project provides a primary irrigation water source for approximately 230,000 acres of farmed lands, including lands within 18 irrigation, drainage, and improvement districts. Project water is stored and released from three reservoirs – UKL, Clear Lake, and Gerber reservoirs – with additional water available for Project use from the natural flow of the Klamath and Lost rivers. Available water supplies from these sources are delivered to Project lands through a network of diversion structures, canals, laterals, and pumps.

<u>Klamath River</u>
The upper reach of the Klamath River begins at the outlet of Link River, at the upper end of Lake Ewauna, and flows 253 miles through southern Oregon and northern California to the Pacific Ocean. Flows in the upper portion of the Klamath River are managed by PacifiCorp (in coordination with Reclamation) through a series of private reservoirs and dams owned and operated by PacifiCorp. See sections 1.5.2 and 3.1.1.3 of the modified 2018 BA for more information on the Klamath River.

<u>National Wildlife Refuges</u>
Four national wildlife refuges, comprising approximately 148,500 acres (*see map in Appendix A),* are potentially impacted by implementation of the Proposed Action Alternative: Lower Klamath, Tule Lake, Clear Lake, and Upper Klamath National Wildlife Refuges (collectively the NWRs). These refuges were established by various Executive Orders beginning in 1908. USFWS manages the NWRs in accordance with Federal law, including the Migratory Bird Treaty Act, as amended (16 U.S.C. §§703-712), the National Wildlife Refuge System

Administration Act of 1966 (Pub. L. 89-669; 16 U.S.C. §§668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Pub. L. 105-57), the Kuchel Act (16 U.S.C. §§695k-695r), and other laws pertaining to the National Wildlife Refuge System. The NWRs support many fish and wildlife species and provide habitat and food resources for migratory birds of the Pacific Flyway. Portions of Tule Lake National Wildlife Refuge (TLNWR) and Lower Klamath National Wildlife Refuge (LKNWR) are also used for agricultural purposes and receive water from the Project for irrigation purposes.

1.3. Legal and Statutory Authorities

The Project was authorized by the Secretary of the Interior (Secretary) on May 15, 1905, in accordance with the Reclamation Act (Act) of 1902 (32 Stat. 388), and the Act of February 9, 1905 (33 Stat. 714), and approved by the President on January 5, 1911, in accordance with the Act of June 25, 1910 (36 Stat. 835). The Secretary, through Reclamation, must manage and operate the Project consistent with Federal and applicable state law and in accordance with the Secretary's tribal trust obligations.

1.4. Related Actions that Influence the Scope of this EA

Several actions or court decisions are related to or would assist the reader in understanding the alternatives and resource issues analyzed here.

1.4.1. Northern District of California Court Cases and Orders

In connection with two related cases in the U.S. District Court for the Northern District of California, *Yurok Tribe v. Bureau of Reclamation*, No. 16-cv-6863, and *Hoopa Valley Tribe v. Bureau of Reclamation*, No. 16-cv-4294, Reclamation was required to provide certain flows in the Klamath River for the stated purpose of disease mitigation for coho salmon until such time that the Klamath ROC is complete (Court Order; March 24, 2017; Case Nos. 3:16-cv-06863-WHO and C16-cv-04294-WHO.)

1.4.2. Lower Klamath Project

In 2016, PacifiCorp and the Klamath River Renewal Corporation (KRRC) submitted an application to the Federal Energy Regulatory Commission (FERC) to amend the existing license for the Klamath Hydroelectric Project (Project No. 2082), establish a new license for the Lower Klamath Project (to consist of J.C. Boyle, Copco No. 1, Copco No. 2, and IGD, along with appurtenant facilities), and transfer this new license to the KRRC. This application was partly approved on March 15, 2018, establishing the Lower Klamath Project as license number 14803; action on the request to transfer the license from PacifiCorp to the KRRC was deferred. Simultaneous with the 2016 joint application, KRRC applied to FERC to surrender the license for the Lower Klamath Project and decommission the four dams.

This action is intended to carry out the terms of the Klamath Hydroelectric Settlement Agreement, as amended in 2016. FERC has yet to take final action on this application. Under the current schedule proposed by the KRRC, the dams would be removed in 2021, followed by environmental restoration into 2022 and possibly beyond (KRRC 2018).

The Lower Klamath Project is under the jurisdiction of FERC; as such, FERC will perform any necessary environmental compliance related to dam removal. Given the uncertainty associated with PacifiCorp and KRRC's pending applications before FERC, this potential future action is not considered reasonably foreseeable for NEPA purposes at this time.

1.4.3 Comprehensive Conservation Plan/EIS for the Klamath National Wildlife Refuge Complex

The Record of Decision for the Final Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS) for Lower Klamath, Clear Lake, Tule Lake, Upper Klamath, and Bear Valley national wildlife refuges was prepared and signed on January 13, 2017, by the USFWS. The CCP is a programmatic plan that describes how the USFWS proposes to manage the NWRs for the next 15 years consistent with Federal law. The CCP is intended to provide a clear and comprehensive statement of the desired future conditions for the refuges and to ensure public involvement in refuge management decisions. Subsequent litigation was filed by environmental and water user groups seeking revisions of the CCP/EIS. Court proceedings are underway and will extend into summer/fall of 2019.

1.4.4. Determination of Priority of Agricultural Lands Within Lower Klamath National Wildlife Refuge to Water from the Klamath Project

In 2016, the USFWS questioned Reclamation's current interpretation of the relative priority of irrigated lands in LKNWR to receive water from the Project. Since the early 1990s, as the water supply for irrigation has become increasingly limited, Reclamation has generally limited water deliveries to LKNWR to such times and such quantities that will not interfere with Reclamation's ability to meet its contractual and/or water right delivery obligations.

Based on information presented by USFWS, in 2017, the Deputy Secretary directed USFWS and Reclamation to compile a full record relevant to the priority of LKNWR to receive water from the Project, and to provide this information to the Secretary for a final determination. In compiling this record, USFWS and Reclamation are to provide an opportunity for affected stakeholders and tribes to provide input. Furthermore, in the process of compiling this record, USFWS and Reclamation are to develop a "shortage sharing" agreement that would apply in connection with a Secretarial determination on the relative priority of LKNWR. This agreement is to be embodied in a written agreement between the agencies.

Reclamation and USFWS are currently in the process of compiling an administrative record consistent with the Deputy Secretary's directions and developing a plan to seek input from affected tribes and stakeholders. As such, the Secretary has not made a final determination in this matter.

USFWS anticipates continuing to engage directly with Project water users to reach an agreement to allocate water among LKNWR and the remainder of the Project, particularly during the spring/summer irrigation season. This approach may ultimately result in an agreement that provides water supplies for LKNWR without a formal determination by the Secretary. Such negotiations are in the initial phases.

Given the uncertainty associated with a Secretarial determination and/or an agreement between USFWS and other Project water users, the outcome of this process is not yet reasonably foreseeable and may require completion of a separate environmental compliance analysis.

2. Proposed Action and Alternatives

Alternatives that were considered but eliminated from further consideration are described below in section 2.1. This EA analyzes two alternatives consisting of a timeframe not to exceed five (5) years covering the time period from 2019-2024: The No Action and the Proposed Action. For the most part, Project operations (water management approach) are similar under both alternatives. The elements in common with both alternatives as well as the differences are described in sections 2.2 and 2.4, respectively.

2.1. Alternatives Considered but Eliminated From Further Consideration

Reclamation conducted an iterative hydrologic modeling process involving the Tri-Agency Hydro Team (comprised of hydrologic modelers from Reclamation and the Services) and representatives from the Tribal and Key Stakeholder Technical Team[2] to develop and evaluate alternative water management approaches for operation of the Project. In fall 2017, Reclamation requested that the tribes and key stakeholders provide input on hydrologic modeling scenarios Reclamation should consider as part of its modified Proposed Action. Requests from the Services, tribes, and key stakeholders included various alternatives to operating the Project.

Alternatives considered and eliminated from further analysis are listed below inclusive of the reasoning why each alternative was not consistent with the *need for the proposal* described in section 1.1 above:

- Fixed UKL elevations identified by The Klamath Tribes
    - *Best available scientific information, hydrologic modeling constraints, unacceptable level of uncertainty for meeting Project contractual and/or water right delivery obligations, uncertain level of protection for coho salmon*

[2] This Tribal and Key Stakeholder Technical Team consisted of technical representatives from Reclamation, the Services, the Klamath Water Users Association, Klamath Irrigation District, Klamath Drainage District, Langell Valley Irrigation District, Tulelake Irrigation District, Horsefly Irrigation District, PacifiCorp, and the Hoopa Valley, Karuk, Quartz Valley, and Yurok Tribes, inclusive of the Resighini Rancheria and The Klamath Tribes.

- Inclusion of all management measures (with a water operations component) included in the *Measures to Reduce Infection of Klamath River Salmonids: A Guidance Document* (Guidance Document; Hillemeier et al. 2017)
  - *Best available scientific information, hydrologic modeling constraints, unacceptable level of uncertainty for meeting Project contractual and/or water right delivery obligations, not appropriately protective of Lost River and shortnose suckers*
- Forcing surface flushing flows if they did not occur the previous year
  - *Not adequately protective of coho salmon*
- In-season regulation of Project deliveries on a five-day time step
  - *Unacceptable level of uncertainty for meeting Project contractual and/or water right delivery obligations*
- Project start date delays in years meeting certain criteria
  - *Unacceptable level of uncertainty for meeting Project contractual and/or water right delivery obligations*
- "Habitat flows" in March and April, rather than surface flushing flows, in years meeting certain criteria
  - *Not adequately protective of coho salmon*
- UKL Credit for Project use
  - *Not adequately protective of Lost River and shortnose suckers*
- Operating to a UKL flood control curve developed by PacifiCorp
  - *Not adequately protective of Lost River and shortnose suckers, coho, and unacceptable level of uncertainty for meeting Project contractual and/or water right delivery obligations*
- Routinely borrowing 20,000 AF from PacifiCorp reservoirs to assist in Project operations
  - *Potentially not adequately protective of Lost River and shortnose suckers and unacceptable level of uncertainty for meeting Project contractual and/or water right delivery obligations*

These alternative water management scenarios were considered and evaluated (if possible) through the hydrologic model (described below in section 2.2) for consistency with Reclamation's obligations for operating the Project. Reclamation determined that the suggested alternatives above resulted in operating the Project in a manner inconsistent with the need for the action.

2.2. Elements Common to Both Alternatives

The elements described in this section are common to both alternatives, such that their inclusion in the Proposed Action does not alter the environmental baseline which is the No Action Alternative. As a result, the common elements and their potential impacts to various resources are not further discussed in detail in sections 3 and 4.

In general, both alternatives consist of several elements: (1) store waters of the Klamath and Lost rivers; (2) operate the Project, or direct the operation of Project facilities, for the delivery of water for irrigation purposes and NWR needs, or as necessary for flood control purposes, subject to water availability; while maintaining conditions in UKL and the Klamath River that meet the legal requirements under section 7 of the ESA; and (3) perform operation and maintenance (O&M) activities necessary to maintain Project facilities.

Reclamation manages the Project to provide water for irrigation and related purposes to the Project's service area. To provide this water, Reclamation stores water year-round in UKL, Clear Lake Reservoir, and Gerber Reservoir. The Project's service area (*see map in Appendix A*) under each alternative does not change and encompasses lands in Klamath County, Oregon and Siskiyou and Modoc counties, California. Approximately 200,000 acres are primarily served from UKL and the Klamath River. Approximately 10,000 acres are served from the Lost River, with about 20,000 acres served from Clear Lake and Gerber reservoirs, although stored water from these reservoirs can be used under certain circumstances to meet irrigation demands in portions of the area typically served from UKL and the Klamath River.

Hydrologic Modeling

Water management under each alternative relies heavily on seasonal water supply forecasts provided by the Natural Resources Conservation Service (NRCS) for UKL and Gerber Reservoir. The water supply forecasts are developed based on antecedent streamflow conditions, precipitation, snowpack, current hydrologic conditions, a climatological index, and historical streamflow patterns. More information and background regarding water supply forecasts can be found at the NRCS website: https://www.wcc.nrcs.usda.gov/about/forecasting.html.

In development of the alternatives, Reclamation utilized the Water Resource Integrated Modeling System (WRIMS) to simulate Klamath River and UKL hydrographs that are likely to occur as a result of implementing the No Action and Proposed Action alternatives. WRIMS is a generalized water resources modeling system, broadly accepted by the hydrologic community, for evaluating operational alternatives of large, complex river basins. Reclamation has worked closely with the Services to develop a WRIMS model specific to the Klamath Basin, referred hereafter as the Klamath Basin Planning Model (KBPM).

The KBPM encompasses the areas of the Project served by UKL and the Klamath River and extends from UKL to IGD. KBPM does not model the portion of the Project served by Clear Lake and Gerber reservoirs, although the net effects of conditions on this portion of the Project on the Klamath River are included in the model via the gains (i.e., accretions to the Klamath River) and losses (i.e., Project diversions) within the Lost River Diversion Channel (LRDC). The KBPM also does not model explicit operational details for many facilities on the Klamath River such as IGD or other reservoirs owned and operated by PacifiCorp. Operation of Project facilities that store and divert water from UKL and the Klamath River was simulated over a range of hydrologic conditions using daily input data to obtain daily, weekly, monthly, and annual results for Klamath River flows (below IGD), Project diversions, (including deliveries to the LKNWR), and UKL elevations.

Data files generated by the KBPM include daily modeled output which has been aggregated into monthly and annual output for this EA. Probability of exceedance (POE) identifies the probability that specific hydrologic conditions would be met or exceeded during a given time. For example, a 90 POE value would represent relatively dry conditions, because actual hydrological conditions can be expected to meet or exceed that value in 90 out of 100 years. Conversely, a 10 POE value would represent a period of unusually high precipitation, given that conditions can only be expected to meet or exceed that value in 10 years out of 100. A 50 POE value represents median hydrologic conditions. Hydrologic conditions within water years (October 1 to September 30) as represented by the exceedance value, vary between and within months. Detailed model output files can be found in both Reclamation's 2012 BA and the modified 2018 BA[3]. For this EA, tables in section 4.3 show the simulated effects to UKL elevations, IGD releases, total spring/summer and total fall/winter diversions from UKL, the Klamath River, and the Lost River (downstream of the LRDC), and total annual LKNWR deliveries from UKL and the Klamath River. Additional details regarding the KBPM used for the No Action Alternative (inclusive of assumptions, and outputs) can be found in Part 4 and Appendix 4A of the 2012 BA while the version of the KBPM used for the Proposed Action Alternative can be found in Part 3.4 and Part 4.2 and Appendix 4 of the modified 2018 BA.

The KBPM is a planning tool that assisted in the development of the Proposed Action Alternative and not all the processes built into the model can be implemented during actual operations. Substantial improvements were made to the KBPM in the time that it was used to develop and evaluate the 2013 BiOp, including an agricultural delivery and accretion sub model and revised stage/discharge relationships at Link River Dam. There are many assumptions associated with modeling efforts of this nature. Specifically, the KBPM assumes that the upper Klamath River basin will experience water year types within the range observed in the 36-year POR and that UKL inflows will be within the range observed in the POR. See both the 2012 BA and modified 2018 BA for additional assumptions associated with the KBPM.

Water Rights

In operating the Project to provide water for irrigation purposes, Federal law requires Reclamation to operate consistent with state law with respect to the diversion, control, and use of water. The laws of both the states of Oregon and California provide a means for a water user to establish a right to divert and apply water to a beneficial use, subject to certain requirements and conditions. Operating the Project consistent with such existing water rights of record is an element common to both alternatives.

Water rights associated with the Project, as established under state law, govern the timing, rate, total volume, and sources and location from which water can be diverted. Likewise, water rights prescribe the manner in which beneficial irrigation use can occur, in terms of the timing, rate, total volume, and the manner in which water is applied to the land. As a result, water rights may preclude the diversion and use of water that is otherwise physically and legally available.

Portions of LKNWR and TLNWR hold water rights for both irrigation and refuge purposes. Water within the refuges is commonly used for both purposes, being applied to a field to grow

[3] Reclamation's 2012 BA and modified 2018 BA can be accessed here: https://www.usbr.gov/mp/kbao/programs/ops-planning.html

an agricultural crop, then drained off, and used for maintaining wetland areas elsewhere (or vice versa). USFWS is responsible for managing water use within the refuges.

Districts and individuals are also responsible for ensuring that their water use is consistent with state water law, including existing water rights of record. Generally, Reclamation's control over the diversion and use of water ends at the point where the water is delivered to the end user. To the extent of Reclamation's direct control and oversight, the operations described under both alternatives will be carried out in a manner consistent with state water law, including existing water rights of record.

Water Deliveries and Releases from Upper Klamath Lake and Minimum Flows in the Klamath River

Under both alternatives, UKL is used to store seasonal runoff to meet irrigation needs with water released via Link River Dam (LRD) for ESA requirements and to prevent flooding. Project water stored in UKL is used for irrigation of lands within the Project's existing service area, including lands surrounding UKL, between the cities of Klamath Falls and Tulelake, the Lower Klamath Lake areas, and along the Klamath River between Lake Ewauna and the town of Keno, including within 14 separate irrigation, drainage, and other districts, and two NWRs. (*See the modified 2018 BA Part 1.3.3., on Reclamation Water Supply Contracts and further information on service area within the Project, and Part 1.3.6, regarding how water is delivered and used within the Lower Klamath and Tule Lake NWRs*).

Water available from UKL for irrigation purposes during the spring/summer period (Project Supply) is diverted directly from UKL via the A Canal or after release from LRD, directly from the Klamath River via Station 48, Miller Hill Pumping Plants, the North Canal, and the Ady Canal. Although the term Project Supply is contained in both alternatives, the manner in which Project Supply is calculated differs between the two alternatives, and thus Project Supply values between alternatives are not directly comparable. (*See parts 2.3 and 2.4 for a description of how Project Supply is calculated under the alternatives*.)

Common to both alternatives, LKNWR receives water consistent with water rights held by the United States for the refuge and the contract priority within the Project. Reclamation has an obligation to deliver water to LKNWR when available as a matter of hydrology, water rights and contracts. The overall quantity of water available to LKNWR is impacted by the Project Supply determined under Reclamation's water management approach.

In addition to irrigation deliveries, Reclamation, through PacifiCorp, makes flood control releases from UKL as conditions require. Under both alternatives discussed in this EA, Reclamation is required under the ESA to make releases from UKL to meet designated stream flows in the Klamath River at IGD, approximately 65 miles downstream of LRD. The water designated to meet these requirements is labeled the Environmental Water Account (EWA), under both alternatives. In addition, the proposed minimum ESA required flows in the Klamath River downstream of IGD remain the same for all alternatives discussed in this EA. Additional details regarding minimum flows and operations for the Klamath River downstream of IGD can be found in Part 4 and Appendix 4A of the 2012 BA[4] and Part 4 and Appendix 4 of the modified 2018 BA.

As water from UKL is used to meet the delivery and flood control release requirements, it is necessary that UKL elevations are maintained at required elevations throughout the year. Under both alternatives, maintenance of the specified UKL elevations are the result of an elevation management component. In the 2018 Proposed Action Alternative UKL elevations are maintained through the "UKL control logic" (*described further in section 2.4*) while under the 2013 BiOp the UKL thresholds are used.

Operational Periods and Period of Record

Both alternatives have a fall/winter and a spring/summer time period, although the periods are slightly different between the two. Generally speaking, the spring/summer period covers the irrigation season and the time of year that UKL elevations gradually decrease as the majority of Klamath River and irrigation releases occur, and the fall/winter period covers the timeframe when the majority of water is stored and UKL refill occurs.

The No Action Alternative (Reclamation's 2012 BA as analyzed in the 2013 BiOp) was modeled using water years 1981 through 2011 Period of Record (POR). Since the simulation (or water year type projections) ended in water year 2011, there are no 2013 BiOp simulated values for the 2012 through 2016 time-frame. However, the actual values that resulted from implementation of the 2013 BiOp from March 1, 2013, through November 30, 2016, can be used to compare the No Action and Proposed Action alternative during the 2013 through 2016 time-frame. Since implementation of the 2013 BiOp didn't occur until March 1, 2013, and there are no simulated values for the November 1, 2011, through February 28, 2013, period, there are no simulated or actual values for the 2013 BiOp to compare, and comparisons between the actions is not possible during that time. The POR for the Proposed Action Alternative was updated with data for water years 2012 through 2016, and uses the water year 1981 through November 30, 2016, POR. Under the Proposed Action Alternative, the full water year 1981 through November 30, 2016, the POR was simulated in the KBPM, utilizing the updated dataset, including UKL bathymetric data (Neuman 2017).

Clear Lake Reservoir, Gerber Reservoir and the Lost River

Stored water in Clear Lake and Gerber reservoirs is generally used for irrigation purposes in Langell and Yonna valleys, although it can be and occasionally has been used for irrigation in the portion of the Project between Klamath Falls and Tule Lake. Natural flow in the Lost River above Harpold Dam is primarily used in Langell and Yonna valleys, and both natural flow and released stored water is used by the Project when present in the Lost River below Harpold Dam. In addition to irrigation deliveries, Reclamation makes flood control releases from Clear Lake and Gerber reservoirs when conditions necessitate. In addition, similar to UKL, certain water levels in both Gerber and Clear Lake reservoirs are required for ESA-

[4] See also: Letter titled *Modifications to and Clarifications on the Proposed Action in the Bureau of Reclamation's December 1, 2012, Biological Assessment sent to the National Marine Fisheries Service on May 29, 2013*, (https://www.usbr.gov/mp/kbao/programs/ops-planning.html) where Reclamation proposes increased minimum flows for the Klamath River in the months of April, May, and June during the term of the action.

listed Lost River and shortnose suckers. Operational procedures, resultant water deliveries and releases, and reservoir elevations at Clear Lake and Gerber reservoirs will be the same under the No Action and Proposed Action alternatives and are therefore not discussed further in this EA.

Operation and Maintenance

To ensure functionality of the Project, various operation and maintenance activities are carried out by Reclamation or through contract by the appropriate irrigation district according to whether a specific facility is a reserved or transferred work, respectively. In general, O&M activities include, but are not limited to: exercising dam gates, stilling well gage maintenance, repairs, inspections, and clearing of canals, laterals, and drains, equipment (e.g., pump, headgate, valves, etc.) replacement, fish screen/ladder maintenance, road, dike, and pumping facility upkeep. These actions have been ongoing throughout the history of the Project. O&M activities under both alternatives remains the same with no new activities proposed. (*See section 4.3.3. of the modified 2018 BA, for additional details on ongoing O&M on Project facilitie*s). Though not evaluated in this EA, the O&M activities needed to operate the Project will be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA and the National Historic Preservation Act (and other applicable laws) is required prior to the activity(ies) being implemented.

Conservation Measures

Under both alternatives Reclamation would continue to implement, in coordination with the Services, several conservation measures intended to minimize the Project's effects on ESA-listed species. Conservation measures under both alternatives include:

<u>Canal Salvage for Suckers</u>: Fish salvage of Project canals occurs when canals are: (1) temporarily dewatered for a discrete action related to maintenance and/or repairs at Project facilities, and (2) when canal systems are dewatered at the end of each irrigation season. Under both circumstances, suckers are salvaged from isolated pools.

<u>Sucker Captive Rearing Program</u>: Reclamation continues to support the USFWS Captive Rearing program for Lost River and shortnose suckers with approximately $300,000 annually. The intent is to improve the numbers of suckers reaching maturity in UKL. Ultimately, the function of a captive rearing program would be to promote survival and recovery of sucker populations that suffer losses from entrainment as a result of Project operations or other threats.

<u>Sucker Monitoring and Recovery Implementation</u>: In coordination with USFWS, Reclamation will continue to support efforts to monitor adult suckers in UKL, Clear Lake and Gerber reservoirs and fund Sucker Recovery Implementation Projects. Reclamation anticipates annual funds of approximately $1.5 million for both monitoring and recovery projects under the term of the No Action Alternative through 2023. Under the Proposed Action Alternative, contingent upon Reclamation's annual budget process and appropriations, Reclamation anticipates annual funds of approximately $1.5 million base funding annually with an additional $700,000 for the first two years (fiscal year 2019 and 2020) for UKL adult

monitoring, Clear Lake adult monitoring, and juvenile cohort monitoring, research, and recovery projects. Funding in fiscal years beyond 2020 will be supplemented with $700,000 should appropriations materialize. Under both alternatives the purpose and related support remains similar *(See section 4.4 of the 2013 BiOp and 4.5.3 of amended 2018 BA for more program specifics).*

Klamath River Coho Restoration: Consistent with Addendum 3 to the modified 2018 BA dated March 25, 2019, in coordination with NMFS, Reclamation would continue to support efforts to improve habitat for coho salmon in the Klamath Basin through the Klamath River Coho Restoration Program (Program). Reclamation proposes that funding for the Program would be $700,000 in each of fiscal years 2019 and 2020, and $500,000 in each of the successive fiscal years beginning with fiscal year 2021 and ending with fiscal year 2024. These funds will support Program administration and projects that address limiting factors for Southern Oregon Northern California Coast (SONCC) coho salmon in the Klamath Basin and are contingent upon Reclamation's annual budget process and appropriations. The Program would be performed consistent with the *2009 California Department of Fish and Wildlife's California Salmonid Restoration Manual*[5]. Restoration projects minimize habitat related effects of the Project by individually and comprehensively improving critical habitat conditions for coho individuals and populations (*See section 4.4 of the 2013 BiOp and 4.5.4 of the modified 2018 BA for more program specifics)*.

Though not specifically evaluated in this EA, the conservation measures will be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA and the National Historic Preservation Act (and other applicable laws) is required prior to the activity(ies) being implemented.

Terms and Conditions

All Terms and Conditions (T&C) that are administrative in nature are included in this analysis and assumed to have no effect on the human environment. Any other actions included in the T&C that are not specifically evaluated in this EA or otherwise have completed environmental compliance, will be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA and the National Historic Preservation Act (and other applicable laws) is required prior to the activity(ies) being implemented.

2.3. No Action Alternative

Under the No Action Alternative, Reclamation would continue to operate the Project consistent with the 2013 BiOp operating procedures. Certain components of the operating procedures of the No Action Alternative were modified and are part of the Proposed Action

[5] The *2009 California Department of Fish and Wildlife's California Salmonid Restoration Manual* can be accessed here: https://www.wildlife.ca.gov/Grants/FRGP/Guidance

Alternative. For evaluation purposes, these components are described in more detail below and in Section 2.4.

UKL management

The No Action Alternative seeks to fill UKL during the fall/winter period to increase the volumes available for the EWA, UKL, and Project Supply during the spring/summer operational period. The No Action Alternative includes monthly minimum "UKL threshold elevations" that must be maintained throughout the year. The monthly minimum UKL threshold elevations result in an annual UKL hydrograph that provides for the seasonal needs of suckers, seasonal water demand for the Klamath River and Project, and end-of-season elevations intended to result in storage volumes appropriate to meet the next year's demands on UKL. If elevations drop below the thresholds, or UKL elevations are projected to drop below the thresholds, deliveries to the Project and LKNWR can be reduced to ensure the ability to meet the end of month minimum threshold elevations. In some circumstances, due to unusual hydrologic conditions, it may not be possible to maintain the end of month threshold elevations. The threshold elevations are not a target to which UKL should be managed, but rather a guideline that maintains UKL elevation in line with both hydrologic conditions and the multiple demands placed upon UKL storage throughout the year. (*See Section 4 and Appendix 4A for additional details regarding UKL management under the 2013 BiOp*)

Klamath River Management

Under the No Action Alternative, Reclamation would continue to calculate EWA monthly from March through June based on available water supply. Under the No Action Alternative, the minimum EWA is 320,000 acre-feet (AF), and increases above this minimum based on hydrologic conditions. If the UKL Supply or [the end of February UKL storage] + [NRCS forecasted UKL inflow for March through September] - [UKL Reserve], is less than 600,000 AF, the EWA is set at 320,000 AF. If UKL Supply is greater than 600,000 AF, the EWA percentage of the UKL Supply will increase, to a maximum of 78 percent in years when the UKL Supply is greater than 1,500,000 AF. Under the No Action Alternative, the flow schedule for EWA distribution would continue to vary based on the remaining EWA, flows in the Williamson River, and accretions between LRD and IGD.

As seen in previous years, during real-time operations of the No Action Alternative, Reclamation may identify a need to deviate from the formulaic calculation of IGD releases due to safety and/or other operational constraints. These situations can include relatively minor deviations in magnitude or duration from the formulaic approach to address urgent ecological concerns such as to alleviate fish disease or die offs, poor water quality events, fish entrainment, fish dispersal and/or migration, and other ecological concerns that may arise during the spring/summer season. In addition, it may be desirable to implement flow regimes to address specific ecological objectives that would result in relatively large deviations from the formulaic distribution of the EWA. However, any recommended deviation from the formulaic distribution of EWA, small or large, must be intended to result in ecological and hydrologic conditions consistent with the requirements for ESA-listed species and cannot create adverse effects greater than analyzed by the Services in the 2013 BiOp.

Project Water Supply
Under the No Action Alternative, Project Supply is available for diversion to the Project through the A Canal, Station 48, Miller Hill Pumping Plant, North Canal, and Ady Canal. Other smaller Project-associated diversions from the Klamath River are accounted for in the EWA (i.e., EWA is sized appropriately to address the effect of these diversions on downstream river flows).

The maximum Project Supply[6] under the No Action Alternative is 390,000 AF. Project Supply would continue to be initially determined in early March as the quantity of water remaining after the end of September UKL target storage and EWA are determined, or a maximum of 390,000 AF, whichever is less. Project Supply is recalculated in early April using the NRCS inflow forecast to reflect the most current hydrologic information. The April 1 Project Supply establishes the minimum Project Supply for the irrigation season. The Project Supply is recalculated again in May and June, and while the Project Supply cannot decrease below the April 1 calculation, it may increase with the May and June NRCS inflow forecasts. However, it is important to note that although "Project Supply" is common to both alternatives, it is calculated differently under each alternative, and flows from Klamath Straits Drain (KSD) are accounted for differently between the two alternatives (i.e., the Project can divert these flows under the Proposed Action Alternative). Therefore, for the purposes of assessing overall impacts to the Project, the Project Supply values between alternatives are not the appropriate comparison. The appropriate comparison for irrigation deliveries to the Project is to assess the differences in modeled total spring/summer diversions.

Irrigation deliveries from Project Supply typically begin in March or April, although the start date can be delayed to meet the spring Klamath River flows and UKL threshold elevations. Project Supply releases may also be curtailed or temporarily cease during the course of the irrigation season in order to meet the Klamath River flows and UKL threshold elevations.

To assist in managing the available Project Supply, Reclamation's 2012 BA included, as part of the proposed action, continued operation of the Water Users Mitigation Program (WUMP). The WUMP was administered under a cooperative agreement between Reclamation and the Klamath Water and Power Agency (KWAPA). The WUMP ended in 2015, with the expiration of the agreement between Reclamation and KWAPA. Reclamation is not currently providing funding for WUMP or any similar program. Note that the WUMP did not affect operations under the 2013 BiOp with respect to ESA-related requirements (i.e., lake levels and river flows), given that under the 2012 BA "Reclamation propose[d] to first meet flows and lake levels which Reclamation believes are sufficient to avoid jeopardizing the continued existence of federally-listed species" (Reclamation 2012). Also note that available water resulting from the WUMP would be in addition to the Project Supply and LRDC flows that are available for diversion under the 2013 BiOp.

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[6] The total spring/summer diversions available under the No Action Alternative includes the Project Supply and LRDC flows.

LKNWR Deliveries
Under the No Action Alternative, the components of the annual LKNWR water supply include: fall/winter supply, spring/summer Project Supply in August through November, and water that is not part of the Project Supply from June through November.

For the fall/winter period, the volume of water available for delivery to LKNWR (and Klamath Drainage District [KDD]) is determined on a daily basis, after calculation of LRD and IGD daily target releases. If UKL is on track to reach an elevation of 4,142.8 feet by the end of February, water is made available for delivery to KDD and/or LKNWR. *(See part 4.3.2.2.1 and Appendix 4A of the 2012 BA for further information on fall/winter operations and water available from UKL during this period for delivery to LKNWR.*)

For the spring/summer period, there are formulaic conditions specifying how much of the Project Supply can be delivered to LKNWR. The volume of spring/summer Project Supply that can be made available to LKNWR is based on a percentage of the remaining Project Supply during the months of August through November. The remaining Project Supply is calculated on the first day of the month during the August through November time period, and the percentage of the remaining Project Supply that can be delivered to LKNWR in that month varies based on the month and the volume of remaining Project Supply.

