United States Department of the Interior

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In Reply Refer To:
Ecosphere Project Code #
2022-0020519-S7-R002

Memorandum

To: Area Manager, Bureau of Reclamation, Klamath Basin Area Office
Klamath Falls, Oregon

From: Field Supervisor, Klamath Falls Fish and Wildlife Office
Klamath Falls, Oregon

JENNIE LAND

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Date: 2024.11.15 14:30:08 -08'00'

Subject: Concurrence and Biological Opinion for Klamath Project Operations from November 15, 2024, to October 31, 2029

This responds to the Bureau of Reclamation's (Reclamation) memorandum dated and received on June 14, 2024, requesting formal section 7 consultation and conference with the U.S. Fish and Wildlife Service (Service) pursuant to the requirements of section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), for the subject action. The Service's response to this request is based on the June 14, 2024, biological assessment (Assessment) accompanying Reclamation's letter, Reclamation's August 27, 2024, addendum to the Assessment, phone calls, meetings, email correspondence, and information in the Service's files. This memorandum includes the Service's concurrence statement and transmits the Service's biological opinion (Opinion) for Klamath Project Operations (Project) from November 15, 2024, to October 31, 2029.

The Project proposes to 1) store waters of the Upper Klamath Basin and Lost River, 2) operate the Project, or direct the operation of the Project, for the delivery of water for irrigation purposes, subject to water availability, while maintaining Upper Klamath Lake (UKL) and Klamath River hydrologic conditions that avoid jeopardizing the continued existence of listed species and adverse modification of designated critical habitat, and 3) perform operation and maintenance activities necessary to maintain Project facilities to ensure proper long-term function and operation.

The Assessment determined the proposed action would have "no effect" on multiple species and critical habitats including but not limited to: Applegate's milkvetch (*Astragalus applegatei*), gray wolf (*Canis lupus*), Greene's tuctoria (*Tuctoria greenei*), slender orcutt grass (*Orcuttia tenuis*), wolverine (*Gulo gulo*), and yellow-billed cuckoo (*Coccyzus americanus*), as well as designated critical habitat for Greene's tuctoria and slender orcutt grass (full list available in the Assessment, p. 10). The Service does not have the authority to provide concurrence for no effect determinations due to policy and the implementing regulations for section 7 of the Act. Therefore, these species and critical habitats will not be addressed further in this memorandum.

Reclamation determined the proposed action "may affect and is likely to adversely affect" the Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*), as well as their designated critical habitat, thus necessitating formal consultation. Reclamation also determined the proposed action "may affect, and is likely to adversely affect," northwestern pond turtle (*Actinemys marmorata*) and requested formal conferencing. The Service's Opinion regarding the potential effects of the proposed action on Lost River sucker, shortnose sucker, and their designated critical habitat, and Conference Opinion on northwestern pond turtles is attached. This Opinion supersedes the biological opinion on the Project provided on September 30, 2023.

Reclamation determined the proposed action 'may affect, but is not likely to adversely affect' bull trout (*Salvelinus confluentus*), bull trout critical habitat, Oregon spotted frog (OSF, *Rania pretiosa*), and OSF critical habitat. The Service's concurrence in consideration of the potential effects of the proposed action on bull trout, bull trout critical habitat, OSF and OSF critical habitat, is provided below.

<u>Effects to Bull Trout</u>
Bull trout populations within the coterminous United States were listed under the ESA as threatened on November 1, 1999 (USFWS 1999). The Klamath Recovery Unit consists of three core populations of bull trout designated as the UKL Core Area, the Sycan River Core Area, and the Sprague River Core Area (USFWS 2015). Agency Lake is a water body that comprises the Northern section of UKL and is connected to the main lake body via a narrow channel. Surface elevations of Agency Lake are therefore considered to be equivalent to those reported for UKL. However, only the area known as Agency Lake is designated critical habitat (USFWS 2010).

Two resident bull trout populations currently occupy streams that are tributaries to Agency Lake including Sun Creek and Threemile Creek. These two streams form the extant UKL Core Area populations of bull trout. Threemile Creek and Sun Creek have full volitional passage from their respective headwaters to Agency Lake for bull trout and other native salmonids. Threemile Creek connects to Crane Creek, which flows a short distance before meeting the intersection of the West Canal and Sevenmile Canal at the Northern border of the Agency-Barnes parcel. Sun Creek meets the Wood River less than a kilometer downstream from its headwater springs, which then continues into Agency Lake near the Northeastern border of the water body.

The Threemile Creek population (informally known as 'resident' bull trout) is particularly vulnerable to a catastrophic event because it is characterized as a small, isolated population. Brook trout and brown trout compete with bull trout for habitat, and in the case of brook trout can hybridize (Kanda et al. 2002). While these exclusions have allowed for redundant populations of bull trout in this core area, the occupancy of nonnative trout in downstream and neighboring habitat has limited expansion. Habitat below the confluence of Threemile Creek and Crane Creek have ongoing habitat restoration efforts (i.e., beaver dam analogs and channel reconstruction), but there are no recent accounts of bull trout presence. However, this is primarily due to lack of monitoring efforts and Crane Creek and Agency Lake is presumed occupied when water temperatures are conducive (between 2 and 15 degrees Celsius).

Accurate historical accounts of surface elevations of UKL are limited to 1905 to 1921 (Kann & Walker 2020). In this research, a historical minimum surface elevation of 4,138.7 feet is reported for UKL due to the basalt reef that existed where the Link River Dam was constructed, with lower levels also being reported in drought years (Kann & Walker 2020). The lowest anticipated water surface elevation modeled in the proposed action indicate an absolute minimum surface elevation at the end of September of approximately 4,137.2. Although this would result in a lower UKL, and therefore Agency Lake, minimum surface elevation than the historical minimum, these lower elevations would only occur when bull trout are not occupying Agency Lake due to naturally high water temperature. The seasonal use of Agency Lake by bull trout will mostly occur from November to early June, during which time the implementation of the proposed action via the storage of water will result in higher water elevations in Agency Lake. These higher surface elevations are expected to extend the seasonal availability of foraging and migration habitat to bull trout.

The seasonal variability of bull trout access to Agency Lake is a key aspect in its use as migratory habitat. Although water temperature might naturally exceed the thresholds for bull trout in the summer and early fall, these same temperatures contribute to the hyper-eutrophic conditions of Agency Lake. This ultimately creates a larger food base of macro-invertebrates and other small fish that migrant bull trout (greater than 240 mm total length) take advantage of, leading to faster growth rates. These nutrient rich systems are important factors leading to increased size and subsequent fecundity of migrating bull trout. By extending the number of days that surface elevations are maintained at a higher-than-baseline level, the proposed action has the beneficial effect of promoting the growth of migrating bull trout beyond the historical condition.

Effects to Bull Trout Critical Habitat

Bull trout critical habitat was designated in 2005 and revised in 2010 (USFWS 2010). Of the designated critical habitat within the Klamath Recovery Unit, only the habitat in UKL Core Area could potentially be affected by the proposed action. Critical habitat in this core area includes Agency Lake, the Wood River, Fort Creek, Crooked Creek, Cherry Creek, Sevenmile Creek, Sevenmile Canal, Threemile Creek, Crane Creek, Fourmile Creek, Sun Creek, Annie Creek, and the West Canal of the Agency-Barnes parcel (USFWS 2010). Of these water bodies, the proposed action will only have effects to Agency Lake via fluctuating water surface elevations. The Service determined that the physical and biological features (PBFs) essential to the conservation of bull trout are: 1) water quality, 2) migration habitat, 3) food availability, 4) instream habitat, 5) water temperature, 6) substrate characteristics, 7) stream flow, 8) water quantity, and 9) absence of non-native species (USFWS 2010). Agency Lake is bull trout designated critical habitat that is characterized as foraging and migrating habitat (USFWS 2010). This nutrient-rich habitat provides feeding grounds for this core population during fall, winter, and spring months that are not otherwise present within the habitat to which they are currently confined.

The benefits described for bull trout via the storage of water would also result in improvements to critical habitat, including increased access to migratory habitat (PBF2) leading to increase in abundant food base (PBF 3), extended days of conducive water temperatures (PBF 5) and greater surface water elevations (PBF 8) as a result of the proposed action.

In summary, the proposed action is not expected to result in negative effects to bull trout or bull trout critical habitat. The proposed action will result in 'wholly beneficial' effects to bull trout and bull trout critical habitat through maintenance of higher surface elevations of Agency Lake that extend access to foraging and migrating habitat. Based on the information provided in the Assessment and information in Service files, the Service concurs with Reclamation's determination that the proposed action 'may affect, but is not likely to adversely affect' bull trout and bull trout critical habitat.

Effects to Oregon Spotted Frog

The OSF was listed as threatened under the Endangered Species Act in 2014 (USFWS 2014). There are three known sub-basins with OSF populations within or near the project action area; UKL, the Williamson River, and the upper Klamath. At the time of listing, the minimum population estimate for the sub-basins were approximately 376 breeding individuals (male and female) based on 2011 and 2012 breeding data; approximately 374 based on 2011 breeding data; and 112 breeding individuals based on an egg mass count, respectively (USFWS 2014).

While there have not been consistently conducted breeding surveys since the 2014 listing, recent surveys from the four known OSF populations within the UKL sub-basin indicate that the minimum adult breeding population is higher than the 374 estimated at listing (USFWS 2022). Recent breeding surveys within the Upper Klamath sub-basin suggest a decline since listing with persistence at extremely low levels (Mean: 5, Range: 0 to 12; USFWS 2022). The only area with consistent breeding surveys since listing is the Jack Creek location, within the Williamson River sub-basin, with counts ranging since 2013 between 19 and 65.

Populations within the Upper Klamath and the Wood River sub-basins are outside of the project area and upstream of areas that could be impacted by changes in UKL and Agency Lake surface elevation or in Wood River flows. Under the proposed action, OSF populations within UKL sub-basin are at or behind levees that are higher than UKL surface elevations. However, project-related increases in river stages and decrease in currents could increase the amount and availability of OSF movement corridors and, if the river stage inundates adjacent depressions, increase the amount of seasonal non-breeding habitat. Although seasonal and temporary, increase of movement corridors and non-breeding habitat would result in wholly beneficial effects to OSF. Therefore, Service concurs with Reclamation's determination that the proposed action 'may affect, but is not likely to adversely affect' OSF.

Effects to Oregon Spotted Frog Critical Habitat

OSF critical habitat was designated in 2016 (USFWS 2016), with three occupied habitat units located within the Klamath Basin: the Williamson River Unit (Unit 12), UKL Unit (Unit 13), and the Upper Klamath Unit (Unit 14). Portions of all three critical habitat units are located within the action area. However, the designated critical habitat is not located within the Project footprint area. Unit 13 lies within close proximity to Agency Lake and includes multiple areas in the Wood River and Sevenmile Creek areas, portions of Crane and Fourmile Creeks, and associated wetted areas and springs. Unit 13 contains all of the essential OSF PBFs (PBF 1: Non-breeding,

breeding, rearing, and overwintering habitat; PBF 2: Aquatic Movement Corridors; and PBF 3: Refugia Habitat).

Implementation of the proposed action is expected to beneficially impact critical habitat Unit 13. Springtime Project water storage activities may increase surface elevations in UKL and Agency Lake, backing up lake waters and potentially increasing Wood River water stages and reducing currents. A seasonal increase in the amount of slower moving water will increase the amount and quality of wetted movement corridors (PBF 2). If river stages also inundate adjacent depressions, the amount of seasonal non-breeding habitat (PBF 1) will also increase. Any impacts to critical habitat are expected to be small, temporary, and beneficial. Additionally, the PBFs for OSF critical habitat are expected to continue to provide their intended recovery support function. Based on the information provided in the Assessment and information in Service files, the Service concurs with Reclamation's determination that the proposed action 'may affect, but is not likely to adversely affect' OSF critical habitat.

The Service appreciates Reclamation's coordination and collaboration throughout the development of the proposed action and consultation period. We look forward to providing appropriate technical assistance during Reclamation's implementation of the new proposed action to ensure optimized use of limited water supplies to protect and recover listed species and meet the needs of farms and Tribes. If you have any questions regarding the subject matter, please contact Jennie Land, Field Supervisor of the Klamath Falls Fish and Wildlife Office, at (541) 885-8481 or Margie Shaffer, Fish Biologist, at (541) 885-8481.