In addition to a portion of Project Supply, LKNWR can also receive water that is not Project Supply from June through November when UKL elevations are above certain thresholds and the Project Supply is at 390 thousand acre-feet (TAF.) (*See part 4.3.2.2.2 and Appendix 4A of the 2012 BA for further information regarding water available for LKNWR during the spring/summer period under the No Action Alternative.*)

Flows from the Lost River Diversion Channel and Klamath Straits Drain
Consistent with both alternatives, under normal Project operations, all water in the Lost River, up to approximately 3,000 cubic-feet-per-second (cfs), is diverted into the LRDC at the Lost River Diversion Dam, just east of Olene (a suburb of Klamath Falls, Oregon). Also, under normal operations, irrigation return flows, flood flows, and drainage water from LKNWR is pumped into the Klamath River via the KSD year-round. Accounting for and use of these two sources of water varies between the two alternatives.

Under the No Action Alternative, during the spring/summer period, water diverted from the Lost River and conveyed through the LRDC is available for Project diversion and irrigation use and does not count against the Project Supply from UKL. This rule applies for water diverted directly from the LRDC (i.e., at Station 48, Miller Hill Pumping Plant) during the period of March 1 through November 15, and for water that flows out from the LRDC into the Klamath River (i.e., at Ady Canal or North Canal) during the period of March 1 through September 30. To the extent that flows from the LRDC into the Klamath River exceed irrigation diversions during this period, the water is treated as an accretion and contributes to IGD releases.

Reclamation measures and accounts for this water on a daily basis, both with respect to its availability and use. For accounting purposes, use of water diverted from the Lost River and conveyed via the LRDC is only attributed to Station 48, Miller Hill Pumping Plant, Ady Canal, and North Canal. Water use associated with other minor Project diversions from the LRDC or the Klamath River is accounted for separately under the No Action Alternative.

Under the No Action Alternative, the total spring/summer water supply available for irrigation within the portion of the Project primarily served from UKL is comprised of Project Supply from UKL plus water diverted from the Lost River and conveyed through the LRDC.

During the fall/winter period under the No Action Alternative water diverted from the Lost River, conveyed through the LRDC, and released into the Klamath River is accounted for as accretions and contributes to IGD releases. This water is not available for irrigation use within the Project during this time period.

With respect to water pumped into the Klamath River via the KSD under the No Action Alternative this water is accounted for as an accretion and contributes to IGD releases year-round. This water is unavailable for irrigation use at all times.

Tule Lake Sump 1A
TLNWR receives return flows from Project lands and facilities. Minimum elevations for Tule Lake Sump 1A (TLS1A; *see Appendix A*) have been established to protect refuge resources and ESA-listed Lost River and shortnose suckers. Under the No Action Alternative, the April through September minimum elevation is 4,034.6 feet, and 4,034.0 feet for October through March. As water supply for TLS1A is largely a result of return flows from irrigation deliveries, Reclamation may not be able to maintain these elevations when Project lands receive less than full water deliveries. When Project lands receive full water deliveries, Reclamation, through its contract with Tulelake Irrigation District (TID), will operate to meet these minimums (established in coordination with the USFWS) in TLS1A (*see 4.2.5., 7.11.4. of the 2013 BiOp).*

2.4. Proposed Action Alternative

Under the Proposed Action Alternative, Reclamation would operate the Project consistent with the Proposed Action described in the modified 2018 BA. Specific elements of the Proposed Action Alternative that differ from the No Action Alternatives include: 1) a reduced cap on Project Supply available from UKL, 2) use and accounting of flows from the LRDC and KSD, 3) inclusion of forced surface flushing flows in the Klamath River, and 4) the change in operating elevations of TLS1A. These specific elements are discussed below and in more detail in Part 4, and Appendix 4 of the modified 2018 BA.

UKL Management
This operational approach seeks to fill UKL during the fall/winter to increase the volumes available for the EWA (including disease mitigation flows), UKL, and Project Supply during the spring/summer operational period. The Proposed Action Alternative also includes a "UKL control logic" that regulates certain releases (as described below) relative to UKL storage and

recent hydrologic conditions in a manner that maintains UKL elevations important for suckers, and a "UKL Credit" that buffers UKL against uncertainties associated with NRCS forecast error and other factors affecting UKL inflow available for subsequent diversion.

The UKL control logic helps to manage UKL elevations for endangered suckers while ensuring adequate storage in UKL for both Klamath River and Project releases, utilizing a "central tendency." The central tendency is based on user-defined end-of-month UKL elevations which are subsequently interpolated to daily values (this is termed the generic central tendency). This results in a generic annual hydrograph that accounts for seasonal needs of suckers, seasonal water demand for the Klamath River and Project, and end-of-season elevations intended to result in (after winter inflows) storage volumes appropriate to meet the next year's demands on UKL. This generic hydrograph is then adjusted daily, based on a normalized 60-day trailing average of raw net inflow to UKL, producing an adjusted central tendency. If UKL elevations drop below the adjusted central tendency, then releases to the Klamath River (*subject to IGD minimums described in Appendix 4, Section A.4.4.2, Table A.4.4.2.2 of the modified BA*) and winter deliveries to Area A2 are reduced until UKL elevations equal or exceed the adjusted central tendency line. The adjusted central tendency is not a target to which UKL should be managed, but rather a guideline that maintains UKL elevation in line with both hydrologic conditions and the multiple demands placed upon UKL storage throughout the year. Finally, note that the generic central tendency end-of-month UKL elevations were arrived at through the iterative modeling process and are not intended to change during operations under this PA. *(See Appendix 4, Section A.4.4.1.1 of the modified BA for technical details regarding the UKL control logic.*

Klamath River Management

Under the Proposed Action Alternative, the minimum EWA is 400,000 AF, increased from 320,000 AF in the No Action Alternative. The EWA was increased partly to make up for how flows from the LRDC and KSD are accounted for under the Proposed Action Alternative (more discussion on LRDC and KSD flows is provided below). Minimum EWA is 400,000 AF, which occurs when UKL Supply is less than 670,000 AF. When UKL Supply is greater than 1,035,000 AF, EWA is calculated as UKL Supply minus the maximum Project Supply (342,564 AF). Refer to the modified 2018 BA, Appendix 4 (*Section 4.3.2.2.2.3*) for EWA calculations when UKL Supply is between 670,000 AF and 1,035,000 AF. Much like Project Supply, the EWA allocation is calculated on the first of each month from March to June based on the NRCS inflow forecast and observed hydrology. In even years (e.g., 2020, 2022), EWA is further increased by 7,000 AF to cover releases for the Yurok Tribe's Ceremonial Boat Dance. In years in which augmentation of May/June flows is required, EWA allocation is increased by 20,000 AF on July 1.

Forced Flushing Flows

The EWA was also increased to provide additional water to address ESA-listed coho disease concerns which were identified during implementation of the No Action Alternative. An independent science review of the Guidance Document indicated that a springtime flushing flow at or above approximately 6,030 cfs for 72 hours in the Klamath River downstream of IGD may reduce disease risk for juvenile Klamath River salmonids and improve habitat availability. A 6,030 cfs flushing flow for 72 hours followed by appropriate ramping of river flows back to those formulated under the rules of the KBPM is expected to utilize approximately 50,000 AF of EWA. The timing of the flushing flow release depends on hydrologic conditions but would occur between March 1 and April 15.

Surface flushing flows (6,030 cfs for 72 hours with appropriate ramp rates (or as high as possible if 6,030 cfs cannot be reached)) are forced between March 1 and April 15 in years when March 1 or April 1 EWA is calculated to be less than 576,000 AF. In any year in which a flushing flow is not forced, (i.e., when EWA is greater than or equal to 576,000 AF), an opportunistic surface flushing flow may be implemented between March 1 and April 15 if UKL elevation is greater than or equal to 4,142.4 feet and the previous day's IGD release was greater than or equal to 3,999 cfs.

The approximate 50,000 AF can be used for purposes other than a surface flushing flow if NMFS and/or other stakeholders (via the Flow Account Scheduling Technical Advisory [FASTA] Team process described below) believe that an alternate use would provide greater ecological benefit for Klamath River salmonids. Under the Proposed Action Alternative, the flow schedule for EWA distribution largely varies based on the remaining EWA, inflows to UKL, and accretions between Link River Dam and IGD.

Reclamation will provide PacifiCorp with at least 24 hours notice prior to planned implementation of a surface flushing flow.

Flows from the Lost River Diversion Channel and Klamath Straits Drain
Consistent with both alternatives, under normal Project operations, all water in the Lost River, up to approximately 3,000 cfs, is diverted into the LRDC at the Lost River Diversion Dam, just east of Olene (a suburb of Klamath Falls, Oregon). Likewise, irrigation return flows, flood flows, and drainage from LKNWR is pumped into the Klamath River via the KSD year-round. Accounting for and use of this water varies between the two alternatives.

Similar to the No Action Alternative, under the Proposed Action Alternative, during the spring/summer period, water diverted from the Lost River and conveyed through the LRDC is available for Project diversion and irrigation use and does not count against the Project Supply from UKL. This rule applies for water diverted directly from the LRDC (i.e., at Station 48, Miller Hill Pumping Plant) during the period of March 1 through November 30, and for water that is released from the LRDC into the Klamath River and subsequently diverted (i.e., at Ady Canal or North Canal) during the period of March 1 through October 31. The availability of LRDC flows for diversion and irrigation use at Ady and North canals during the month of October differs from the No Action Alternative.

Similar to the No Action Alternative, during the fall/winter period, under the Proposed Action Alternative water diverted from the Lost River, conveyed through the LRDC, and released into the Klamath River is accounted for as an accretion and contributes to IGD releases. This water is not available for irrigation use within the Project during this time period.

Also similar to the No Action Alternative, under the Proposed Action Reclamation measures and accounts for this water released into the Klamath River from the LRDC on a daily basis, both with respect to its availability and use. For accounting purposes, use of water diverted from the Lost River and conveyed via the LRDC is only attributed to Station 48, Miller Hill Pumping Plant, Ady Canal and North Canal. Water use associated with other minor Project diversions from the LRDC or the Klamath River is accounted for separately under the No Action Alternative.

Unlike the No Action Alternative, where KSD flows are accounted for as accretions to the Klamath River and contribute towards IGD releases year-round, the Proposed Action Alternative makes KSD flows available for irrigation use within the Project during the spring/summer period and not counted against the Project Supply from UKL. During the fall/winter period, like the No Action Alternative, under the Proposed Action Alternative, water pumped into the Klamath River from the KSD is accounted for as an accretion to the Klamath River and contributes towards IGD releases.

Under the Proposed Action Alternative, the total spring/summer water supply available for irrigation within the portion of the Project primarily served from UKL is comprised of Project Supply from UKL plus water diverted from the Lost River and conveyed through the LRDC and water pumped from KSD. Unlike the No Action Alternative, where LRDC and KSD flows not otherwise diverted for irrigation during the spring/summer period are accounted for as accretions and contribute to IGD releases, under the Proposed Action Alternative, such water is accounted for as a “UKL Credit.”

The purpose of the UKL Credit is to buffer UKL against uncertainties associated with NRCS forecast error and other factors affecting UKL inflow available for subsequent diversion, and to allow for calculation of a minimum Project Supply on April 1 of each year. The UKL Credit accrues when LRDC and KSD flows in excess of direct diversions for irrigation are utilized to meet IGD flow targets, resulting in a reduction in LRD releases to support river flows. The reduced releases from UKL allow for additional volume to be stored in UKL as a credit to help protect UKL elevations from an early season over-forecast of seasonal inflow, which might result in over-allocation of EWA and Project Supply. It can only be accrued from March 1 through September 30 during controlled flow conditions (i.e., not during flood control operations). This treatment of undiverted flows from the LRDC and KSD is a difference between the No Action and Proposed Action alternatives. Under the No Action Alternative, flows from the LRDC and KSD that were not diverted for irrigation were accounted for as accretions and contributed to IGD releases. Under the Proposed Action Alternative, these flows are instead accounted for as a “UKL Credit”, as described above. The EWA volume under the Proposed Action Alternative was increased from the No Action Alternative in part to account for this change in treatment of KSD flows.

Project Water Supply
The maximum Project Supply under the Proposed Action Alternative is 350,000 AF (as further qualified below), which is a reduction from the No Action Alternative (maximum of 390,000 AF). Project Supply is initially determined in early March as the quantity of water remaining after the end of September target UKL storage and EWA are determined, or a

maximum of 350,000 AF, whichever is less. It is recalculated in early April using the NRCS inflow forecast to reflect the most current information on hydrologic conditions. Should EWA allocation be less than 576,000 AF on April 1, the calculated Project Supply is further reduced by 10,000 AF in order to support augmented May/June river flows. *(See Part 4 of the modified 2018 BA (Section 4.3.2.2.2.2) and Appendix 4 of the modified BA for additional details regarding Project Supply calculations and augmented May/June river flows*.) The April 1 Project Supply establishes the minimum Project Supply for the irrigation season. The Project Supply is recalculated again in May and June, and while the Project Supply cannot decrease below the April 1 allocation, it may increase in May and June.

Under the Proposed Action, as addressed in the addendum to the modified 2018 BA dated March 25, 2019, to properly account for Project-associated diversions from the Klamath River other than Station 48, Miller Hill Pumping Plant, North Canal and Ady Canal, the Project Supply would be initially reduced by 7,436 AF from the Project Supply calculations after March 1, April 1, May 1, and June 1. To the extent Reclamation determines and can adequately verify that actual irrigation deliveries at Project-associated points of diversion from the Klamath River other than Station 48, Miller Hill Pumping Plant, Ady Canal and North Canal are occurring at volumes less than 7,436 AF during the spring-summer period, the verified volume will be added back to the available Project Supply for diversion at A Canal, Station 48, Miller Hill Pumping Plant, North Canal, and Ady Canal. In actual operations, Reclamation will make this determination by notifying Project contractors of the volume available for diversion at these locations, then visually verifying that diversions are consistent with that volume identified as available and notifying the Services accordingly.

Additionally, Reclamation will monitor these diversions to ensure that there is no increase in the amount diverted compared to the POR (1981-2016), and to the extent there is an increase, adjust Project Supply to account for these additional diversions. Based on the assumption that Project-associated diversions from the Klamath River other than at Station 48, Miller Hill Pumping Plant, North Canal, and Ady Canal will occur at a level consistent with diversions at these locations during the POR, further reference in this EA to the available Project Supply under the Proposed Action will reflect the anticipated deduction of 7,436 AF from the Project Supply as described above (e.g., 350,000 AF - 7,436 AF = 342,564 AF).

LKNWR Deliveries
Under the Proposed Action Alternative, the components of the annual LKNWR water supply consist of: fall/winter supply, spring/summer Project Supply, and UKL water in June and July (not part of Project Supply).

For the fall/winter period, the Proposed Action provides for deliveries to LKNWR of up to 11,000 AF, subject to the UKL control logic. Specifically, if UKL elevation is at or above the adjusted central tendency throughout the fall/winter period, the only modeled constraints to delivery would be the delivery cap (11,000 AF), conveyance capacity, and demand. However, if UKL elevation is below the adjusted central tendency, daily deliveries to LKNWR would be reduced incrementally by up to 80 percent. (*See part 4.3.2.2.1 of the modified 2018 BA for additional details on fall/winter operations.*)

For the spring/summer period, LKNWR can receive any portion of the available Project Supply from UKL, consistent with Reclamation's contractual and other legal obligations. There are no formulaic conditions for determining what portion of the available Project Supply is available for delivery to LKNWR. Rather, Reclamation proposes to coordinate with USFWS and other Project water users (e.g., districts) to determine anticipated irrigation water demands within the Project and what portion of Project Supply is available for delivery to LKNWR after Reclamation's contractual and other legal obligations have been met.

In addition to Project Supply, the modified 2018 BA provides for (*See part 4.3.2.2.2 of the 2018 modified BA for additional details on calculation and use of the Project Supply during the spring/summer period.)*

Tule Lake Sump 1A
TLNWR receives return flows from Project lands and facilities. Minimum elevations for TLS1A have been established to protect TLNWR values and ESA-listed Lost River and shortnose suckers. Under the Proposed Action Alternative, the year-round minimum elevation is proposed to be 4,034.0 feet (*see section 4.3.2.2.7. of the modified 2018 BA).* As water supply for TLS1A is largely a result of return flows from irrigation deliveries, Reclamation may not be able to maintain these elevations when Project lands receive less than full water deliveries. When Project lands receive full water deliveries, Reclamation in coordination with TID will operate to meet these minimums in TLS1A.

3. Affected Environment

This section summarizes the existing environment that could be affected by the No Action and Proposed Action alternatives.

3.1. Water Resources

3.1.1. Surface Water

The Upper Klamath Basin drains approximately 4,630 square miles above IGD. The region encompasses two watersheds, the Klamath River watershed and the Lost River watershed. The Lost River system includes Clear Lake, Gerber Reservoir, Lost River, and Tule Lake (known as Sump 1A and Sump 1B). UKL, a main component of Project operations, is fed by three major tributaries, including the Williamson, Wood and Sprague rivers and is the start of the Klamath River which ultimately flows through southern Oregon into Northern California out to the Pacific Ocean.

3.1.1.1. Upper Klamath Lake

Hydrology
UKL is the largest lake by surface area in Oregon (approximately 67,000 acres) and is fed by a watershed of 3,768 square miles, including the Williamson, Wood, and Sprague rivers. Outflow from UKL is controlled by LRD, which releases water into the Link River at the

south end of the lake. UKL varies in width from six to 14 miles and is approximately 25 miles long. The mean surface elevation is 4,140 feet above sea level Reclamation Datum (Neuman 2017), at which the mean depth is approximately 14 feet and the maximum depth is 49 feet. Current bathymetric data (Neuman 2017) indicates that UKL has an active storage capacity of 562,000 AF between the elevations of 4,136.0 and 4,143.3 feet above sea level, which is the range within which UKL has been operated since completion of LRD in 1921. Naturally occurring water surface elevations prior to completion of LRD fluctuated between approximately 4,140 and 4,143 feet above sea level (Kann 2010). The mean annual net inflow to UKL is approximately 1,200,000 AF; however, this figure ranges from approximately 500,000 to 2,500,000 AF depending on hydrologic conditions.

Water Quality
Water quality in UKL is considered poor, primarily as a result of eutrophication. UKL is considered a hypereutrophic system, characterized by excessive nutrient concentrations and frequent large algal blooms and subsequent bloom crashes (Oregon Department of Environmental Quality [ODEQ] 2002). The source of excessive nutrients (primarily phosphorus) is a combination of relatively high background concentrations, internal sediments, and anthropogenic factors, such as the conversion of wetlands and marshlands to agricultural lands and the drainage of agricultural lands into UKL and its tributaries (ODEQ 2002).

The ODEQ has developed Total Maximum Daily Loads (TMDLs) targeting total phosphorus for UKL and Agency Lake (ODEQ 2002). The TMDLs were developed to address impairments to dissolved oxygen, pH, and chlorophyll-a (nuisance phytoplankton growth) specific to the summer months of the year.

3.1.1.2. Link River

Hydrology
The Link River is an approximately 1.5-mile long waterbody connecting UKL and the Klamath River. The Link River begins at the outlet of UKL, just upstream of LRD, and runs through a narrow canyon to Lake Ewauna, which constitutes the beginning of the Klamath River. The Link River drops 44 feet over its course, including a series of small rapids approximately 500 feet below LRD. Two canals which were historically used primarily for hydroelectric purposes divert water at LRD and run along the east and west sides of the river itself. PacifiCorp continues to intermittently operate the East Side and West Side powerhouses that are supplied by these two canals. From 1962 through 2018, the mean annual rate of flow from LRD into the Link River was approximately 1,250 cfs, and the mean annual volume was approximately 900 TAF.

Water Quality
Due to the short travel time (generally around two hours), water quality in Link River generally follows conditions in UKL with respect to pH, ammonia, chlorophyll-*a*, and cyanobacteria. During periods when dissolved oxygen levels in UKL are either extremely low or high, aeration of the water in the rapids between LRD and Lake Ewauna returns concentrations closer to saturation.

3.1.1.3. Klamath River

Hydrology

The Klamath River begins at the outlet of Link River and flows approximately 253 miles through southern Oregon and northern California to the Pacific Ocean. The first two miles of the river form a broad, flat body of water known as Lake Ewauna. Water levels remain relatively constant from Lake Ewauna downstream approximately 18 miles to Keno Dam (at approximately river mile 233), which is owned and operated by PacifiCorp. Downstream of Keno Dam, the Klamath River enters a narrow canyon where it descends approximately 1,550 feet over the next 40 miles.

Four additional dams, owned by PacifiCorp and operated for hydroelectric purposes, are located along this reach, between river miles 224 and 190. Downstream of IGD, the river increases in size with the inflow of the Shasta, Scott, Salmon, and Trinity rivers and several smaller tributaries. The natural drainage area of the Klamath River (excluding the Lost River watershed) is approximately 12,700 square miles.

The Upper Klamath Basin is relatively dry, as compared to the Lower Klamath Basin. This distinction is demonstrated by the average annual precipitation of approximately 13 inches in Klamath Falls, Oregon, as compared to approximately 75 inches in Klamath, California. The relative difference in precipitation also is reflected in the dramatic increase in the size of the river as it flows towards the coast. Annual mean flow at the beginning of the Klamath River is approximately 1,250 cfs, compared to approximately 17,000 cfs near the mouth at the Pacific Ocean.

Since 1956, releases from IGD to the Klamath River were governed by flow requirements specified in PacifiCorp's operating license from the Federal Power Commission, now FERC. Since the 1997 listing of SONCC coho salmon in the Klamath River as threatened, flow requirements downstream of IGD have been governed in accordance with the ESA. Reclamation coordinates with PacifiCorp on operations such that IGD flow targets are achieved. Currently, PacifiCorp's February 16, 2012, Interim Operations Habitat Conservation Plan and subsequent Incidental Take Statement issued by NMFS requires PacifiCorp to operate IGD, located 63 miles below LRD, in accordance with any required flow releases identified in a BiOp resulting from Reclamation's current or future ESA section 7 consultations.

Established under Section 2(a)ii of Wild & Scenic Rivers Act (WSRA; Public Law 90-542; 16 U.S.C. 1271 et seq.), portions of the Klamath River are included in the National Wild and Scenic Rivers System because of their free-flowing conditions and outstandingly remarkable values (Reclamation and California Department of Fish and Game [CDFG] 2012). Specifically, the portion of the Klamath River from the J.C. Boyle Powerhouse to the California-Oregon State border is classified under the WSRA as *scenic* with identified "outstandingly remarkable" fisheries, recreation, historic, wildlife, American Indian traditional use, and pre-historic values (USFWS et al. 2018). Additionally, the portion of the Klamath River in California, 3,600 feet below IGD to the Pacific Ocean (250 miles), is designated as *recreational* with "outstandingly remarkable" fisheries values (Reclamation and CDFG 2012).

Water Quality
The approximately 20-mile reach of the Klamath River from the outlet of the Link River to Keno Dam generally exhibits poor water quality conditions on a seasonal basis, including low levels of dissolved oxygen (DO) and high temperatures and elevated levels of ammonia, nutrients, chlorophyll-a, and pH. Releases from UKL, particularly during the summer, are the primary cause of these conditions, due to the high concentration of algal biomass in the water. Flows from the KSD, treated municipal sewage effluent, and log storage operations also contribute to excessive nutrient loads and other contaminants in this reach of the Klamath River (modified 2018 BA).

The ODEQ has developed TMDLs targeting total phosphorus, total nitrogen dissolved inorganic nitrogen and biological oxygen demand in the Link to Keno Dam Reach of Klamath River (ODEQ 2018). The TMDLs were developed to address impairments to DO, pH, ammonia toxicity, and nuisance phytoplankton growth. The current TMDLs for the Klamath River in California address temperature, DO, nutrient, and microcystin water quality impairments for the Klamath River Hydrologic Unit, Middle Hydrologic Area (Oregon to Trinity River) and Lower Hydrologic Area, Klamath Glen Hydrologic Sub-area (Trinity River to Pacific Ocean) (North Coast Water Quality Control Board 2010).

Total phosphorus loads tend to remain elevated through the hydroelectric reservoirs of the middle and lower Klamath River Reaches. Excess phosphorus in proportional combination with nitrogen contributes to algal blooms in this reach, which cause seasonally elevated pH, ammonia, chlorophyll-*a*, and microcystin levels upstream of IGD. Nitrification downstream of IGD causes a decrease in ammonia and organic nitrogen levels and a corresponding increase in nitrate, which is less harmful to aquatic life. However, water quality in the Klamath River below IGD is still impaired at times of the year due to high levels of phosphorus, nitrogen, and other organic material, and corresponding low DO levels.

3.1.1.4. Lost River

Hydrology
The approximately 60-mile long Lost River begins at the outlet of Clear Lake Reservoir, in Modoc County, California, and flows northward into Klamath County, Oregon. After flowing through Langell Valley, the river turns westerly near the town of Bonanza, and then after passing through Olene Gap, turns southward and flows back into California, where it terminates at Tule Lake. In its natural condition, the Lost River constituted a mostly closed basin, with a drainage area of approximately 3,000 square miles. Historically, during periods of high flow, the Klamath River would flow through the Lost River Slough, into the Lost River, and eventually Tule Lake. Major tributaries to the Lost River include Miller Creek, Rock Creek, and the East Branch of the Lost River.

To reclaim lands underlying Tule Lake, between 1910 and 1912 Reclamation constructed the Lost River Diversion Dam and Channel, approximately four miles southwest of Olene Gap. The Lost River Diversion Dam diverts the flow of the Lost River into the LRDC, where it can be conveyed approximately eight miles to the Klamath River, just downstream of Lake

Ewauna. The LRDC, which roughly follows the course of the former Lost River Slough, has a current capacity of 3,000 cfs.

Throughout the year, all flows in the Lost River that reach the Lost River Diversion Dam, up to approximately 3,000 cfs, are diverted into the LRDC. During the irrigation season (March 1 to November 15), these flows are relatively small (i.e., 50-150 cfs) and generally are re-diverted from the LRDC for irrigation purposes prior to reaching the Klamath River. At other times of the year, the entire flow in the Lost River, up to the capacity of the LRDC, is diverted to the Klamath River (during the fall/winter period). During the fall/winter period, flows in the lower Lost River primarily consist of tributary runoff, irrigation return flows, and stored water from UKL (conveyed and released into the Lost River through the LRDC). When flows in the Lost River exceed the capacity of the diversion channel, the excess water is spilled over the Lost River Diversion Dam to the lower Lost River and Tule Lake.

In 1942, as part of a coordinated plan with the Bureau of Biological Survey (now USFWS), Reclamation constructed Pumping Plant D, the Tule Lake Tunnel, and the P Canal system, to convey excess water from Tule Lake to the Lower Klamath Lake area. Through operation of the LRDC, Pumping Plant D, and the KSD, water from the Lost River, of varying rates and volumes, is currently exported to the Klamath River. The rate and volume of these diversions are influenced by a variety of conditions, including reservoir storage levels in the Lost River watershed, existing water levels in Tule Lake and LKNWR, flows in the Klamath River, and available capacity in both LRDC and KSD. Overall, from October 1, 1980 to September 30, 2016, average flows from the LRDC and the KSD were approximately 21 percent of the annual volume released from Keno Dam.

In addition to the LRDC, there are three other major impoundments on the main stem of the Lost River. Malone Diversion Dam, twelve miles downstream of Clear Lake and just over the Oregon border, diverts water for irrigation purposes in Langell Valley. Approximately three miles west of the town of Bonanza, Harpold Dam regulates upstream water levels to facilitate pumping from the river for irrigation purposes in Yonna Valley. Anderson-Rose Dam, two miles south of the town of Merrill, diverts water from the Lost River four miles upstream from the terminus of the Lost River at Tule Lake.

Water Quality

Similar to the tributaries to UKL, land use practices in the Lost River watershed, including modifications to the river channel and adjacent riparian areas, contribute to the current hypereutrophic conditions in the Lost River (ODEQ 2018). Nutrient loading, greatest in the middle and lower portions of the watershed, produces algal blooms in the summer and the associated low DO and high pH and ammonia levels (ODEQ 2018).

The ODEQ has developed TMDLs targeting dissolved inorganic nitrogen and carbonaceous oxygen demand (ODEQ 2018). The TMDLs were developed to address impairments to DO, pH, ammonia toxicity, and nuisance phytoplankton growth specific to various reaches of the Lost River system.

3.1.2. Groundwater

The Upper Klamath Basin covers a broad volcanic plateau between the Cascade Range and the Basin and Range geologic provinces in south-central Oregon and northern California. Despite low precipitation levels, tributary runoff and groundwater recharge from the Cascade Range on the western margin and volcanic uplands on the eastern margin contribute to local groundwater levels. As a result, the permeable volcanic bedrock in the basin contains an extensive groundwater system that contributes to surface water supplies and serves as a water source for natural spring flows as well as irrigation, municipal, domestic and other uses (Gannett et al. 2012).

Groundwater originates as recharge in the Cascade Range and upland areas in the basin interior and eastern margins and flows toward stream valleys and interior sub-basins. Natural springs discharge groundwater into streams and lakes throughout the basin, particularly in the Wood River and lower Williamson River watersheds, along the margins of the Cascade Range, and directly into UKL. Natural springs also occur in the eastern part of the basin, including the Lost River watershed. As the permeability of soils in the Lower Klamath Basin (below IGD) is less than the soils in the Upper Klamath Basin, there is negligible groundwater flow between the upper and lower basins (Gannett et al. 2012). The groundwater system in the basin is most directly affected by basin-wide, decadal-scale climatic cycles. Irrigation pumping has increased throughout the basin over the last half-century, and particularly over the last two decades within the Project service area (Gannett et al. 2012).

Groundwater use is governed, authorized, and regulated under the laws of the respective states. In Oregon, the extent of impacts to groundwater (e.g., drawdown) is monitored and regulated by the OWRD, which has the responsibility to determine and enforce acceptable levels of impact to groundwater resources. Oregon has in the past exercised this regulation and enforced these limits in order to reduce or eliminate impacts to third parties and/or the groundwater resources in accordance with Oregon water law.

In California, groundwater use is governed by the 2014 Sustainable Groundwater Management Act, which calls for the establishment of Groundwater Sustainability Agencies and Groundwater Sustainability Plans by 2022, with a goal of sustainability by 2042 for the medium priority Tule Lake Basin. For the purposes of the Proposed Action Alternative and EA, only 2022 falls within the scope of the Proposed Action Alternative in California.

3.2. Biological Resources

3.2.1. Upper Klamath River Basin/ Upper Klamath Lake Federally Protected Species

Several fish species are located and carry out their life cycles in the Upper Klamath Basin/UKL. The Lost River (*Deltistes luxatus*; endangered under the ESA) and shortnose sucker (*Chasmistes brevirostris;* endangered under the ESA) are the species in the Upper Klamath Basin of interest in this EA. For the considered species, greater detail on life history timing is below.

Lost River sucker
Lost River suckers are limited in distribution to UKL, Clear Lake Reservoir, and Tule Lake Sumps in the Upper Klamath Basin. The largest remaining populations of Lost River suckers are in UKL. Despite high survival for most years from 1999 to 2015, the abundance of LRS males in the lakeshore-spawning subpopulation declined approximately 64 percent and the abundance of females declined by approximately 56 percent (Hewitt et al. 2018). Additionally, preliminary data from USGS reports that tributary-spawning LRS may have experienced dramatic declines of approximately 50 percent from 2016 to the spring of 2018. The abundance of tributary-spawning LRS is likely 30 percent of what it was in 2001 (Janney and Hewitt, USGS, pers. comm. August 2018). The total number of Lost River suckers is estimated to be less than 40,000 suckers; approximately 7,200 lakeshore spawners and approximately 32,000 tributary spawners. Individuals in this population have exceeded the average life expectancy for the species and Lost River suckers in Upper Klamath Lake. Meaningful recruitment for Lost River suckers in UKL has not occurred since the early 1990s (Hewitt et al. 2018).

Populations in the Tule Lake Sumps are not well studied, and it is estimated that there are only several hundred suckers. Of the tagged suckers, only 53, 56, and 43 Lost River suckers were detected on an antenna array in Tule Lake in 2015, 2016, and 2017, respectively (Hayes, USGS, pers. comm. August 2018). It is unknown what percent of suckers are tagged in Tule Lake, thus it is not possible to estimate population size. Historic records suggest sucker populations in Tule Lake were among the largest in the region. The population of suckers has decreased from several hundred-thousand or even millions of suckers to less than several hundred adults of both species in Tule Lake sumps (USFWS 2002). Spawning grounds from the Tule Lake Sumps are limited to the area below Anderson Rose Dam. Spawning events are not well documented, though spawning has occurred in some years. The remaining sucker populations in TLS1A is small, isolated, and there have been no documented successful recruitment events into the adult population.

Shortnose sucker
Shortnose suckers occur in most lakes in the Upper Klamath Basin. The largest remaining population of shortnose suckers is in UKL. Between 2001 and 2016, the abundance of male shortnose suckers declined by 78 percent and the abundance of females declined 77 percent (Hewitt et al. 2018). Preliminary data from USGS reports that shortnose suckers have experienced declines of approximately 40 percent from 2016 to the spring of 2018. Individuals in this population have exceeded average life expectancy and are near the maximum known age for the species (33 years). Meaningful recruitment for shortnose suckers in UKL has not occurred since the early 1990s (Hewitt et al. 2018).

Populations in the Tule Lake Sumps are not well studied, and it is estimated that there are only several hundred suckers remaining. Of the tagged suckers, only 30, 30, and 24 shortnose suckers were detected in Tule Lake sumps in 2015, 2016, and 2017, respectively (Hayes, USGS, pers. comm. August 2018). It is unknown what percent of suckers are tagged in Tule Lake Sumps, thus it is not possible to estimate population size. Historic records indicate sucker populations in Tule Lake Sumps were among the largest, suggesting the population has decreased from several hundred-thousand or even millions of suckers (prior to the construction of the Project) to less than several hundred adults of both species in Tule Lake Sumps (USFWS 2002). Similar to Lost River suckers, the shortnose sucker population in TLS1A is small, isolated, and there has been no documented successful recruitment events.

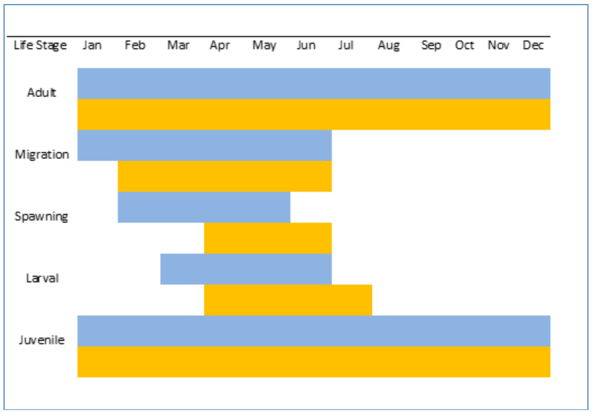


Figure 3-1 Seasonal timing of various life history stages for Lost River (blue) and shortnose (yellow) suckers.
Source: USFWS forthcoming

3.2.2. Lower Klamath Basin/Klamath River Federally Protected Species

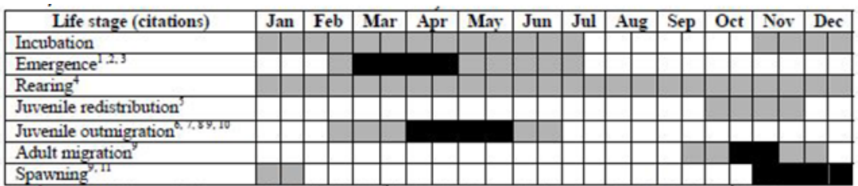
Several anadromous (migratory) fish species use the Klamath River to complete their life cycles (Reclamation 2012). These species are also listed under the ESA and/or considered for evaluation under the Magnuson-Stevens Fishery Conservation and Management Act Public Law 94-265 as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (P.L. 109-479) (MSA or Magnuson-Stevens Act). The coho salmon (*Oncorhynchus kisutch*; threatened under the ESA/evaluated under MSA under an Essential Fish Habitat (EFH) assessment, [*see section 5.3*]), Southern Distinct Population Segment (DPS) Eulachon (*Thaleichthys pacificus*; threatened under ESA), Southern DPS Green sturgeon (*Acipenser medirostris*; threatened under ESA), Chinook salmon (*Oncorhynchus tshawytscha*; evaluated under MSA EFH) and Southern Resident DPS killer whale (*Orcinus orca*; endangered under the ESA) are the species in the Lower Klamath Basin of interest in this EA. For the considered species, greater detail on life history timing is below.

Coho Salmon
Coho salmon populations in the Klamath River Basin are severely reduced from historic levels. Ten SONCC coho salmon populations in the Klamath River Evolutionary Significant Unit (ESU) are at high risk of extinction because they are below, or likely below, their depensation threshold (NMFS 2016). The Middle Klamath River, Scott River, and Upper Trinity River populations are classified at a “moderate” risk of extinction. Populations that are under depensation[7] have increased likelihood of being extirpated, and because the population abundance of most independent populations are below their depensation threshold, the

[7] In Population dynamics, “depensation” is the effect on a population (such as fish stock) whereby, due to certain causes, a decrease in the breeding population (mature individuals) leads to reduced production and survival of individuals or offspring.

SONCC coho salmon ESU is at high risk of extinction and is currently not viable. Life history timing for coho salmon in the Klamath River are provided in Table 3-1 (Reclamation 2016).

Table 3-1: Life-history of coho salmon in the Klamath River Basin downstream of IGD. Peak activities are indicated in black.
Source: Reclamation 2016, Stillwater Sciences 2009



[1] CDFG (2000, unpubl. data, as cited in NRC 2004); [2] CDFG (2001, unpubl. data, as cited in NRC 2004); [3] CDFG (2002, unpubl. data, as cited in NRC 2004); [4] Sandercock (1991); [5] T. Soto, Fisheries Biologist, Yurok Tribe, pers. comm., August 2008; [6] Scheiff et al. (2001); [7] Chesney and Yokel (2003); [8] T. Shaw (USFWS, unpubl. data, 2002, as cited in NRC (2004); [9] NRC (2004); [10] Wallace (2004); [11] Maurer (2002)

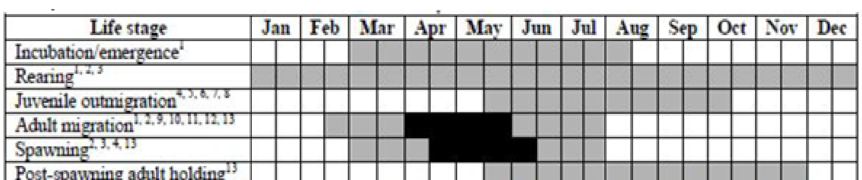
Eulachon, Southern Distinct Population Segment

In the Klamath River, eulachon were once abundant, but have declined to the point where detecting them has become difficult (NMFS 2010b). There have been no long-term monitoring programs targeting eulachon, making estimates of historical abundance and abundance trends difficult to generate (Gustafson et al. 2008).

Green sturgeon, Southern Distinct Population Segment

Green sturgeon are present within the Klamath River Basin downstream of IGD. Using Klamath River tribal fishery harvest data for green sturgeon and assuming that adults represent 10 percent of the population at equilibrium, the Klamath green sturgeon population (Northern DPS) estimate is <20,000 individuals (Reclamation 2008b). Furthermore, the number of individuals in the Southern DPS is approximately 15,000 individuals, or somewhat smaller than the estimate for the Klamath population, both likely less than historic levels.

Table 3-2. Life-history of green sturgeon in the Klamath River Basin downstream of IGD. Peak activities are indicated in black.
Source: Reclamation 2016, Stillwater Sciences 2009



[1] CALFED ERP (2007), [2] NRC (2004), [3] FERC (2006), [4] Emmett et al. (1991, as cited in CALFED ERP 2007), [5] CH2M Hill (1985), [6] Hardy and Addley (2001), [7] Scheiff et al. (2001), [8] Belchik (2005, as cited in CALFED ERP 2007), [9] KRBFTF (1991), [10] Moyle (2002), [11] PacifiCorp (2004), [12] Van Eenennaam et al. (2006), [13] Benson et al. (2007)

Chinook Salmon

Spring-run Chinook salmon in the Klamath Basin are distributed mostly in the Salmon and Trinity rivers and in the mainstem below these tributaries only during migratory periods, although a few fish are occasionally observed in other areas (Stillwater Sciences 2009). Spring-run Chinook salmon adults spawn from mid-September to late-October in the Salmon River and from September through early November in the South Fork Trinity River (Stillwater

Sciences 2009). Fry emergence takes place from March and continues until early-June (West et al. 1990). There appears to be three juvenile life-history types for spring-run Chinook salmon in the Klamath Basin: Type I (ocean entry at age 0 in early spring within a few months of emergence); Type II (ocean entry at age 0 in fall or early winter) (Olson 1996); and Type III (ocean entry at age 1 in spring) (Sullivan 1989). Spawning, incubation, rearing, and smolting habitat characteristics for spring-run Chinook salmon are similar to fall-run Chinook salmon.

Fall-run Chinook salmon are distributed throughout the Klamath River downstream of IGD and spawn later in the year in the mainstem as well as in several tributaries. Adult upstream migration through the estuary and lower Klamath River peaks in early September and continues through late October (Moyle 2002, FERC 2007, Strange 2009). Spawning peaks in late October and early November. Fall-run Chinook salmon fry in the Klamath River emerge from redds between December and late February (Reclamation 2011). Fall-run Chinook salmon in the Klamath Basin exhibit three juvenile life-history types: Type I (ocean entry at age 0 in early spring within a few months of emergence), Type II (ocean entry at age 0 in fall or early winter), and Type III (ocean entry at age 1 in spring) (Sullivan 1989).

Wild spring run Chinook salmon populations are reportedly a remnant of their historical abundance and primarily occur in the South Fork Trinity River and Salmon River Basins (NMFS 2011), with returns below 1,000 fish. NMFS (2011) indicates fall run Chinook in the last several decades have ranged from below 50,000 to 225,000 fish. Naturally produced (i.e, non-hatchery) smolt production is largely unknown but has also dropped due to the decline in wild adult Chinook salmon runs over the last several decades. Oregon considers Klamath Chinook as “extinct” or “extirpated” because they are no longer present in the upper basin. California considers the spring-run Chinook salmon as a candidate endangered species, a testament to its decline.

Southern Resident Killer Whale

The southern Resident DPS killer whales (SRKW) consist of three pods (identified as J, K, and L pods) which reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall Pods visit coastal sites off Washington and Vancouver Island (Ford et al. 2000) but travel as far south as central California and as far north as Southeast Alaska. A primary food source for SRKW includes Klamath River salmon with largest component of their diet being fall run Chinook salmon.

3.2.3. Other Species

The Project area is home to a large number of wildlife species with great diversity. Previous surveys have identified more than 200 vertebrate species, including amphibians, reptiles, mammals, and birds. Appendix B lists the species that may be present within the geographic scope of both alternatives.

Of specific note is the presence of bald eagles (*Haliaeetus leucocephalus)* in the Upper Klamath Basin. USFWS 2016 notes that due to the relatively mild winters and abundant food resources, the Upper Klamath Basin attracts the largest wintering population of bald eagles in the U.S. outside of Alaska. Starting in November, eagles begin arriving with the peak of populations occurring in February. Areas of Lower Klamath and Tule Lake as known to serve as communal night roosts.

3.2.4. Wetland and Riparian Areas

Upper Klamath Lake and Upper Klamath National Wildlife Refuge

Upper Klamath National Wildlife Refuge (UKNWR) is comprised of 24,762 acres divided into three units: Hanks Marsh (approximately 1,191 acres, Upper Klamath Marsh (approximately 13,775 acres), and the Barnes-Agency Unit (approximately 9,796 acres). Wetlands in UKNWR constitute some of the last remnant marshes adjacent to UKL, and are dominated by emergent plant species including sedges, wocus, hardstem bulrush, cattail, and willow. The Agency-Barnes Unit, which is surrounded by remnant dikes, is comprised primarily of wet meadow with interspersed marshy areas. Wetlands in the other two units, which are not diked, are generally flooded when UKL water levels are above 4,139.5 feet in elevation (USFWS 2016).

UKNWR serves as an important breeding ground for several species of diving ducks, including canvasback, redheads, and ringnecks, and as a staging area for migratory waterfowl of the Pacific Flyway. UKNWR also represents one of the few remaining nesting areas for American pelicans in the western U.S. A number of species of waterbirds also use UKNWR as a nesting area. Klamath Basin redband trout rely upon wetlands and adjacent creeks within UKNWR as a spawning ground and for a thermal refugia in the summer (USFWS 2016).

Link and Klamath Rivers

There are riparian wetland areas of varying sizes within the existing floodplain of the Link and Klamath rivers. The National Wetland Inventory, as well as more site-specific data (e.g., Forney et al. 2013; KRRC 2017, 2018), describe the floodplain vegetation along the Link and Klamath Rivers (down to the lower Klamath River below IGD) as ribbons of emergent wetlands (dominated by hardstem bulrush, cattail, sedges, and rushes) along the shorelines of the reservoirs and mixed with forested/shrub wetlands on the slopes beyond the Klamath River.

Lower Klamath National Wildlife Refuge

LKNWR occupies 51,247 acres within and surrounding the former bed of Lower Klamath Lake, on the border between Oregon and California. Of the total area, approximately 24,000 acres is wetland habitat, with range/pasture lands and croplands comprising the remainder. Through dikes and other improvements, LKNWR is divided into a number of smaller units, ranging from 63 acres to over 4,000 acres, which can be managed to produce a variety of vegetative communities, which in turn provide food resources and habitat for wildlife, particularly for waterfowl and other migratory birds (USFWS 2016).

Wetland areas within LKNWR consist of permanently flooded wetlands (up to 10,000 acres) and seasonally flooded wetlands (up to 16,000 acres). Seasonally flooded wetlands are characterized by a partial flooding regime of at least six months, of which two months occur during the growing season. Vegetation in both wetland areas is composed of emergent vegetation consisting primarily of hardstem bulrush and cattail. Submergent vegetation, predominantly sago pondweed, is also a key characteristic of these shallowly flooded wetland areas (USFWS 2016).

LKNWR supports one of the densest breeding populations of waterfowl in the NWR system across the U.S., producing between 30,000 and 60,000 waterfowl annually. A variety of colonial waterbirds, such as white pelicans, double-breasted cormorants, great blue herons, and eared and western grebes, also nest in LKNWR (USFWS 2016). Additionally, LKNWR also hosts the highest number of migrating waterfowl within the Klamath Basin Refuge Complex, through which 80 percent of the birds in the Pacific Flyway pass each spring and summer. Permanently flooded areas also serve a critical role for molting waterfowl during the summer, when the birds are flightless for several weeks. The submergent plant community in wetlands, and the fish, invertebrates, and amphibians it supports, are the primary food source for migrating birds, along with grain and other crops produced on the surrounding agricultural lands (USFWS 2016).

Tule Lake National Wildlife Refuge (Tule Lake Sump 1A)

Tule Lake National Wildlife Refuge (TLNWR) comprises 39,116 acres in Siskiyou and Modoc counties, California, encompassing the reclaimed lands from the historic Tule Lake. The refuge consists of two open water sumps (Sump 1A and 1B) (totaling 13,000 acres), surrounded by cropland and upland areas. Sumps 1A and 1B receive water from the Lost River, agricultural return flows, and precipitation. Return flows constitute the largest source of the water, occurring primarily during the spring/summer irrigation season. Water is diverted from the sumps for agricultural purposes on surrounding croplands, and pumped from the sumps for flood control purposes via Pumping Plant D.

Water surface elevations in the Sumps are managed by TID, consistent with operating criteria established by Reclamation, including minimum elevations required under the ESA. Water surface elevations in the Sumps can be operated between 4,034.0 and 4,035.5 feet. At the lower elevation, the combined storage capacity of TLS1A and 1B ranges between approximately 23,000 AF (at 4,034.0 feet) and 41,000 AF (at 4,035.5), with TLS1A comprising approximately 70 percent of this volume.

TLS1A and 1B consist of a combination of permanently flooded wetlands and open water with submerged vegetation. Vegetation is dominated by emergent plants, such as hardstem bullrush and cattail, and submerged plants, such as sago pondweed. Plant diversity is lower in Sumps 1A and 1B compared to wetland areas in LKNWR; however, these areas provide an important food source and habitat for breeding and migrating waterfowl. The Sumps support a substantial population of breeding waterfowl (5,000 ducks on average), and during the late summer, they become a focal point for molting waterfowl, hosting between 50,000 and 100,000 flightless birds that use emergent wetland vegetation for cover and protection (USFWS 2016).

Lower Klamath River and Hydropower Reach
Several different associations are present including Klamath mixed conifer forest dominated by ponderosa pine (*Pinus ponderos*a), Douglas-fir (*Pseudotsuga menziesii*), and black oak (*Quercus kelloggii*). On drier slopes, such as those along Copco No. 1 and No. 2, the reservoir shorelines are dominated by Oregon oak (*Quercus garryana*) and western juniper (*Juniperus occidentalis*). Other communities include coyote willow (*Salix exigua*), red and white alder (*Alnus rubra, A. rhombifolia*), Fremont's and black cottonwoods (*Populus fremontii*, *P. trichocarpa*), bigleaf maple (*Acer macrophyllum*), and reed canarygrass (*Phalaris arundinacea*).

3.2.5. Migratory Birds

The NWRs within the geographic scope of the proposed action, as part of the Klamath Basin Refuge Complex, are internationally known for their great abundance and diversity of birdlife, particularly migratory birds. Migratory birds that pass through these NWRs include waterfowl, shorebirds, gulls, terns, cranes, rails, herons, grebes, egrets, songbirds, and raptors (USFWS 2016). Of special interest to these refuges are the large concentrations of waterfowl during the spring and summer migration. These refuges are situated on a major Pacific Flyway migration corridor between breeding grounds in the north and wintering grounds in the south.

Over the long term, waterfowl abundance (birds per day) in the Klamath Basin Refuge Complex averaged about one million birds in the fall and 360,000 in the spring, with the majority of these birds in Lower Klamath and Tule Lake NWRs (USFWS 2016). Population numbers of waterfowl have fluctuated. After record levels in the 1950s and early 1960s, there was a period of decline into the 1980s. A gradual recovery occurred in the 1990s, but since 2000, there has been a decline in total waterfowl abundance in the autumn, likely because of reduced diversity and productivity of wetland areas within the refuges (USFWS 2016). In addition to the spring and fall migration, waterfowl and other migratory birds utilize the NWRs for breeding and molting during the summer.

3.3. Recreation

Reclamation and CDFG (2012) state the recreational setting within the Klamath River Basin are characterized by an expansive rural landscape that offers a myriad of outdoor recreational opportunities. Within the geographic scope of the Proposed Action there are two national forests (Klamath, Six Rivers), one joint national and state park (Redwood), and four NWRs (*see section 1.2.).* Reclamation and CDFG (2012) further describe that the area of analysis of the Proposed Action Alternative includes recreation areas along the Klamath River from its headwaters in Oregon to the mouth of the river at the Pacific Ocean. Generally, fishing, camping, hunting, bird-watching, photography, and use of recreational trails are common throughout the geographic scope of the Proposed Action, with whitewater boating opportunities and fly fishing available throughout the mainstem Klamath River.

3.4. Land Use

The proposed action area, shown in Appendix A, includes portions of Klamath County in Oregon and Siskiyou, Modoc, Humboldt, and Del Norte counties in California. Land use in the proposed action area is dominated by agriculture (e.g., farming and ranching) and forestry; municipal and industrial land uses are minor. The largest urban areas are Klamath Falls and Eureka.

Counties

<u>Klamath County, Oregon</u>

Klamath County is in south-central Oregon. The county is bordered on the south by California, on the east by Lake County, on the north by Deschutes County, and on the west by Jackson and Douglas counties. The county, Oregon's fourth largest, covers 6,135 square miles. Klamath County was home to about 66,935 people in 2017, with about 21,359 of those people residing in the city limits of Klamath Falls (U.S. Census Bureau 2019b). Approximately 73 percent of the county is managed by federal and state agencies, including USFWS, National Park Service (NPS), the Bureau of Land Management (BLM), and the Oregon Department of State Lands (ODSL) (Reclamation and CDFG 2012).

<u>Siskiyou County, California</u>

Siskiyou County is in inland northern California, adjacent to the Oregon border. It is the fifth largest county in the state, with an area of approximately 6,340 square miles and a population in 2017 of 43,853 (U.S. Census Bureau 2019b). The largest urban population in Siskiyou County resides in Yreka, with a population of 7,600 (U.S. Census Bureau 2019b). More than 60 percent of the County is managed by federal and state agencies, including the United States Forest Service (USFS), BLM, the USFWS, and CDFG. These lands are maintained in various National Forests, Parks, Wilderness Areas, National Grasslands, NWRs, other public lands and State Wildlife Areas (Reclamation and CDFG 2012). Part of the Tule Lake NWR and the Project is in eastern Siskiyou County.

<u>Modoc County, California</u>

Modoc County is just east of Siskiyou County in the northeastern corner of California, where it borders Oregon to the north and Nevada to the east. The county is 4,203 square miles and in 2017 had approximately 8,859 residents (U.S. Census Bureau 2019b); the largest urban population in the county resides in Alturas, population 2,827 (U.S. Census Bureau 2019b). Almost 70 percent of the county is federally owned in the Modoc National Forest, the Modoc and Tule Lake National Wildlife Refuges, and BLM lands managed out of the Alturas Field Office (Modoc County 2011). Approximately 29 percent of the county is in private ownership. Part of the Tule Lake NWR and the Project is in western Modoc County (Reclamation and CDFG 2012).

<u>Humboldt County, California</u>

Humboldt County lies along the northern coast of California, bounded by Del Norte County on the north, Siskiyou and Trinity counties on the east, and Mendocino County on the south. The county covers 4,052 square miles and in 2017 had a population of 136,754. The largest urban area is Eureka, the county seat, with a 2017 population of 27,177 (U.S. Census 2019b).

About 28 percent of the county is in public ownership; the Yurok and Hoopa tribal lands occupy about 5.6% of the land area of the county. Timberlands are the cornerstone of the Humboldt County economy (Humboldt County General Plan 2017). The action area within Humboldt County consists of the Klamath River corridor.

Del Norte County, California

Del Norte County is the northernmost county on the California coast, bordered by Oregon on the north, Siskiyou County on the east, and Humboldt County on the south. The county covers 1,230 square miles and in 2017 had a population of 27,470. The largest urban area is Crescent City, the county seat, with a 2017 population of 6,399. (U.S. Census Bureau 2019b). The action area within Del Norte County consists of the Klamath River corridor.

Table 3-3 shows the relative distribution of land use within the five-county area (U.S. Department of Agriculture 2012). Pastureland predominates in all counties except Del Norte, where cropland dominates. Cropland is the second-most widespread land use in the three counties containing the Klamath Project.

Table 3-3. Land use distribution in the five-county action area
Source: USDA 2012 Census of Agriculture

Land Use	Klamath	Siskiyou	Modoc	Humboldt	Del Norte
Pastureland	56.1%	48.7%	60.6%	62.8%	38.5%
Cropland	31.5%	27.0%	29.6%	-0-	41.9%
Woodland	9.3%	15.2%	5.5%	30.5%	10.8%
Other Uses*	3.0%	9.1%	4.3%	6.6%	8.8%

*Land not classified as cropland, pastureland, or woodland.

Within the Project, land use is shown in Table 3-3. Between 2010 and 2016 an average of 178,000 acres were irrigated and harvested within the Project (Table 3-4). Approximately 62 percent of the land is used to grow animal feed in the form of alfalfa and pasture; about 26 percent grows wheat and other small grains. The remaining 12 percent of land is used to grow high valued potatoes, onions, peppermint, and other specialty crops.

Table 3-4. Project Irrigated Acres by Aggregate Crop.
Source: Reclamation 2018c.

Crop	2010	2011	2012	2013	2014	2015	2016	7-Year Average
Alfalfa Hay	66,568	72,690	75,874	74,777	72,566	73,554	78,867	73,557
Irrigated Pasture	40,033	43,541	42,731	38,046	33,824	28,021	37,963	37,737

Small Grain	25,561	20,570	23,578	26,439	21,494	19,098	25,011	23,107
Wheat	13,653	34,572	29,478	26,456	20,989	18,644	25,286	24,154
Potatoes	10,029	14,924	15,329	12,842	12,593	11,952	13,386	13,008
Other	6,450	6,141	6,572	7,358	6,515	6,134	6,933	6,586
Total	162,294	192,437	193,562	185,919	167,980	57,402	187,446	178,149
Alfalfa %	41%	38%	39%	40%	43%	7%	42%	41%
Irrigated Pasture %	25%	23%	22%	20%	20%	8%	20%	21%
Small Grain %	16%	11%	12%	14%	13%	12%	13%	13%
Wheat %	8%	18%	15%	14%	12%	12%	13%	13%
Potatoes %	6%	8%	8%	7%	7%	8%	7%	7%
Other %	4%	3%	3%	4%	4%	4%	4%	4%

Comprehensive Conservation Plan
As discussed in section 1.4.3, USFWS has developed the CCP for Federal lands within Lower Klamath, Clear Lake, Tule Lake, Upper Klamath, and Bear Valley NWRs[8], which together comprise the Klamath Basin Refuge Complex. The CCP provides a comprehensive 15-year management plan for the Refuge Complex, consistent with refuge purposes and applicable laws, regulations, and policies, the CCP describes and governs land management functions.

3.5. Socioeconomic Resources

This section describes regional socioeconomic conditions and information for the specific economic sectors in which potential effects may occur as a result of implementation of either the Proposed Action or No Action alternatives. The relevant economic sectors include irrigated agriculture, commercial fishing, and recreation. Socioeconomic effects include potential changes to household income, gross domestic product (GDP), and employment in the area of analysis, as well as fiscal effects on local governments.

The geographic scope of potential impacts varies by economic sector. Socioeconomic impacts to irrigated agriculture and refuge recreation are limited to the Klamath Project area of Modoc, Siskiyou, and Klamath counties, while impacts to commercial fishing extend to those California and Oregon counties with local economies linked to the Klamath River

[8] Bear Valley and Clear Lake NWRs are described in the CCP. Clear Lake NWR within the geographic scope of this EA, however, as Reclamation's Proposed operations for Clear Lake Reservoir are not altered from the No Action Alternative, neither Clear Lake NWR nor Bear Valley NWR (which is outside the geographic scope of analysis) are discussed in this EA.

through fishing and water-based recreation/tourism. These include Curry, Coos, Douglas and Lane Counties in Oregon and Del Norte, Humboldt, Mendocino, San Mateo, San Francisco, Marin, and Sonoma Counties in California. Impacts to recreation may occur throughout the area. Indian Tribes' economic and social welfare is also closely linked to the fisheries of the Klamath Basin.

Data to describe regional socioeconomic conditions was obtained from the U.S. Census 2013-2017 American Community Survey 5-Year Estimates (U.S. Census 2019a) as well as the U.S. Census QuickFacts web page (U.S. Census 2019b).

In general, the counties in the area of analysis (except for counties in the San Francisco Bay area) are in rural areas of California and Oregon and have resource and environmental amenity-based economies (e.g., timber, agriculture, fishing, recreation). Similar to many rural areas, the counties in the area of analysis have lower population densities, household incomes, contributions to gross domestic product, and employment opportunities than counties with larger urban centers in the two states. With respect to population density, Oregon counties in the area of analysis have a mean density (people per square mile) of 32.6 compared with 38.9 for Oregon as a whole. In California, counties in the area of analysis have a mean density of 112.7 compared with 227.6 for California as a whole.

With respect to household income, Oregon counties in the area of analysis have a mean household income of $58,962 compared with $75,851 for Oregon as a whole. In California, counties in the area of analysis have a mean household income of $93,052 compared with $96,104 for California as a whole, although this comparison is skewed by the inclusion of urban counties in the San Francisco bay area (Marin, San Francisco, and San Mateo counties); if these counties are excluded, the remaining counties have a mean household income of $64,325.

In 2015, Oregon counties in the area of analysis contributed $2.18 billion to Oregon's $203 billion economy. In California, counties in the area of analysis contributed $306 billion to California's $2.56 trillion economy. Subtracting the influence of the urbanized Marin, San Francisco, and San Mateo counties, the remaining counties contributed $31.9 billion.

With respect to unemployment, Oregon counties in the area of analysis have a mean unemployment rate of 8.9 percent compared with 6.8 percent for Oregon as a whole. In California, counties in the area of analysis have a mean unemployment rate of 7.3 percent compared with 7.7 percent for California as a whole, although this comparison is skewed by the inclusion of Marin, San Francisco, and San Mateo counties; if these counties are excluded, the remaining counties have a mean unemployment rate of 8.6 percent.

Nearly 90 percent of employment in the area of analysis is supported by private (both nonfarm and farm) employment, but only 1.3 percent of all private industry jobs are farm jobs, a trend that has been relatively steady over the period 2013-2017. Farm jobs are important in some counties, however, providing up to 14.6 percent of jobs (Modoc County). Forestry, fishing, and related jobs range from near zero up to 4.7 percent of jobs in the region (Coos County).

Federally recognized tribes in the Klamath Basin are potentially affected by the Project alternatives. For the tribes of the Klamath Basin, fish are integral to a worldview that emphasizes interconnectedness, balance, and mutual respect as guiding principles. Fishing is central to the tribes' culture and access to fish and fish health provide important links to balance and cycles of nature. Fish are honored in rituals, and fishing traditions are passed on to subsequent generations. Trade and barter occur both within and between tribes as a means of increasing access to fish and other valued goods, and cementing social relationships. For the Yurok and Hoopa tribes, harvest opportunities over the last few decades are much lower than they were historically. The Klamath Tribes suspended harvest of Lost River and shortnose suckers since 1986. For the Karuk Tribe, current harvest opportunities are limited to a short season at Ishi Pishi Falls. Sections 4.9, Indian Trust Resources, and 4.10, Environmental Justice include additional analysis on potential social effects to Indian Tribes.

3.6. Air Quality

Air Quality: Section 176 (C) of the Clean Air Act (CAA; 42 U.S.C. 7506 [C]) requires any entity of the Federal Government that engages in, supports, or in any way provides financial support for, license or permits, or approves any activity to demonstrate that the action conforms to the applicable State Implementation Plan (SIP) required under Section 110 (s) of the Federal CAA (42.U.S.C. 7401 [a]) before the action is otherwise approved.

Air quality in the State of Oregon is regulated by ODEQ under designation by the Environmental Protection Agency. The National Ambient Air Quality Standards, established under the Clean Air Act (42 U.S.C. § 7401), specify limits air pollutant levels of several pollutants. Of those pollutants, particulate matter (PM) 2.5 and PM 10 have been identified and included in attainment plans for the Klamath Falls area (Klamath County, Oregon). Since 1994, the Klamath Falls attained the standards associated with PM 10, while the area has been designated as in nonattainment (not meeting air quality standards for PM 2.5). In 2012, ODEQ adopted an attainment plan to meet PM 2.5 standards.

Air quality in California counties within the geographic scope of the alternatives are managed by the North Coast United Air Quality Management District (Humboldt and Del Norte counties), Siskiyou County Air Pollution Control District (Siskiyou County), and Modoc County Air Pollution Control District (Modoc County). Table 3-5. identifies the attainment status for air pollutants with regard to the State of California Ambient Air Quality Standards.

Table 3-5. Air pollutants and attainment specific to California counties within the geographic scope of the alternatives.
Source Reclamation and CDFG 2012 (modified)

Pollutant	California Status
Ozone (O_3)	Nonattainment-Transitional (Siskiyou County) Nonattainment (Shasta County) Attainment (Del Norte, Humboldt, and Modoc counties)
Inhalable particulate matter (PM_{10})	Attainment (Siskiyou County) Nonattainment (Del Norte, Humboldt, and Modoc Counties)
Fine particulate matter ($PM_{2.5}$)	Attainment/Unclassified (All counties)
Carbon monoxide (CO)	Attainment/Unclassified (All counties)
Nitrogen dioxide (NO_2)	Attainment (All counties)
Sulfur dioxide (SO_2)	Attainment (All counties)

Source: CARB 2010b.

3.7. Indian Trust Resources

There are six federally recognized Indian Tribes in the Klamath Basin including The Klamath Tribes in Oregon (which include the Klamath, Modoc, and Yahooskin Tribes; collectively The Klamath Tribes), and the Yurok Tribe, the Karuk Tribe, the Hoopa Valley Tribe, and the Quartz Valley Tribe, and the Resighini Rancheria in California. Reclamation has a trust responsibility, as a federal agency, to protect water and fishery tribal trust resources of three of the six federally recognized tribes: The Yurok, Hoopa Valley, and Klamath Tribes.

An Indian Trust Asset (ITA) is a legal interest in assets held in trust by the federal government for Indian tribes or individuals. The Department of the Interior’s policy is that when a proposed federal action would likely adversely affect an ITA, the action agency should seek ways to minimize or avoid the adverse effect, or if the effect cannot be avoided, to compensate or mitigate for it.

In the Upper Klamath Basin, a treaty was entered into in 1864 between the U.S. and the predecessors of The Klamath Tribes reserving fishing, hunting, and gathering rights on lands formerly part of the Klamath Indian Reservation in Oregon. The Klamath Tribes' trust resources include fish, specifically the Lost River sucker, or *C'waam* and the shortnose sucker, or *Koptu* as well as wildlife species within or adjacent to the former Klamath Reservation. The *C’waam* and *Koptu* serves as an important traditional food source as well as a component of cultural, spiritual and economic health for the Klamath Tribes (The Klamath Tribes 2019). *C’waam* and *Koptu* as well as other fish and plant species like wocus, an aquatic plant species native to the Upper Klamath Basin are central to the heritage of The Klamath Tribes.