Attachment: Biological Opinion for Bureau of Reclamation's Klamath Project Operations Plan, effective November 15, 2024, through October 31, 2029; 2022-0020519-S7-R002

cc: w/ attachment
Jim Simondet, National Marine Fisheries Service, Northern California Office
Lisa Van Atta, National Marine Fisheries Service, California Coastal Office

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Biological Opinion on the Effects of the Proposed Klamath Project Operations Plan, Effective November 15, 2024, through October 31, 2029, on Federally Listed Threatened and Endangered Species

(Ecosphere Project Code # 2022-0020519-S7-R002)

November 15, 2024
U.S. Fish and Wildlife Service
Klamath Falls Fish and Wildlife Office
Klamath Falls, Oregon

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ABBREVIATIONS AND ACRONYMS

Abbreviation	**Definition**
ac	acres
ACFFOD	Amended and Corrected Findings of Fact and Order of Determination
ACT	Agency Coordination Team
AF	acre-feet
AFA	*Aphanizomenon flos-aquae*
Agency-Barnes	Agency and Barnes units of Upper Klamath National Wildlife Refuge
Assessment	Biological Assessment
° C	degrees Celsius
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
DDT	Dichlorodiphenyltrichloroethane
DO	dissolved oxygen
ESA	Endangered Species Act
EWA	Environmental Water Account
FASTA	Flow Account Scheduling Technical Advisory
° F	degrees Fahrenheit
FES	Fish Evaluation Station
FR	Federal Register
ft.	feet
ha	hectares
HCP	Habitat Conservation Plan
HID	Horsefly Irrigation District
IGD	Iron Gate Dam
in	Inches
ITS	Incidental Take Statement
KBAO	Klamath Basin Area Office
KBPM	Klamath Basin Planning Model
KDD	Klamath Drainage District
KID	Klamath Irrigation District
KLS	Klamath Largescale Sucker
KSD	Klamath Straits Dam
LKNWR	Lower Klamath National Wildlife Refuge
L	Liter
LOESS	locally estimated scatterplot smoothing
LRD	Link River Dam

Abbreviation	Definition
LRDC	Lost River Diversion Channel
LRS	Lost River sucker
LVID	Langell Valley Irrigation District
m	Meters
mg	Milligram
mm	Millimeters
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
ODEQ	Oregon Department of Environmental Quality
Opinion	Biological Opinion
OWRD	Oregon Water Resources Department
PA	Proposed Action
PBF	physical or biological features
PIT	Passive Integrated Transponder
POR	period of record
Reclamation	Bureau of Reclamation
RPM	reasonable and prudent measure
Service	U.S. Fish and Wildlife Service
SNS	shortnose sucker
SONCC	Southern Oregon/Northern California Coastal
SSA	species status assessment
SV	state variable
sec	seconds
TAF	thousand acre-feet
TID	Tulelake Irrigation District
TLNWR	Tule Lake National Wildlife Refuge
TMDL	Total Maximum Daily Load
UKL	Upper Klamath Lake
USBR	U.S. Bureau of Reclamation
USDI	U.S. Department of Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
WRIMS	Water Resources Integrated Modeling System
WY	Water Year

1 INTRODUCTION

This document provides the biological opinion (Opinion) of the U. S. Fish and Wildlife Service (Service) based on its review of the proposed operations of the Klamath Project (Project) by the Bureau of Reclamation (Reclamation) in Klamath County in Oregon, Siskiyou, and Modoc Counties in California (Figure 1). The federally listed species (hereafter referred to as listed species) and designated critical habitats considered in this document are the endangered Lost River sucker (*Deltistes luxatus*, LRS), the endangered shortnose sucker (*Chasmistes brevirostris*, SNS), and their designated critical habitats; the proposed threatened northwestern pond turtle (*Actinemys marmorata*, NWPT); and the candidate monarch butterfly (*Danaus plexippus*). Critical habitat has not been proposed or designated for northwestern pond turtles. Monarch critical habitat may be proposed, should the species be listed. Included in this Opinion is the Service's section 7 conference opinion for the actions described in the Assessment relative to their effects on the proposed threatened NWPT. If the proposed listing rule for NWPT is finalized without any substantive changes, this conference opinion will represent the Service's Opinion on the "may affect, likely to adversely affect" determination of the Project to NWPT. As such, additional section 7 consultation for NWPT for the proposed action will not be necessary unless reinitiation is triggered (see Section 13). Listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) are also present within the action area. The effects of the Project on those species are considered in a separate 2024 Opinion prepared by NMFS.

This document was prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. § 1531 et seq.) and implementing regulations. This Opinion supersedes the September 30, 2023, Opinion, which expires under its own terms on October 31, 2024. This Opinion analyzes the effects of continued Project operations as described in Reclamation's Proposed Action. This Opinion is based on information provided in Reclamation's Final Biological Assessment (USBR 2024) provided to the Service on June 14, 2024, as amended on August 27, 2024.

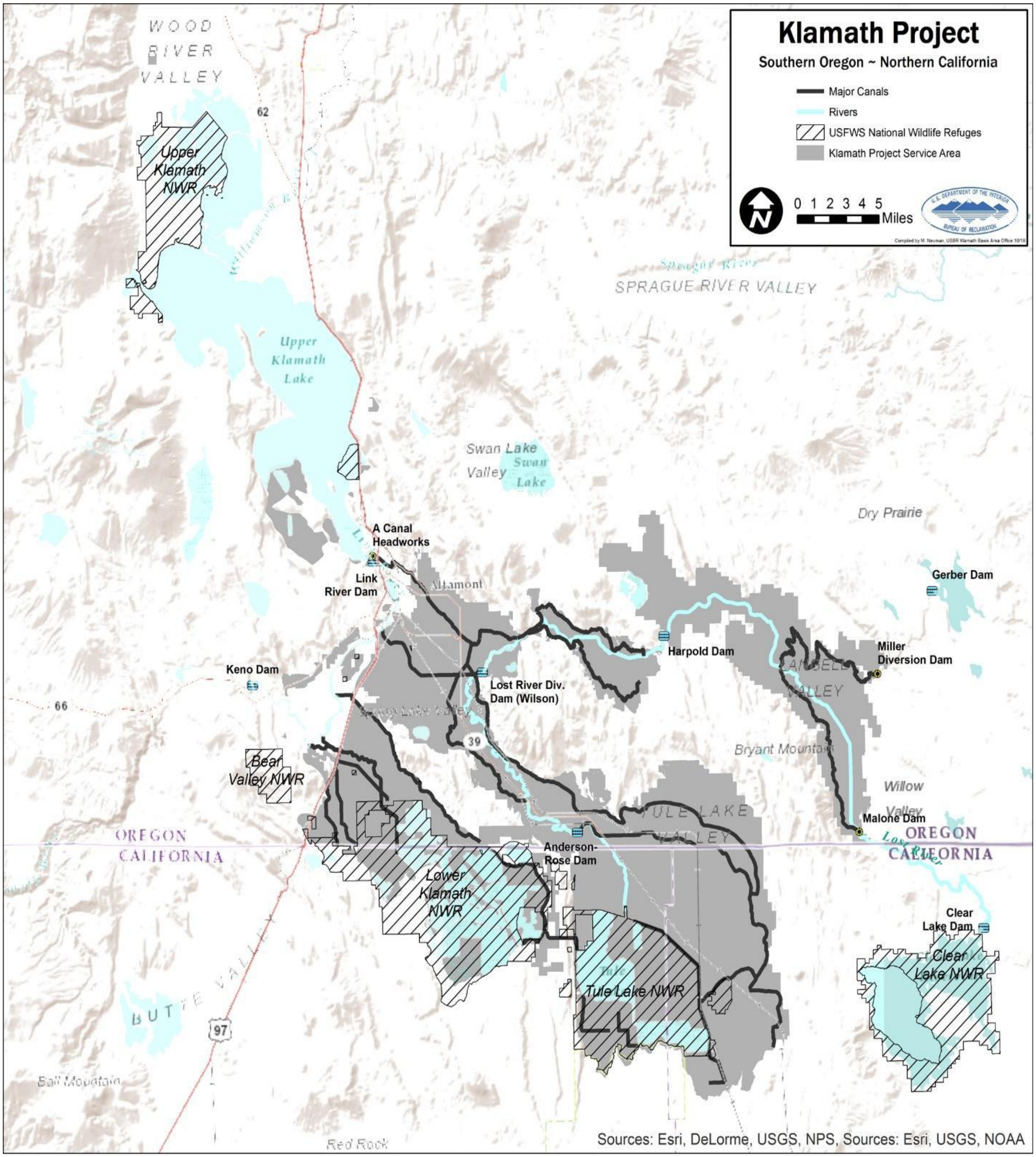


Figure 1. Location of the Project in the Upper Klamath River Basin of Oregon and California (USBR 2018a).

2 CONSULTATION HISTORY

Reclamation has completed a series of consultations on Project operations since the Service listed the Lost River and shortnose suckers as endangered on July 18, 1988. Reclamation formally reinitiated consultation with NMFS and the Service pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1531 et seq.) on the continued operation of the Klamath Project under a new Proposed Action (PA) on June 14, 2024. Reclamation's Klamath Reinitiation of Consultation (ROC) consists of analyzing Reclamation's PA to implement a new management approach that utilizes Keno Dam as a compliance point for river releases and the bathymetric changes of reconnecting the Agency and Barnes units of Upper Klamath National Wildlife Refuge (hereafter, Agency-Barnes) to Upper Klamath Lake (UKL). The PA allocates a water supply for Project irrigators, while addressing ESA requirements for listed species and/or designated critical habitat for a 5-year period.

Reclamation's PA represents a coordinated effort among Reclamation, the Service, and NMFS to develop a modified PA for ongoing Project operations. Reclamation assembled multiple teams to coordinate the different aspects of the development of the new PA, including the Management Team, the Agency Coordination Team (ACT), and the Technical Team. The teams consisted of federal resource managers including hydrologists, biologists, and managers from each agency and support staff that met numerous times starting in August of 2023, to address in the development of the new PA issues that had been identified in the implementation of the 2019 IOP. The Management Team and Agency Coordination Team (ACT) meetings ensured that stakeholders were actively involved in the consultation process and that comprehensive adaptive management plan was developed for the SNS, LRS, and SONCC coho salmon. The Technical Team focused on the development of the new PA hydrologic model, including experimental model runs, demonstrating the use of Keno Dam as a compliance point for river releases, applications of the wetness index tool for management, impacts to Upper Klamath Lake (UKL) of dedicated water allocations to the refuges and the new bathymetry and resulting changes to the net inflow calculations from the re-connecting Agency-Barnes to UKL. The new Keno Release Model (KRM) was introduced and demonstrated to the Management Team on November 8, 2023, with additional refinement, balancing, and additional model runs at the suggestion of team members.

A draft biological assessment (Assessment) was submitted to the Service for review on May 3, 2024. Recommendations from the review process were incorporated into the final Assessment, to the extent practicable. Reclamation submitted a request for consultation and the Final Biological Assessment on the Effects of the PA to Operate the Klamath Project from November 15, 2024, through October 31, 2029, to the Service and NMFS on June 14, 2024. Reclamation provided an addendum to the BA to the Service and NMFS on August 27, 2024, that included modifications to, and clarifications of, components of the conservation measures described and analyzed in the BA.

As part of their NEPA process for Klamath Project operations under the new PA, Reclamation released a draft Environmental Assessment (EA) for public comment on September 12, 2024. While the EA does not directly impact ESA consultation or this Opinion, it is important to note that the draft EA included new modeling as part of the No Action Alternative as well as some discrepancies in the description of the PA relative to what was provided to the Service. The Service is only evaluating and consulting upon the PA as presented in the Assessment transmitted on June 14, 2024, and the subsequent addendum from August 27, 2024.

3 DESCRIPTION OF THE PROPOSED ACTION

3.1 Project Location

The Project is located in the Klamath River watershed. The Project is in Klamath County in southern Oregon, and Siskiyou and Modoc Counties in northern California (Figure 1). The Project contains all Reclamation-administered facilities, including reservoirs, diversion channels and dams, canals, laterals, and drains, as well as all land, water, and facilities in or providing irrigation or drainage for the service area of the Project (230,000 acres of irrigable land). The action area of Project operations extends downstream from UKL to Keno Dam, which will be the new compliance point for Klamath River flows pursuant to the anticipated Opinion from NMFS following the removal of Iron Gate Dam (the previous compliance point for Klamath River flows was at Iron Gate Dam, which was removed in 2024).

3.2 Proposed Action

Reclamation stores, diverts, and conveys waters of the Klamath and Lost rivers to meet authorized Project purposes and contractual obligations in compliance with state and federal laws and carries out the activities necessary to maintain the Project and ensure its proper long-term functioning and operation. This PA is intended for a period of 5 years to allow monitoring and analysis of changes due to removal of PacifiCorp's four hydropower facilities on the Klamath River and reconnection of Agency-Barnes to UKL.

Reclamation's proposed Project operations span a period of 5 years November 15, 2024, through October 31, 2029, and consists of the following three major elements:

1) Store waters of the Upper Klamath Basin and Lost River
2) Operate the Project, or direct the operation of the Project, for the delivery of water for irrigation purposes, subject to water availability, while maintaining UKL and Klamath River hydrologic conditions that avoid jeopardizing the continued existence of listed species and adverse modification of designated critical habitat.
3) Perform O&M activities necessary to maintain Project facilities to ensure proper long-term function and operation.

Reclamation has managed UKL elevations and Klamath River flows at IGD in accordance with a series of Opinions from the Service and NMFS. For the 2018 Biological Assessment, Reclamation, in consultation with the Service and NMFS, used the Klamath Basin Planning Model (KBPM) to simulate operations of the Project for the 1981 through 2016 period of record (POR) of historical hydrology for development of the PA. For the current consultation effort, Reclamation has incorporated recent hydrologic data to expand the POR from 2016 through

2022 (WY's 1981 to 2022). Although the current Assessment simulates conditions since 1981, daily and monthly exceedances are computed using the 1991-2022 period. This 30-year period is more consistent with other climatological data, such as the National Weather Service normal, and acknowledges that decade-by-decade inflows have decreased (Figure 2). Extending the data set through 2022 captures the drought period that occurred during water years 2020-2022.

For this PA, Reclamation has made substantial improvements to the KBPM structure and has incorporated data updates and refinements, including: revised accretions and UKL inflow datasets, updated UKL net inflow estimates for the POR, and updated daily Project diversion data and return flows for the POR. Operational improvements include the year-round operational indices (NWI and UKL status) and two separate, year-round, water allocations for the Lower Klamath and Tule Lake National Wildlife Refuges.