Based on the treaty between the U.S. and The Klamath Tribes, dated October 14, 1864, the Klamath Tribes and the U.S. Bureau of Indian Affairs (BIA) have claimed federally-reserved water rights to support hunting, fishing, and gathering by The Klamath Tribes within their former reservation boundaries. In 2014, the State of Oregon issued the Amended and Corrected Findings of Fact and Order of Determination (ACFFOD), which identifies specific instream flows in tributaries to UKL within the boundaries of the former Klamath Indian Reservation. The ACFFOD also recognizes a water right in UKL, to maintain water surface at various elevations during different times of the year. Under the ACFFOD, these water rights are held by the BIA, on behalf of The Klamath Tribes, and have a priority date of "time immemorial," making them prior to ("senior") all other water rights recognized in the ACFFOD. The ACFFOD is now being judicially reviewed by the Klamath County Circuit Court.

The Yurok and Hoopa Valley Tribes have Federal Indian reserved fishing rights secured to the Tribes by a series of 19th century executive orders and confirmed in the 1988 Hoopa-Yurok Settlement Act which also, established, in connection with an Executive Proclamation in 1855, Executive Orders in 1876 and 1891, the present Yurok and Hoopa Valley Indian Reservations (Reclamation 1998). The Yurok and Hoopa Valley tribes' fishing rights entitle them to take fish for ceremonial, subsistence, and commercial purposes (Reclamation 1998). Theses tribes also hold reserved water rights to an instream flow sufficient to 1) protect the right to take fish within their reservation, 2) prevent others from depleting the stream flow below a protected level and 3) the right to water quality and flow to support all life stages of fish (Reclamation 1998)

As noted by Reclamation (1998), salmon has historically been a central species to the cultures and economies of the Tribes of the Lower Klamath Basin which exceeded other food sources in the traditional diets of the Lower Basin Tribes. Described by Reclamation in 1998, "the significance of the tribes' reliance on, and veneration for nature is evident in all facets of their culture, their traditions, their religions, and their resource use and management. Consequently, increasing resource scarcity over the last century has had a profound effect on the tribes of the Klamath Basin. Tribal cultures are no longer able to fully embrace their traditional ways of life; the declining availability of resources critical to their traditional and spiritual practices has made some of those resources even more precious as a means of sustaining their culture."

3.8. Environmental Justice

Executive Order 12898 (February 11, 1994) mandates Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and lower-income populations.

The Project as well as UKL and the Lost River are within Klamath County, Oregon, and/or Modoc, Siskiyou, counties, California with the Klamath River flowing through rural areas. These counties considered rural and in general consisting of lower-income populations rely on cultivation of agricultural land and recreational fishing as important sources of revenue. Lost River and shortnose suckers reside in UKL and are important resources to The Klamath Tribes. The Klamath River also runs through the Hoopa Valley and Yurok Tribes' reservations and the aboriginal lands of the Karuk Tribe, all of which consist of lower-income households traditionally relying on salmon and steelhead as an important part of tribal subsistence.

4. Environmental Consequences

4.1. Resources Not Considered

Impacts to the following resources were considered and found to be incalculable or absent. Brief explanations for their eliminations from further consideration are provided below:

- Cultural Resources: The Proposed Action would not produce any ground disturbances, would not result in the construction of new facilities or the modification of existing facilities, and would not result in land use changes. Neither the Proposed Action or the No Action Alternative have the potential to cause effects to historical property pursuant to 36 CFR § 800.3(a)(1). (See Appendix C for Reclamation's determination).

- Indian Sacred Sites: There would be no impact to Indian Sacred Sites under the Proposed Action Alternative as conditions would remain the same as existing conditions. Similarly, the Proposed Action Alternative would not inhibit access to, or ceremonial use of, an Indian Sacred Site nor would the Proposed Action Alternative adversely affect the physical integrity of such sacred sites.

- Climate Change and Greenhouse Gases (GHGs): Climate Change and GHGs refers to change in measures of climate (e.g., temperature, precipitation, or wind) lasting for decades or longer. Many environmental changes can contribute to climate change (e.g., changes in the sun's intensity, changes in ocean circulation, deforestation, urbanization, burning fossil fuels) (EPA 2015). Climate change implies a change having important economic, environmental, and social effects in a climatic condition such as temperature or precipitation. Climate change is generally attributed directly or indirectly to human activity that alters the composition of the global atmosphere, additive to natural climate variability observed over comparable time periods. Due to the limited term of the Proposed Action (five years) and the nature of the Proposed Action, there would be no measurable impacts contributing to climate change or greenhouse gases.

4.2. Resources Considered

Implementation of either alternative could potentially affect the following resources:

- Water Resources
- Biological Resources
- Recreation
- Land Use
- Socioeconomic Resources
- Air Quality
- Indian Trust Resources
- Environmental Justice

As described above in section 2.4, the No Action Alternative and the Proposed Action Alternative differ by four elements: 1) the reduced cap on Project Supply available from UKL, 2) use and accounting of LRDC and KSD flows, 3) inclusion of forced surface flushing flows in the Klamath River, and 4) the change in operating elevations of TLS1A. Therefore, in the discussion below, the impacts as a result of implementing the Proposed Action Alternative as compared to the No Action Alternative are described for each resource.

4.3. Water Resources

4.3.1. Surface Water

4.3.1.1. Upper Klamath Lake

No Action Alternative

Under the No Action Alternative, UKL elevations would vary throughout the spring/summer and fall/winter periods. Table 4-1 shows the modeled end of February and end of September water surface elevations in UKL. UKL elevations at these times are important as they are the transition periods between the spring/summer and fall/winter operational seasons under both alternatives.

Under the No Action Alternative, Table 4-1 shows that the modeled end of February average elevation for UKL would be 4,142.14 feet, the maximum elevation would be 4,142.69 feet (1981, 1988, and 2007), and the minimum would be 4,140.73 feet (1993). The end of September average elevation would be 4,139.06, the minimum elevation would be 4,137.74, and maximum would be 4,140.56.

Figure 4-1 below depicts simulated UKL elevations over a five-year period (water years 1991-1995) for the No Action Alternative. For Figure 4-1 and all following example graphs in section 4.3, the time period was randomly selected and represents the full range of project conditions which includes extremely dry years (1991, 1992, 1994), a relatively wet water year (1993) followed by a more average year (1995). Comprehensive output data, in the form of tables and graphs, and additional details regarding anticipated UKL elevations from implementation of the No Action Alternative can be found in Part 4 and Appendix 4A of the 2012 BA and Part 4 of the 2013 BiOp.

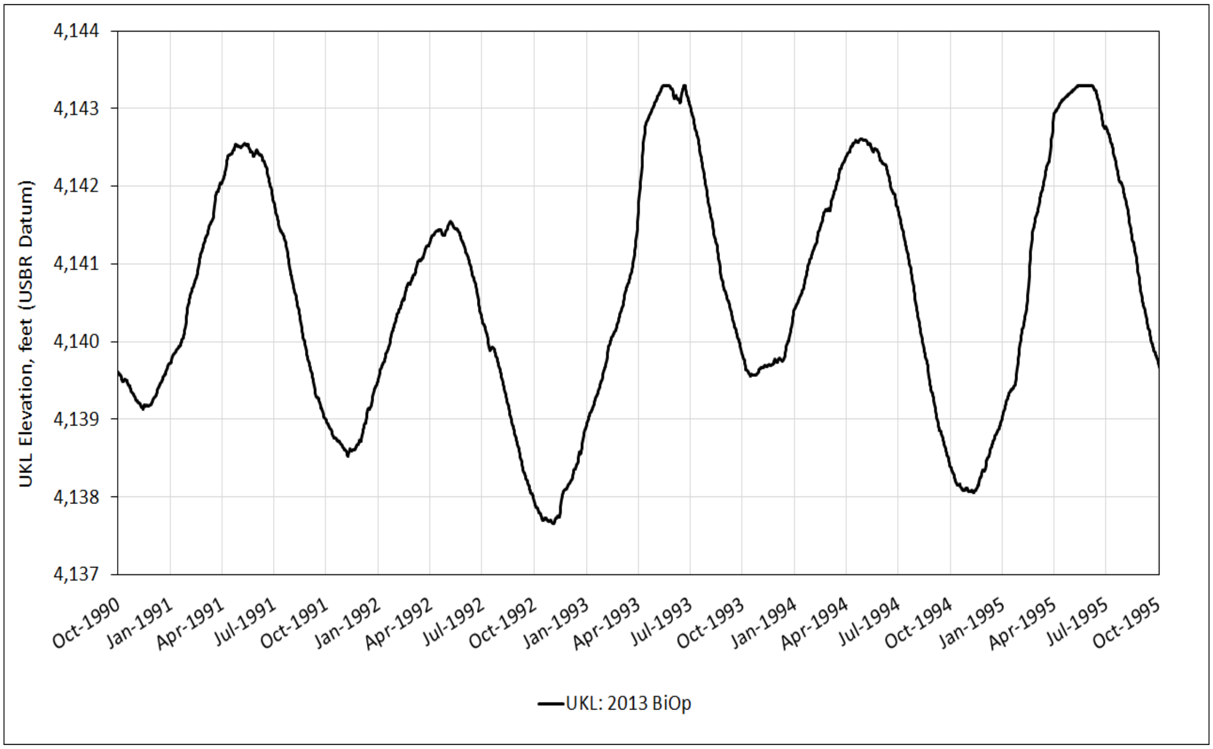


Figure 4-1. Modeled UKL elevations under the No Action Alternative.

Proposed Action Alternative
Table 4-1 shows that under the Proposed Action Alternative, the modeled end of February average elevation for UKL would be 4,142.30 feet, with a range from 4,140.88 feet (1992) to 4,142.73 feet (1986). The end of September average elevation would be 4,139.44 feet, with a range from 4,138.28 feet (1981) to 4,141.13 feet (1984).

Figure 4-2 below depicts simulated UKL elevations over a five-year period for the Proposed Action Alternative. Additional details regarding anticipated UKL elevations from implementation of the Proposed Action Alternative can be found in Part 4 and Appendix 4 of the modified 2018 BA.

Table 4-1 below also shows the difference in UKL elevations between the No Action and the Proposed Action alternatives.

Table 4-1. Difference in UKL Elevations (feet) Between the Proposed Action Alternative and the No Action Alternative for the End of February and September.

Probability of Exceedance (%)	February No Action	February Proposed Action	February Difference	September No Action	September Proposed Action	September Difference
10	4,142.68	4,142.69	0.01	4,140.14	4,140.63	0.49
20	4,142.40	4,142.69	0.29	4,139.69	4,139.99	0.30
30	4,142.39	4,142.60	0.21	4,139.53	4,139.73	0.20
40	4,142.38	4,142.40	0.02	4,139.28	4,139.60	0.32
50	4,142.31	4,142.39	0.08	4,138.88	4,139.32	0.44
60	4,142.19	4,142.38	0.19	4,138.79	4,139.08	0.29
70	4,142.03	4,142.23	0.20	4,138.72	4,139.00	0.28
80	4,141.76	4,142.13	0.37	4,138.27	4,138.72	0.45
90	4,141.43	4,141.66	0.23	4,138.18	4,138.51	0.33
Avg	**4,142.14**	**4,142.30**	**0.16**	**4,139.06**	**4,139.44**	**0.38**
Min	**4,140.73**	**4,140.88**	**0.15**	**4,137.74**	**4,138.28**	**0.54**
Max	**4,142.69**	**4,142.73**	**0.04**	**4,140.56**	**4,141.13**	**0.57**

The difference between the average end of February elevations in UKL between the alternatives would be 0.16 feet. The difference between the minimum calculated end of February elevations would also be small (0.15 feet). The difference between the maximum calculated end of February elevations would be 0.04 feet. The differences between the end of September elevations show a similar pattern, with the difference between the calculated average, minimum, and maximum of 0.38, 0.54 and 0.57 feet, respectively (Table 4-1).

Figure 4-2 below compares the simulated UKL elevations over a five-year period for the No Action and Proposed Action alternatives.

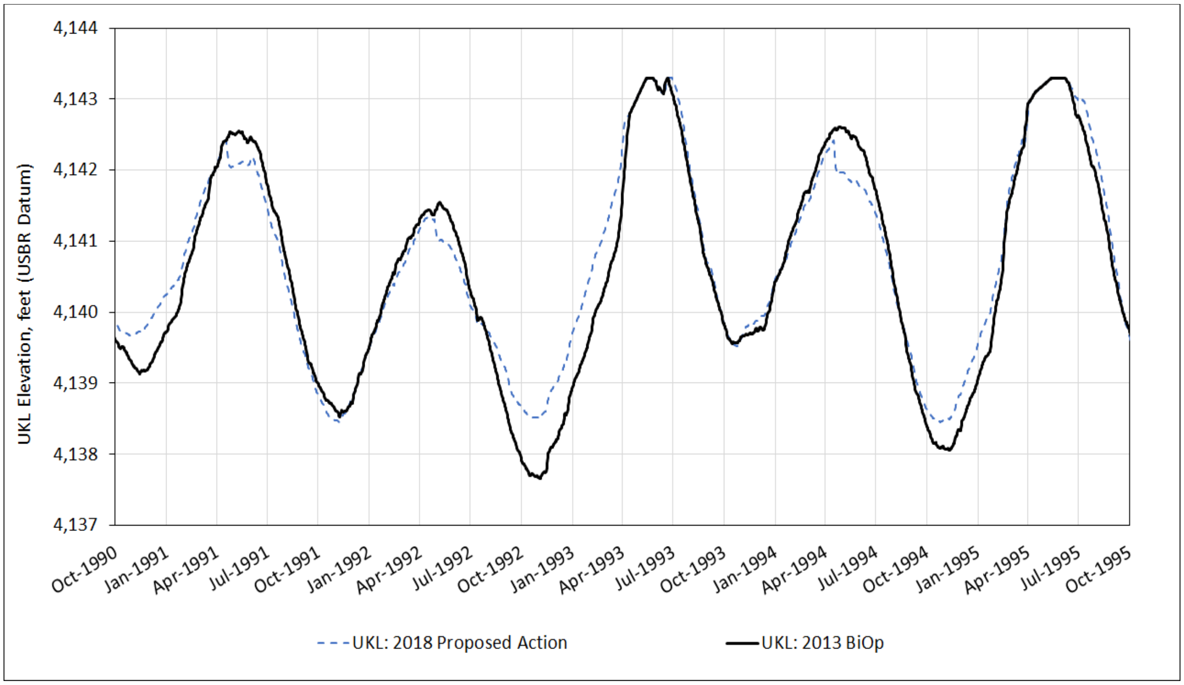


Figure 4-2. Example of modeled UKL elevations comparing the No Action Alternative with the Proposed Action Alternative

4.3.1.2. Klamath River

No Action Alternative

Flows in the lower Klamath River are controlled at IGD. The simulated flows for March and September are shown in Table 4-2 along with POE for all months. Under the No Action Alternative, the minimum EWA would be 320,000 AF. The EWA increases above this minimum based upon the UKL Supply. This volume is managed to produce flows at IGD necessary for the protection of coho salmon.

Figure 4-3 shows that release rates at IGD vary based upon water year and month. The average volume for the fall/winter period would be 525,000 AF, with a minimum of 307,000 AF (simulated year 1994) and a maximum of 1,198 TAF (1997). The average spring/summer volume would be 849,000 AF, with a minimum of 458,000 AF (1992) and a maximum of 1,572 (1983).

In July, August, and September, maximum flows at IGD are defined by available EWA volume. As the EWA volume increases the maximum target flow increases. At the minimum EWA volume (320,000 AF), maximum flows are 1,000 cfs in July; 1,050 cfs in August; and 1,100 cfs in September. These maximum flows are adjusted as EWA volumes increase to a maximum of 1,500 cfs in July; 1,250 cfs in August; and 1,350 cfs in September.

The minimum average daily fall/winter flows at IGD would be 1,000 cfs in October and November, and 950 cfs in December, January, and February.

Figure 4-3 below depicts simulated Klamath River releases downstream of IGD over a five-year period for the No Action Alternative. Additional details regarding anticipated Klamath River releases downstream of IGD from implementation of the No Action Alternative can be found in Part 4 and Appendix 4A of the 2012 BA and Part 4 of the 2013 BiOp.

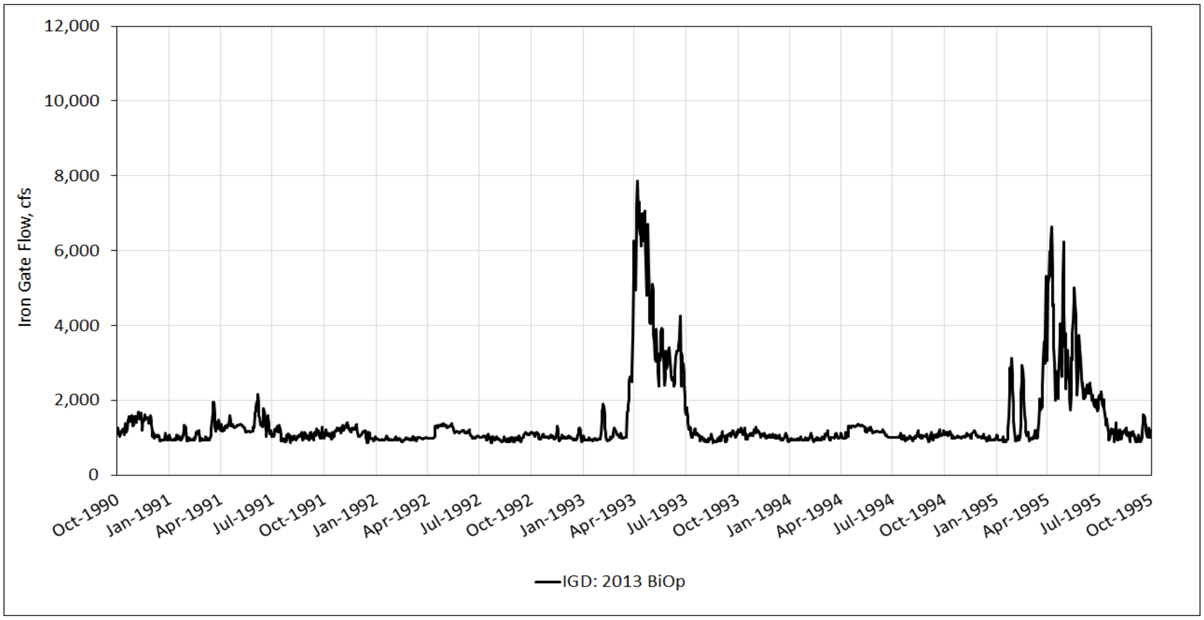


Figure 4-3. Example of modeled Klamath River releases downstream of IGD under the No Action Alternative

Proposed Action Alternative

Table 4-2 shows that under the Proposed Action Alternative, minimum flows for both seasons remain the same but the total volume of EWA would be larger and managed to implement disease control measures and provide habitat for juvenile coho in the spring/summer season. Generally, the spring/summer formulaic approach for Klamath River releases is based on the EWA allocation and UKL control logic from March 1 – September 30 and is additionally shaped by UKL net inflow.

Table 4-2 shows that release rates under the Proposed Action Alternative at IGD vary based upon water year and month. The average volume for the fall/winter period would be 512 TAF, with a minimum of 292,000 AF (simulated year 1992) and a maximum of 1,227,000 AF (1997). The average spring/summer volume would be 806,000 AF, with a minimum of 489,000 AF (1992) and a maximum of 1,434,000 AF (1983).

In addition to the spring/summer distribution of EWA, the Proposed Action Alternative incorporates the use of a portion of the EWA for flushing flows downstream of IGD, to assist in control of salmon disease and habitat improvement. Surface flushing flows (6,030 cfs for 72 hours or as high as possible if 6,030 cfs cannot be achieved) are forced between March 1 and April 15 in years when March 1 or April 1 EWA is calculated to be less than 576,000 AF. In any year in which a flushing flow is not forced (i.e., when EWA is greater than or equal to 576,000 AF), an opportunistic surface flushing flow may be implemented between March 1 and April 15 if UKL elevation is greater than or equal to 4,142.4 ft and the previous day's IGD release was greater than or equal to 3,999 cfs.

Minimum EWA would be 400,000 AF, which occurs when UKL Supply is less than 670,000 AF. When UKL Supply is greater than 1,035,000 AF, EWA is calculated as UKL Supply minus the maximum Project Supply (342,564 AF). When UKL Supply is between 670,000 AF and 1,035,000 AF, EWA is calculated as a percentage of the UKL Supply. The percentage of UKL Supply that is dedicated to EWA is variable based on the size of UKL Supply and ranges from approximately 60 percent when UKL Supply is 670,000 AF and approximately 66 percent when UKL Supply is 1,035,000 AF.

Figure 4-4 below depicts simulated Klamath River releases downstream of IGD over a five-year period for the Proposed Action Alternative. Additional details regarding anticipated Klamath River releases downstream of IGD from implementation of the Proposed Action Alternative can be found in Part 4 and Appendix 4 of the modified 2018 BA.

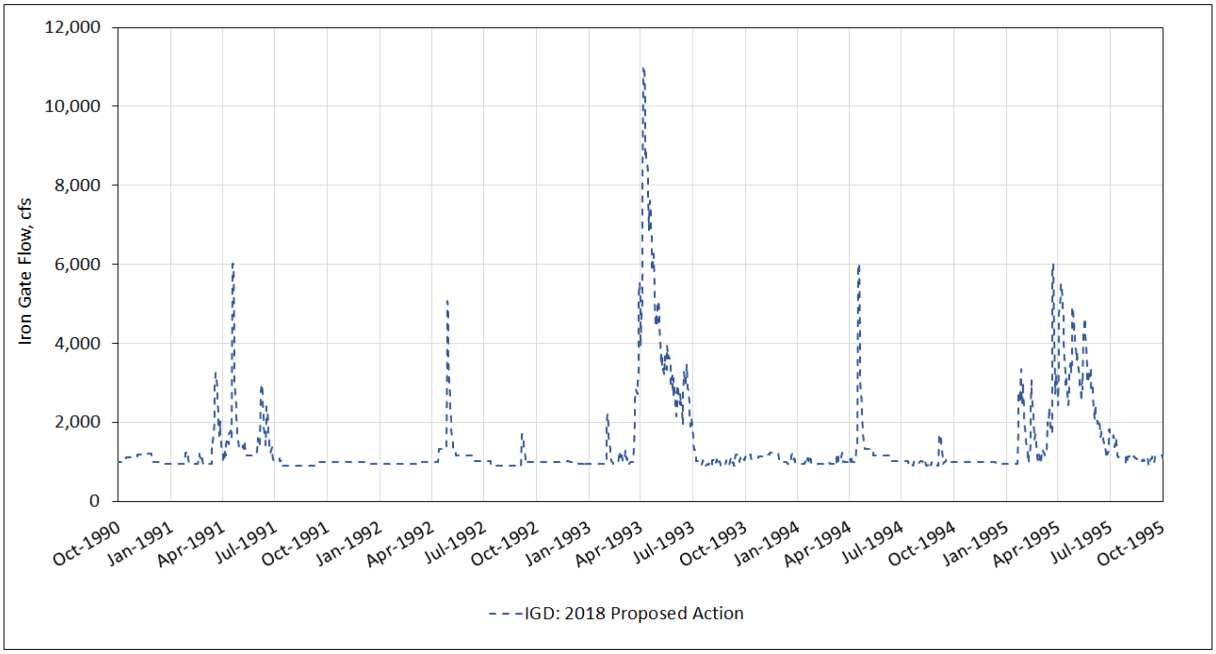


Figure 4-4. Example of modeled Klamath River releases downstream of IGD under the Proposed Action Alternative

Table 4-2 shows that both alternatives have relatively similar flows at IGD by month or POE. The average flow volume in the fall/winter would be 14 TAF more under the Proposed Action Alternative, and the average spring/summer flow would be 13 TAF less under the Proposed Action Alternative. The minimum flow volume in fall/winter would be 15 TAF less under the Proposed Action Alternative, and the minimum spring/summer volume would be 31 TAF higher under the Proposed Action Alternative, reflecting the additional water provided to perform a flushing flow in low water years.

Table 4-2. Comparison of monthly Klamath River Flows (cfs) below IGD, at the 10 percent, 50 percent, and 90 percent of exceedance, between the No Action and Proposed Action alternatives.

Month	No Action 10%	Proposed Action 10%	Difference between Alternatives 10%	No Action 50%	Proposed Action 50%	Difference between Alternatives 50%	No Action 90%	Proposed Action 90%	Difference between Alternatives 90%
Oct	1,571	1,368	-203	1,170	1,132	-38	1,029	1,000	-29
Nov	2,041	1,730	-311	1,132	1,119	-13	1,018	1,000	-18
Dec	3,189	2,957	-232	1,090	1,085	-5	974	950	-24
Jan	3,489	3,784	295	1,265	1,321	56	974	974	0
Feb	5,714	5,664	-50	1,426	1,590	164	1,000	986	-14
Mar	6,053	6,176	123	2,863	3,170	307	1,072	1,357	285
Apr	5,591	5,499	-92	2,302	2,342	40	1,338	1,379	41
May	4,632	4,084	-548	2,092	1,968	-124	1,189	1,175	-14
Jun	3,009	2,376	-633	1,496	1,278	-218	1,045	1,025	-20
Jul	1,299	1,221	-78	1,043	1,024	-19	929	908	-21
Aug	1,156	1,193	37	1,045	1,037	-8	910	901	-9
Sep	1,271	1,221	-50	1,138	1,081	-57	1,012	1,000	-12

Figure 4-5. below compares the simulated Klamath River releases downstream of IGD over a five-year period for the No Action and Proposed Action alternatives.

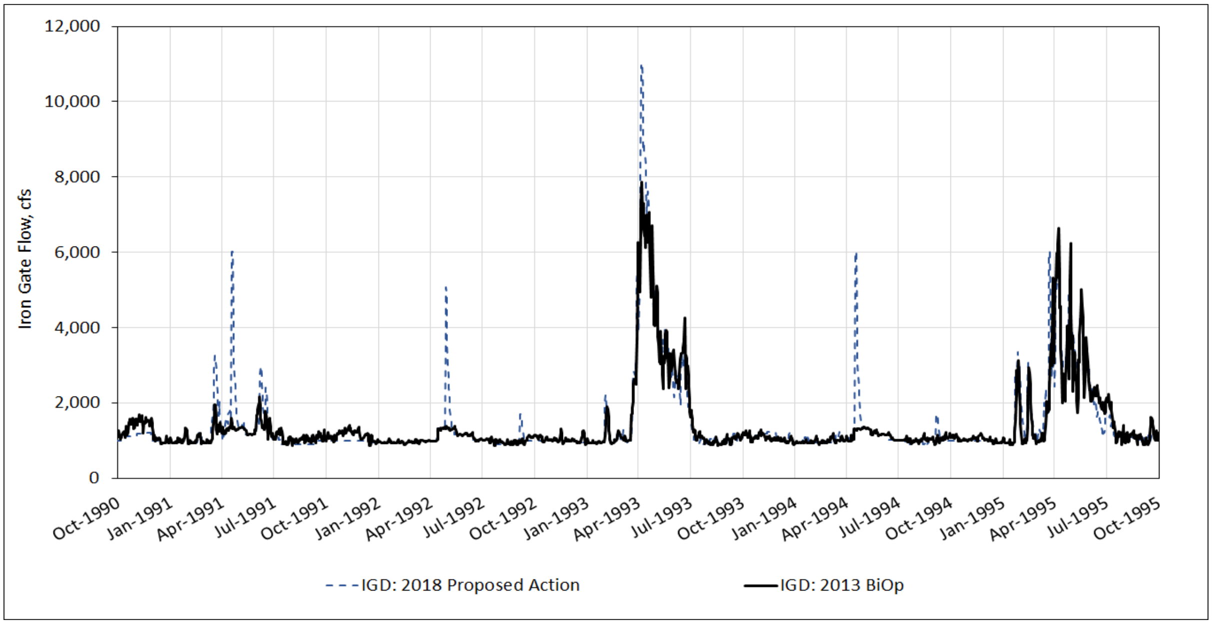


Figure 4-5. Example of modeled Klamath River releases downstream of IGD comparing the No Action Alternative with the Proposed Action Alternative

Both alternatives mimic a natural hydrograph with peak flows in the spring (March/April) and base (lowest) flows in late summer (August). The differences would be within the range of flows observed for the Klamath River at IGD during the POR. The higher average flow in March reflects implementation of flushing flows intended to reduce the incidence of disease in salmon.

4.3.1.3. Project Supply

The maximum Project Supply (water available from UKL for Project use) under the No Action Alternative is 390,000 AF and the maximum Project Supply under the Proposed Action Alternative, as analyzed here, is 342,564 AF. These values are identified and discussed further in Sections 2.2 and 2.3 above and in the following text. During development of the 2013 BiOp, the KBPM was utilized to model Klamath River flows under the rules within the 2012 BA (No Action Alternative) between water years 1981 and 2011. The Project began to be operated under the 2013 BiOp in 2013 and that is what is shown under the No Action Alternative in Figure 4-6. However, since 2012 was neither modeled nor operated according to the 2013 BiOp, values are not available for that year.

No Action Alternative
The simulated available Project Supply under the No Action Alternative is compared to the Proposed Action in Figure 4-6 below. Under the No Action Alternative, the cap on Project Supply is 390,000 AF. Figure 4-6 shows that the mean No Action Project Supply is 351,000 AF, with a minimum of 160,000 AF (1992) and a maximum of 390,000 AF in many years.

Proposed Action Alternative

The simulated available Project Supply under the Proposed Action Alternative is shown in Figure 4-6, which shows that the Project Supply averages 284,000 AF, with a minimum of 4,000 AF (1992) and a maximum of 342,564 AF in many years. Figure 4-6 below shows the Project Supply values for the No Action Alternative and the Proposed Action Alternative.

Proposed	269	343	343	343	334	343	295	259	343	250	195	4.3	343	97	337	343	330	343	343	327	256	298	283	284	279	343	296	326	291	249	343		256	120	217	303
No Action	354	390	390	390	390	390	365	337	390	323	277	160	390	261	390	390	390	390	390	390	310	373	353	371	327	390	379	390	364	302	390		289	239	255	389
Difference	-85	-47	-47	-47	-56	-47	-70	-78	-47	-73	-82	-156	-47	-164	-53	-47	-60	-47	-47	-63	-54	-75	-70	-87	-48	-47	-83	-64	-73	-53	-47		-33	-119	-38	-86

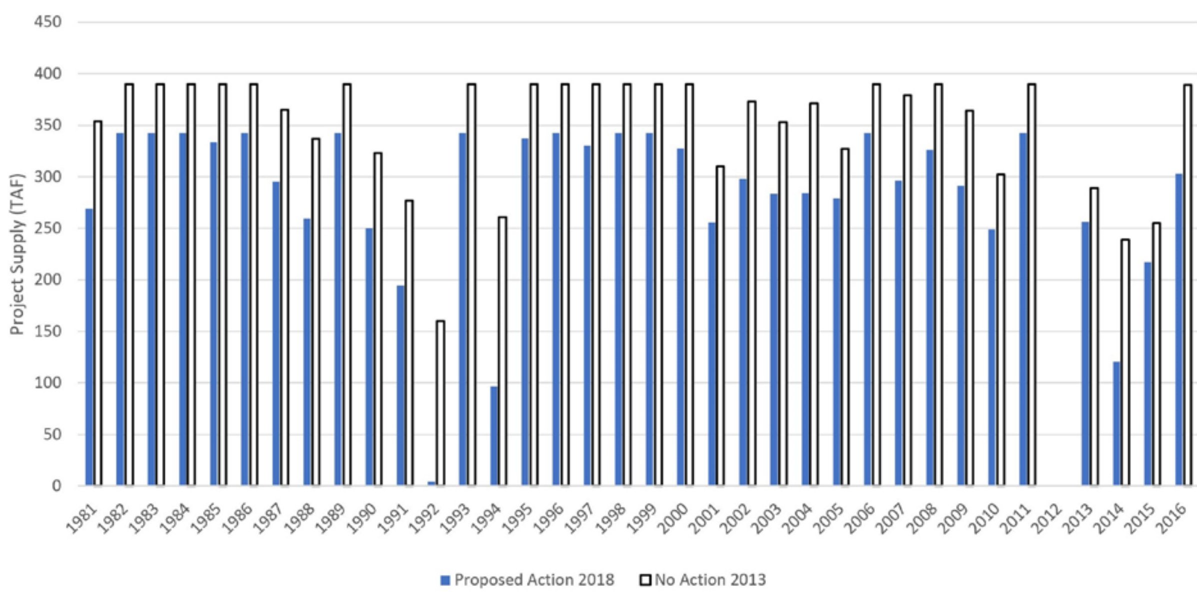


Figure 4-6. Modeled Project Supply values for the No Action Alternative and the Proposed Action Alternative. Note: there are no simulated or actual values for the No Action Alternative for 2012.

Total Spring/Summer Water Supply

The total spring/summer diversions consist of the modeled Project Supply plus modeled LRDC and KSD flows that are diverted by the Project. Figure 4-7 lists the anticipated total volume (or total spring/summer supplies) available for diversion to the Project as a result of the No Action Alternative and the Proposed Action Alternative modeling calculations (inclusive of Project Supply caps of either 390,000 AF and 342,564 AF for the No Action Alternative and Proposed Action Alternative, respectively).

No Action Alternative

The simulated available total spring/summer diversions under the No Action Alternative is compared to the Proposed Action Alternatives in Figure 4-7 below. Under the No Action Alternative, LRDC flows are available for diversion in addition to Project Supply from UKL. Figure 4-7 shows that the total spring/summer diversions average 366,000 AF, with a minimum of 155,000 AF (1992) and a maximum of 446,000 AF (1999).

Proposed Action Alternative

The simulated available total spring/summer diversions under the Proposed Action Alternative is also shown in Figure 4-7. Under the Proposed Action Alternative, Project Supply from UKL of up to 342,564 (as analyzed here), plus flows from the KSD and LRDC constitute the total spring/summer supply. Figure 4-7 shows that the total spring/summer diversions average 336,000 AF, with a minimum of 7,000 AF (1992) and a maximum of 446,000 AF (1999).

Figure 4-7 below compares the spring/summer diversions between the No Action Alternative and the Proposed Action Alternative. The 2012 Proposed Action as analyzed in the 2013 BiOp was modeled using water years 1981 through 2011. Since the simulation ended in 2011, there are no 2013 BiOp simulated values for the 2012 through 2016 time-frame. However, the actual values that resulted from implementation of the 2013 BiOp can be used to evaluate the 2013 through 2016 time-frame (there are no simulated or actual values for 2012 as discussed above).

The No Action Alternative as analyzed in the 2013 BiOp was modeled using water years 1981 through 2011 POR. Since the simulation ended in water year 2011, there are no 2013 BiOp simulated values for the 2012 through 2016 time-frame. However, the actual values that resulted from implementation of the 2013 BiOp from March 1, 2013, through November 30, 2016, can be used to compare the No Action Alternative and Proposed Action Alternative during the 2013 through 2016 time-frame. Since implementation of the 2013 BiOp didn’t occur until March 1, 2013, and there are no simulated or actual values for the November 1, 2011, through February 28, 2013 period for the 2013 BiOp, comparisons between the alternatives is not possible during that time period. The POR for the Proposed Action Alternative was updated with data for water years 2012 through 2016, and uses the water year 1981 through November 30, 2016, POR.

Proposed	319	343	346	373	408	405	368	321	385	309	224	7	350	126	354	395	413	357	446	424	327	386	365	374	342	410	365	395	344	314	375		317	134	257	365
No Action	392	343	346	373	408	405	423	378	385	374	289	155	350	264	354	395	417	357	446	438	317	430	404	427	375	410	425	401	390	323	375		319	275	273	379
Difference	-73	0	0	0	0	0	-55	-57	0	-65	-65	-148	0	-138	0	0	-4	0	0	-14	10	-44	-39	-53	-33	0	-60	-6	-46	-9	0		-2	-141	-16	-14

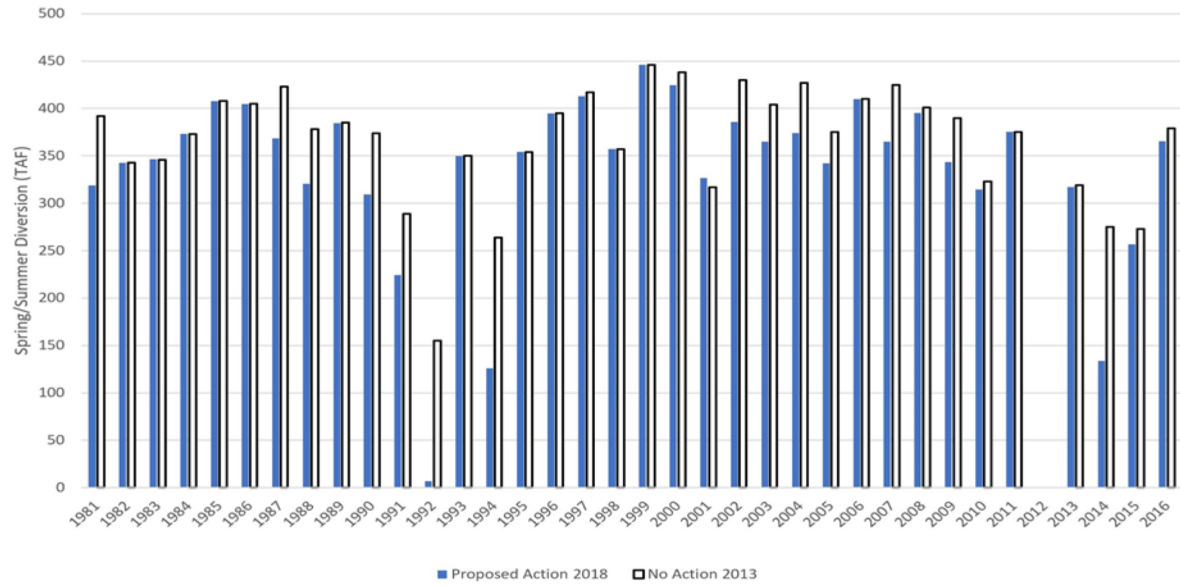


Figure 4-7. Comparison of Modeled Total Spring/Summer Diversions Between the No Action Alternative and the Proposed Action Alternative. Note: there are no simulated or actual values for the No Action Alternative for 2012.

Fall/Winter Water Supply

The fall/winter diversions consist of releases from UKL during the October 1 through February 28/29 timeframe for the No Action Alternative and from November 1 through February 28/29 for the Proposed Action Alternative. Figure 4-8 below shows the anticipated fall/winter volume available for diversion as a result of the No Action Alternative and the Proposed Action Alternative. The fall/winter water supply discussed here does not include fall/winter water supply available to LKNWR, which is discussed in the "Total Annual LKNWR Water Supply from UKL and the Klamath River" section below.

No Action Alternative

The simulated available fall/winter diversions under the No Action Alternative are listed in Figure 4-8 below. Under the No Action Alternative, the minimum available supply during the fall/winter period is approximately 19,000 AF, with additional water made available in wetter hydrologic conditions. However, fall/winter diversions may be reduced below 19,000 AF if UKL elevations are expected to drop below the end of month thresholds identified in the 2013 BiOp. Figure 4-8 shows that the fall/winter diversions average 26,000 AF, with a minimum of 6,000 AF (2016) and a maximum of 43,000 AF (1984 and 1985).

Proposed Action Alternative

The simulated available fall/winter diversions under the Proposed Action Alternative are also listed in Figure 4-8. Under the Proposed Action Alternative, the maximum volume available for delivery is approximately 29,000 AF and can be reduced by the UKL central tendency control logic as discussed in Section 2.4 above. Figure 4-8 shows that the fall/winter diversions average 27,000 AF, with a minimum of 12,000 AF (1992) and a maximum of 29,000 AF in many years.

Figure 4-8 below compares the fall/winter supply values between the No Action Alternative and the Proposed Action Alternative. The 2012 Proposed Action as analyzed in the 2013 BiOp was modeled using water years 1981 through 2011. Since the simulation ended in 2011, there are no 2013 BiOp simulated values for the 2012 through 2016 time-frame. However, the actual values that resulted from implementation of the 2013 BiOp can be used to evaluate the fall/winter supplies for the 2014 through 2016 time-frame (there are no simulated or actual fall/winter values available for comparison for 2012 and 2013).

Proposed	29	29	29	29	29	29	29	29	29	29	29	12	20	29	20	29	29	29	29	29	29	29	22	29	29	29	29	29	29	29	29			22	29	15
No Action	26	34	39	43	43	23	22	41	40	21	20	19	28	21	25	30	28	26	31	28	20	25	25	19	21	36	21	28	22	19	26			18	13	6
Difference	3	-5	-10	-14	-14	6	7	-12	-11	8	9	-7	-8	8	-5	-1	1	3	-2	1	9	4	-3	10	8	-7	8	1	7	10	3			4	16	9

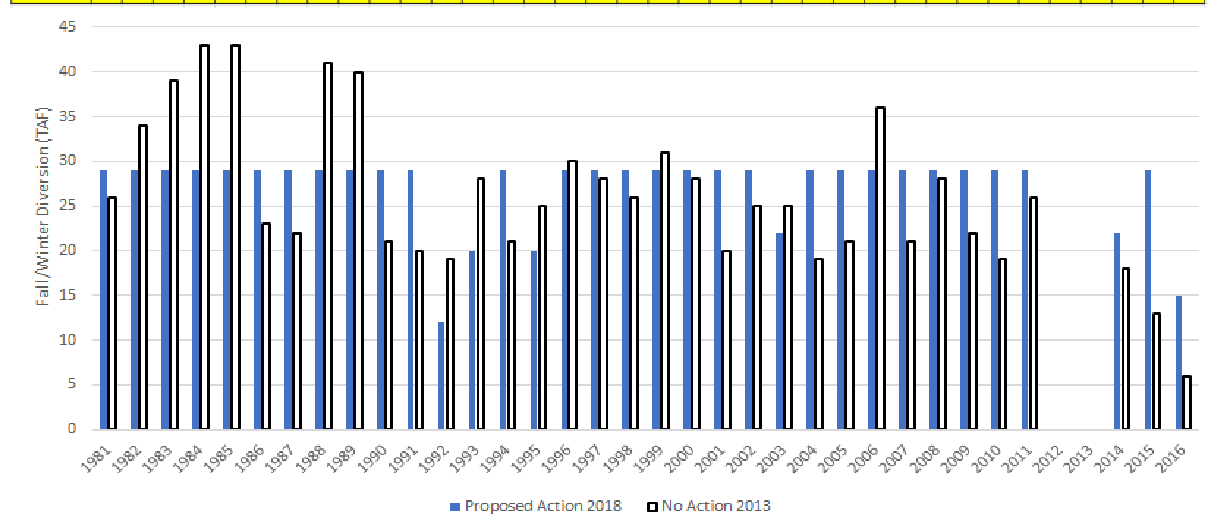


Figure 4-8. Comparison of Modeled Fall/Winter Diversions Between the No Action Alternative and the Proposed Action Alternative. Note: there are no simulated or actual values for the No Action Alternative for 2012 or 2013.

Total Annual LKNWR Water Supply from UKL and the Klamath River

The water supply available from the Klamath River and UKL for LKNWR is presented here in terms of total annual deliveries, to reflect how water is currently managed within the refuge (i.e., with extensive reuse of water and little drainage off the refuge over the course of a year). The volumes available and the limitations on delivery of water to LKNWR from these various components vary between alternatives.

No Action Alternative

The various components of, and conditions placed upon, water deliveries from UKL and the Klamath River to LKNWR under the No Action Action Alternative are addressed in section 2.3, above. The simulated total annual water supply available for LKNWR from UKL and the Klamath River under the No Action Alternative for the POR is shown in Figure 4-9 below, which shows that annual deliveries to LKNWR average 28,000 AF, with a minimum of 0 AF (several years) and a maximum of 73,000 AF (1984). Note these figures only show the simulated deliveries from UKL and the Klamath River; water delivered to LKNWR via Pumping Plant D or through exercise of transferred water rights is not simulated in the KBPM.

Proposed Action Alternative

The various components of, and conditions placed upon, water deliveries from UKL to LKNWR under the Proposed Action Alternative are addressed in section 2.4, above. As discussed in that section, there are no formulaic conditions placed upon delivering any portion of Project Supply to LKNWR during the spring/summer period. Accordingly, for purposes of analyzing the effects of the Proposed Action Alternative on LKNWR deliveries, Reclamation must make some assumptions about what portion of Project Supply will be available for delivery to LKNWR consistent with Reclamation's contractual and other legal obligations.

For purposes of analyzing the outer bounds of the environmental impacts, Reclamation is making the following assumptions with respect to deliveries of Project Supply to LKNWR during the spring/summer period: When the Project Supply is calculated at the maximum of 342,564 AF, approximately 8.57 percent of this volume (30,000 AF) is assumed to be delivered to LKNWR. When the Project Supply is less than or equal to 175,000 acre-feet, 2.86 percent of the Project Supply is assumed to be delivered to LKNWR. When the Project Supply is between 175,000 AF and 342,564 AF, the portion of the Project Supply assumed to be delivered to LKNWR will be linearly interpolated between 2.86 percent to 8.57 percent of the Project Supply. These assumptions are considered reasonable given the lack of specific formulaic conditions contained in the Proposed Action Alternative for determining what portion of Project Supply is available for delivery to LKNWR during the spring/summer period.

The simulated deliveries from UKL to LKNWR under the Proposed Action Alternative, based on the above described assumptions, are presented in Figure 4-9, which shows average diversions of 20,000 AF, with a minimum of 3,000 AF (1992 and 2014) and a maximum of 43,000 AF (several years).

Figure 4-9 below compares the total annual water deliveries from UKL to LKNWR between the No Action Alternative and the Proposed Action Alternative (i.e., fall/winter supply + spring/summer Project Supply + spring/summer non-Project Supply). The 2012 Proposed Action Alternative, as analyzed in the 2013 BiOp, was modeled using water years 1981 through 2011. Since the simulation ended in 2011, there are no 2013 BiOp simulated values for the 2012 through 2016 time-frame. However, the actual values that resulted from implementation of the 2013 BiOp can be used to evaluate total annual LKNWR deliveries for the 2014 through 2016 time-frame and are presented in Figure 4-9. This leaves only 2012 and 2013 as the years where no simulated or actual total annual deliveries to LKNWR can be presented for the No Action Alternative (and compared to the Proposed Action Alternative).

Proposed	11	43	43	43	35	42	11	11	42	11	8	3	35	10	32	31	11	43	21	11	11	11	5	8	8	43	11	11	11	11	43			3	11	4
No Action	4	64	65	73	67	43	0	10	41	1	0	0	59	1	59	53	55	62	56	31	0	7	4	5	1	51	6	38	5	1	44			0	19	20
Difference	7	-21	-22	-30	-32	-1	11	1	1	10	8	3	-24	9	-27	-22	-44	-19	-35	-20	11	4	1	3	7	-8	5	-27	6	10	-1			3	-8	-16

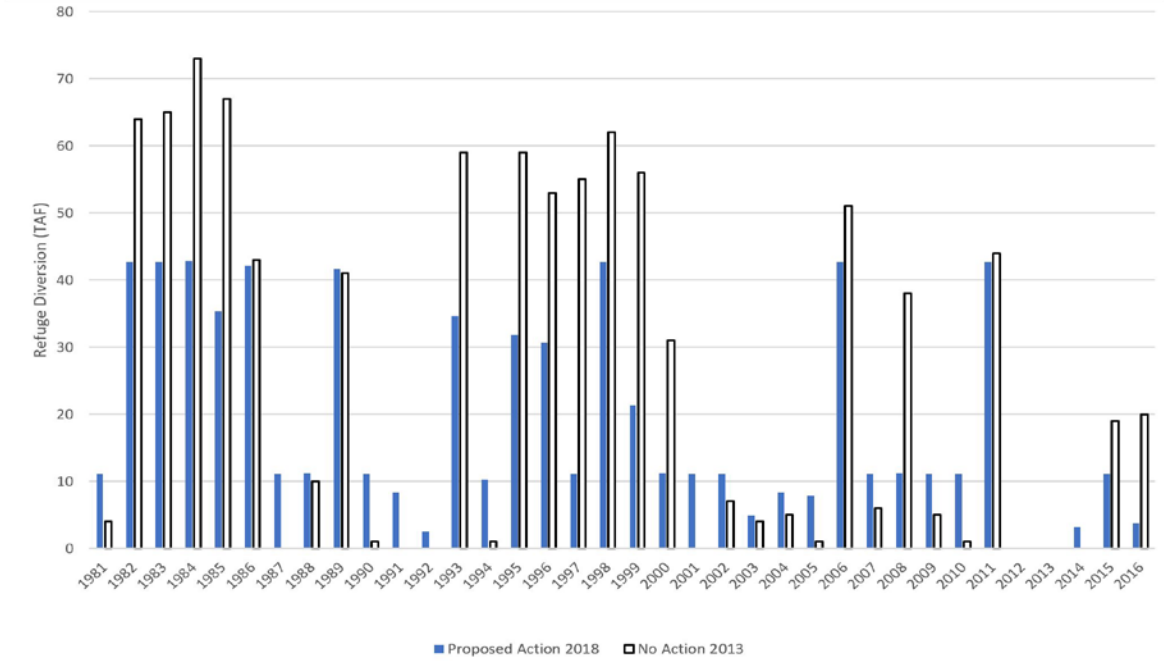


Figure 4-9. Comparison of Modeled LKNWR Deliveries Between the No Action Alternative and the Proposed Action Alternative. Note: there are no simulated or actual values for the No Action Alternative for 2012 or 2013

4.3.1.4. LRDC and KSD Flows Diverted by the Project

No Action Alternative

The simulated usage of LRDC and KSD flows for irrigation under the No Action Alternative is listed in Figure 4-10 below. Average diversion of LRDC and KSD flows by the Project is 52,000 AF, with a minimum of 7 AF (1992) and a maximum of 85,000 AF (1984) (Figure 4-10). Note that under the No Action Alternative KSD flows were not available for diversion independent of Project Supply. Note that No Action Alternative was modeled using water years 1981 through 2011. Since the simulation analyzed in the 2013 BiOp ended in 2011, there are no 2013 BiOp simulated values for the 2012 through 2016 time period. Given how KSD flows were handled under the No Action Alternative, there are also no actual values for diversions of this water by the Project for the 2013 through 2016 time period.

Proposed Action Alternative

The simulated usage of LRDC and KSD flows for irrigation under the Proposed Action Alternative is listed in Figure 4-10 below. Figure 4-10 shows that the usage of LRDC and KSD flows by the Project averages 71,000 AF, with a minimum of 2 AF (1992) and a maximum of 111,000 AF (1999). Note that under the Proposed Action Alternative, KSD flows are available for diversion during the spring/summer operations period.

Proposed	50	91	106	107	96	98	73	60	89	60	32	2	70	24	74	71	82	98
No Action	42	66	78	85	71	70	60	47	56	53	19	7	40	14	51	51	43	80
Difference	8	25	28	22	25	28	13	13	33	7	13	-5	30	10	23	20	39	18

Proposed	111	96	70	86	82	89	77	105	70	69	53	66	71	62	60	14	46	62
No Action	78	75	12	60	63	62	52	68	50	54	37	27	48					
Difference	33	21	58	26	19	27	25	37	20	15	16	39	23					

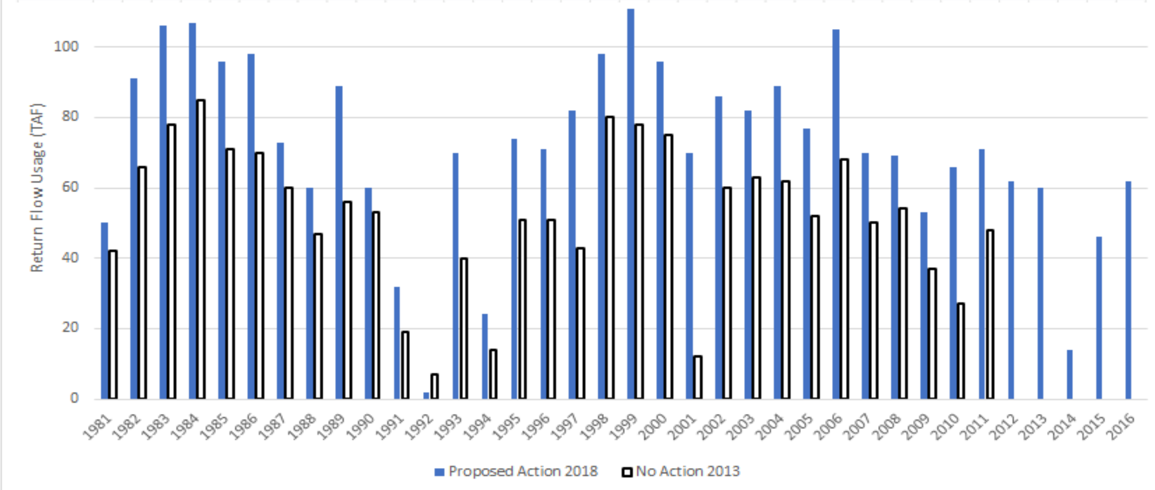


Figure 4-10. Comparison of Modeled Diversions to the Project of LRDC and KSD Flows Between the No Action Alternative and the Proposed Action Alternative. Note that there are no simulated or actual values for the No Action Alternative for 2012-2016.

4.3.2. Water Quality

Neither alternative is expected to directly change water quality parameters in UKL. Similarly, return flows from Project lands into the Klamath and Lost rivers would be similar or reduced under the Proposed Action Alternative versus the No Action Alternative and no measurable change to water quality is expected due to the alternatives.

Current peer reviewed literature suggests that there is little or no relationship between, water levels in UKL and water quality parameters (Morace 2007; Wood et al. 1996; and NRC 2004). Although the Proposed Action Alternative could result in generally higher water levels within UKL, it is unlikely that increased elevations will have any notable effect on water quality. In fact, the generally increased water levels of the proposed action in UKL may potentially benefit water quality if lower lake elevations indeed have some valid relationship to poorer water quality versus the No Action Alternative.

The Proposed Action Alternative is anticipated to have no direct impacts to current water quality in the Upper Klamath River or Lost River. The driving force for water quality in the Upper Klamath River is water emanating from UKL. The quality of water entering, within, and leaving the Keno Impoundment is largely due to the export of algal biomass from UKL, and subsequent decomposition within this reach (ODEQ 2018). Because the water quality from UKL is not believed to change under the proposed action, water quality in the Upper Klamath River should not be impacted. Additionally, irrigation withdrawals and releases in the Upper Klamath River and Lost River should be similar or reduced under the Proposed Action Alternative versus the No Action Alternative and should not affect current water quality conditions.

4.3.3. Groundwater

The USGS, in coordination with Reclamation, OWRD and other local entities, has conducted recent investigations attempting to quantify, through hydrologic models, the sustainable level of groundwater pumping within the Upper Klamath Basin and more specifically the Klamath Project (USGS 2014, 2012). The models show differing amounts of supplemental groundwater that can be sustainably pumped within the Project depending on the constraints placed on pumping impacts (e.g., acceptable drawdown levels, reductions in groundwater discharge to surface water, or reductions in agricultural return flows).

These investigations and further communication with OWRD (Gall 2018) indicate that to be sustainable, supplemental groundwater pumping within the Project should not exceed 80,000 acre-feet of water in any given year and should not exceed an annual average of 30,000 AF over a ten-year period. Reclamation will continue to rely on the state agencies with jurisdiction over groundwater to ensure that it is used in a sustainable manner.

Accordingly, for the purposes of estimating the socioeconomic impact (described below in section 4.7) of the No Action alternative, and recognizing that the sporadic nature of surface water shortages can result in highly variable demand for groundwater (e.g., several years of adequate surface water supply requiring no groundwater supplementation followed by severe drought necessitating high levels of groundwater supplementation), Reclamation is assuming that groundwater use of up to 80,000 acre-feet in any given year, with a ten-year running average not to exceed 30,000 acre-feet, is consistent with OWRD's assessment.

No Action Alternative
Implementation of the No Action Alternative would result in groundwater pumping in water short years in a manner similar to years since 2001.

Proposed Action Alternative
Under the Proposed Action Alternative, it is likely that groundwater pumping would continue to occur for the purpose of supplementing available Project surface water supplies in years when they are inadequate to meet the full demand of irrigated agriculture.

As seen in section 4.3.1.3., due to an increased number of years experiencing shortages in Project water supplies, there would be an increase in years requiring groundwater supplementation. Total groundwater withdrawal would be expected to increase approximately 22 percent if sustainable pumping limits are observed.

In California, where the state's groundwater management apparatus is still being developed through the formation of Groundwater Sustainability Agencies, this may result in increases in impacts to groundwater resources within the term of the Proposed Action in the form of declining groundwater levels. However, surface water impacts are unlikely (Gannett et al. 2012).

In Oregon, it would fall upon OWRD to limit groundwater extraction in order to ensure long-term sustainable groundwater use. This might occur through limitation on the quantity of drought permits issued or other measures under state law. The result might be that groundwater may not be available for some well owners not holding primary or supplemental groundwater rights, particularly after a series of dry years in which groundwater has been extensively used and the 30,000 AF average annual use might be exceeded.

Indirect Impacts - Subsidence Resulting from Groundwater Pumping
Excessive groundwater-level declines have the potential to cause land subsidence. However, there are no known published studies of land subsidence in or near the Project area correlated with groundwater pumping (Reclamation and CDFG 2012).

Groundwater Quality
Because there are no known areas of impaired groundwater quality in the geographic scope of the Proposed Action Alternative, changes in groundwater flow directions due to the implementation of either alternative assessed in this effort would not result in impacts on groundwater quality.

4.4. Biological Resources

4.4.1. Upper Klamath River Basin/UKL and Federally Protected Species

No Action Alternative
Implementation of the No Action Alternative would result in UKL conditions that align with the baseline conditions simulated in the 2012 BA (POR 1981-2011) and those that occurred during implementation of the 2013 BiOp (2013-2016). The storage of water in UKL has generally resulted in increasing UKL elevations during the winter and spring with the target of filling the lake during April or May. UKL elevations generally decrease thereafter, with annual low elevations generally occurring in September and October. The result of filling UKL in the winter and spring for suckers is an increase in available spawning habitat for lakeshore spawners prior to or during the spawning season. In some years under the No Action Alternative, shoreline spawning habitat is reduced impacting Lost River suckers in two ways; fewer individuals participate in spawning aggregations and the spawners spend less time on the spawning grounds.

The amount of emergent vegetation in UKL varies with lake elevation; it is likely that UKL elevations under the No Action Alternative provide sufficient wetland habitats during June and July for larvae and juvenile suckers. The impact of decreasing amounts of wetland habitat throughout the summer is unclear because juvenile suckers use wetland and open-water habitats.

Adult suckers prefer deep water habitat (13-20 feet) in the northern portion of the lake in late summer. The amount of habitat greater than 13 feet deep in September has varied among years. When adult suckers are concentrated into less habitat, food resources may become scarce, disease may become more prevalent, body condition may deteriorate, and mortality may increase. Adults may select depths of 13 to 20 feet deep to avoid avian predation, to obtain preferred food resources, or some other reason (Banish et al. 2009). In most years, the

No Action Alternative would likely provide sufficient habitat, although the availability of preferred habitats is reduced in the late summer and fall (particularly in drier years). Estimates of adult sucker survival rates in UKL have been high and stable across the range of elevations expected under the No Action Alternative. Conversely, it is expected the No Action Alternative is likely to result in continued low survival of juvenile suckers in UKL and limited recruitment into the adult sucker populations.

Proposed Action Alternative
Under the Proposed Action Alternative, the calculated volume of Project Supply (inclusive of the 342,564 AF cap), in part, results in increased UKL elevations during the late summer that will provide additional deep-water habitat (13 to 20 feet) available for adult suckers in the northern portion of UKL. The increased late summer elevations may also reduce avian predation on adult and juvenile suckers and improve access to refugial habitat in Pelican Bay. Based on observed high adult survival across a wide range of lake elevations, the Proposed Action Alternative is not expected to appreciably reduce adult sucker survival in UKL. Recent data suggest that survival between spring of 2016 and 2017 was lower than usual (Hewitt et al. 2018); it is possible that the lower adult survival rates from the most recent year may be the result of aging sucker populations, but additional years of data will be necessary to evaluate this hypothesis.

Relative to the forced surface flushing flows, the Proposed Action Alternative aims to minimize the impacts of implementing a surface flushing flow on UKL elevations by implementing flows in conjunction with an accretion event and maintaining UKL levels above 4,142 feet as often as possible. Even with implementation of forced flushing flows, the modeled output for the Proposed Action Alternative indicates that the frequency at which reduced habitat may concentrate spawning or compel suckers to skip spawning at the shoreline areas is relatively low.

Under the Proposed Action Alternative, when Project irrigators do not divert LRDC or KSD flows and these unused volumes are utilized to offset LRD releases, a volume of water (the UKL Credit, equal to the reduction in LRD releases) is stored in UKL. The purpose of the UKL Credit is to buffer UKL elevations against an over-forecasting of UKL inflows; as a result, UKL elevations will be higher under the Proposed Action Alternative in years where inflows are over forecast, providing additional habitat for adult and juvenile suckers.

Relative to TLS1A management, the proposed change to a year-round minimum elevation of 4,034.0 feet and resultant water depths appear to provide adequate habitat for juvenile and adult Lost River and shortnose suckers life stages (USFWS 2008, 2013). Under both alternatives, some level of avian predation of suckers in TLS1A is likely to occur. Surface elevations in TLS1A of 4,034.0 ft appear to provide areas with water depth greater than 3.3 ft, the depth at which sucker vulnerability to American white pelican predation is expected to be increased (Scoppettone et al. 2014 p. 65). As the Proposed Action Alternative provides areas of TLS1A with a water depth of at least 4 ft adult suckers would continue to have some level of protection from avian predation. The proposed change in operation at TLS1A to a year-round minimum surface elevation of 4034.0 ft is not anticipated to have additional measurable impacts to suckers relative to the No Action Alternative.

4.4.2. Lower Klamath River Basin/Klamath River and Federally Protected Species

No Action Alternative
Reclamation consulted on the effects of implementing the No Action Alternative (2013 BiOp) on the species identified in section 3.2.2. Based on the information provided in the 2012 BA and the analysis performed in the 2013 BiOp. Detailed information regarding effects to ESA-listed species as a result of implementation of the No Action Alternative can be found in the 2012 BA and 2013 BiOp. While implementing the No Action Alternative (2013-2016) prevalence of infection for juvenile Chinook salmon exceeded the Incidental Take Statement included in the NMFS 2013 BiOp. Continued operation under the No Action Alternative could produce similarly high infection rates, especially in consecutive drought years in which the Klamath River is characterized by low, stable flows. Under the No Action Alternative, potential increased disease risk to coho and Chinook salmon may occur and potentially result in a reduced prey base for SRKW.

Proposed Action Alternative
The calculated Project Supply under the Proposed Action Alternative (inclusive of the cap at 342,564 AF), in part, results in higher end of season UKL elevations and carryover volumes for subsequent water years, compared to the No Action Alternative. This results in increased likelihood of reaching the flood control curve in the fall/winter period and the ability to produce flushing flows in the Klamath River. The forced and opportunistic surface flushing flows in the Proposed Action Alternative may improve disease conditions (*C. shasta*) relative to the No Action Alternative by disrupting polychaete habitats. A 25 percent reduction of the prevalence of infection (POI) in juvenile salmonids (coho and Chinook) is anticipated due to implementation of surface flushing flows, which should reduce the prevalence of mortality (POM) and increased juvenile-to-adult survival. The reduced POI, and consequently POM, should improve smolt survival and forage for other interconnected species, such as SRKW. Green sturgeon and eulachon should only be minimally impacted due to life history traits, winter use of the river, and their primary occupancy being in the lower 10 miles of the Klamath River.

Implementation of the Proposed Action Alternative as it relates to the use/accounting of LRDC and KSD flows (including establishment of the UKL Credit) is not anticipated to alter the Klamath River flow regime identified as needed in the No Action Alternative (2013 BiOp) or the modified 2018 BA. Conditions necessary to protect ESA-listed species within the Klamath River will not be impacted through implementation of the Proposed Action Alternative as river flows are now accounted for out of UKL rather than being dependent on natural and return flows from the Project. As a result, impacts to coho salmon, Chinook salmon, green sturgeon, eulachon, or SRKW are anticipated to remain the same as existing conditions.

Relative to the implementation of the Proposed Action Alternative’s new proposed elevation at TLS1A, impacts to coho salmon, Chinook salmon, green sturgeon, eulachon, and SRKW will not occur as these species are not impacted by elevation changes within the TLS1A.

Ramping rates in the Klamath River below IGD are largely consistent with what would be observed under natural conditions and therefore would not be expected to impact biological resources.

4.4.3. Other Wildlife Species

No Action Alternative

Aquatic Species

It is anticipated that the status of aquatic species in the Upper and Lower Klamath basins would be maintained if the No Action Alternative was implemented. Species around and dependent on surface waters would continue to experience the current conditions as there would be no change from the existing management plan.

Terrestrial Species

Similar to aquatic species, terrestrial species would maintain their current status as there would be no change to the current environment due to the implementation of the No Action Alternative. Species around and dependent on surface waters and agricultural, upland, or forested areas would experience the same condition at present and would likely migrate to areas that fulfill their biological needs.

Proposed Action Alternative

Aquatic Species

The Proposed Action Alternative, the calculated volume of Project Supply (inclusive of the 342,564 AF cap) could result in additional habitat for many species dependent upon wetlands or other aquatic resources. For example, muskrats, otters, garter snakes, would benefit from increased UKL elevations in the late summer and fall. Conversely, higher UKL could reduce food resources for some avian piscivores such as American white pelicans, that may be limited by depth.