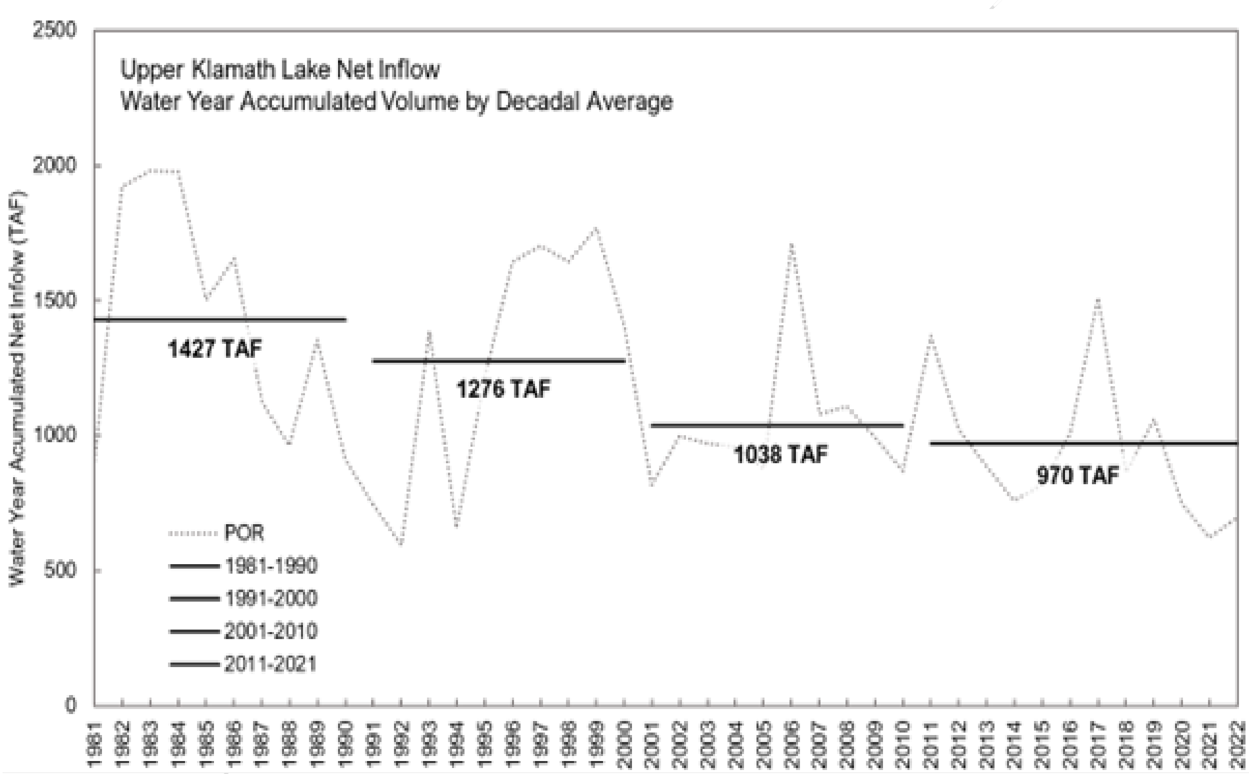


Figure 2. Decreasing trend in Upper Klamath Lake total annual net inflow since water year 1981 as indicated by decadal average (Reclamation 20024, p. 76).

3.2.1 Element One – Store Waters of the Upper Klamath Basin and Lost River

Reclamation operates three reservoirs for the purpose of storing water for delivery to the Project's service area: UKL, Clear Lake Reservoir, and Gerber Reservoir.

Updated bathymetric data compiled by Reclamation in 2023 for UKL (including nearshore areas such as Upper Klamath National Wildlife Refuge, and Tulana and Goose Bay farms), including the reconnected Agency-Barnes units, have a combined “active” storage volume of 645,627 AF between the elevations of 4,136.0 and 4,143.3 feet above sea level (Reclamation datum), which is the historical range of water surface elevations within which UKL has been operated.

Clear Lake Reservoir has an active storage capacity of 467,850 AF (between 4,521.0 and 4,543.0 feet above sea level, Reclamation datum). Of this, 139,250 AF is reserved for flood control between 4,537.4 and 4,543.0 ft.

Gerber Reservoir has an active storage capacity of 94,270 AF (between 4,780.0 and 4,835.4 feet above sea level, Reclamation datum). No storage capacity in Gerber Reservoir is reserved for flood control purposes.

Reclamation proposes to store water annually in UKL and Clear Lake and Gerber Reservoir with most inflow occurring from October through April. In some years of high net inflows or atypical inflow patterns (i.e., significant snowfall or other unusual hydrology in late spring/early summer), contributions to the total volume stored can also be significant in May and June. The majority of water deliveries occur during March through September, although storage releases for irrigation purposes occur year-round. Storing water through the winter and spring results in peak lake and reservoir storage between March and May. Flood control releases may occur at any time of year as public safety, operational, storage, and inflow conditions warrant.

The Project’s primary storage reservoir, UKL, is shallow with approximately 6 ft (1.8 m) of usable storage when at full pool (approximately 645,627 AF). Clear Lake and Gerber Reservoir also have a limited storage capability. Thus, UKL, Clear Lake, and Gerber Reservoir do not have the capacity to carry over significant amounts of stored water from one year to the next. UKL also has limited capacity to store higher than normal inflows during spring and winter months, because the levees surrounding parts of UKL are not adequately constructed or maintained for that purpose. Therefore, the amount of water stored in any given year is highly dependent on volume and timing of inflows in that year and, to a much lesser extent, preceding years. Because of this limited capacity in reservoirs, snowpack plays a large role in water supply within the Klamath Basin.

3.2.2 Element Two – Operation and Delivery of Water from Upper Klamath Lake and the Klamath River

3.2.2.1 General Description

The Project has two service areas: the east side and the west side. The east side of the Project includes lands served primarily by water from the Lost River and Clear Lake and Gerber Reservoirs. The west side of the Project includes lands that are served primarily by water from UKL and the Klamath River, although Reclamation has made occasional allocations of stored water from the east side of the Project for uses or offsets on the west side of the Project. The west side also may use other sources of water from the east side, such as winter runoff and return flows. Return flows are diverted water that was not entirely consumed by irrigation practices. This excess diversion water drains off agricultural lands into catchments and is recirculated or returned to other points of diversion for reuse. The Project was designed based on the re-use of a given volume of water several times. Therefore, water diverted from UKL and the Klamath River for use within the west side may be reused several times before it discharges back into the Klamath River via the Klamath Straits Drain. Return flows from water delivered from the reservoirs on the east side may also be reused several times.

3.2.2.2 Operation and Delivery of Water from Upper Klamath Lake

The portion of the Project served by UKL and the Klamath River consists of approximately 230,000 acres of irrigable land, including areas around UKL, along the Klamath River (from Lake Ewauna to Keno), Lower Klamath Lake, and from Klamath Falls to Tulelake. Most irrigation deliveries occur between April and October, although water is diverted year-round for irrigation use within certain areas of the Project.

Stored water and live flow in UKL are directly diverted from UKL via the A Canal and smaller, privately-owned diversions. Consistent with state water law and, as applicable to the Project, the term “live flow” encompasses surface water in natural waterways that has not otherwise been released from storage (i.e., “stored water”). Live flow can consist of tributary runoff, spring discharge, return flows, and water from other sources such as municipal or industrial discharges (USBR 2018d p. 63). The A Canal (1,150 cubic feet per second (cfs) capacity) and the connected secondary canals it discharges into (i.e., the B, C, D, E, F, and G canals) serve approximately 71,000 acres within the Project. In addition to the A Canal, there are about 8,000 acres around UKL that are irrigated by direct diversions from UKL under water supply contracts with Reclamation.

In addition to direct diversions from UKL, stored water and live flow is released from UKL through Link River Dam (LRD), for re-diversion from the Klamath River between Klamath Falls and the town of Keno. Water released from LRD flows into the Link River, a 1.5-mile river that discharges into Lake Ewauna, which is the upstream extent of the Klamath River. The approximately 16-mile section of the Klamath River between the outlet of Link River and Keno Dam is commonly referred to as the Keno Impoundment. Water elevations within the Keno Impoundment must be maintained within a relatively narrow range due to agreements with property owners whose lands were inundated by the construction of Keno Dam.

There are three primary points of diversion along the Keno Impoundment that are used to re-divert stored water and live flow released from UKL via the LRD. Approximately 3 miles below the outlet of Link River, water is diverted into the Lost River Diversion Channel (LRDC), where it can then be pumped or released for irrigation use. Pumping from the LRDC primarily occurs at the Miller Hill Pumping Plant (105 cfs capacity), which is used to supplement water in the C-4 Lateral for serving lands within Klamath Irrigation District (KID) that otherwise receive water through the A Canal. KID operates and maintains the Miller Hill Pumping Plant. Water re-diverted into the LRDC can also be released through Station 48 (650 cfs maximum capacity), where it is then discharged into the Lost River below the Lost River Diversion Dam for re-diversion and irrigation use downstream. Tulelake Irrigation District (TID) makes gate changes at Station 48 based on irrigation demands in the J Canal system, which serves approximately 62,000 acres within KID and TID. To the extent that live and return flows in the Lost River at

Anderson-Rose Dam and the headworks of the J Canal (810 cfs capacity) are insufficient to meet associated irrigation demands and maintain Tule Lake Sump elevations, water is released from Station 48 to augment the available supply. In addition to Miller Hill and Station 48, there are other smaller, privately-owned pumps along the LRDC that serve individual tracts within KID.

The other two primary points of diversion along the Keno Impoundment that re-divert stored water and live flow from UKL are the North and Ady canals (200 cfs and 400 cfs capacity, respectively), which are operated by Klamath Drainage District (KDD). In addition to lands within the boundaries of KDD, the Ady Canal also delivers water to the California portion of Lower Klamath National Wildlife Refuge. Together, the North and Ady canals deliver water to approximately 45,000 acres of irrigable lands in the Lower Klamath Lake area, including lands in KDD.

In addition to the lands served by the LRDC and Ady and North canals, Reclamation has entered into water supply contracts along the Keno Impoundment, including lands on the west side of the Klamath River and on Miller Island. Privately owned pumps are generally used to service these lands. These diversions require that the Keno Impoundment be operated within a narrow range of elevations. The area covered by Project contracts is approximately 4,340 acres, including lands within Plevna District Improvement Company (523 acres), Pioneer District Improvement Company (424 acres), Midland District Improvement Company (581 acres), and Ady District Improvement Company. Another 1,090 acres are covered under eight separate contracts, for lands currently within the Miller Island Refuge Area, managed by the Oregon Department of Fish and Wildlife (ODFW). The remaining lands (1,285 acres) irrigated as part of the Project are privately owned. Reclamation estimates annual irrigation diversions associated with these lands under contract (excluding LRDC and North and Ady canals) to be approximately 8,000-15,000 AF, with the maximum duty allowed under Oregon law being 15,185.5 AF.

Demands for irrigation supply and historical wetland habitat deliveries over the proposed lifetime of this PA are similar to those that have occurred in the 42-year POR for water years 1981 through 2022. However, continued improvements in irrigation infrastructure and equipment combined with advances in irrigation practices and technology may help to reduce Project irrigation demand in the future. The irrigation “demand” is the amount of water required to fully satisfy the irrigation needs of the Project. While these historical demands are retained for analysis and comparison purposes, irrigation deliveries to the Project within this PA were modeled within the KRM (USBR 2024). Modeled deliveries during this 42-year POR generally fall within the range of historical Project deliveries. In addition, the POR exhibits a large range of hydrologic and meteorological conditions, and the various modeled deliveries during this period are reasonably expected to include the range of conditions likely to occur during the proposed term of this Opinion.

3.2.2.3 Klamath River

With the removal of Iron Gate Dam, Keno Dam has now become the compliance point for river releases. Reclamation will operate Keno Dam in accordance with the daily flow values calculated within the KRM, ensuring that flows are at or above the minimum needed for ESA listed species in the river.

3.2.2.4 Tule Lake and Lower Klamath Lake National Wildlife Refuges and Dedicated National Wildlife Refuge Supply from Upper Klamath Lake

Project operations make water available for use in the national wildlife refuges, and water within the refuges is commonly used for both irrigation and wetland purposes. See Assessment Section 2.3.2., Project Water Rights, regarding the various water rights appurtenant to lands in Lower Klamath and Tule Lake National Wildlife Refuges (USBR 2024, p. 34). Operationally, Lower Klamath National Wildlife Refuge can receive Project water from UKL and the Klamath River, as well as water from the Tule Lake sumps, which is conveyed through Sheepy Ridge via the P-Canal Tunnel. Tule Lake National Wildlife Refuge can receive Project water from irrigation return flows, which are stored in the Tule Lake sumps; however, when irrigation demand is high, stored water from UKL (diverted at the Lost River Diversion Channel (LRDC) and released through Station 48) may be used to meet associated demands for historical wetland habitat. Tule Lake National Wildlife Refuge can also use water from natural flow in the Lost River. In some instances, stored water from Clear Lake Reservoir has been released to support irrigation operations within TID, including Tule Lake National Wildlife Refuge.

The Tule Lake and Lower Klamath National Wildlife Refuges are dependent on live flow in UKL and the Klamath River as well as the Lost River for water supply. Each irrigation season, 43,000 AF from UKL is dedicated to the National Wildlife Refuges when consistent with Oregon water rights for the purpose of keeping Lower Klamath National Wildlife Refuge Unit 2 and Tule Lake National Wildlife Refuge Sump 1A at specified surface water elevations to maintain habitat for endangered suckers at these locations. This volume can be delivered to the National Wildlife Refuges from April-October as required to overcome evaporative or other losses that may impact available habitat. The rate of cumulative delivery should not exceed the rate that would occur with uniform daily delivery of the dedicated supply from April-October.

As part of project operations, if the delivery of the dedicated refuge supply is below the maximum cumulative rate, the remaining volume of water is transferred to Deferred Project Supply to ensure Project operations are balanced. The Project gets credit for the undelivered water remaining in UKL so that UKL Status and targeted Klamath River flows are not affected. Whether this credit is delivered to the Project or to historical wetland habitat depends on coordination between the Service and Reclamation regarding other potential replacement water supplies to maintain Unit 2 and Sump 1A.

In addition to the 43,000 AF of dedicated water form UKL, project operations can make water available for use in the national wildlife refuges, and water within the refuges is commonly used for both irrigation and wetland purposes. Operationally, Lower Klamath National Wildlife Refuge can receive Project water from UKL and the Klamath River, as well as water from the Tule Lake sumps, which is conveyed through Sheepy Ridge via the P-Canal Tunnel. Tule Lake National Wildlife Refuge can receive Project water from irrigation return flows, which are stored in the Tule Lake sumps; however, when irrigation demand is high, stored water from UKL (diverted at the LRDC and released through Station 48) may be used to meet associated demands for historical wetland habitat. Tule Lake National Wildlife Refuge can also use water from natural flow in the Lost River. In some instances, stored water from Clear Lake Reservoir has been released to support irrigation operations within TID, including Tule Lake National Wildlife Refuge.