Reducing UKL elevations to support a proposed surface flushing may increase the survivorship or fitness of many species such as waterfowl that prey upon Lost River sucker eggs that are abundant at the east side springs during the sucker-spawning season. For aquatic species below UKL and above Keno, the Proposed Action Alternative would result in a similar environment as to No Action Alternative as it is likely that flow regimes would be tightly regulated in both scenarios (e.g. flows in Link River).

The increased frequency of flushing flows coupled with ramping rates in the Klamath River below Link River Dam and Keno Dam may increase the frequency of fluctuations in water levels that may result in stranding of fish species.

Under the Proposed Action Alternative, modified use and accounting of natural and return irrigation flows will likely benefit most aquatic species in UKL when lake elevations are higher. These flows could contribute to a UKL Credit (e.g., higher UKL elevations) and contribute to impacts as described above.

Relative to the proposed elevations TLS1A and compared to the No Action Alternative, reduced levels from April to September could result in greater levels of avian predation on fish (e,g. Sacramento perch, bass, yellow perch), which may result in higher survival and fitness for American white pelicans, double-crested cormorants, California gull, terns, and other piscivorous avian predators.

<u>Terrestrial Species</u>
Impacts to terrestrial species under the Proposed Action Alternative relative to UKL elevations (resulting, in part, from the calculated volume of Project Supply and the Project Supply cap of 342,564) are unquantifiable and therefore uncertain. It is likely that terrestrial species would maintain their current status as these species, dependent on surface waters and agricultural, upland, or forested areas would migrate to areas that fulfill their biological needs. The need for movement to areas of more suitable habitat would likely be less than a few miles.

It is not likely that terrestrial species will be impacted by increased surface flushing flows as these flows are temporary in duration. Temporary displacement of short distances for terrestrial species along LRD to below IGD could occur but would not result in a quantifiable impact.

Similar to impacts anticipated from a cap on Project Supply, Terrestrial species would maintain their current status as these species, dependent on surface waters and agricultural, upland, or forested areas would migrate to areas that fulfill their biological needs. The need for movement to areas of more suitable habitat would likely be less than a few miles. These impacts are as applicable to the proposed elevations changes as TLS1A.

Though removed from protection under the ESA, bald (and golden) eagles continue to be protected under the Bald and Golden Eagle Protection Action (16 U.S.C. 668-668c) which would be no change relative to the No Action Alternative.

4.4.4. Wetland and Riparian Areas

No Action Alternative
Under the No Action Alternative, water levels in UKL and TLS1A and irrigation deliveries to the Project, including irrigated lands within LKNWR and TLNWR, would be maintained consistent with the 2013 BiOp, as described herein.

As noted previously, UKNWR contains some of the last remnant wetland areas around UKL, and emergent wetland areas in UKNWR are only inundated when water levels in UKL are above 4,139.5 feet in elevation (USFWS 2016). Under the No Action Alternative, water levels in UKL are frequently below 4,139.5 for extended periods of time, particularly in drier years (e.g., 1992, 1994, 1995) (Figure 4-2). With respect to the end of September, UKL elevations are projected to be at or above 4,139.5 in approximately 30 percent of all years (Table 4-1).

Periods when the UKL elevation is below 4,139.5 feet, surrounding wetland areas, including within UKNWR, would largely be without standing surface water (spring and tributary fed waterways would still continue to exist). In terms of scope, the Hanks Marsh and Upper Klamath Marsh units of UKNWR (comprising approximately 15,000 acres) are most directly affected when water levels in UKL are below 4,139.5 feet. Wet meadow habitat within the Agency-Barnes Unit (9,796 acres) is less dependent on water levels in UKL, being generally surrounded by dikes and is wetted due to the effect of sub-irrigation.

With respect to seasonally and permanently flooded wetlands within LKNWR, these areas are dependent upon adequate water supplies from the Klamath River (via Ady Canal) and the Tule Lake Sumps (via Pumping Plant D). Under the No Action Alternative total annual water deliveries to LKNWR from UKL and the Klamath River average approximately 28,000 AF but are 1,000 AF or less in nine out of 34 years of record (one-quarter of all years), and less than 5,000 AF in 13 out of 34 years (more than one-third of all years) (*see* Figure 4-9). (Note that there are no simulated or actual values for LKNWR deliveries under the No Action Alternative for 2012 or 2013). As wetlands (permanent or seasonal) generally require at least 2.5 AF per acre per year to maintain wetland vegetation, it is reasonable to assume that the majority (at least 90 percent and possibly all) of the 24,000 acres within LKNWR that are managed as seasonally, or permanently flooded wetland areas may be affected in years when water deliveries from UKL and the Klamath River are 5,000 AF or less. There are also instances where the No Action Alternative results in multiple years of severely limited water deliveries. For example, compared to the POR, under the No Action Alternative, LKNWR would have received 1,000 AF over a three-year period (1990-1992), and 17 TAF over a five-year period (2001-2005). In those instances, it is reasonable to assume that there would be no wetland areas with standing water in LKNWR. Wetland areas need regular inputs of freshwater to maintain standing surface water, due to evaporation, evapotranspiration, and groundwater infiltration.

The precise extent of the impact, in terms of acres affected, necessarily depends on other conditions, particularly recent precipitation and water deliveries to LKNWR during preceding years, including from Pumping Plant D. However, as has been observed in actual operations, years with deliveries to LKNWR from UKL and the Klamath River of approximately 5,000 AF or less (e.g., 2014) have resulted in LKNWR having essentially no standing water in any wetland areas (either permanent or temporary). Such conditions, which are anticipated to occur in half of all years, will generally persist until either water deliveries resume or there is substantial precipitation. At times since 2013, all wetland areas within LKNWR (i.e., approximately 24,000 acres) have been without standing water for extended periods of time.

In some cases, periodic drying of wetlands areas can facilitate vegetative succession; however, extended periods without water can cause vegetation to shift to more upland species, and corresponding loss of habitat and food sources for other wetland-dependent wildlife.

Overall, the average volume of water deliveries to LKNWR from UKL and the Klamath River under the No Action Alternative is inadequate for refuge needs. The constraints on the average annual volume of water for LKNWR limits USFWS' ability to manage the various units within the refuge to provide a variety of vegetative communities, particularly for wetland-dependent species. Overall, less habitat can be maintained as wetland areas at any given time. In severely dry years, the lack of water may result in LKNWR having no wetland areas with standing water (i.e., approximately 24,000 acres).

Under the No Action Alternative, minimum water levels in TLS1A would vary throughout the year, with a minimum of 4,034.6 feet from April through September, and 4,034.0 feet for October through March. For the 13,240 acres of permanently flooded wetlands within TLNWR (TLS1A and 1B), these minimum elevations for TLS1A under the No Action Alternative provide sufficient water levels to maintain the emergent and submergent vegetation, and associated invertebrates, fish, and amphibians, that characterize these wetland areas.

Proposed Action Alternative
The Proposed Action Alternative results in water surface levels in UKL being slightly higher at times in comparison to the No Action Alternative. This change is generally evident with respect to water surface elevations at or below 4,139.5 feet. Specifically, the minimum observed water elevations each year are approximately one-half foot or higher, and the periods of time when the lake levels are below 4,139.5 feet are shorter in duration (Figure 4-2). With respect to the end of September elevation, UKL elevations are projected to be at or above 4,139.5 feet in 40-50 percent of all years (Table 4-1).

The observed change in UKL water levels resulting from the Proposed Action Alternative would result in less frequent and shorter periods of time when wetlands around UKL, including within UKNWR, lack standing surface water. Standing surface water supports emergent and submergent wetland vegetation, and invertebrates, fish, and amphibians that occupy this habitat. Wetland areas provide food and habitat for other wetland-dependent wildlife, including waterfowl and other migratory birds.

Under the Proposed Action Alternative, the average volume of annual water deliveries to LKNWR from UKL and the Klamath River is approximately 20,000 AF, which is 8,000 AF less than the No Action Alternative (Figure 4-9). However, overall deliveries to LKNWR from UKL and the Klamath River are more consistent, with no years with zero deliveries and only four years with deliveries of 5,000 AF or less (or approximately one-tenth of all years). The lack of extended periods (i.e., more than twelve months) with no deliveries is a material change when comparing the Proposed Action to the No Action Alternative. This change should reduce the frequency and duration of periods when all wetlands, both permanent and temporary, (i.e., approximately 24,000 acres) in LKNWR lack standing surface water, although it is recognized that there will still likely be extensive portions of LKNWR that lack standing water in such dry years. The precise extent of the impact, in terms acres of wetlands without standing surface water, would necessarily depend on other conditions, particularly recent precipitation and water deliveries to LKNWR during immediately preceding years, including from Pumping Plant D.

Securing a reliable water supply has been identified as a “critical conservation need” for LKNWR (Ivey and Herziger 2006). Based on the volume of annual deliveries as shown in Figure 4-9, the Proposed Action Alternative provides a more reliable supply of water compared to the No Action Alternative.

While the water supply for LKNWR under the Proposed Action Alternative may be more reliable than the No Action Alternative, the average volume of water for LKNWR under the Proposed Action Alternative is still inadequate to meet refuge needs. The constraints on the average annual volume of water available for LKNWR limits USFWS' ability to manage the various units within the refuge to provide a variety of vegetative communities, particularly for wetland-dependent species. Overall, less habitat can be maintained as wetland areas at any given time. In severely dry years, the lack of water may result in LKNWR being completely dry (i.e., no wetland areas) due to evaporation and seepage consuming the small volumes of water that are anticipated to be available. However, any impacts to wetland areas are not a result of operation of the Project under the Proposed Action, but rather due to the lack of an established allocation for LKNWR of a portion of the Project Supply (*see section 1.4.4*).

Under the Proposed Action Alternative, minimum water levels in TLS1A would be 4,034.0 feet year-round. Therefore, minimum elevations under the Proposed Action Alternative could be lower than under the No Action Alternative during the spring/summer period. For the 13,240 acres of permanently flooded wetlands within TLNWR (TLS1A and 1B), this minimum elevation for TLS1A under the Proposed Action Alternative provides sufficient water levels to maintain the emergent and submergent vegetation, and associated invertebrates, fish, and amphibians, that characterize these wetland areas.

4.4.5. Migratory Birds

No Action Alternative

The effects of the No Action Alternative on migratory birds are directly related to the effects on wetland areas, as discussed above. Under the No Action Alternative, wetland areas around UKL and within LKNWR are periodically without standing water, often for extended periods of time. When dry, wetland areas do not support the submergent vegetation, invertebrates, and fish populations that serve as an important food source for wetland-dependent species, particularly waterfowl and other migratory birds. Wetland areas that lack standing surface water also cannot serve as a refuge for molting or migrating waterfowl, or temperature-stressed aquatic life.

Wetland areas around UKL are projected to be without standing water at the end of September in seventy percent of all years (due to the UKL elevation being below 4,139.5 feet), with a corresponding loss of food resources and habitat for fall migrating waterfowl. Open water areas within UKL would still provide food and habitat for waterfowl, particularly diving ducks such as canvasback, redheads, and ringnecks; however, wetland-dependent waterfowl (mallards, pintail, widgeon, Canada geese) would be without access to suitable habitat. During such times, migratory birds would also lose access to emergent vegetation that is crucial during periods of inclement weather when conditions on the open lake are inhospitable (USFWS 2016). Waterfowl populations within UKNWR have been recorded as high as 83,740 birds (USFWS 2016).

The total volume of water available for delivery to LKNWR from UKL and the Klamath River under the No Action Alternative also will result in a reduction in the total number of acres within the refuge being maintained as wetlands at any given time (up to 24,000 acres), which will result in a corresponding reduction in food and habitat for wetland-dependent migratory birds.

As noted previously, approximately 80 percent of waterfowl along the Pacific Flyway pass through the Klamath Basin each spring and fall, as the area is located in a critical migration corridor between breeding grounds in the north and wintering grounds in the south (USFWS 2016). Over the long-term, waterfowl abundance (birds per day) within the Klamath Basin Refuge Complex in the autumn has averaged approximately 1 million birds, of which approximately 60 percent are in LKNWR and eight percent are in UKNWR (USFWS 2016). The effect of the No Action Alternative on wetland areas would result in a corresponding reduction in the historical level of food resources and habitat in the Klamath Basin for wetland-dependent migratory birds, including waterfowl, shorebirds, gulls, terns, cranes, rails, herons, grebes, egrets, songbirds, and raptors.

An appropriate measure of the impact to waterfowl can be observed in aerial surveys completed each fall within LKNWR. When large portions of wetlands within LKNWR lack standing water, such as 2014 and 2015, aerial surveys have recorded a marked decline in bird populations, with the highest observed waterfowl populations in those years being less than 175,000 birds. In comparison, during years like 2017, when wetland areas are inundated, aerial waterfowl surveys have observed in excess of 700,000 birds in LKNWR. Impacts of this magnitude, in terms of the reduction in waterfowl populations, would be anticipated in approximately one-third of all years under the No Action Alternative, or in other words, when deliveries to LKNWR from UKL and the Klamath River are 5,000 AF or less.

Another specific concern associated with low water levels in wetland areas in LKNWR is the increased likelihood and potential severity of waterfowl diseases, particularly avian botulism. Avian botulism is a paralytic disease caused by ingestion of a toxin produced by the bacteria *Clostridium botulinum*. This bacteria exists naturally in the soil and produces toxin under warm, anaerobic conditions, particularly in wetland areas. Birds ingest the toxin directly or by consuming invertebrates containing the toxin, including fly larvae (maggots) that have been feeding on animal carcasses that contain the toxin. The toxin affects the nervous system, causing flaccid paralysis that causes birds to drown, succumb to predation, or die from other health complications (e.g., respiratory failure). When wetland areas with standing water within LKNWR are reduced, birds become concentrated, which can exacerbate disease conditions. Shallow water can also contribute to disease conditions, by warming water and soil temperatures. Losses of over 50,000 waterfowl were recorded in the early 1950s but have been reduced with modified land and water management practices. Nevertheless, outbreaks commonly occur, particularly in dry years. Insufficient water deliveries to LKNWR will exacerbate conditions, and limit management options for mitigating the disease.

With respect to TLS1A, the No Action Alternative is anticipated to provide sufficient water levels to maintain the 13,240 acres of emergent and submergent vegetation, within Sumps 1A and 1B, thereby providing food and habitat for wetland-dependent migratory birds consistent with conditions over the POR.

Proposed Action Alternative

Compared to the No Action Alternative, the Proposed Action Alternative would reduce the frequency and duration of time during which wetland areas around UKL and within LKNWR lack standing surface water. Although the increase in standing water may be relatively short in duration or small in land size relative to the No Action Alternative, to the extent wetland areas have standing water when they would not otherwise, such wetlands should provide better access to food resources and habitat for wetland-dependent migratory birds compared to the No Action Alternative.

Under the Proposed Action Alternative, wetland areas around UKL are anticipated to be without standing water at the end of September in approximately half of the years, which is less frequent compared to the No Action Alternative. However, this figure means there will still be a loss of food resources and habitat for fall migrating waterfowl in roughly half of all years. Open water areas within UKL would still provide food and habitat for waterfowl, particularly diving ducks such as canvasback, redheads, and ringnecks; however, wetland-dependent waterfowl, such as mallards, pintail, widgeon, and Canada geese, would be without access to suitable habitat. During such times, migratory birds would also lose access to emergent vegetation that is crucial during periods of inclement weather when conditions on the open lake are inhospitable (USFWS 2016).

Although deliveries to LKNWR from UKL and the Klamath River will be more reliable in dry years, the average volume of water annually delivered still does not meet refuge needs, which will necessarily limit USFWS' overall ability to maintain wetland areas within LKNWR on a year to year basis (USFWS 2016). The impacts to migratory birds due to insufficient water supplies for LKNWR under the Proposed Action will be similar to the No Action Alternative. Limited water supplies for wetland areas will result in a reduction in the historical level of food resources and habitat in the Klamath Basin for wetland-dependent migratory birds, including waterfowl, shorebirds, gulls, terns, cranes, rails, herons, grebes, egrets, songbirds, and raptors. Similarly, low water levels in LKNWR will exacerbate waterfowl disease conditions, particularly avian botulism. However, any impacts to migratory birds are not a result of operation of the Project under the Proposed Action, but rather due the lack of an established allocation for LKNWR of a portion of the Project Supply (*see* section 1.4.4).

With respect to TLS1A, the Proposed Action Alternative is anticipated to provide sufficient water levels to maintain the 13,240 acres of emergent and submergent vegetation, within Sumps 1A and 1B, thereby providing food and habitat for wetland-dependent migratory birds consistent with conditions over the POR. No difference in access to food and habitat in TLNWR for wetland-dependent migratory birds is expected between the two alternatives.

4.5. Recreation

Impacts to recreation on the Klamath River under each alternative would be minor and temporary (specifically in the spring/early summer period) as a result of fluctuations in river operations to implement surface flushing flows downstream of IGD, to assist in control of salmon disease and habitat improvement. These flows are short in duration (7-10 days) and would only temporarily affect river activities (e.g., fishing), but may assist in providing benefits to species and thus recreational fishing opportunities. Ramping rates in the Klamath River below IGD are largely consistent with what would be observed under natural conditions and are unlikely to impact recreational fishing however, ramp rates below Link River Dam and Keno Dam may impact recreational fishing opportunities. Overall, recreational fishing and boating in the Lower Klamath Basin are anticipated to remain largely consistent with existing conditions under both alternatives.

For the Upper Klamath Basin, recreation (e.g., boating) associated with open water bodies like UKL, would remain unchanged between both alternatives, and would remain consistent with historical operations. Boat access to adjacent wetland areas, including in UKNWR, would also be similar under both alternatives. Channels and open water areas within marshes adjacent to UKL generally are accessible by boat, including canoes and kayaks, when water levels are at or above 4,140.0 feet in elevation. Under either alternative, UKL water surface levels for the start of the spring/summer recreation season (March 1) are in excess of 4,140 in more than 90 percent all years, and conversely less than this elevation at the start of the fall recreation season (September 30) in more than 90 percent of all years. In other words, wetland areas surrounding UKL, including within UKNWR, are generally expected to be accessible at the start of the spring (March) and inaccessible at the start of the fall (October) under both alternatives. The duration during which UKL elevations are at or below 4,140 feet is relatively consistent between the two alternatives (Figure 4-2).

Portions of LKNWR are open to and accessible for hunting (waterfowl and ring-necked pheasant), boating, wildlife observation, and photography. Hunting opportunities vary between walk-in areas, boat-in marshes, agricultural fields, and established pit blinds. As such, although waterfowl hunting use is primarily focused around flooded, wetland areas, there are still hunting opportunities when wetlands lack standing water. The annual numbers of waterfowl hunters that visit LKNWR varies between approximately 1,500 and 2,600, including years with severely reduced water deliveries. Wildlife observation and photography are also aided by the presence of water, but not dependent upon it, and can be assumed to continue at the same general level under both alternatives. Boating, however, does require existing open water areas, and thus water deliveries to LKNWR to support these conditions would be impacted similarly under both alternatives.

Recreation opportunities within TLNWR, which are primarily focused around wildlife observation, boating, waterfowl hunting, and interpretation, are anticipated to continue at historic levels under both alternatives.

4.6. Land Use

The scope of the analysis in this EA for both alternatives is the five-county area discussed in Section 3.4. Neither alternative is anticipated to impact land use outside the Klamath Project. The alternatives are also not anticipated to change established land management practices within the Klamath Basin Refuge Complex, as identified in USFWS' CCP. Further discussion below is therefore limited to privately owned lands within Klamath, Modoc, and Siskiyou counties.

No Action Alternative
Under the No Action Alternative and within the Project, involuntarily idling or crop forbearance would be unchanged from present practices, with short-term impacts such as weed growth and dust mobilization if cover crops are not planted. Long-term land use patterns would be unchanged. In economic impact simulations of the No Action Alternative (Section 4.6.), involuntary land idling occurred in seven years of the 35-year POR (20 percent of years). Fallowed acreage averaged 5,100 acres over the POR, or 25,500 acres in each occurrence of a short water year.

Proposed Action Alternative
Under the Proposed Action Alternative, there would be an increase in the frequency and magnitude of shortages of Project surface water. Likely responses to this shortage include groundwater supplementation and involuntary land idling. Due to sustainable management of groundwater resources by the respective state water resource agencies, groundwater supplementation may be limited or altogether unavailable, resulting in an increase in involuntarily idled land. In economic impact simulations of the Proposed Action Alternative (Section 4.6), involuntary land idling occurred in 13 years of the 35-year POR (37 percent of years). Fallowed acreage averaged 15,100 acres over the POR, or 40,700 acres per occurrence of years of short water supplies. Short-term impacts due to involuntary land idling may include weed growth and dust mobilization if cover crops are not planted (*see Section 4.7*). However, long-term land use patterns would not be expected to change.

The impact of the Proposed Action Alternative as compared to the No Action Alternative is therefore an additional six years of involuntary land idling (Figure 4-11), and an increase in fallowed acreage of 10,000 acres on average, or 15,200 acres per occurrence in water-short years, with corresponding potential increases in weed growth and dust. As a percentage of the Project's irrigated acreage, involuntarily fallowed land would increase from three percent to 10 percent over the POR. The short duration of the Proposed Action Alternative is not expected to lead to long-term changes in land use.

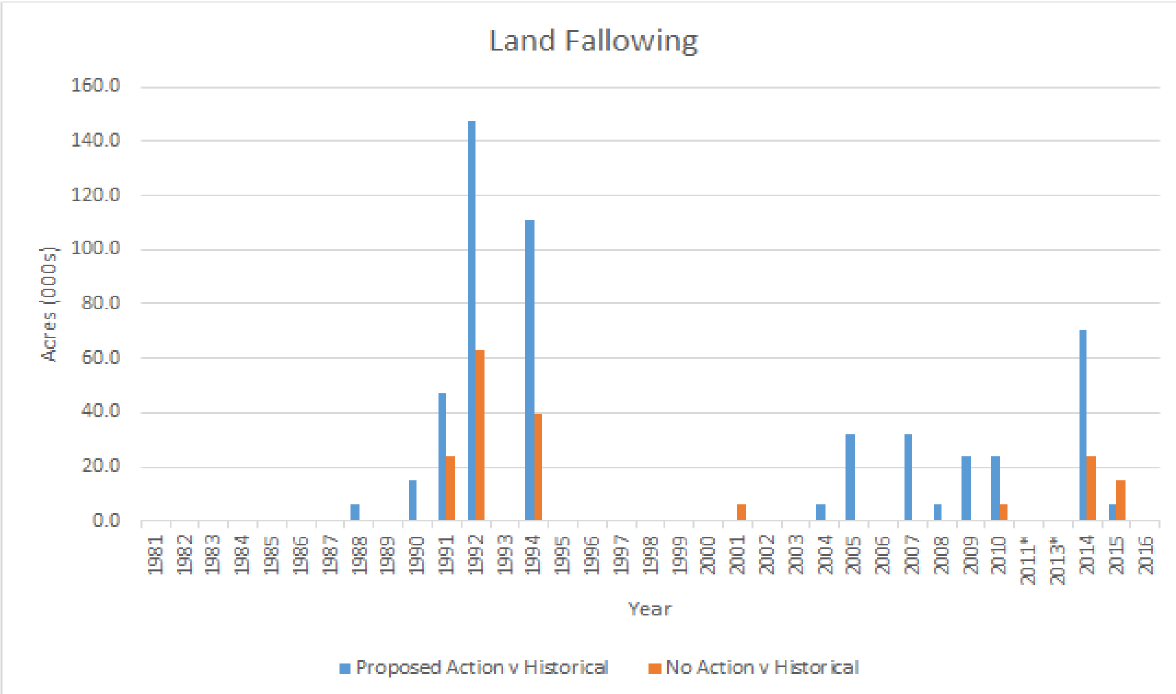


Figure 4-11. Comparison of No Action and Proposed Action alternatives with respect to involuntary land idling expected to result from shortages of irrigation water supply (Project surface water and groundwater[9].

4.7. Socioeconomic Resources

Irrigated Agriculture

The modeling approach used for estimating socioeconomic impacts to the Klamath Project is presented in Appendix D; the results of the socioeconomic analysis are derived from a simulation of the impact of the No Action and Proposed Action alternatives over the POR.

Briefly, the availability of Project water under the two alternatives is superimposed on historic demand over the POR. When shortages of Project water occur in a given year under either alternative, sustainably managed groundwater (*see Section 4.3.3*) is used to fill the gap between available water supply and demand to the extent possible. No influence or effect of the WUMP is considered in the analysis, as the WUMP or any similar program does not exist and is not reasonably foreseeable under either alternative. The cost of individual and private groundwater supplementation is estimated based on the cost of pumping (cost of power and average well efficiency) (Figure 4-12). Groundwater supplementation may not be sufficient to fill the gap between Project water supply and agricultural demand if the gap exceeds 80,000 AF or if groundwater has been utilized in previous years such that the ten-year average

[9] This information presented correlates with the analysis conducted in section 4.7. which accounts for the socioeconomic impacts of shortages if each alternative is implemented for years similar to those in the POR. The number of acres idled for both alternatives compares available Project spring/summer supplies plus some assumed amount of groundwater pumped to historical demand during the POR.

withdrawal exceeds 30,000 AF. If a water supply shortage remains after groundwater supplementation, the resultant reduction in irrigated land due to involuntary land idling is used to estimate lost farm revenue. The model takes into account the average cropping patterns on the Project, the market value of various crops, and priority of access to Project water supply per Reclamation's contractual obligations. Finally, the extended effects of lost farm revenue on the regional economy are estimated (Figure 4-13).

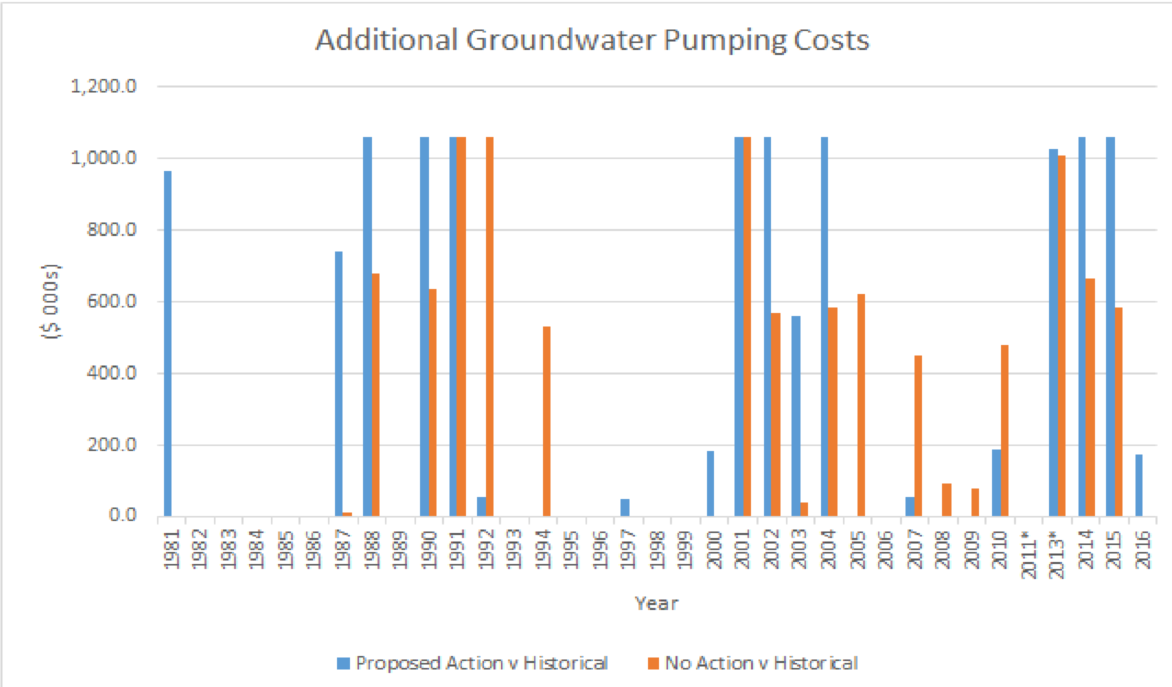


Figure 4-12. Simulated groundwater pumping costs due to shortages of Project water.

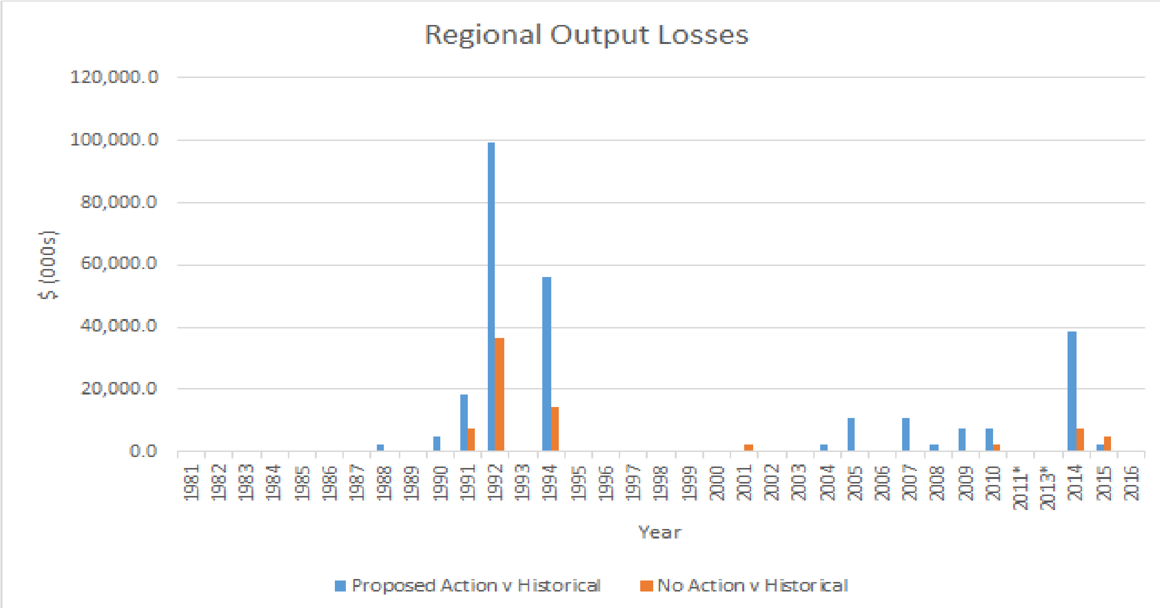


Figure 4-13. Simulated regional economic losses occurring due to unmitigable shortages of irrigation water under implementation of the No Action and Proposed Action alternatives. Values include gross on-farm revenue losses.

No Action Alternative

Under the No Action Alternative, shortages in Project surface water supplies are estimated to occur in 51 percent of years (18 of 35 years). Sustainable use of groundwater is able to mitigate the shortage in 11 of these years at an average cost of $568,000 per occurrence. After groundwater mitigation, the frequency of unmitigated shortages in irrigation water (Project surface water plus groundwater) is reduced to seven years (20 percent of years) (see Figure 4-13). The economic impact of these unmitigated water short years averages $10.8 million per occurrence, or $2.2 million per year when averaged over the POR. The highest economic impact of a short water year is $36.5 million, or a loss of 22 percent of regional economic activity attributable to agriculture in that year.

Under the No Action Alternative, regional job losses within the geographic scope of analysis in this EA averages 79.9 jobs in each year of unmitigated short water supplies, with a maximum annual loss of 270.6 jobs lost.

Proposed Action Alternative

Under the Proposed Action Alternative, shortages in Project surface water supply are estimated to occur in 63 percent of years (22 of 35 years). Sustainable use of groundwater is able to mitigate the shortage in 7 of the 22 years at an average cost of $694,000 per occurrence. After groundwater mitigation, the frequency of unmitigated shortages in irrigation water (Project surface water plus private groundwater) is reduced to 15 years (43 percent of years in the POR). In two of those 15 years, the magnitude of the unmitigated shortage is insufficient to cause significant (> 2.5 percent) acreage of involuntary land idling and resultant economic impacts in socioeconomic impact modeling. Estimated annual regional output losses in the remaining 13 years average $20.2 million (12 percent below estimated full output of $163.2 million) per occurrence, or $7.5 million when averaged over the POR. The highest economic impact of a short water year is $99.5 million, or a loss of 61 percent of regional economic activity attributable to agriculture in that year.

Under the Proposed Action Alternative, regional job losses within the geographic scope of analysis in this EA average 150.1 jobs in each year of unmitigated short water supplies, with an annual maximum of 737.5 jobs lost.

To summarize, comparing the Proposed Action Alternative to the No Action Alternative, while groundwater pumping as a result of inadequate Project water supplies would occur no more often, pumping costs would be 22 percent higher because of the need to pump more supplemental groundwater. In years when groundwater pumping is insufficient to mitigate the Project water shortage, losses to the Project's $163.2 million regional output would be expected to occur more frequently and would be more severe (average increase from $10.8 million to $20.2 million per occurrence, from $2.2 million to $7.5 million over the POR). Repeated years of inadequate Project water supplies may be more impactful than isolated years which provide irrigators greater opportunity to recover from their economic losses.

Implementation of the Proposed Action Alternative would result in more frequent and deeper regional job losses. Compared to the No Action Alternative, the Proposed Action Alternative would result in an increase in the frequency of years with job losses, and the loss of an additional 70.2 jobs on average per occurrence.

Indian Tribal Communities
This analysis focuses on fishing opportunities, related cultural and social practices, standard of living, and health for four federally recognized tribes in the Klamath Basin (The Klamath Tribes, Karuk Tribe, Yurok Tribe, and Hoopa Valley Tribe).

Under the Proposed Action, Reclamation anticipates that there would be no change to fishing opportunities for the Klamath Tribes, relative to the No Action Alternative.

Reclamation anticipates a reduced disease risk to coho and Chinook salmon in the Klamath River which is likely to result in increased fitness and decreased vulnerability, relative to the No Action Alternative. In turn, there may be less potential for adverse effects to tribal fisheries-related socioeconomic resources which may increase fish harvest for subsistence and commercial fishing and associated cultural and associated practices for the Klamath River Tribes. Due to the integral nature of fish to the worldview, status, and health of the Tribes, any improvements to the health and availability of fish and the Klamath River could contribute to improved standard of living and health for the Tribes. However, standard of living and health improvements would likely occur over the long term which would exceed the 5-year period of the Proposed Action.

Commercial Fishing
The Proposed Action Alternative is expected to improve riverine conditions for commercially-fished species including coho and Chinook salmon relative to the No Action Alternative. However, because 1) the long-term benefit has not been quantified, 2) the duration of this

Proposed Action Alternative is relatively short (five years), and 3) salmon populations are currently depressed, commercially harvestable populations are unlikely within the term of the Proposed Action Alternative. Therefore, implementation of the Proposed Action Alternative is unlikely to significantly impact commercial fishing opportunities and resultant economic activity as compared to the No Action Alternative.

Recreation
Socioeconomic impacts related to recreation include refuge recreation in the Klamath Basin National Wildlife Refuges associated with water from the Klamath Project, and water-based recreation on the Klamath River and along the southern Oregon and northern California coastline in the range of the SONCC ESU of coho salmon.

Because water supplies to the refuges would not be substantially changed, refuge recreation is unlikely to be significantly impacted by implementation of the Proposed Action Alternative. Likewise, as noted for commercial fishing above, water-based recreation centered on recreational fishing is unlikely to change significantly.

4.8. Air Quality

No Action Alternative
Air quality conditions would remain the same as existing in Del Norte and Humboldt, California counties. Reclamation's operations under the No Action Alternative center on managing Klamath River flows in these counties and would not create any direct/indirect increases/decreases of emissions like PM2.5.

Air quality conditions would also remain the same as existing in Klamath County, Oregon, Modoc and Siskiyou, California counties with some level of PM2.5 being emitted due to dust resulting from fallowed agricultural fields. Fields within the Project may be either voluntarily or involuntarily fallowed as a result of individual farming practices or due to reductions in available Federal water supplies. Under the No Action Alternative involuntary land fallowing would likely continue to occur in seven years of the 35-year POR (20 percent of years). Fallowed acreage averaged 25,500 acres in each occurrence of a short water year *(see section 4.5)*[10]. It is likely that due to water supply allocations based on Reclamation's contractual prioritization these fallowed acres and resultant dust emissions would occur in Klamath County, Oregon. To mitigate dust and any potential soil erosion, it is likely that best management practices (BMPs) would be employed at the individual level inclusive of planting of cover crops. Overall, some unquantifiable level of PM2.5 emissions would likely continue to occur as part of the baseline even with implementation of BMPs.

Proposed Action Alternative
Similar to the No Action Alternative, air quality condition is anticipated to remain the same as existing in Del Norte and Humboldt, California counties. Reclamation's operations under the

[10] These figures are the acres in which surface water and groundwater is not available to be applied as those sources have already been utilized.

Proposed Action Alternative are centered on managing Klamath River flows in these counties and would not create any direct/indirect increases/decreases of emissions like PM2.5.

Under the Proposed Action Alternative there is an increased likelihood that a greater acreage of agricultural lands within the Project boundaries would be fallowed as a result of individual farming practices or due to reductions in available Federal water supplies. Under the Proposed Action Alternative involuntary land fallowing would increase (as compared to the No Action Alternative) from 7 to 13 years of the 35-year POR. In simulations of the socioeconomic impact of the Proposed Action Alternative (see Section 4.6), fallowed acreage averages 40,700 acres in each occurrence in years of short water supplies. The impact of the Proposed Action Alternative as compared to the No Action Alternative is therefore an increase in fallowed acreage of 25,500 acres per occurrence in water-short years. It is likely that, due to water supply allocation based on Reclamation's contractual prioritization, the increase in fallowed acres would result in a higher level of PM2.5 or dust emissions in Klamath County, Oregon. Similar to the No Action Alternative, dust mitigation and soil retention BMPs would likely be employed. Although unquantifiable, it is probable that the level of PM2.5 or dust emissions under the Proposed Action Alternative would be greater than under the No Action Alternative.

4.9. Indian Trust Resources

No Action Alternative

The No Action Alternative includes measures to reduce fish disease but provides reduced certainty of implementation of those measures thereby potentially causing increased risk for mortality of coho and Chinook salmon as observed in 2015 and 2016. Continued high infection rates of disease under the No Action Alternative could impact the tribal trust fishery in the Klamath River by reducing the opportunities for the Karuk, Hoopa Valley, and the Yurok tribes to harvest salmon for subsistence, ceremonial, and commercial needs. Under the No Action Alternative tribes like the Yurok Tribe would likely provide for only very limited subsistence fishing like was seen in 2016 and 2017 due to concerns over the fishery.

Under the No Action Alternative 7,000 AF of water for the Yurok Tribe's Ceremonial Boat Dance would continue to be provided in even years. Ceremonial events dependent on water resources for the Hoopa Valley Tribe would not be impacted by implementation of the No Action Alternative as Klamath River flows for those purposes are supported by releases from the Trinity River in odd years.

Under the No Action Alternative, management of UKL would likely provide sufficient habitat for adult and juvenile suckers and adult survival would likely remain consistent with recent years; though juveniles are experiencing continued low survival and very limited recruitment into the adult sucker populations. As such, The Klamath Tribes current levels of ceremonial use would continue and fishing for subsistence and commercial needs would not occur.

Under the No Action Alternative, operation of the Project would continue to be managed consistent with federal law, Oregon water law and the ACFFOD, and the stipulated agreement between the U.S., The Klamath Tribes, and Project water users that provides that the water right for minimum water surface levels in UKL would not be exercised against any water rights prior to August 9, 1908. The stipulated agreement is valid until the judicial review of the Klamath Basin General Stream Adjudication within the Klamath County Circuit Court is complete. The ACFFOD is subject to ongoing judicial review but is still currently enforceable. The Klamath Tribes, through the BIA, have made a call to enforce some or all of the water rights for instream flows in tributaries to UKL, at varying levels, every year since issuance of the ACFFOD in 2013 which would continue to occur under the No Action Alternative. There would be no change to The Klamath Tribes federal reserved water rights under the No Action Alternative.

Proposed Action Alternative

Under the Proposed Action Alternative, a preventative measure for minimizing disease in the form of a forced surface flushing flow would be provided with certainty in nearly every year. Additionally, 20,000 AF of habitat flows for May and June in certain year are being provided. This water can either be used for habitat flows in certain years or be used for disease mitigation purposes at the recommendation of the FASTA Team to meet fisheries needs. Therefore, it is anticipated that the tribal trust fishery in the Klamath River would experience increased fitness and decreased vulnerability, relative to the No Action Alternative allowing for increased harvest of salmon for subsistence, ceremonial, and commercial needs.

Under the Proposed Action Alternative, 7,000 AF of water for the Yurok Tribe's Ceremonial Boat Dance would continue to be supported in even years. Ceremonial events dependent on water resources for the Hoopa Valley Tribe would not be impacted by implementation of the Proposed Action Alternative as Klamath River flows for those purposes are supported by releases from the Trinity River in odd years.

Under the Proposed Action Alternative, continued management of UKL would result in the elevations outlined in the modified 2018 BA). In most years, the Proposed Action Alternative would likely provide sufficient habitat for adult suckers that have led to relatively consistent and high survival rates, with juvenile suckers experiencing continued low survival and very limited recruitment into the adult sucker populations. The Klamath Tribes current levels of ceremonial use would continue and fishing for subsistence and commercial needs would still not occur. As such, there would be no change relative to the No Action Alternative.

Under the Proposed Action Alternative, operation of the Project would continue to be managed consistent with federal law, Oregon water law, and the stipulated agreement between the U.S., The Klamath Tribes, and Project water users that provides that the water right for minimum water surface levels in UKL would not be exercised against any water rights prior to August 9, 1908. The stipulated agreement is valid until the judicial review of the Klamath Basin General Stream Adjudication within the Klamath County Circuit Court is complete. The ACFFOD is subject to ongoing judicial review but is still currently enforceable. The Klamath Tribes, through the BIA, have made a call to enforce some or all of the water rights for instream flows in tributaries to UKL, at varying levels, every year since issuance of the ACFFOD in 2013 which would continue to occur under the Proposed Action Alternative. As such, there would be no change relative to the Proposed Action Alternative relative to The Klamath Tribes federal reserved water rights.

4.10. Environmental Justice

Under both alternatives some involuntary idling of productive irrigable land within the Project boundary would occur leading to an increased risk to local rural agricultural communities. Though uncertain, the use of supplemental water supplies, changes in agricultural practices, application of on-farm crop insurance program, use of NRCS programs, and other potential state and federal programs and activities are expected to be implemented if shortages exist, thereby reducing risks to populations within Klamath, Modoc, and portions of Siskiyou counties.

Increasing the amount of water used to meet ESA-listed species requirements under the Proposed Action Alternative would not adversely affect the likelihood of dependent Tribal communities (Karuk, Klamath, Yurok, and Hoopa Valley Tribes) to continue utilizing fisheries as a community economic and cultural resource relative to the No Action Alternative. Under the Proposed Action Alternative, it is anticipated that the tribal fishery in the Klamath River would experience increased fitness and decreased vulnerability, relative to the No Action Alternative allowing for a potential increase in coho and Chinook salmon availability as an economic and cultural resource. For suckers there would be no change from existing levels related to use as an economic and cultural resource. In turn, the overall risk to the tribal fisheries and the associated environmental justice would be reduced.

Overall, under both alternatives the impacts on minority and low-income populations throughout the action area are expected to be minor and limited to the five-year term of the action. Therefore, ethnic minority and/or low-income sectors of the population are not expected to be disproportionately affected by adverse environmental impacts associated with the project alternatives.

4.11. Cumulative Impacts

According to CEQ regulations for implementing the procedural provisions of NEPA, a cumulative impact is 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 other actions." Cumulative impacts can result from individually-minor, but collectively-significant actions taking place over a period of time. Reclamation considers only future actions which have completed planning and any required compliance activities to be reasonably foreseeable and those that will have effects within the five-year period of analysis for this action. The necessity of these considerations is based on the likelihood of an action actually occurring and any associated effects being experienced within the term of analysis covered in this EA (2019-2024).

<u>Water Resources</u>

No reasonably foreseeable actions are known to Reclamation that would affect water resources beyond the past and present actions (included in the affected environment discussion) and the effects of the proposed action. As a result, for the five-year period of the proposed action, there are no anticipated substantial cumulative impacts on Klamath River water resources related to the Proposed Action.

Biological Resources

Past and present actions, as presented in the affected environment discussion, have modified the biological resources in the Klamath Basin over the last century. Reasonably foreseeable future actions that could affect biological resources include implementation of FWS Sucker Recovery Program and PacifiCorp's Coho Enhancement Fund actions required under their Habitat Conservation Plan (Coho Enhancement Fund). During the 5-year period of the proposed action, the cumulative effects are likely to be minor, as sucker recovery, coho enhancement, and changes to the biological resources will require a much longer time frame and are speculative beyond the period of analysis.

Recreation

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative effect upon recreation resources in the action area during the five-year period of the proposed action. No cumulative effects beyond those specific to the proposed action are anticipated.

Land Use

Implementation of the Proposed Action Alternative is largely a water management action taking place within aquatic habitat. Reclamation has identified no reasonably foreseeable actions that would add to a cumulative effect upon land use in the action area during the five-year period of the proposed action. Past and present actions are included in the affected environment discussion of land use. No cumulative effects beyond the effects of the proposed action are anticipated.

Socioeconomic Resources

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative effect upon socioeconomic resources in the action area during the five-year period of the proposed action. No cumulative effects beyond those specific to the proposed action are anticipated.

Air Quality

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative effect upon air quality in the action area during the five-year period of the proposed action. No cumulative effects beyond those specific to the proposed action are anticipated.

Indian Trust Assets

Reasonably foreseeable future actions that could affect Indian Trust Assets include implementation of USFWS Sucker Recovery Plan and implementation of PacifiCorp's Coho Enhancement Fund actions. During the 5-year period of the proposed action, the cumulative effects are likely to be minor, as sucker recovery and changes to the biological resources will require a much longer time frame and are speculative beyond the period of analysis.

Environmental Justice

Reclamation has identified no reasonably foreseeable actions that would add to a cumulative effect upon socioeconomic resources in the action area during the five-year period of the proposed action. Cumulative effects of future activities beyond the five-year period of the proposed action on minority and low-income populations are speculative. The net cumulative impacts are anticipated to be minor due to the likely (if somewhat uncertain, because decisions by individuals are speculative) use of supplemental water supplies, changes in agricultural practices, and/or application of on-farm crop insurance program that are expected to be implemented if shortages exist, thereby minimizing effects to populations within Klamath, Modoc, and Portions of Siskiyou counties.

5. Consultation and Coordination

5.1. Agencies and Groups Consulted

Reclamation coordinated with USFWS, NMFS, and OWRD in the preparation of this EA. Reclamation released a draft EA on March 5, 2019 for a 15-day public comment period which ended on March 19, 2019. Comments received from the public review of the draft were used to develop the final EA and FONSI.

5.2. Endangered Species Act

Section 7(a)(2) of the ESA requires federal agencies to ensure that any action they authorize, fund, or carry out "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of designated critical habitat. 16 U.S.C. § 1536(a)(2). Thus, the Klamath Reclamation Project is prohibited from engaging in any action that is likely to jeopardize the continued existence of an endangered or threatened species or result in destruction or adverse modification of designated critical habitat. On December 21, 2018, Reclamation transmitted a biological assessment for Klamath Project operations from April 1, 2019 through March 31, 2024, as revised and clarified by subsequent letters and addenda.

NMFS issued a biological opinion on March 29, 2019, concluding that Reclamation's Proposed Action Alternative is not likely to jeopardize the continued existence of the Southern Oregon/Northern California Coast (SONCC) coho salmon Evolutionarily Significant Unit (ESU), or the Southern Resident Killer Whale Distinct Population Segment (DPS) (Southern Residents), or destroy or adversely modify designated critical habitat for the SONCC coho salmon ESU. Critical habitat for Southern Residents is outside of the action area. However, NMFS anticipates non-jeopardizing incidental take of SONCC coho salmon and Southern Residents. Included with the NMFS 2019 biological opinion is an incidental take statement with non-discretionary terms and conditions. NMFS also concluded that the Proposed Action Alternative is not likely to adversely affect green sturgeon, eulachon, or designated critical habitat for eulachon, thereby concluding informal consultation for those species.

USFWS also issued a biological opinion on March 29, 2019, concluding that the Proposed Action Alternative is not likely to jeopardize the continued existence of the Lost River sucker and shortnose sucker and is not likely to result in the destruction or adverse modification of critical habitat for Lost River sucker and shortnose sucker. However, USFWS does anticipate incidental take of Lost River sucker and shortnose sucker as well as adverse effects to their designated critical habitat. The Services' biological opinions were highly coordinated to ensure compatibility with the effects on the species in which each agency has jurisdiction.

5.3. Essential Fish Habitat

EFH is designated for commercially fished species under the Magnuson-Stevens Act. The Magnuson-Stevens Act requires federal fishery management plans, developed by NMFS and the Pacific Southwest Fisheries Management Council, to describe the habitat essential to the fish being managed and to describe threats to that habitat from both fishing and non-fishing activities. Pursuant to section 305(b) of the Magnuson-Stevens Act (16 U.S.C. 1855(b)), federal agencies are required to consult with NMFS on actions that may adversely affect EFH for species managed under the Pacific Coast Salmon Fishery Management Plan. This section also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

Reclamation conducted an EFH analysis which covered Chinook salmon and SONCC coho salmon and submitted the EFH Assessment to NMFS on March 8, 2019. On March 29, 2019, NMFS concluded that Reclamation's Proposed Action Alternative would adversely affect coho salmon and Chinook salmon EFH. The following EFH conservation recommendations that NMFS states would protect, by avoiding or minimizing the adverse effects described above, the mainstem Klamath River and tributaries designated as EFH for Pacific Coast salmon.

- Reclamation should maximize the benefits of opportunistic high flow releases to create habitat conditions conducive to salmonid fitness, and detrimental to the disease pathogen Ceratanova shasta. For example, to the extent practicable, Reclamation should implement deep flushing flow events described as Measure 2 in Hillemeier et al. (2017) Implementation of Guidance Measure 2 will also help reduce adverse effects of the proposed action to water quality.

- Reclamation should ensure that habitat restoration projects funded through the coho restoration grant program are designed and implemented consistent with techniques and minimization measures presented in California Department of Fish and Wildlife (CDFW) California Salmonid Stream Habitat Restoration Manual, Fourth Edition, Volume II (Part IX: Fish Passage Evaluation at Stream Crossings, Part XI: Riparian Habitat Restoration, and Part XII: Fish Passage Design and Implementation; referred to as the Restoration Manual) (Flosi et al. 2010). This will help ensure that any short-term adverse effects to the streambed and associated benthic organisms EFH are minimized.

Reclamation will review NMFS's EFH assessment response document and associated conservation recommendations. Consistent with the MSA, Reclamation will provide a detailed written response to NMFS's EFH conservation recommendations within 30 days of receipt of the recommendations (50 CFR S 600.920(k)(l)).

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Hoopa Valley Indian Tribe v. Bureau of Reclamation of the Department of the Interior of the U.S. et al., No. 3:2016cv04294, Document 161. Case: 16cv04294-WHO. Judge William H. Orrick. HOOPA VALLEY TRIBE, Plaintiff, v. U.S. BUREAU OF RECLAMATION, et al., Defendants, and KLAMATH WATER USERS ASSOCIATION, et al., Defendant Intervenors. UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION. Case No. 3:16cv04294-WHO (N.D. Cal. Mar. 24, 2017) (https://casetext.com/case/hoopa-valley-tribe-v-us-bureau-of reclamation).

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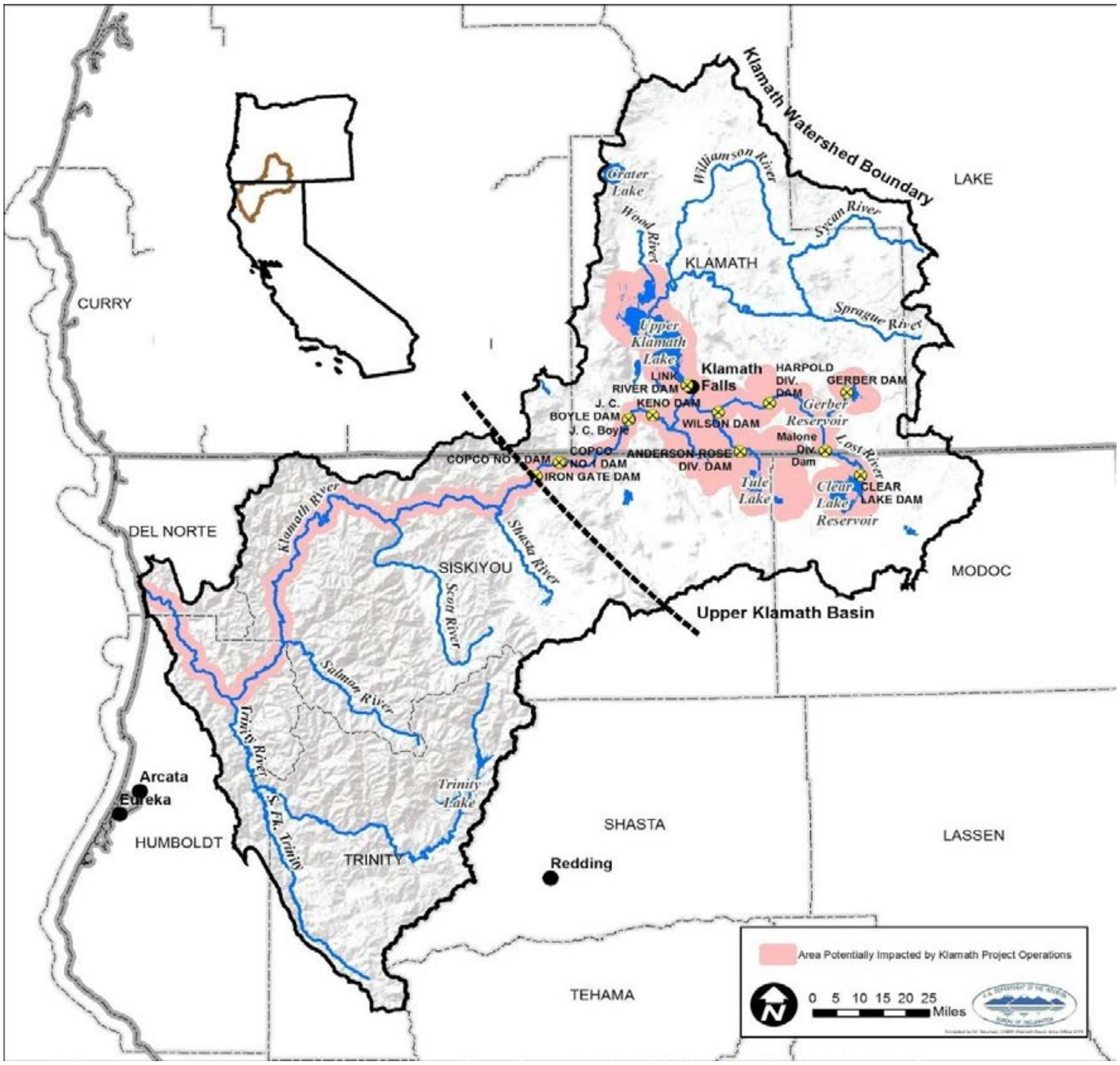
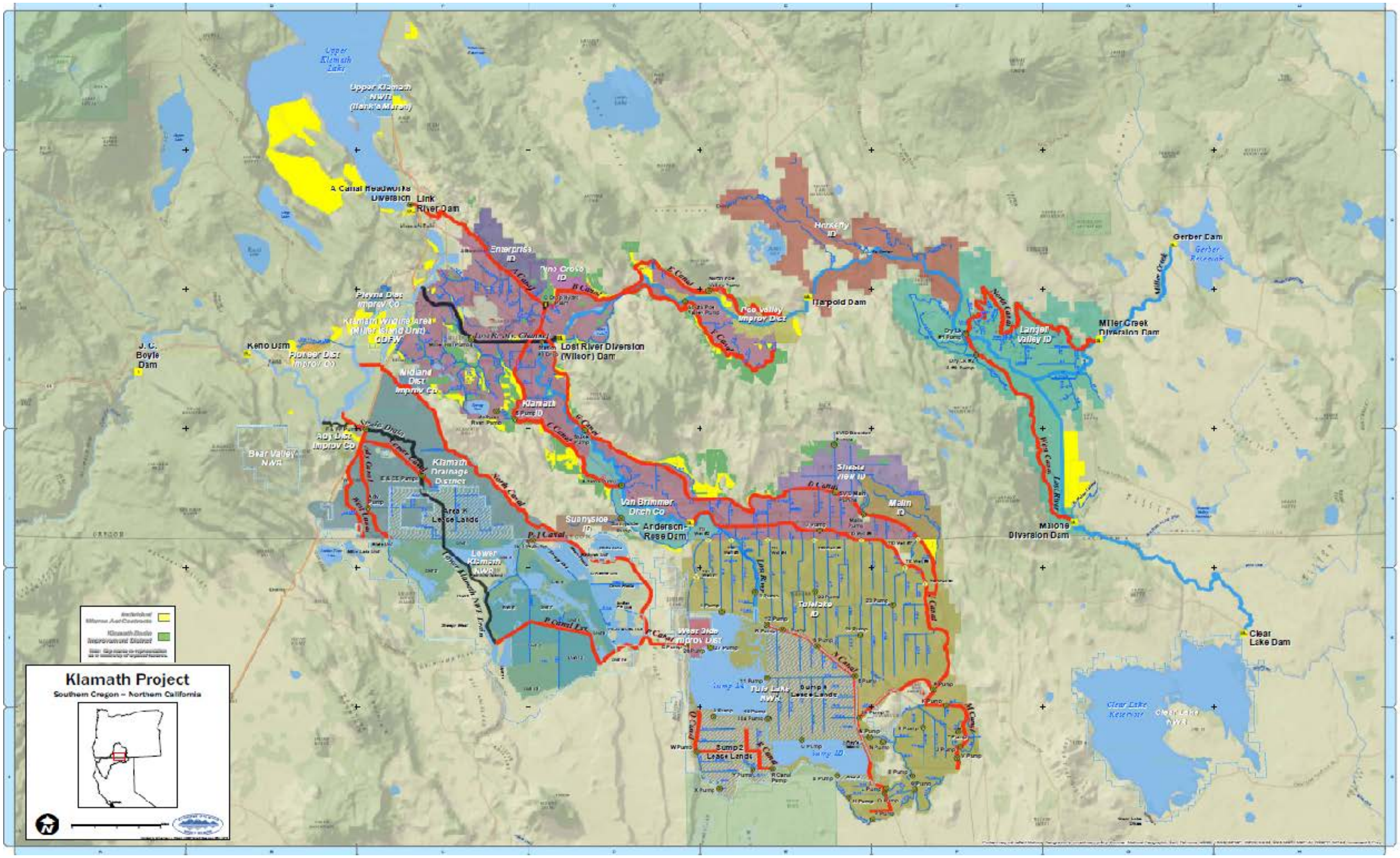
Appendices

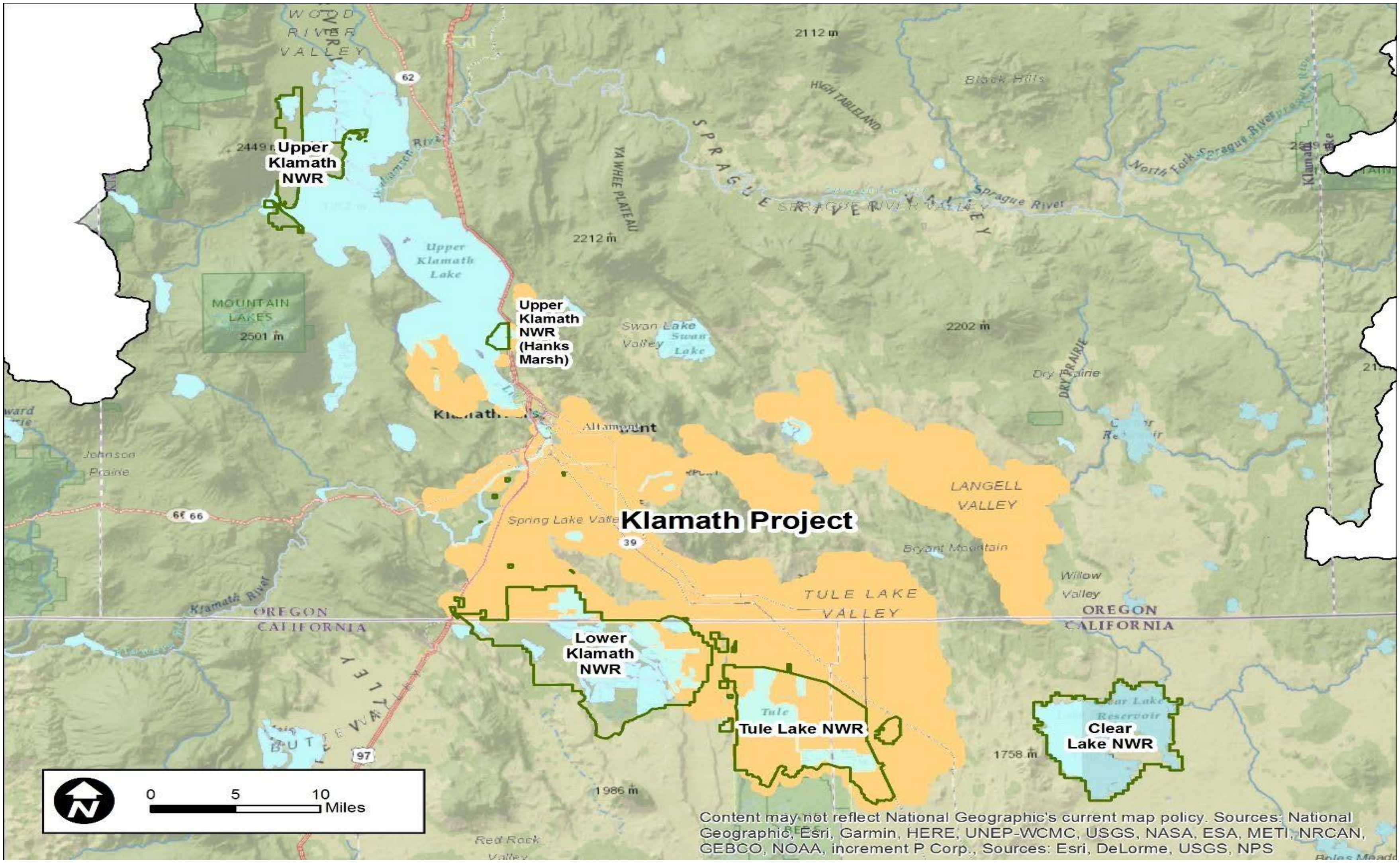
Appendix A - Maps of the Klamath River Basin, Klamath Project, and National Wildlife Refuges within the geographic scope of both alternatives.



Geographic scope of the No Action and Proposed Action alternatives, Klamath River Basin.
Source: Bureau of Reclamation, 201



The Bureau of Reclamation, Klamath Project
Source: Bureau of Reclamation, 2016



Four U.S. National Wildlife Refuges within the bounds of the Bureau of Reclamation's Klamath Project
Source: Reclamation 2018

Appendix B - Other Wildlife Species

Other species that may be present within the geographic scope of the EA.

Reptiles
Reptile species diversity and relative abundance is considered high (PacifiCorp 2004). The western fence lizard (*Sceloporus occidentalis*) is a highly abundant reptile species found in a variety of habitats in the area. Other reptile species include gopher snake (*Pituophis catenifer catenifer*), northern sagebrush lizard (*Sceloporus graciosus graciosus*), western rattlesnake (*Crotalus viridis*), southern alligator lizard (*Elgaria multicarinata*), western yellow-bellied racer (*Coluber constrictor mormon*), common garter snake (*Thamnophis sirtalis*), western terrestrial garter snake (*Thamnophis elegans*), western pond turtle (*Actinemys marmorata*), common king snake (*Lampropeltis getula*), striped whipsnake (*Masticophis taeniatus*), sharptail snake (*Contia tenuis*), ringneck snake (*Diadophis punctatus*), western skink (*Eumeces skiltonianus*), rubber boa (*Charina bottae*), and California mountain king snake (*Lampropeltis zonata*) (PacifiCorp 2004).

Mammals
In addition, many common mammals are found throughout the area, including black-tailed jackrabbit (*Lepus californicus*), mule deer (*Odocoileus hemionus*), and California ground squirrel (*Otospermophilus beecheyi*). Small mammals in the area include deer mouse (*Peromyscus*), bushy-tailed woodrat (*Neotoma cinerea*), least chipmunk (*Neotamias minimus*), several species of bats, and montane vole (*Microtus montanus*). Medium-sized mammals in the area include bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), yellow-bellied marmot (*Marmota flaviventris*), and coyote (*Canis latrans*). Large mammals such as deer (*Cervidae*), elk (*Cervus canadensis*), mountain lion (*Puma concolor*), and black bear (*Ursus americanus*) are also present. Five aquatic or riparian-associated fur-bearing mammals are present, including raccoon (*Procyon lotor*), beaver (*Castor*), muskrat (*Ondatra zibethicus*), mink (*Neovison vison*), and river otter (*Lontra canadensis*) (PacifiCorp 2004).