In the KRM, 21,000 AF of the 43,000 AF dedicated historical wetland habitat supply is reserved for Lower Klamath National Wildlife Refuge. The remaining 22,000 AF of supply is reserved for Tule Lake National Wildlife Refuge. The division of dedicated supply in real-time operations should be based solely on the immediate needs of the individual National Wildlife Refuges in meeting specified environmental thresholds. Figures 3 and 4 plot annual delivery to the Lower Klamath and Tule Lake National Wildlife Refuges, respectively.

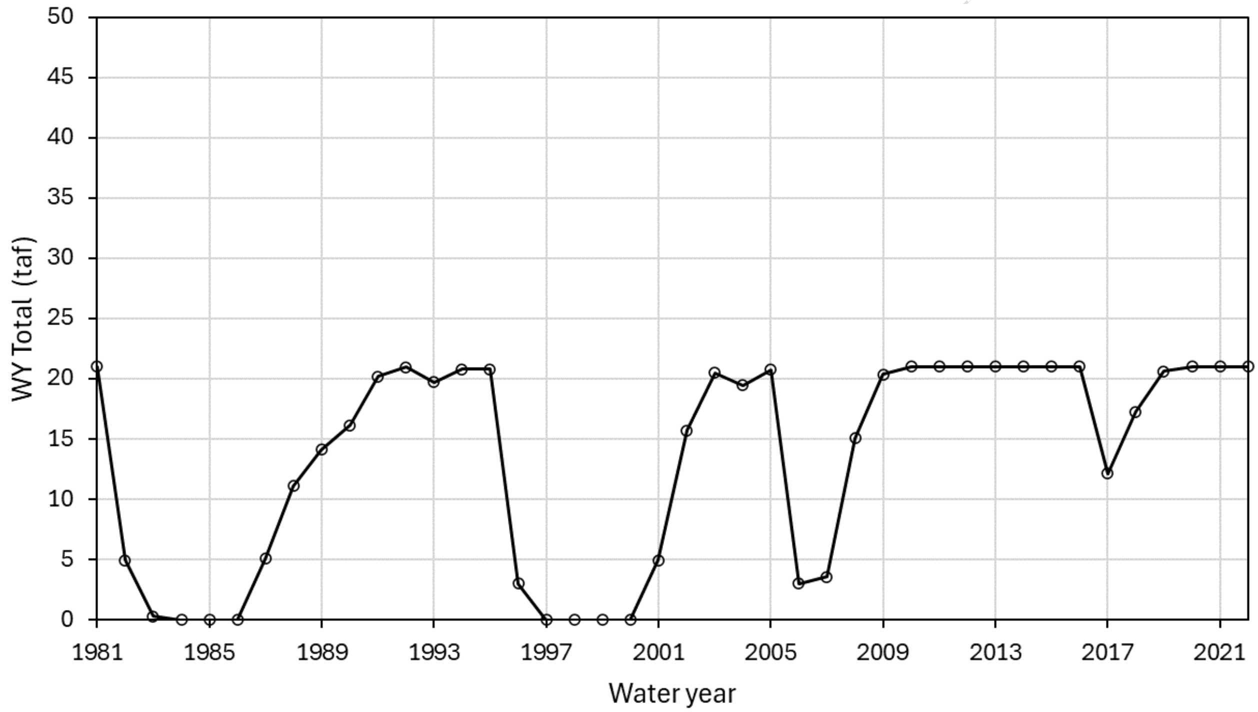


Figure 3. Delivery of dedicated Upper Klamath Lake historical wetland habitat supply to Lower Klamath National Wildlife Refuge in the Keno Release Model PA simulation, April – October through Ady Canal

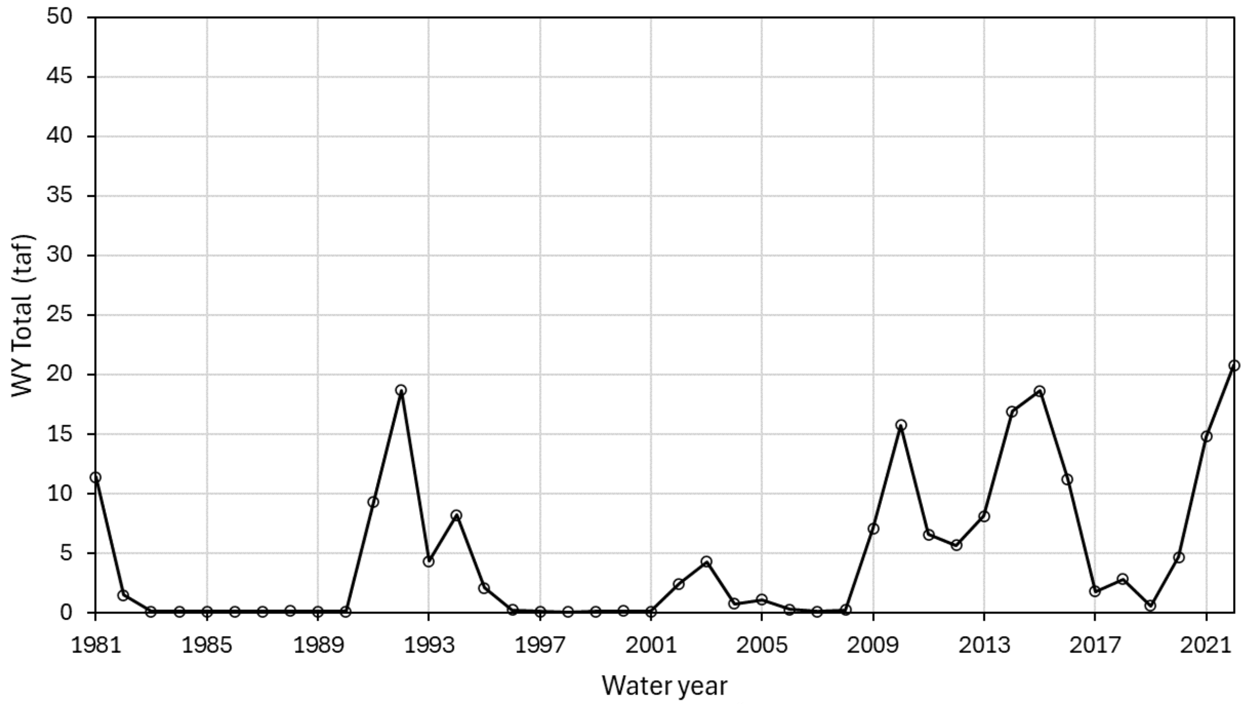


Figure 4. Delivery of dedicated Upper Klamath Lake historical wetland habitat supply to Tule Lake National Wildlife Refuge in the Keno Release Model PA simulation, April – October

Note the years that there is less than 21,000 AF of UKL supply delivered to Lower Klamath National Wildlife Refuge or less than 22,000 AF delivered to Tule Lake National Wildlife Refuge. These are years where all or a portion of the dedicated supply was credited to the Project because the Lower Klamath National Wildlife Refuge Unit 2 and Tule Lake National Wildlife Refuge Sump1A environmental thresholds were met using other water sources (i.e., Lost River, Deferred Project Supply, FFA Spill discussed below). Reclamation will coordinate closely with the Services and Project contractors to identify opportunities to use available water supplies in a manner that maximizes water availability for Project irrigation while also optimizing historical wetland habitat on National Wildlife Refuge lands and meeting obligations to listed species.

Lost River Refuge Supply

Throughout the year, water from the Lost River can be allowed to flow to the Tule Lake National Wildlife Refuge. This water may be used to replenish storage in Sump 1A, Sump 1B, and, during the winter, to pre-irrigate agricultural lands (called Sump 3 in the KRM) in the Tule Lake National Wildlife Refuge lease lands. Additionally, throughout the year, any Lost River water that is diverted into the LRDC, not re-diverted by irrigators, and not needed for UKL Deferred Project Supply can be diverted at Ady Canal and conveyed to the Lower Klamath National Wildlife Refuge.

Surplus Lost River water and TID irrigation drainage can be delivered to the Lower Klamath National Wildlife Refuge through D Plant. There is no specified schedule for D Plant pumping in the PA, but it is assumed that D Plant pumping will occur at the discretion of TID and the Service.

The KRM PA simulated Lost River water that flowed to the Tule Lake National Wildlife Refuge including D Plant is shown in Figure 5, and the KRM PA simulated Lost River water conveyed to the Lower Klamath National Wildlife Refuge by way of the LRDC and Ady Canal is shown in Figure 6.

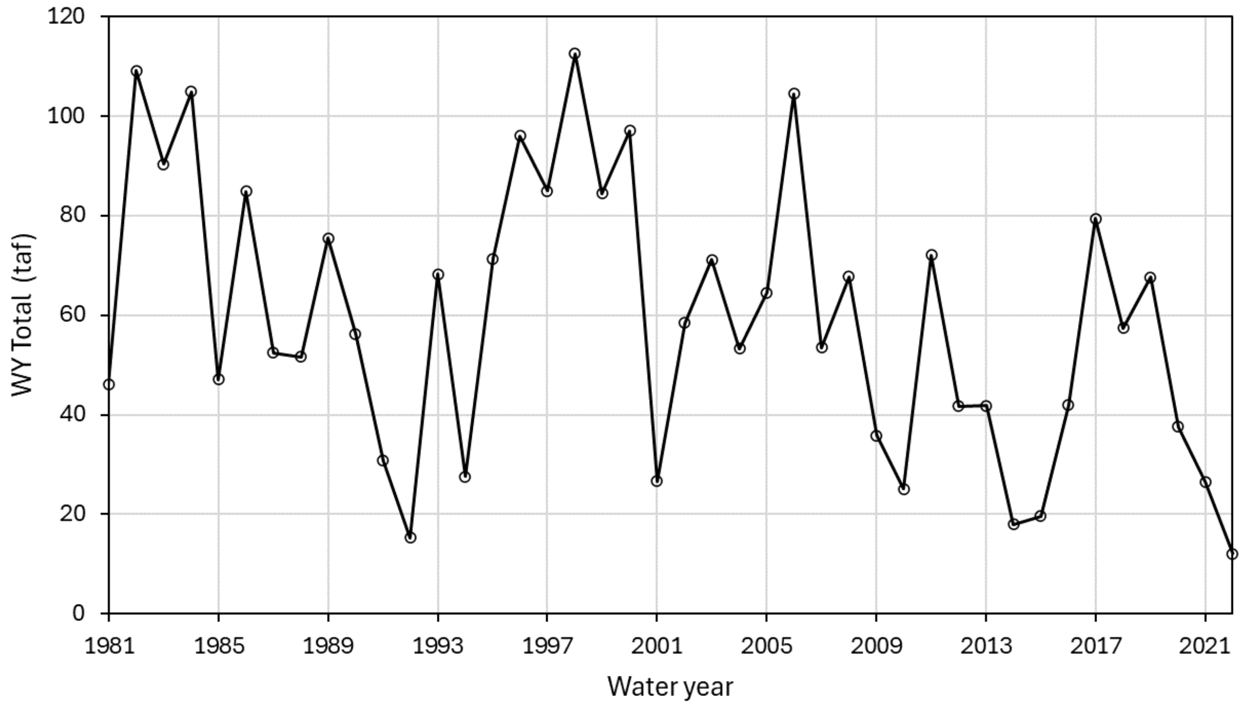


Figure 5. Lost River water flowing to Tule Lake sumps and, a fraction of the flow, through D Plant

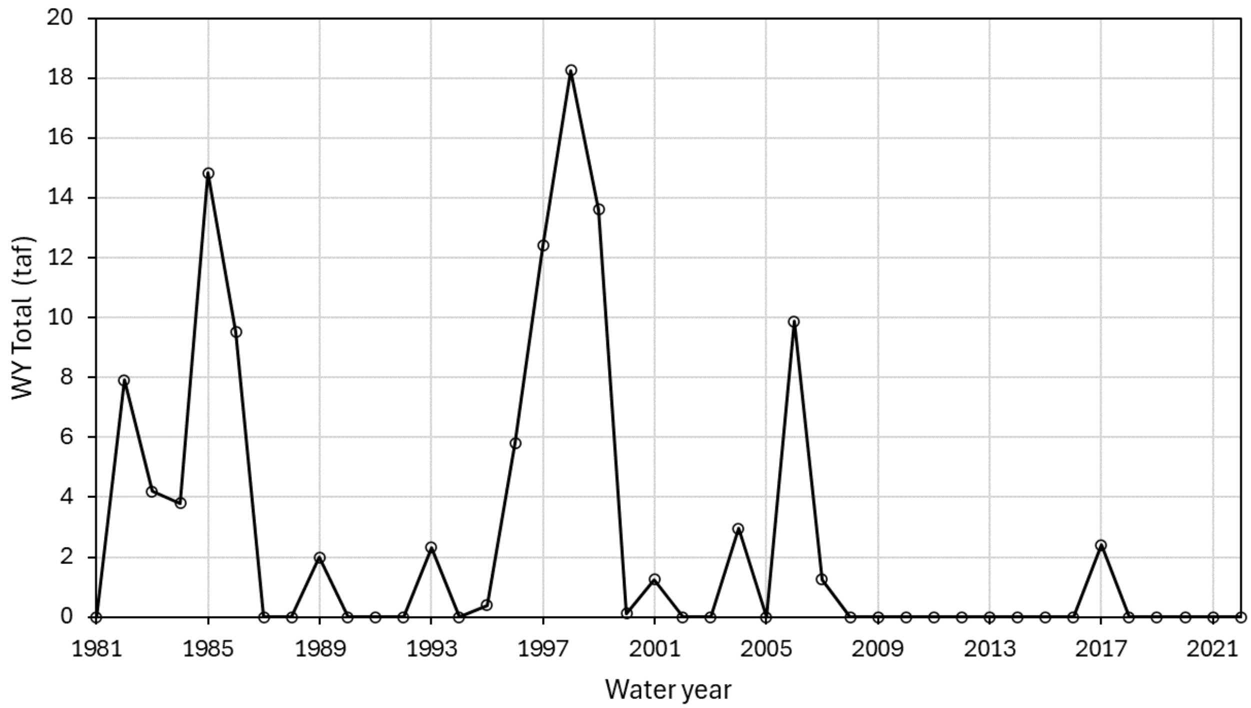


Figure 6. Lost River water flowing through the Lost River Diversion Channel and diverted at Ady Canal to the Lower Klamath National Wildlife Refuge

Flood Control Releases of Deferred Project Supply for Historical Wetland Habitat

If it is determined by Reclamation in coordination with water users that there is a high likelihood that Deferred Project Supply will have to be released for flood control, early release of Deferred Project Supply can be made from UKL for distribution to the Tule Lake and Lower Klamath National Wildlife Refuges. When UKL is in flood control and Deferred Project Supply is spilling, the spill can be diverted to the Tule Lake and Lower Klamath National Wildlife Refuges. Figure 7 shows Deferred Project Supply redistributed to the Tule Lake and Lower Klamath National Wildlife Refuges before and during UKL flood control operations in the KRM PA simulation.