Birds
The Project area is along the Pacific Flyway, which supports the largest concentration of migratory waterfowl in North America, with many thousands of migratory birds during fall migration and about half that number in spring (Jarvis 2002). Waterfowl fall migration peaks in September and October, and spring migration peaks in March and April. After the final agricultural harvest of the season while fields remain unfarmed, they may be flooded to benefit waterfowl. These fields offer vital nesting habitat and feeding grounds for migrating waterfowl (USFWS 2013b). Large numbers of water-related birds also use the area for breeding (Shuford et al. 2004). The wetlands support large breeding colonies of American white pelicans (*Pelecanus erythrorhynchos*); double-crested cormorants (*Phalacrocorax auritus*); eared, Western, and Clark's grebes (*Phalacrocorax auritus*, *Aechmophorus occidentalis*, and *Aechmophorus clarkii*); great egret (*Ardea alba*); white-faced ibis (*Plegadis chihi*); ring-billed gull (*Larus delawarensis*); California gull (*Larus californicus*); and

Caspian, Forster's, and black terns (*Hydroprogne caspia, Sterna forsteri,* and *Chlidonias niger*) (Reclamation and CDFG 2012).

In addition, the area supports the largest wintering population of bald eagles (*Haliaeetus leucocephalus*) in the contiguous United States (Shuford et al. 2004). Eagles typically nest mid-January to mid-August (Reclamation and CDFG 2012). Riparian and wetland habitats support other migratory birds such as western wood pewee (*Contopus sordidulus*), song sparrow (*Melospiza melodia*), Brewer's blackbird (*Euphagus cyanocephalus*), yellow warbler (*Setophaga petechia*) (a California species of special concern), brown-headed cowbird (*Molothrus ater*), black-headed grosbeak (*Pheucticus melanocephalus*), and mourning dove (*Zenaida macroura*) (PacifiCorp 2004). Most nesting by migratory birds occurs between March 1 and August 31 (Reclamation and CDFG 2012).

Special-Status Terrestrial Species

Although numerous special-status species have the potential to occur in the project area because they have been sighted at similar habitats in the Lost River Subbasin, most the species listed below have been reported in the project area (USFWS 2013d, CNDDB 2014, ORBIC 2014):

- American white pelican – common in suitable habitat spring through fall; uncommon in winter.
- Bald eagle – abundant fall through spring; common in summer. The closest bald eagle nest is more than 6 miles from the nearest construction site.
- Bank swallow (*Riparia riparia*) – uncommon in summer; rare in spring and fall; not present in winter.
- Golden eagle (*Aquila chrysaetos*) – uncommon year-round.
- Gray wolf (*Canis lupus*) – infrequent; confirmed at LKNWR in 2012.
- Greater sandhill crane (*Grus canadensis tabida*) – common in spring and fall; uncommon in summer and winter.
- Purple martin (*Progne subis*) – very rare; breeds April through August.
- Swainson's hawk (*Buteo swainsoni*) – uncommon spring through fall; not present in winter.
- Western snowy plover (*Charadrius alexandrinus nivosus*) – very rare; breeds March through September.

Aquatic Species
Resident fish (both native and nonnative) in the project area include Klamath largescale sucker (*Catostomus snyderi*), bullhead, chubs, sunfish, perch, trout, and bass. Redband trout (*Oncorhynchus mykiss gairdnerii*) are present in Upper Klamath Lake and the Klamath River. Pacific lamprey (*Lampetra tridentata*) are present in the Klamath River downstream of Iron Gate Dam.

Amphibian Species
Amphibian species most likely to occur in the project area include long-toed salamander (*Ambystoma macrodactylum*), bullfrog (*Lithobates catesbeianus*), Pacific chorus frog (*Pseudacris regilla*), and western toad (*Anaxyrus boreas*). These species are generally restricted to ponds or other still-water habitats, except the western toad, which can breed in streams and standing water (Reclamation and CDFG 2012).

Appendix C - Cultural Resources

CULTURAL RESOURCES COMPLIANCE
Division of Environmental Affairs
Cultural Resources Branch (MP-153)

MP-153 Tracking Number: 19-KBAO-088

Project Name Implementation of Klamath Project Operating Procedures 2019-2024

NEPA Document: 2019-EA-007

NEPA Contact: Kirk Young, Natural Resource Specialist

MP 153 Cultural Resources Reviewer: Scott Williams, Archaeologist

Date: February 26, 2019

Reclamation is proposing to modify the water management approach for the Klamath Project outside of the range of historic operations. This is the type of undertaking that does not have the potential to cause effects to historic properties, should such properties be present, pursuant to the Title 54 U.S.C. § 306108, commonly known as Section 106 of the National Historic Preservation Act (NHPA) regulations codified at 36 CFR § 800.3(a)(1). Reclamation has no further obligations under NHPA Section 106, pursuant to 36 CFR § 800.3(a)(1).

In general, the Proposed Action defines how Project operations will be conducted, consistent with Reclamation's responsibilities and obligations, with an April 1 determination of available Project Supply. Implementation of the Proposed Action also defines how Reclamation will manage Upper Klamath Lake (UKL) elevations and Klamath River flows below Iron Gate Dam (IGD). Specific elements of the modified Proposed Action include 1) a reduced cap on Project Supply available from UKL, 2) use and accounting of natural and return flows, 3) inclusion of forced surface flushing flows in the Klamath River, and 4) the change in operating elevations of Tule Lake Sump 1A. The action will use existing structures and features; no construction or any ground disturbing activities are proposed. Any operation and maintenance (O&M) of Project facilities (e.g., maintenance, repair, and replacement of gates, conduits, pumps, trash racks, water measurement gages, boat ramps, canals, pipes, fish screens, etc.) needed to operate the Project will be identified and evaluated on a case-by-case basis and undergo evaluation by Reclamation to determine if additional compliance with NEPA and the National Historic Preservation Act is required prior to the activity(ies) being implemented.

Klamath River Management

Under the Proposed Action Alternative, the minimum amount of water for release to the Klamath River (referred to as the Environmental Water Account; EWA) is 400,000 acre-feet (AF0, increased from 320,000 AF in the No Action Alternative. Minimum EWA is 400,000 AF, which occurs when UKL Supply is less than 660,000 AF. When UKL Supply is greater than 1,035,000 AF, EWA is calculated as UKL Supply minus the maximum Project Supply (350,000 AF). In even years (e.g., 2020, 2022), EWA is further increased by 7,000 AF to cover releases for the Yurok Tribe's Ceremonial Boat Dance.

1

Appendix D - Analysis of Socioeconomic Impacts

Models

Two models were used to estimate potential impacts. The first is a farm budget application called KB_HEM, developed by Reclamation, to measure net farm income for the No Action and Proposed Action alternatives. For a complete description of KB_HEM see Reclamation 2011. The second modeling package used to assess the regional economic impacts resulting from the potential change in the on-farm gross crop revenue was IMPLAN (IMpact analysis for PLANning). IMPLAN is a commonly used, industry accepted economic input-output modeling system that estimates the effects of economic changes in a defined analysis area. MIG, Inc., developed the IMPLAN modeling system. This analysis leverages the analysis that was prepared for the 2011 Secretarial Determination of the Klamath Basin Restoration Agreement, thereby increasing the efficiency and lowering the costs of the analysis without significant impact to the results. That analysis used 2009 IMPLAN data for the counties which encompass the Study Area.

On-Farm Model Inputs

Water Allocation

Surface water on the Klamath Project is allocated according to the relative priority of each user's water delivery contract. Contracts are categorized as either A, B or C priority, where A-contracts are senior to B-contracts, which are senior to C-contracts. Under the A/B/C water type allocation, C-users are the first to experience a reduction in diversions. B-users are next in line to experience a reduction in diversions but only after all diversions to C-users have completely ceased. A-users are the last users to experience a reduction in diversions, and only after all diversions to B-users have ceased. Under the A/B/C allocation, A-contract holders receive 100 percent of historical irrigation supplies when project-wide irrigation supplies are estimated to be above 60 percent of historical irrigation supplies (Figure 3). C-contract holders, because there are so few of them, lose all their irrigation supplies under even minimal project-wide shortages. B-contract holders experience a reduction in irrigation supplies when project-wide supplies are between 95 percent and 65 percent of historical deliveries. Below 65 percent of project-wide historical deliveries B-contract users receive no irrigation diversions.

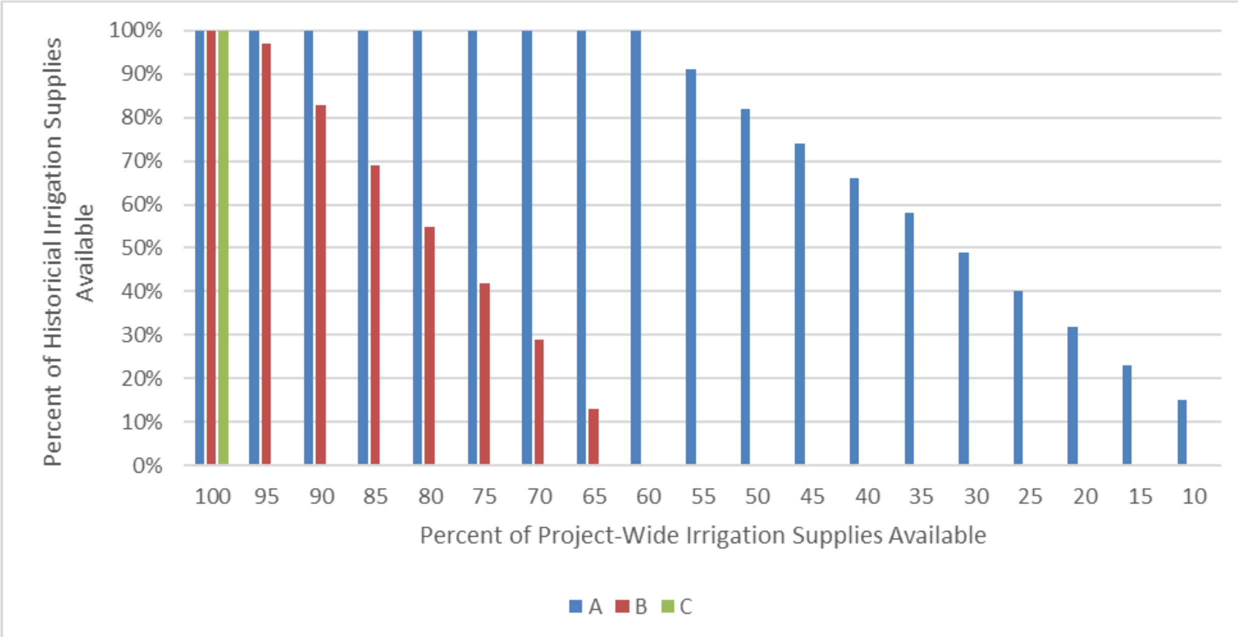


Figure 3. Percent of Irrigation Supply Available to A/B/C Water Users under Declining Estimates of Project-Wide Irrigation Supply Availability. Source: Reclamation 2018a. NOTE: There is no data for 2012.

Under the No Action Alternative, A-contract holders receive full water diversion in every year (Table 1), all shortages are absorbed by the B- and C-contract holders, occurring in 7 out of 35 years and ranging between a 3 percent reduction in supply to 100 percent of supply. Under the Proposed Action Alternative, the A-contract holders experience diversion shortages in three of the 36 years, 1992, 1994 and 2014 (Table 1). B-contract holders only receive 100 percent of full supply in 24 of the 35 years, in the remaining 11 years shortages range between three percent of historical diversion to 100 percent of historical diversions. C-contract holders experience 100 percent shortages in 11 of the 35 years.

Table 1. Irrigation Water Supply as a Percent of Historical Water Diversions, Study Area and by Water Contract Priority. Source: Reclamation 2018b. * NOTE: there is no data for 2012.

Year	No Action Alternative Irrigation Water Supply Available as a Percent of Historic Demand (%)	No Action Alternative Irrigation Water Supply Available to "A" Priority Water Contracts as a Percent of Historic Demand (%)	No Action Alternative Irrigation Water Supply Available to "B" Priority Water Contracts as a Percent of Historic Demand (%)	No Action Alternative Irrigation Water Supply Available to "C" Priority Water Contracts as a Percent of Historic Demand (%)	Proposed Action Alternative Irrigation Water Supply Available as a Percent of Historic Demand (%)	Proposed Action Alternative Irrigation Water Supply Available to "A" Priority Water Contracts as a Percent of Historic Demand (%)	Proposed Action Alternative Irrigation Water Supply Available to "B" Priority Water Contracts as a Percent of Historic Demand (%)	Proposed Action Alternative Irrigation Water Supply Available to "C" Priority Water Contracts as a Percent of Historic Demand (%)
1981	100%	100%	100%	100%	100%	100%	100%	100%
1982	100%	100%	100%	100%	100%	100%	100%	100%
1983	100%	100%	100%	100%	100%	100%	100%	100%
1984	100%	100%	100%	100%	100%	100%	100%	100%
1985	100%	100%	100%	100%	100%	100%	100%	100%
1986	100%	100%	100%	100%	100%	100%	100%	100%
1987	100%	100%	100%	100%	100%	100%	100%	100%
1988	100%	100%	100%	100%	93%	100%	78%	0%
1989	100%	100%	100%	100%	100%	100%	100%	100%
1990	100%	100%	100%	100%	92%	100%	73%	0%
1991	87%	100%	57%	0%	72%	100%	4%	0%
1992	62%	88%	0%	0%	3%	88%	0%	0%
1993	100%	100%	100%	100%	100%	100%	100%	100%
1994	73%	100%	5%	0%	30%	100%	0%	0%
1995	100%	100%	100%	100%	100%	100%	100%	100%
1996	100%	100%	100%	100%	100%	100%	100%	100%
1997	100%	100%	100%	100%	100%	100%	100%	100%
1998	100%	100%	100%	100%	100%	100%	100%	100%
1999	100%	100%	100%	100%	100%	100%	100%	100%
2000	100%	100%	100%	100%	100%	100%	100%	100%
2001	96%	100%	85%	0%	98%	100%	93%	0%
2002	100%	100%	100%	100%	98%	100%	95%	0%
2003	100%	100%	100%	100%	100%	100%	100%	100%
2004	100%	100%	100%	100%	96%	100%	88%	0%
2005	100%	100%	100%	100%	81%	100%	35%	0%
2006	100%	100%	100%	100%	100%	100%	100%	100%
2007	100%	100%	100%	100%	80%	100%	32%	0%
2008	100%	100%	100%	100%	97%	100%	89%	0%
2009	100%	100%	100%	100%	87%	100%	54%	0%
2010	95%	100%	81%	0%	87%	100%	54%	0%
2011*	100%	100%	100%	100%	100%	100%	100%	100%
2013*	100%	100%	100%	100%	100%	100%	100%	100%
2014	83%	100%	41%	0%	55%	100%	0%	0%
2015	89%	100%	61%	0%	94%	100%	80%	0%
2016	100%	100%	100%	100%	100%	100%	100%	100%
Average		100%	89%	80%		100%	79%	57%
Min		88%	0%	0%		88%	0%	0%
Max		100%	100%	100%		100%	100%	100%

Estimated Baseline Economic Contribution of the Project

Summary

The Klamath Project contributes an estimated $163.2 million annually to the regional economy assuming historical water diversions (Table 2), of which $122.9 million is gross on-farm revenue. An estimated 1,210 jobs are supported by this agricultural production generating over $40 million in labor income.

Table 2. Summary Economic Metrics under Historical Water Diversions, 2019 dollars. Source: Ecoresourcegroup

On-Farm Gross Revenue	Output	Total Output	Employment	Labor Income
($ millions)	($ millions)	($ millions)	(full and part-time jobs)	($ millions)
122.9	40.3	163.2	1,210	40.2

On-Farm Revenue Estimates (KB_HEM)

The on-farm gross revenue produced on 158.4 thousand acres in the study area and irrigated by the historical surface water diversions in estimated to be $122.9 million annually (Table 2 and 3). Potatoes make up 33 percent of the total revenue on just 8 percent of the acres. Alfalfa hay comprises the majority of the acres in production, 64.4 thousand acres or 41 percent of the land, and produces 30 percent of the revenue.

Table 3. Study Area On-farm Gross Receipts, Acres by Crop Types 2019 dollars in millions. Source: Ecoresourcegroup 2018.

Crop Type	On-Farm Revenue	Percent of Total Revenue	Acres in Production	Percent of Total Acres
	($ millions)	**(%)**	**(000s)**	**(%)**
Alfalfa Hay	36.9	30%	64.4	41%
Irrigated pasture	4.1	3%	26.7	17%
Other	27.9	23%	7.1	4%
Potato	40.1	33%	13.1	8%
Small Grain	5.9	5%	23.5	15%
Wheat	8.0	7%	23.7	15%
Grand Total	**122.9**	**100%**	**158.4**	**100%**

Crop prices and yield used as input in the KB_HEM model are shown in Table 4.

Table 4. Crop Price and Yield, 2019 dollars. Source: Siskiyou County Agriculture Commissioner's Crop Report, 2018. California County Agricultural Commissioner Reports., UC Cooperative Extension Crop Enterprise Budgets, multiple years.

	Alfalfa hay	Irrigated pasture	Potatoes	Other (Onions)	Small grains (oats)	Wheat
		Grazing				
	(per ton)	(aum/aa)	(per cwt)	(per cwt)	(per ton)	(per ton)
Yield	6.5	5	450	500	2.7	3.17
Price	$185	$15	$7.4	$7.92	$186	$142

Approximately 61 percent of the land in production is served with A-priority water service contracts (Table 5). B-priority water contracts comprise nearly the rest of the study area at 38 percent. C-priority contracts only serve approximately 1 percent of the study area acres. Land served by A-priority contracts generates 75 percent of the total study area revenue.

Table 5. Study Area On-farm Gross Receipts, Acres by Water Contract Type 2019 dollars in millions. Source: Ecoresourcegroup 2019.

Water Contract Priority	On-Farm Revenue	Percent of Total Revenue	Acres in Production	Percent of Total Acres
	($ millions)	(%)	(000s)	(%)
A	91.6	75%	94	61%
B	29.6	24%	59	38%
C	1.6	1%	6	1%
Grand Total	**122.9**	**100%**	**158.4**	**100%**

Socioeconomic Impact

Under the Proposed Action Alternative irrigation diversion shortages occur in 22 years of the 35-year POR, compared to historical deliveries. The diversion shortages are estimated to be mitigated in 7 of the 22 years by the growers' ability to substitute ground water. Comparing the Proposed Action Alternative to the No Action Alternative the frequency of irrigation water shortages increases by 22 percent, and the magnitude of the shortages is greater.

The two primary impacts comparing the difference of the No Action Alternative to historical and the difference of the Proposed Action Alternative to historical are:

- Growers cost of pumping additional groundwater would increase.
    - Under the No Action Alternative, compared to historical, an estimated total 770 TAF of groundwater would be sustainably withdrawn over the 35-year POR with a commensurate increase in the growers' cost of pumping of $10.2 million (annual average cost of $292.1 thousand over the POR and annual average cost of $567.9 thousand in the 18 years when pumping occurs).
    - Under the Proposed Action Alternative, compared to historical, an additional estimated total 171 TAF of groundwater would be sustainably withdrawn over the POR with a commensurate increase in growers' cost of pumping of $2.3 million to a total of $12.5 million (annual average cost of $356.9 thousand over the POR and annual average cost of $693.9 thousand in the 18 years when pumping occurs).

- Irrigation water shortages cause a reduction in regional economic output
    - Under the No Action Alternative, compared to historical, total regional output declines by $75.5 million over the 35-year POR, for an annual average decline of $2.2 million.

- Under the Proposed Action Alternative, compared to historical, total regional output declines an additional $187.8 million over the 35-year POR, for an increase in annual average decline in output of $5.4 million.

Groundwater Pumping Impacts

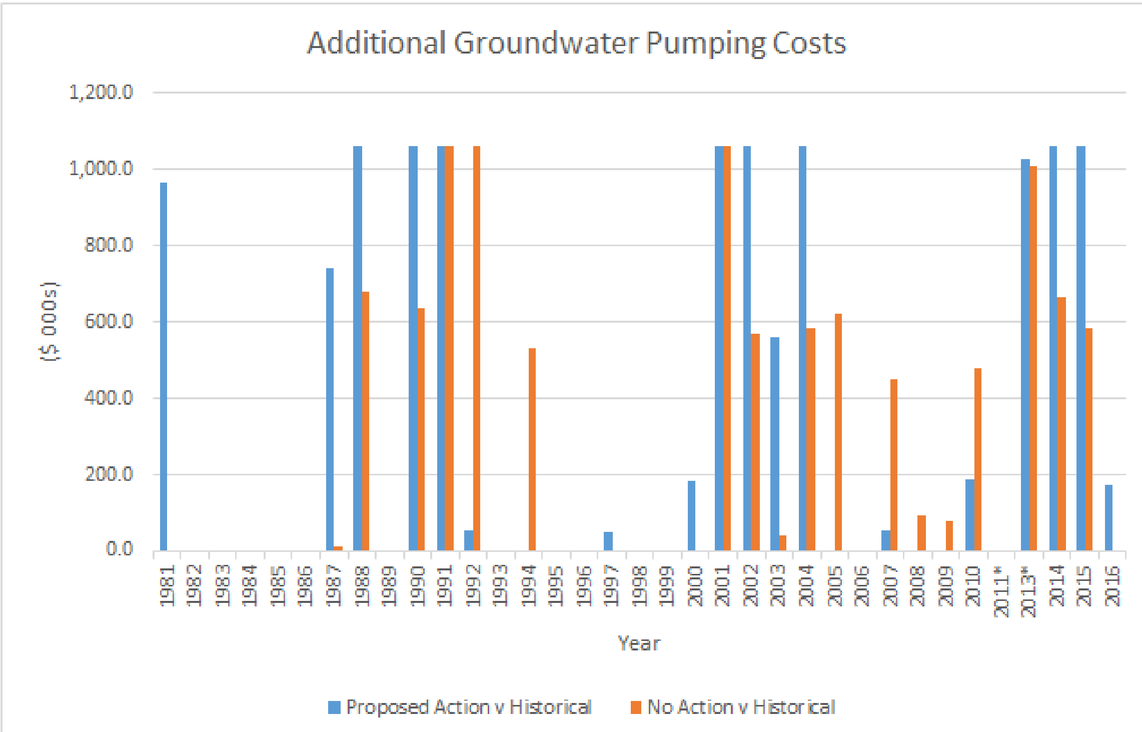


Figure 4. Estimated Annual Cost of Pumping Additional Groundwater. Source: Ecoresourcegroup.

Groundwater pumping is assumed to occur in half of the years in the POR (Figure 4). Under both the No Action Alternative and the Proposed Action Alternative annual groundwater pumping is limited by two constraints; 1) an 80 TAF maximum annual withdraw and 2) a 10-year rolling average annual withdrawal of 30 TAF. These constraints reduce the amount of groundwater available to use as a replacement for a shortage of surface water diversion. The additional annual cost of pumping needed to replace diversion shortages compared to historical amounts is estimated to range between $1.1 million to $0.2 million in years that groundwater is pumped. Over the course of the 35-years in the study total groundwater pumping volumes are 171 TAF higher under the Proposed Action Alternative compared to the No Action Alternative (Table 6), for additional total cost of $2.2 million.

The weighted average cost of groundwater pumping was estimated to be $13.27/acre foot pumped. This weighted average is based on the facts that “in Oregon, the primary OPUC-approved rate for Schedule 41 energy use is 9.6 cents per kilowatt-hour (¢/kWh) and in California, the CPUC-approved rate for Schedule PA-20 is 13.4 ¢/kWh” (Reclamation 2016). The cost of pumping water is based on the following equation: kWh/AF = 1.0241 * TDH /

OPE where: kWh/AF = kilowatt-hours required to pump an acre-foot of water through the irrigation system TDH = Total dynamic head required by the system in feet, assumed to be 60 feet OPE = Overall pumping plant efficiency as a decimal, assumed to be 60 percent. Two thirds of all pumping is assumed to occur in Oregon, where the majority of the B-contract holders are located.

Table 6. Annual Groundwater Pumping Costs. Source: ECO Resource Group.

Year	Estimated Groundwater Pumping Attempting to Alleviate Surface Water Diversion Shortage under the NAA (TAF)	Estimated Groundwater Pumping Attempting to Alleviate Surface Water Diversion Shortage under the PAA (TAF)	Difference in Differences (TAF)	Estimated Cost of Pumping under the NAA ($ millions)	Estimated Cost of Pumping under the PAA ($ millions)	Difference in Differences ($ millions)
1981	*0*	*72.8*	72.8	*0*	*1*	1
1982	*0*	*0*	0	*0*	*0*	0
1983	*0*	*0*	0	*0*	*0*	0
1984	*0*	*0*	0	*0*	*0*	0
1985	*0*	*0*	0	*0*	*0*	0
1986	*0*	*0*	0	*0*	*0*	0
1987	*1*	*55.7*	54.7	*0*	*0.7*	0.7
1988	*51*	*80*	29	*0.7*	*1.1*	0.4
1989	*0*	*0*	0	*0*	*0*	0
1990	*48*	*80*	32	*0.6*	*1.1*	0.4
1991	*80*	*80*	0	*1.1*	*1.1*	0
1992	*80*	*4*	-76	*1.1*	*0.1*	-1
1993	*0*	*0*	0	*0*	*0*	0
1994	*40*	*0*	-40	*0.5*	*0*	-0.5
1995	*0*	*0*	0	*0*	*0*	0
1996	*0*	*0*	0	*0*	*0*	0
1997	*0*	*3.8*	3.8	*0*	*0.1*	0.1
1998	*0*	*0*	0	*0*	*0*	0
1999	*0*	*0*	0	*0*	*0*	0
2000	*0*	*13.7*	13.7	*0*	*0.2*	0.2
2001	*80*	*80*	0	*1.1*	*1.1*	0
2002	*43*	*80*	37	*0.6*	*1.1*	0.5
2003	*3*	*42*	39	*0*	*0.6*	0.5
2004	*44*	*80*	36	*0.6*	*1.1*	0.5
2005	*47*	*0*	-47	*0.6*	*0*	-0.6
2006	*0*	*0*	0	*0*	*0*	0
2007	*34*	*4*	-30	*0.5*	*0.1*	-0.4
2008	*7*	*0*	-7	*0.1*	*0*	-0.1
2009	*6*	*0*	-6	*0.1*	*0*	-0.1
2010	*36*	*14*	-22	*0.5*	*0.2*	-0.3
2011*	*0*	*0*	0	*0*	*0*	0
2013*	*76*	*77.5*	1.5	*1*	*1*	0
2014	*50*	*80*	30	*0.7*	*1.1*	0.4
2015	*44*	*80*	36	*0.6*	*1.1*	0.5
2016	*0*	*13.2*	13.2	*0*	*0.2*	0.2

Regional Economic Impacts
The regional economic impacts are measured by estimating the difference between the Proposed and No Action alternatives (after each is estimated relative to historic demand). The difference in total estimated regional output is $187.8 million over the 35-year POR (Table 7). Under the Proposed Action Alternative there is an increase in the frequency and the magnitude of shortages when compared to historical (Figure 5). For example, under the Proposed Action Alternative the estimated loss in regional output in 1992 is approximately $63 million more than the estimated $36 million loss in regional output under the No Action Alternative. The magnitude of estimated output losses is greater in every water short year when comparing the differences in differences.

In addition to an increase in the magnitude of losses, the frequency of regional economic losses is also greater when comparing the Proposed Action Alternative differences to the No Action Alternative differences. For example, in the 5- year period from 2004 to 2009 there are no estimated losses when comparing the No Action Alternative to Historical, however when comparing the Proposed Action Alternative to Historical there are losses in regional output in all but one year (2006).

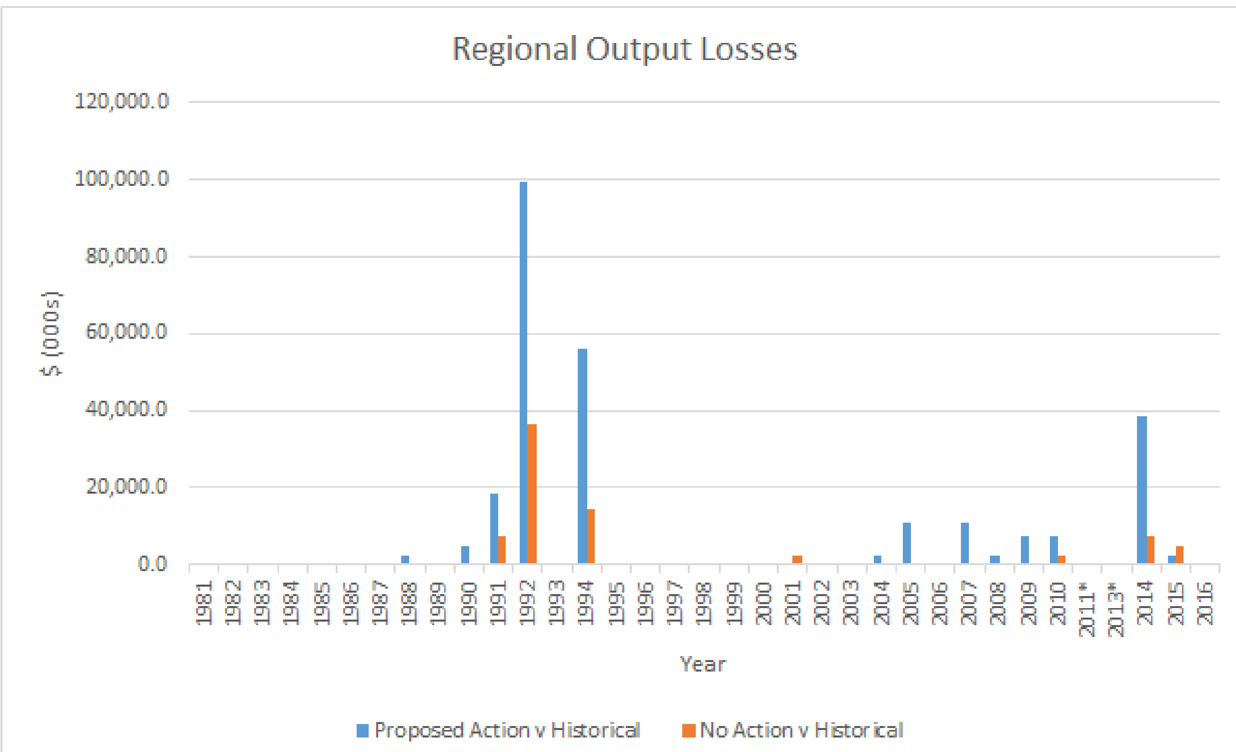


Figure 5. Estimated Annual Regional Economic Output Losses, Proposed Action versus No Action alternatives.
Source: Ecoresourcegroup

Table 7. Annual Estimated Regional Output Reductions. Source: Ecoresourcegroup.

Year	Irrigation Water Supply as a Percent of Historical Demand under the NAA (% Historic)	Irrigation Water Supply as a Percent of Historical Demand under the PAA (% Historic)	Difference in Differences (%)	Regional Output Reduction from Historical under the NAA ($ millions)	Regional Output Reduction from Historical under the PAA ($ millions)	Difference in Differences ($ millions)
1981	100%	100%	0%	0	0	0
1982	100%	100%	0%	0	0	0
1983	100%	100%	0%	0	0	0
1984	100%	100%	0%	0	0	0
1985	100%	100%	0%	0	0	0
1986	100%	100%	0%	0	0	0
1987	100%	100%	0%	0	0	0
1988	100%	93%	-7%	0	2.4	2.4
1989	100%	100%	0%	0	0	0
1990	100%	92%	-8%	0	4.8	4.8
1991	87%	72%	-15%	7.5	18.2	10.7
1992	62%	3%	-59%	36.5	99.5	63
1993	100%	100%	0%	0	0	0
1994	73%	30%	-42%	14.4	56.2	41.8
1995	100%	100%	0%	0	0	0
1996	100%	100%	0%	0	0	0
1997	100%	100%	0%	0	0	0
1998	100%	100%	0%	0	0	0
1999	100%	100%	0%	0	0	0
2000	100%	100%	0%	0	0	0
2001	96%	98%	2%	2.4	0	-2.4
2002	100%	98%	-2%	0	0	0
2003	100%	100%	0%	0	0	0
2004	100%	96%	-4%	0	2.4	2.4
2005	100%	81%	-19%	0	10.7	10.7
2006	100%	100%	0%	0	0	0
2007	100%	80%	-20%	0	10.7	10.7
2008	100%	97%	-3%	0	2.4	2.4
2009	100%	87%	-13%	0	7.5	7.5
2010	95%	87%	-8%	2.4	7.5	5.1
2011*	100%	100%	0%	0	0	0
2013*	100%	100%	0%	0	0	0
2014	83%	55%	-28%	7.5	38.7	31.2
2015	89%	94%	6%	4.8	2.4	-2.4
2016	100%	100%	0%	0	0	0
SUM	n/a	n/a	n/a	75.5	263.2	187.8
Average for all years	97%	91%	-5%	2.2	7.5	5.4
Average for all shortage years	n/a	n/a	n/a	10.8	20.2	13.4
MIN	62%	7%	-55%	0	0	0
MAX	100%	100%	0%	36.5	99.5	63
# Years of Shortage	7	15	8	7	13	14
% of years	20%	43%	23%	20%	37%	17%