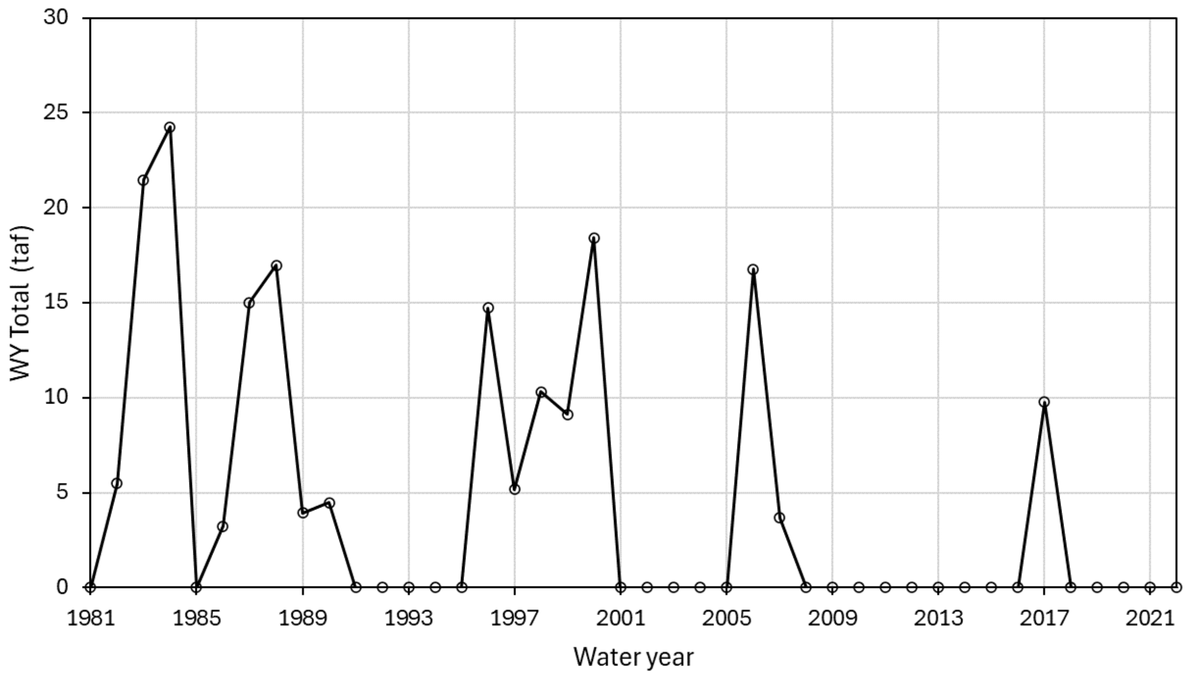


Figure 7. Flood control redistribution of Deferred Project Supply for Historical Wetland Habitat

Flexible Flow Account Spill and Lower Klamath National Wildlife Refuge Any spill of FFA due to flood control is not available for diversion by the refuge or irrigators. Spill of FFA must result in flow to the Klamath River at Keno. However, once FFA is exhausted, any UKL spill for flood control can be diverted at Ady Canal to the Lower Klamath National Wildlife Refuge in priority with other uses at that time. Figure 8 shows water year UKL spills captured at Ady Canal and delivered to the Lower Klamath National Wildlife Refuge as simulated in the KRM.

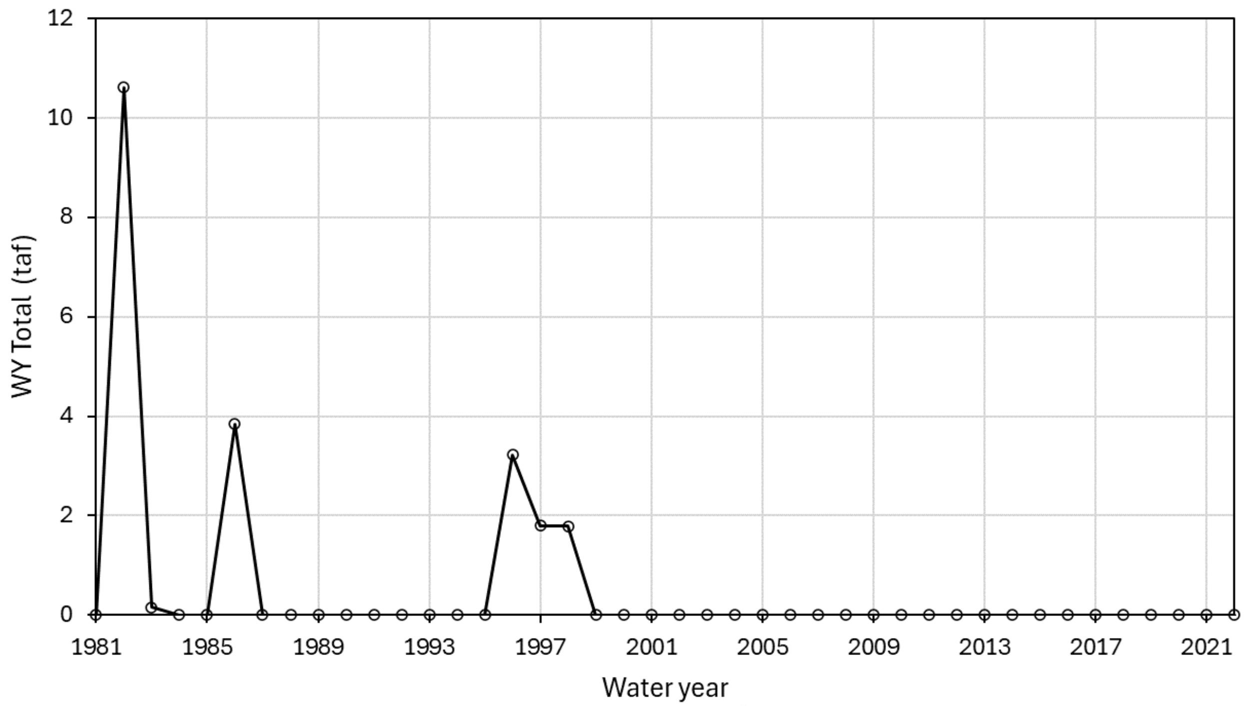


Figure 8. Lower Klamath National Wildlife Refuge capture of Upper Klamath Lake flood control releases after all Flexible Flow Account released to the Klamath River

3.2.2.5 Operation and Delivery of Water from the East Side of the Project

The east side of the Project consists of approximately 37,000 acres (ac) of irrigable land and reservoirs, dams, canals, laterals, drains, and pumping plants. The east side diverts water from Clear Lake and Gerber Reservoirs. Although the water year is October to September 30 of each year, delivery of water from the east side of the Project occurs primarily from mid-April through the end of September. East side Project features are shown in Figure 1.

Clear Lake and Gerber Reservoirs are used to store seasonal runoff to meet irrigation needs of the Project and to prevent flooding in and around Tule Lake. Stored water from Clear Lake and Gerber Reservoirs is generally used for irrigation purposes within Langell Valley Irrigation District (LVID), Horsefly Irrigation District (HID), lands covered by individual contracts; and, depending on the hydrology, supplied to KID and TID (USBR 2024, Appendix C, p. C-39). Reclamation will continue to operate Clear Lake and Gerber Reservoirs in the same manner as described in the previous biological assessment (USBR 2018, pp. section 4, 34-37) with no change to the water supply calculations, timing of releases, releases rates, minimum elevation(s), and maintenance work (B. Philips, USBR, Personal Communication Oct 7, 2024).

Stored water released from Clear Lake Reservoir is generally diverted at Malone Diversion Dam into either the West Canal or East Malone lateral. The East Malone Lateral serves approximately 1,800 acres on the east side of the Lost River. The West Canal serves approximately 6,750 acres within LVID. The West Canal also has a spill structure at its terminus, so that water can be discharged into the Lost River for re-diversion and use within HID. Stored water from Clear

Lake Reservoir can also be released through the spillway gates on Malone Diversion Dam, for use within LVID, HID, KID, and TID.

Stored water from Gerber Reservoir is generally diverted at Miller Creek Diversion Dam into the North Canal, for irrigation use within LVID. The North Canal serves approximately 9,550 acres within LVID.

Stored water from Clear Lake and Gerber Reservoirs, live flow in the Lost River is typically used for irrigation. The live flow from the Lost River generally consists of natural accretions and tributary runoff, particularly discharges from the Bonanza Big Springs, as well as return flows from irrigation. Depending on hydrology, Reclamation may divert some live flow into one or both National Wildlife Refuges as mentioned in previously and modeled in the KRM (USBR 2024 Appendix C, p. C-39). In addition to irrigation deliveries, Reclamation makes flood control releases from Clear Lake and Gerber Reservoirs, when conditions necessitate.

The POR for hydrologic data for this Assessment as it relates to the east side of the Project is water years 1903 through 2023 for Clear Lake Reservoir, and water years 1925 through 2023 for Gerber Reservoir. The POR includes a broad range of hydrologic conditions that likely encompasses the range of future conditions that may occur during the term of this Opinion. The POR for irrigation operations with reliable data is considerably shorter for each body of water, encompassing water years 1986 through 2023 for both Clear Lake Reservoir and Gerber Reservoir, with constant electronic monitoring of water surface elevations beginning in 1999 for both reservoirs. Reclamation proposed to operate the east side of the Project as described below.

<u>Clear Lake Reservoir Operations</u>

Reclamation proposes to operate Clear Lake Reservoir, alongside Gerber reservoir, to meet the full irrigation demand of the east side of the Project (70,000 AF) when that volume is available, while maintaining the end of September minimum elevation.

Under the PA, Clear Lake Reservoir will provide a range of water supplies consistent with historical operations necessary to meet demand throughout the duration of this Opinion. Historical operations show annual releases vary based on the available water supply and irrigation demand, with an average release of approximately 35,000 AF. This is based on the POR for which adequate data is available (1986-2023). Historical releases from Clear Lake Reservoir have ranged from zero AF, when no irrigation water supply was available, to more than 115,000 AF when flood control operations occurred. The delivery period for irrigation purposes is typically from April 15 – September 30 of each year. Changes in releases during the irrigation season are largely dictated by irrigation demand throughout the spring/summer period. The outlet at Clear Lake Dam is generally opened on April 15 and closed by October 1, although slight deviations have occurred in the POR. The typical release rate during irrigation season is approximately 120 cfs, with a typical maximum irrigation release of approximately 170 cfs. Releases can be greater during flood control operations and when irrigation demand is high.

Available water supply from Clear Lake Reservoir is estimated annually using a seasonal forecasting model that is currently in use by Reclamation and can be provided to all stakeholders (B Philips, USBR, personal communication Oct. 7, 2024). The forecasting model allows Reclamation to estimate available water supplies and provide insight on appropriate deliveries that will provide elevations greater than the end of September minimum reservoir elevation (4,520.6 ft.), while taking into account projected inflows, typical delivery patterns, seeps, and evaporation. Changes in releases during the irrigation season are largely dictated by irrigation demand throughout the spring and summer period.

Gerber Reservoir Operations

Under the PA, Gerber Reservoir will provide a range of water supplies consistent with historical operations that are necessary to meet irrigation demand throughout the period covered by this Opinion. Reclamation proposes to operate Gerber Reservoir to meet the irrigation demand of the east side of the Project, while maintaining the end of September minimum elevation of 4,798.1ft (Bureau of Reclamation Datum). Historical annual releases vary based on available water supply and demand, with an average of approximately 35,000 AF, based on the POR for which adequate data is available (1986 through 2023). Historical releases from Gerber Reservoir have ranged from approximately 1,000 AF, when little irrigation water supply was available, to almost 95,000 AF when flood control operations occurred. Water supply for irrigation purposes is generally used from April 15 to September 30 each year. The typical release rate during irrigation season is approximately 120 cfs with a typical maximum irrigation release of approximately 170 cfs. Releases can be greater during flood control operations and when irrigation demand is high. Some releases have also historically occurred during the months of November through March, primary for flood control.

Historically, approximately 2 cfs is by passed and released into Miller Creek during the winter months to prevent a valve in the dam from freezing and improve conditions for ESA-listed suckers that may be present in pools below the dam when irrigation deliveries are not occurring. This bypass has typically occurred in late October and early November until the beginning of the following irrigation season, although it has occurred as early as July. Reclamation intends to continue the 2 cfs bypass from Gerber Reservoir as part of operations in this PA. In the event of a mid-irrigation season shut off (as occurred in 2015), or concerns about meeting minimum lake elevations, Reclamation will coordinate with the Service on whether or not opening the frost valves is warranted.

Available water supply for Gerber Reservoir is estimated annually with a seasonal forecasting model. The model allows Reclamation to estimate available water supplies and provide appropriate deliveries that will provide elevations greater than the established end of September minimum lake elevation while taking into account projected inflows, typical delivery patterns, seepage, and evaporation. Changes in releases during the irrigation season are largely dictated by irrigation demand throughout the spring and summer period.

Diversions of Live Flow from the Lost River

During the irrigation season, live flow from the Lost River diverted into the LRDC (in addition to any direct storage releases from Clear Lake or Gerber reservoirs) and is re-diverted for irrigation purposes prior to reaching the Klamath River (at Station 48, the Miller Hill Pumping Plant, or the various private pumps that exist along the LRDC). Typically, there is always some water from the Lost River flowing into the LRDC, although during the spring/summer irrigation season, water from this source is relatively small compared to the amount coming from the west side of the project.

To ensure that HID, Poe Valley Improvement District, and individual landowners have access to water, HID operates Harpold Dam and other small dams within the Lost River to ensure upstream water levels are sufficient for pumping facilities to operate. Whereas LVID primarily relies upon gravity diversions of stored water. Similar private dams and other structures, including private pumps, exist in the Lost River downstream of Harpold Dam. The operations and maintenance of these structures is handled by their respective owners and is coordinated with Reclamation.

During high flow events, the entire capacity of the LRDC (approximately 3,000 cfs) can be used for diverting water from the Lost River to the Klamath River for flood control purposes. Any water in the Lost River in excess of LRDC capacity must be released through Lost River Diversion Dam and into the Tule Lake Sumps.

3.2.3 Element Three – Operation and Maintenance Activities

Operations and maintenance (O&M) activities related to the PA that are performed on Reclamation’s various features within the Project to ensure proper function of all project facilities are described in this section. O&M activities are carried out either by Reclamation or through contract by the appropriate irrigation district according to whether the specific facility is a reserved or transferred work, respectively.

Generally, Project facilities, including but not limited to Link, Keno, Clear Lake, Gerber, and Lost River Diversion dams, will continue to be operated consistent with all applicable federal laws and regulations. O&M activities for each facility type are summarized below. Reclamation recognizes this is not an exhaustive list and there may be items omitted inadvertently. However, Reclamation believes that if any activities were omitted, they are similar in scope and will not cause an effect to listed species or critical habitat outside the effects analyzed for the activities described herein.

With the transfer of ownership of Keno Dam to Reclamation completed on August 1, 2022, Keno Dam O&M activities have been added to the PA. Additionally, anadromous fish are expected to repopulate upstream of their previous extent at IGD. O&M of Keno Dam, the fish ladder at Keno Dam, fish screens, headgates, and canals owned by Reclamation, will now be conducted in a way that minimizes impacts to listed species.

Dams and Reservoirs

Generally, Project facilities, including but not limited to Link, Keno, Clear Lake, Gerber, and Lost River Diversion dams, will continue to be operated consistent with past practice. Specific operating characteristics are detailed below.

Keno Dam will become the new reference point for assessing Project compliance with Klamath River flow requirements because it is now the lowest point of control for Project operations controlling flows in the Klamath River, post-removal of the four downstream Klamath Hydroelectric Project dams.

Exercising of Dam Gates

The gates at Gerber, Clear Lake, Link River, and Lost River Diversion dams are exercised bi-annually, before and after each irrigation season to be sure they properly operate. The approximate dates the gates are exercised are March to April 15 and October 15 to November 30, and potentially in conjunction with any emergency or unscheduled repairs. The need for unscheduled repairs is identified through site visits. Once identified, the repair need is documented and scheduled.

Exercising gates requires anywhere from 10 to 30 minutes depending on the facility. The gates at Gerber, Link River, and Lost River Diversion dams are opened, and water is discharged during the exercising process. To maintain required downstream flows, as one gate is closed another is opened by a corresponding amount. When exercising the gates at LRD, the Keno Impoundment elevation/storage would be drafted as needed to ensure NMFS' Opinion required flows at Keno Dam are met; once the dam exercise operation was completed, the drafted volume would be replenished by increased releases at LRD. The following information describes facility-specific maintenance activities performed when exercising gates:

- LRD will be operated by Reclamation similar to PacifiCorp operations. The dam is operated continuously due to the daily flows required from UKL to the Klamath River. As such, the gates are considered exercised whenever full travel of the gates and a minimum flow of 250 cfs is achieved; Reclamation will document these occurrences. The stoplog gates at LRD are not exercised annually and are typically only removed under flood control operations and during infrequent stoplog replacement. A review of O&M inspection should be performed every 6 years.
- Clear Lake Dam gate exercise activities include exercising both the emergency gate and the operation gate. Depending on water conditions, some water may be allowed to discharge to allow for sediment flushing. Flushing requires a release of flows that must be near 200 cfs for approximately 30 minutes. This activity occurs once a year generally between March and April and is contingent on Clear Lake Reservoir surface water level elevations.
- The frost valves at Gerber Dam are exercised annually to prevent freezing of dam components. Valves are opened sometime in the fall, when the risk of freezing begins, at

a flow rate of approximately 2 cfs and closed in the spring once persistent freezing temperatures have ceased.

Stilling Well Maintenance

Gage maintenance is required at various Project facilities to ensure accurate measurement of flows. Gage maintenance generally includes sediment removal from the stilling well, replacement of faulty equipment, modification and/or relocation of structural components, and/or full replacement of the structure, as necessary. Reclamation estimates that every 5 to 10 years, one structure is replaced. Stilling wells are cleaned once a year during the irrigation season, which typically runs from April 1 through October 15.

Other Maintenance

To determine if repair and/or replacement of dam components is necessary, activities may include land-based observation and/or deployment of divers. Divers are deployed at Clear Lake Reservoir, Gerber Reservoir, Lost River Diversion Dam, LRD, and Keno Dam every 6 years prior to the Comprehensive Facilities Review for inspection of the underwater facilities. In addition, at Gerber Dam, the adjacent plunge pool is de-watered approximately every 8 years for inspection of headgates, discharge works, and other components; fish salvage by Reclamation staff would be conducted for this effort. Through these inspections, if replacement is deemed necessary, Reclamation would evaluate the potential effects to federally listed species and determine if additional ESA consultation would be required.

Design Operation Criteria, which outlines O&M guidelines for facilities maintenance is required at LRD, Keno Dam, Clear Lake Dam, Gerber Dam, and the LRDC gates. The Design Operation Criteria is used to develop Standard Operating Procedures for Reclamation facilities. The Standard Operating Procedures outline the maintenance procedures, requirements, and schedule. The activities address the structural, mechanical, and electrical concerns at each respective facility. Some of the components of facilities that require maintenance are typically reviewed outside of the irrigation season and include, but are not limited to, the following:

- Trash racks - Maintained when necessary and are not on a set schedule. Trash racks are cleaned, and debris removed daily, and maintenance is specific to each pump as individual pumps may or may not run year-round. Cleaning can take anywhere from 1 to 8 hours.
- Fish screens.
- Concrete repair occurs frequently and as needed (not on a set time schedule). The amount of time necessary to complete repairs to concrete depends on the size and type of patch needed.
- Gate removal and repair/replacement are performed when needed (i.e., no set time schedule). Inspections of gates occur during the dive inspection prior to the Comprehensive Facilities Review every 6 years. Gates are continually visually monitored.

Boat ramps and associated access areas at all reservoirs must be maintained, as necessary, to allow all weather boating access to carry out activities associated with O&M of the Project. If the boat ramp is gravel, it should be maintained on a 5-year cycle. If the structure is concrete, it should be maintained on a 10-year cycle. Maintenance can include grading, geotextile fabric placement, and gravel augmentation/concrete placement depending on boat launch type. Reclamation does not perform maintenance of boat ramps on a time schedule, but rather as needed.

Canals, Laterals, and Drains

All canals, laterals, and drains are either dewatered after irrigation season (from approximately October 15 through April 15) or have the water lowered for inspection and maintenance every 6 years as required as part of the review of O&M or on a case-by-case basis. Inspection includes checking the abutments and examining concrete and foundations, mechanical facilities, pipes, and gates. The amount of time necessary for inspection is based on size and specific facility.

As with other typical facilities, the C Siphon, which replaced the C Flume in 2018, would be operated, maintained, and monitored in a similar manner. Along with the external inspection of the facility, maintenance staff would enter the siphon when de-watered to perform an inspection of the siphon's internal features. Additionally, inspections of the concrete piers that support the siphon above the LRDC would be conducted. As necessary, hardware would be replaced throughout the life of the facility. Historically, dewatering of canals, laterals, and drains has included biological monitoring and (as needed) listed species salvage. This practice would continue under the current PA.

The facilities are also cleaned to remove sediment and vegetation on a timeline ranging from annually to every 20 years. Inspections of all facilities take place annually. Inspections occur year-round or as concerns are raised by Project patrons; cleaning and maintenance takes place year-round on an as-needed basis. Cleaning the facilities may include removing sand bars in canals, silt from drains, or material filling the facilities. Animal burrows that may be impeding the facilities are dug up and compacted to repair them. Trees that are deemed to interrupt operations of facilities (and meet criteria outlined in the O&M guidelines) and/or pose a safety threat to the structural integrity of the facilities are removed and the ground returned to as close to previous conditions as practicable.

All gates, valves, and equipment associated with the facilities are to be exercised bi-annually before and after the irrigation season. Any pipes and structures located on dams or in reservoirs that are associated with irrigation facilities are replaced when needed and have an average lifespan of 30 years. Reclamation O&M staff replace approximately 10 sections of pipe per year and attempt to perform this maintenance activity when the canals are dry. The following information describes facility-specific maintenance activities performed when exercising gates:

- A Canal headgates include six gates that need to be checked. The A Canal headgates are only operated and exercised when the fish screens are in place. If the breakaway screens were to fail, the A Canal would still be operating until the screen is put back into place. This allows for uninterrupted operation at A Canal if a screen needs to be replaced to its previous position. Screens typically break once or twice a year (during normal operation). KID is notified through an alarm, and the screens are repaired at the earliest time practicable.

- The A Canal headgates are typically exercised in the spring (February through March timeframe) and fall (October through November timeframe). This activity occurs when the bulkheads are in place and the A Canal is drained and empty.
- The LRDC diagonal gates and banks should be inspected every 6 years. Review of O&M inspections alternate every 6 years and take place anywhere from October 15 through March 31. This inspection would require drawdown of the LRDC (i.e., drawdown at least once every 6 years; however, as maintenance requires, LRDC drawdowns may be more frequent). The drawdown of the LRDC would leave enough water to ensure that fish were not stranded during this activity. The appropriate drawdown level is coordinated by Reclamation O&M and fisheries staff. Biological monitoring would be incorporated, and, if necessary, flows would be increased for fish protection.
- The gates in the concrete structure in the railroad embankment immediately upstream of the Ady Canal are exercised annually. This activity includes closing and opening the gates and typically occurs in the July to September timeframe. All debris is also removed once a year, generally during the June through September timeframe.

Primary Fish Screen Maintenance

The A Canal fish screens have automatic screen cleaners. Cleaning is triggered by timing or head difference. When cleaned on a timer, the timing intervals are set at 12 hours, but intervals can be changed at (KID) operator’s discretion for a period defined by hours or on a continuous basis. Fish screens at Clear Lake Dam are manually cleaned periodically when 6 to 12 inches of head differential between forebay one and forebay two is encountered. The need for cleaning the fish screen is dictated by water quality and lake elevation and varies from year to year. For instance, in some years, such as 2009, the screen was cleaned every other day beginning approximately the end of June/early July until it was shut off. In contrast, in 2011, no cleaning took place during irrigation season because the head differential never exceeded 0.3 foot. There is an extra set of fish screens that the Reclamation O&M staff uses during the cleaning process. The extra fish screen is lowered in place behind the first set of screens so that no fish can pass. The primary screens are then lifted and cleaned and then placed behind the second pair of screens in the lineup. This process is continued until all screens are cleaned. This process can take up to 10 hours. Upon completion, the remaining set is stored away until the next cleaning which is anytime a head difference of 0.5 foot occurs. During flood releases (when Clear Lake Reservoir elevations are 4,543.0 ft or above), fish screens would not be in place.

Fish Ladder Maintenance

LRD fish ladder gate exercise activities include exercising both the head gate and the attraction flow gate, which includes closing and opening the gates and physical inspection of the ladder. This activity occurs twice annually and generally occurs in the February/March timeframe and again in the November/December timeframe. The amount of time necessary for the gates to be exercised is no longer than 15 minutes. This activity includes biological monitoring by Reclamation staff biologists.

Road and Dikes

Road and dike maintenance, including gravel application, grading, and mowing, occurs as necessary from April through October. Pesticides and herbicides are also used on Reclamation managed lands, primarily canal rights-of-way to control noxious weeds. This activity typically occurs annually, and ESA coverage for this activity is covered under a separate biological opinion (USFWS 1995, entire). Pesticide and herbicide application during road and dike maintenance are not analyzed for effects in this Opinion, though other maintenance activities listed above are part of this analysis.

Pumping Facilities

All pumping plants are monitored yearly by visual evaluation. Dive inspections occur every 6 years according to the review of O&M inspection criteria. This activity would include dewatering of the adjacent facility and installation of coffer dams. Dive inspections and dewatering of the facilities typically occurs in the August to December timeframe. Biological monitoring occurs daily during the dewatering of the facility and has historically been, and will continue to be, incorporated into maintenance activities to ensure the protection of fish, as necessary. Aquatic weeds that collect on trash racks and around pump facilities are monitored continuously throughout the irrigation season and removed as needed. Weed removal typically occurs daily for those pumps that are operating continually through the season.

All pumps are greased, oil checked, cleaned, and exercised monthly if they are not in regular use. Pumps used for irrigation are maintained daily during the irrigation season. Drainage pumps would be maintained and operated daily, year-round. Pumps are greased and oiled according to the pump manufacturer's specifications. Excess grease and oil are removed and cleaned. When oil is being changed, oil spill kits are kept on site and used, as necessary.

Should a pump require repair, the pump chamber would be isolated from the water conveyance facility by placement of a gate, bulkhead, or coffer dam. The chamber would then be de-watered to allow for maintenance access. Appropriate staff would be on site to perform fish salvage, as necessary, during the de-watering process.

3.3 Modeling of the Proposed Action

The Klamath Basin Planning Model (KBPM), based in the Water Resources Integrated Modeling System (WRIMS), was used to simulate operations under the previous PA. Due to physical changes in the system, reflected in new modeling, the KBPM was updated for the new PA. For this current consultation, removal of the four dams in the Klamath Hydroelectric Project required that the downstream (river) compliance point be moved from the U.S. Geological Survey (USGS) gage below IGD (USGS Station ID#11516530) to the USGS gage below Keno Dam (USGS Station ID #11509500). The replacement for the KBPM was developed in support of this consultation has been named the Keno Release Model (KRM) and is based on the model viewer entitled "Viewer_v11d for MST11b_DraftPA_Jan26. The model viewer includes two model runs: MST11b_DraftPA_Jan26 and MST11b_DraftPA_PFoff_Jan26. The model runs are identical in rules, parameter settings, and results; however, one model study releases the Flexible Flow Account (FFA) in form of a pulse flow (similar to the spring flushing flow of the IOP in previous KBPM models), and the other releases the FFA evenly over a longer period of time in the spring/summer. Reclamation has presented both models runs to simulate both types of FFA releases, as the decision to release water as a pulse flow or more evenly is not predetermined event as FFA releases may change from one Water Year (WY) to another depending on hydrologic conditions.

Project operations using facilities that store and divert water from UKL, the Klamath River, and the Lost River were simulated in the KBPM over a wide range of hydrologic conditions for the period of October 1, 1980, through November 30, 2022, using daily input data to obtain daily, weekly, monthly, and annual results for river flows, UKL elevations, and Project diversions, including deliveries to the Lower Klamath and Tule Lake National Wildlife Refuges. The resulting simulations produced estimates of the water supply available from the Klamath River system (including UKL) for the POR. Under implementation of the PA, Reclamation has developed and will maintain a spreadsheet version of the KRM) that translates KRM logic into a format for daily operational use. The operational strategy embodied in the PA is described below. The description conforms to the operational rules used to simulate the PA in the KRM except in specific instances which will be highlighted and discussed.

The KRM includes the following critical assumptions:

- The Upper Klamath River Basin will experience water year types within the range observed in the POR.
- UKL inflows will be within the range observed in the POR.
- Normalized Wetness Index (NWI) inflow forecasts will be within the range and accuracy of historical inflow forecasts.
- Accretions between LRD and Keno Dam will be consistent with accretion timing, magnitude, and volume assumed in the KRM.
- Water deliveries to the Project will be consistent with distribution patterns analyzed for the KRM.
- Revised UKL bathymetry in the model is reasonably representative of actual UKL bathymetry and therefore accurately represents UKL storage capacity.
- Agency-Barnes has been reconnected to UKL at the outset of operations under this PA and was therefore modeled as being connected.
- Facility operational constraints and limitations, and/or associated maintenance activities, will be within the historical range for the POR.
- Water deliveries to Project lands will be consistent with the contractual, ESA, and other obligations Reclamation set forth in the development of the PA.

Reclamation will implement the PA as described to the greatest extent practicable. However, implementation of the PA may not exactly replicate the modeled results and actual Klamath River flows and UKL elevations may differ slightly during real-time operations.

See the Assessment for additional information about how Reclamation used the model to build the proposed action and for a detailed description of the KRM model simulation of the PA (USBR 2024b, Appendix C, pp. C1-C44).

3.4 Compliance Monitoring

Reclamation will monitor flows daily at LRD, Keno Dam, Clear Lake Reservoir, Gerber Reservoir, and all major diversion points (A Canal, Station 48, Miller Hill, North Canal, and Ady Canal). Reclamation will also continue monitoring at other locations necessary to effectively manage the Project, such as the LRDC, pumping plants E/EE and F/FF, and Harpold Dam. Reclamation will also continue to fund USGS gauges at Sprague River, Williamson River, UKL, LRD, Keno Dam, and other locations within the Project area. Reclamation will also work with USGS, Oregon Water Resources Department, NMFS, and the Service to identify other locations necessary to effectively administer the Project.

In addition, Reclamation will closely coordinate with agricultural or other diverters to anticipate and adjust for any significant changes in diversions that could affect releases from Keno to the Klamath River.

If in the course of monitoring these various hydrologic gaging stations or through coordination with the Service and NMFS, it becomes apparent that flows are not in compliance with the modelled outcomes in the PA, Reclamation will immediately take steps to adjust operations to bring them back in compliance. Any volumetric difference in prescriptive flows will be assessed and remedied through an equal release as soon as practicable.

3.5 Water Shortage Planning

Reclamation generally follows an established process for identifying and responding to the situation where available water supplies are inadequate to meet beneficial irrigation demands within the Project. During the fall-winter period, Reclamation coordinates directly with KDD and the Service regarding Project water availability and demands (for both National Wildlife Refuge and irrigation purposes). Reclamation does not make any public announcement of the volume of water available during the fall-winter period for delivery to the Project, including Lower Klamath National Wildlife Refuge.

Near the beginning of the spring-summer irrigation season, Reclamation issues an annual Operations Plan, which identifies the anticipated volume of water available from the various sources used by the Project and the associated operating criteria applicable that year. The Operations Plan is posted on Reclamation's website, a press release is issued, and copies are sent by letter to Project water users and affected Tribes.

In the event of an anticipated shortage in the volume of water available for irrigation use from Clear Lake and Gerber Reservoirs, Reclamation coordinates the allocation and delivery of limited supplies with LVID, HID, and others with a contractual right to receive stored water from these reservoirs.

In the event of an anticipated shortage in the volume of water available for irrigation use from UKL and the Klamath River, Reclamation will coordinate with irrigation districts and water users regarding anticipated irrigation demands within the Project. If the volume of water or the timing when it is available is less than the anticipated demands of the repayment districts (KID and TID), Reclamation may determine it necessary to issue an Annual Drought Plan, which identifies and explains how water from UKL and the Klamath River is to be allocated among various entities with different contractual priorities to Project water. The Annual Drought Plan is posted on Reclamation's website, a press release is issued, and affected Project water users are provided a copy and notified by letter of the volume of water available under their respective contract.

The Annual Drought Plan will identify an initial allocation from UKL and the Klamath River for entities and individuals by order of contractual priority. Reclamation then updates the allocation (either increasing or decreasing the water available) as the irrigation season progresses and hydrologic conditions change, again notifying affected contractors by letter. Reclamation staff attends district board meetings, calls contractors by telephone, and answers direct inquiries related to the Annual Drought Plan allocation.

In addition to possibly allocating the available water through the Annual Drought Plan, there are other actions that Reclamation can take or directly facilitate in response to a shortage in water available from the Project.

Consistent with Reclamation policy, Reclamation may administratively approve the transfer of water between districts and individual water users within the Project. To approve a transfer, Reclamation must determine that such transfers do not increase the amount of water available to the Project or expand the Project's service area but rather simply temporarily change the place of use within the Project. Prior to approval, Reclamation reviews each application on a case-by-case basis to make sure these basic conditions are met.

These internal transfers are generally used by irrigators to address a shortage in the water available under a given contract, based on the contractual priority it provides to Project water. Overall, these types of transfers promote the efficient and economical use of water.
Internal Project transfers are also available for irrigable lands within Lower Klamath and Tule Lake National Wildlife Refuges, subject to the approval of the Service. Water made available for National Wildlife Refuge lands through an internal transfer approved by Reclamation is separate from any water that may be available for delivery to the National Wildlife Refuge consistent with the terms of this PA.

Reclamation may also engage in irrigation demand reduction activities within the Project. Similar efforts have occurred periodically over the last two decades, subject to proper legal authority and the availability of federal appropriations. In the past, these activities have included agreements with individual landowners to forgo use of Project water or to pump supplemental groundwater.

3.6 Conservation Measures

The USFWS and NMFS (1998 p. xii) ESA Section 7 Handbook defines "conservation measure" is defined as an action to benefit or promote the recovery of listed species that are included by the federal agency as an integral part of the PA. These actions will be taken by the federal agency or applicant, and serve to minimize or compensate for, project effects on the species under review. These may include actions taken prior to the initiation of consultation, or actions which the federal agency or applicant have committed to complete in a Biological Assessment or similar document. The conservation measures proposed assist Reclamation in best meeting the requirements under Section 7 of the ESA by (1) "…utilizing our authorities in furtherance of the purpose of this Act by carrying out programs for the conservation of endangered species…" and (2) avoiding actions that jeopardize the continued existence of listed species. The following Conservation Measures were included in Reclamation's Assessment and their Addendum:

1. Fish salvage at Project canals occurs when canals are: (1) temporarily dewatered for a discrete action related to maintenance and/or repairs at Project facilities inclusive of canals, canal banks, levees, levee roads, water control structures, and drain features, and (2) when canal systems are dewatered at the end of each irrigation season. Under both circumstances fish are salvaged from pools where they are stranded. Reclamation proposes, in coordination with both the Service and NMFS, to continue the salvage of suckers and salmon species consistent with salvage efforts since 2005 both for routine maintenance and repair at Project structures and at the conclusion of the irrigation season for those project canals, laterals, and drains that are seasonally dewatered.

2. Reclamation proposes to continue support of a captive rearing efforts by the Service for LRS and SNS. The intention is to improve the numbers of suckers reaching maturity in UKL. Ultimately, a captive rearing program's function would be to promote survival and recovery of the sucker populations that suffer losses from entrainment due to the Project or other threats. Captive propagation is already an important part of listed fish recovery efforts nationwide, including at least three sucker species (i.e., June sucker, razorback sucker, and robust redhorse sucker).

3. Since about 2000, Reclamation has funded monitoring of sucker populations in the lakes and reservoirs of the Upper Klamath Basin. Reclamation has also funded projects identified through the Service's Sucker Recovery Implementation Team since 2013 and participated in the Recovery Implementation Team discussions and project identification. In coordination with the Service, Reclamation proposes to continue efforts to monitor adult suckers in UKL, Clear Lake and Gerber Reservoirs, monitor juvenile suckers in UKL and Clear Lake, and fund sucker research, restoration, and recovery actions throughout the Upper Klamath Basin. Contingent upon Reclamation's annual budget process and appropriations, Reclamation anticipates annual funds of $700,000 in 2025

and 2026 for UKL adult monitoring, Clear Lake adult monitoring, and juvenile cohort monitoring, research, and recovery projects (subject to receipt of previously funded monitoring data and reports). Funding in fiscal years beyond 2026 will be based upon recommendations and priorities identified through the Adaptive Management process as discussed below. Reclamation envisions that monitoring and research projects funded through the Recovery Program will continue to answer questions about sucker recruitment in UKL and sucker population trends in both UKL and Clear Lake Reservoir and inform science based prioritized actions. Reclamation also envisions that projects under a sucker Recovery Program will improve the amount and quality of sucker habitats, sucker passage issues, and sucker survival in the Upper Basin thereby offsetting PA impacts to habitat and entrainment of suckers at UKL, Gerber Reservoir, and Clear Lake Reservoir. In coordination with the Service, Reclamation proposes to continue participation in the Klamath Sucker Recovery Program. The 2013 Revised Recovery Plan for the LRS and the SNS (Plan) outlines a strategy for a Recovery Program (USFWS 2013a). Reclamation has worked with the Service toward achieving the goals and objectives of the Plan since 2013 and intends to continue to do so, including dedication of resources determined in coordination between Reclamation and the Service and participation on recovery efforts. 4

3.7 Adaptive Management

Reclamation (2024) describes the use of an adaptive management process during implementation of the PA in an effort to collaborate and provide transparency with Klamath Basin stakeholders. To that end, Reclamation has initiated, and will continue to support through the duration of the PA and beyond, adaptive management that meets the long-term management, research, and monitoring needs of the Klamath Basin. Reclamation envisions continuing stakeholder conversations initiated in 2023 with both a management/policy group and a technical group—collectively, the Adaptive Management Team—that represents the multiple entities and interests in the Klamath Basin, supported by facilitation.

In an addendum to the Assessment, Reclamation (2024) describes their intent to implement a structured decision making (SDM) framework to establish a formal, transparent, and collaborative process to develop quantifiable and measurable objectives and determine the best alternatives to meet those objectives using quantitative models. Reclamation intends to utilize SDM as the process to transparently and collaboratively gather and analyze data associated with implementation of the PA. Further, Reclamation intends to adaptively manage those actions through a combination of evaluating current and future data and external expertise to support SDM.

Adaptive Management, as defined in Interior's Technical Guide on Adaptive Management (Interior, 2007), is a decision process that promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a ‘trial and error’ process, but rather emphasizes learning while doing. Adaptive management does not represent an end, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.

Reclamation is committed to a long-term adaptive management process that is conducted in a transparent, collaborative manner with Klamath Basin stakeholders. To that end, Reclamation has initiated, and will continue to support through the duration of this PA and beyond, adaptive management that meets the long-term management, research, and monitoring needs of the Klamath Basin. Reclamation envisions continuing stakeholder conversations initiated in 2023 with both a management/policy group and a technical group—collectively, the Adaptive Management Team—that represents the multiple entities and interests in the Klamath Basin, supported by facilitation. Reclamation will continue to support a robust series of conversations in a constructive and collaborative approach, such as Structured Decision-Making, that leads to development of long-term goals, objectives, and work plans, including identification and fulfillment of science needs; discussion of collaborative management approaches; collection, dissemination, storage, and utilization of collected data; and development of models and decision-making tools. Reclamation understands that, notwithstanding the description of the long-term program described above, a Klamath Basin adaptive management program and Structured Decision-Making structure will be shaped by the participation of member entities. However, Reclamation’s intent for the program is for it to foster transparent and collaborative resource management as it has in the Great Plains (Working Together to Control Invasive Plants and Restore Prairies (U.S. National Park Service) (nps.gov)), Delaware Bay (Developing objectives with multiple stakeholders: adaptive management of horseshoe crabs and Red Knots in the Delaware Bay (usgs.gov)), the Prairie Pothole Region (of 2013-1279.pdf (archive.org)), and California’s Central Valley (Home CVPIA Science Integration Team). The management and technical group members will help determine topics and identify management needs in a collective format through the structured and joint development of tools such as diagrams and models that may be used to understand outcomes and risks that inform management actions. The groups will also be able to support monitoring and research needs through the joint development of models to help inform medium and long-term management actions.

Adaptive management will represent an important strategy in Reclamation’s long-term effort to minimize impacts to ESA-listed species. For example, there is little data to inform how ESA-listed species will repopulate new habitats post dam removal, nor is there data on how the Project might impact that recolonization. The Adaptive Management Team’s engagement on such questions could drive establishment of a wide-ranging, multi-year research program that leads to the development of management practices and restoration projects that are focused on program objectives.

Short-term actions and evaluation criteria may be formulated by a subset of the technical stakeholder working group based on technical expertise. Informed recommendations will be made to the Management Team. Environmental responses to actions will be monitored and evaluated to assess the effectiveness of the action. As new science accumulates, project opportunities arise, and environmental conditions evolve, the adaptive management program provides an opportunity to collaboratively and strategically manage activities to efficiently apply stakeholder resources and to realize tangible benefits to ESA-listed species and their habitats.

3.8 Inter-seasonal and Intra-seasonal Management

While the adaptive management program addresses the long-term science and management needs of the Klamath Basin, there remains a need for transparent communication and collaboration with regard to short- and long-term seasonal operation of the Project to ensure consistency with the anticipated outcomes of the PA. Therefore, Reclamation has created a technical team to speak to specific needs such as the Real-time Operations (RTO) (formerly known as the Flow Account Scheduling Technical Advisory (FASTA) team) and if needed will convene a longer-term Water Year Operations team (WY Ops) (formerly known as the Klamath Project Operations (KPO) team).

The RTO will support seasonal (with a forward-looking time horizon of roughly 30 days to the end of the Water Year horizon) water management operations through regular engagement with Reclamation on hydrologic conditions and flow management. This team will fill a similar role to the previous FASTA team, meeting as often as weekly during critical time periods to offer technical input to Reclamation staff. This team will attempt balanced representation in the Klamath Basin, consisting of technical representatives from Klamath Basin Tribes, Klamath Water Users Association, federal and state agencies, and other groups with appropriate and relevant expertise. Among other tasks, the RTO will work with Reclamation to support decisions around disposition of the FFA, allocation of historical wetland habitat water to the Deferred Project Supply, and drought-related water shortage planning.

If the RTO is inadequate to address the longer-term planning needs required by the Opinion, Reclamation will convene the WY Ops to meet this need. The WY Ops will support long term seasonal (with a focus on forward-looking time horizon of roughly 6 months) water management operations, also through regular engagement with Reclamation on hydrologic conditions and flow management. With similar representation as the RTO, the WY Ops will work with Reclamation to focus on optimizing the Project’s ability to successfully transition from the current season into the next season and year.

3.9 Action Area

The implementing regulation for section 7(a)(2) of the Act (50 CFR 402.02) define the “action area” as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The action area for this Opinion is the Klamath River watershed in southern Oregon and northern California (Figure 9). The action extends from UKL (including a reconnected Agency-Barnes wetland complex) in south-central Oregon, approximately 254 miles downstream to the mouth of the Klamath River at the Pacific Ocean, near Klamath, California, including all Project reservoirs, water transport structures, and irrigated lands. Within the Upper Klamath Basin, the action area covers Agency Lake, Upper

Klamath Lake, Keno Reservoir (also known as Lake Ewauna or Keno Impoundment), Gerber Reservoir, Clear Lake (also known as Clear Lake Reservoir), the Tule Lake sumps, the Lost River including Miller Creek (Figure 11), and all Project-influenced areas, including reservoirs, diversion channels and dams, canals, laterals, drains, and areas within Tule Lake and Lower Klamath National Wildlife Refuges (Figure 1). The action area also includes the mainstem Klamath River from Keno Dam to the Klamath River mouth at the Pacific Ocean, near Klamath California, as well as an undefined boundary in the Pacific Ocean where Southern Resident Killer Whale and Chinook salmon habitat overlap.

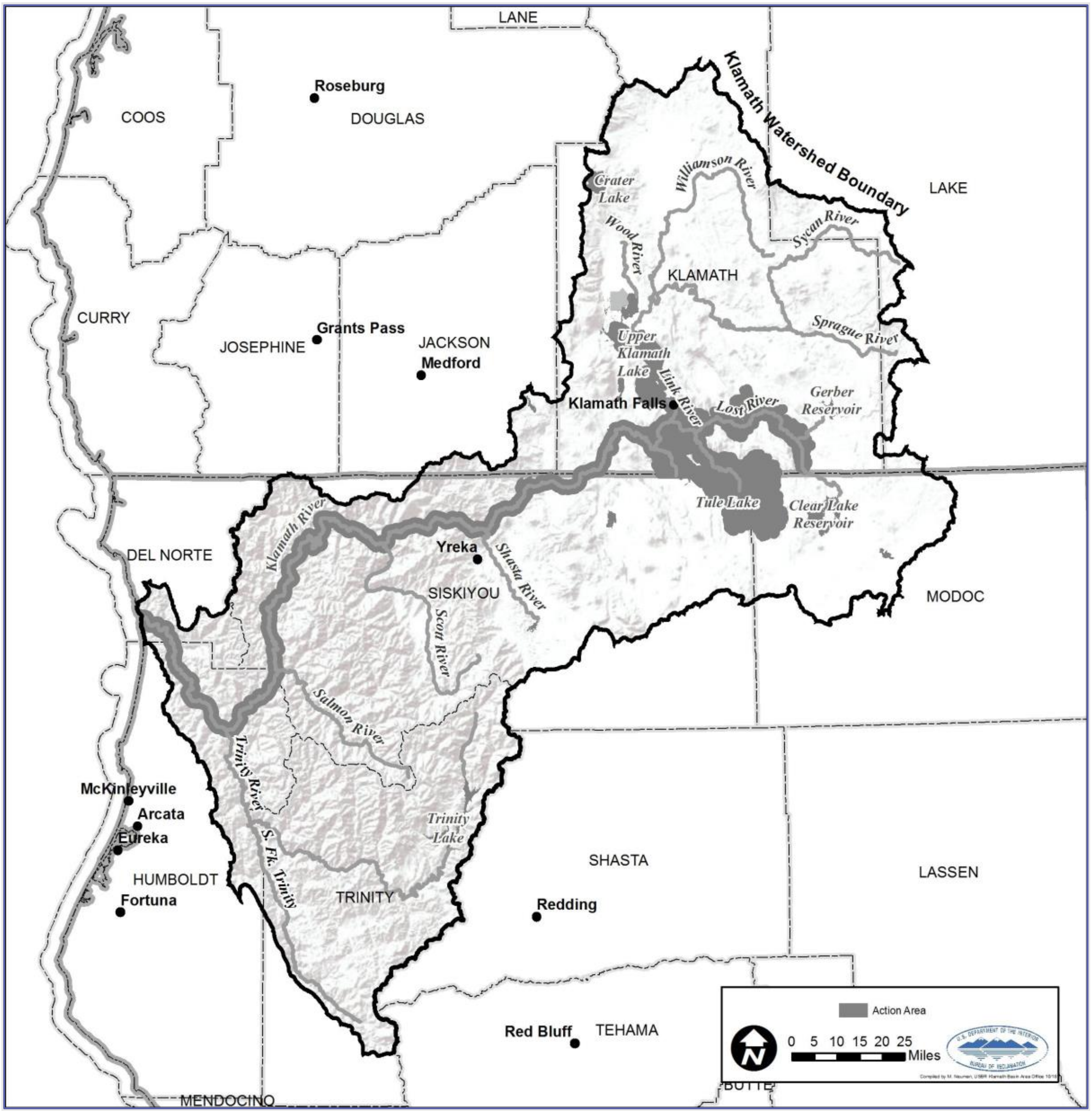


Figure 9. The action area for Reclamation's proposed action (USBR 2018a).

4 PURPOSE AND ORGANIZATION OF THIS BIOLOGICAL OPINION

The Bureau of Reclamation determined water management actions associated with the PA may affect and are likely to adversely affect Lost River and shortnose suckers, and therefore requested formal consultation with the Service. Formal consultation results in the Service issuing a biological opinion as to whether the PA is likely to jeopardize the continued existence of Lost River and shortnose sucker or result in the destruction or adverse modification of any designated critical habitat. A description of the formal consultation process is provided at 50 CFR[1] 402.14. The following sections provide the analytical framework for the basis of the jeopardy and destruction or adverse modification of critical habitat determinations. In the following sections, the jeopardy analysis for the Lost River sucker, shortnose sucker, and northwestern pond turtles are presented first, followed by the destruction or adverse modification analysis for Lost River and shortnose sucker designated critical habitat. Critical habitat has not been proposed or designated yet for northwestern pond turtle. The conclusion section provides the section 7(a)(2) determinations based on each of these analyses.

4.1 Analytical Framework for the Jeopardy Determination

Section 7(a)(2) of the Act requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. The regulatory definition of "jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the species range-wide condition, the factors responsible for that condition of the Lost River sucker, shortnose sucker, and northwestern pond turtle and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the Lost River sucker, shortnose sucker, and northwestern pond turtle in the action area, the factors responsible for that condition, and the role of the action area in the species survival and recovery; (3) the *Effects of the Action*, which determines all the consequences to the Lost River sucker, shortnose sucker, and northwestern pond turtle caused by the PA that are reasonably certain to occur in the action area; and (4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities, that are reasonably certain to occur in the action area on the Lost River sucker, shortnose sucker, and northwestern pond turtle.

In accordance with the policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the current status of the Lost River sucker, shortnose sucker, and northwestern pond turtle, taking into account any cumulative effects, to determine if implementation of the PA is likely to reduce appreciably the likelihood of

[1] CFR represents the Code of Federal Regulations, which is a codification of the general and permanent rules published in the Federal Register by Executive departments and agencies of the Federal Government. It is published by the Office of the Federal Register National Archives and Records Administration. More information can be found at http://www.gpoaccess.gov/cfr/index.html

both the survival and recovery of these species in the wild by reducing the reproduction, numbers, and distribution of these species.

4.2 Analytical Framework for the Destruction or Adverse Modification of Critical Habitat Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

The destruction or adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which describes the range-wide condition of designated critical habitat for the Lost River sucker and shortnose sucker; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which are all consequences to the critical habitat caused by the PA that are reasonably certain to occur in the action areas; and (4) the *Cumulative Effects*, which evaluates the effects of future non-Federal activities in the action area that are reasonably certain to.

For the section 7(a)(2) determination regarding destruction or adverse modification, the Service begins by evaluating the effects of the proposed Federal action and the cumulative effects. The Service then examines those effects against the condition of all critical habitat described in the listing designation to determine if the PA's effects are likely to appreciably diminish the value of critical habitat as a whole for the conservation of the species.

5 STATUS AND ENVIROMENTAL BASELINE OF THE LOST RIVER SUCKER AND SHORTNOSE SUCKER

This section assesses the range-wide condition of LRS and SNS. The Service describes factors, such as life history, distribution, population size and trends, which help determine the likelihood of both survival and recovery of the species. The Service presents the environmental baseline of the species, to which the effects of the PA will be compared.

The distribution of LRS and SNS is largely contained within the action area for the current PA (Figure 9). The only locations that LRS and SNS are known to occur that do not fall within the action area are the tributaries to UKL, Clear Lake, and Gerber Reservoir that contain spawning habitat. A small number of LRS and SNS may remain in these tributaries outside the spawning season due to stranding or volitionally; however, the vast majority of individuals that use these tributaries migrate into them during the spring spawning season and reside within the action area for most of the year. Thus, the status of the species within the action area is essentially equivalent to the range-wide status of the species.

The Service completed the *Species Status Assessment for the Endangered Lost River Sucker and Shortnose Sucker* in 2019 (SSA, USFWS 2019). This SSA provides a comprehensive assessment of the species' range-wide status and serves as the basis for defining the status and environmental baseline for consultation under section 7 of the ESA (USFWS 2019). As such, much of the information presented in this section is derived from the SSA and will provide an overview of the ecology of the species and their threats. The information presented below also includes current best available information to provide updated population and other information since the last consultation.

5.1 Legal Status

The LRS and the SNS were federally listed as endangered throughout their entire ranges on July 18, 1988 (USFWS 1988). They are also listed as endangered by the States of California and Oregon (CalGame 2004). The Service reviewed the status of each of these species in 2019 and again in 2024 and did not recommend changes to classification or recovery priority numbers (USFWS 2019b, 2019c, 2019a, 2024a, and 2024b). A final revised recovery plan for these species was published in 2013 (USFWS 2013a).

5.2 Life History

LRS and SNS are large-bodied, long-lived fishes. The oldest individual for which age has been estimated was 57 years for LRS and 33 years for SNS (Buettner and Scoppettone 1991 p. 21, Terwilliger et al. 2010 p. 244). Juveniles grow rapidly until reaching sexual maturity sometime between four and nine years of age for LRS and between four and six years of age for SNS (Perkins et al. 2000b pp. 21-22). On average, approximately 90 percent of adults of both species survive from year to year, though survival may vary among populations, which enables populations to persist through periods with unfavorable spawning or recruitment conditions (Hewitt et al. 2018a pp. 17, 21). Upon achieving sexual maturity, LRS are expected to live on average 12.5 years based on annual survival rates (Hoenig 1983, USFWS 2013a p. 12). Similarly, SNS adults are estimated to live on average 7.4 years after having joined the adult population. Females produce a large number of eggs per year: 44,000 to 236,000 for LRS and 18,000 to 72,000 for SNS, of which only a small percentage survive to become juveniles as is typical for freshwater fish (Houde 1989 p. 479, Houde and Bartsch 2009 p. 31) LRS and SNS can generally be classified into five life stages and behaviors that occur at various times throughout the year: migration, spawning, larval, juvenile, and adult (Figure 10). The timing of occurrence of each life stage is similar between the two species, with the main difference occurring during spawning and incubation.

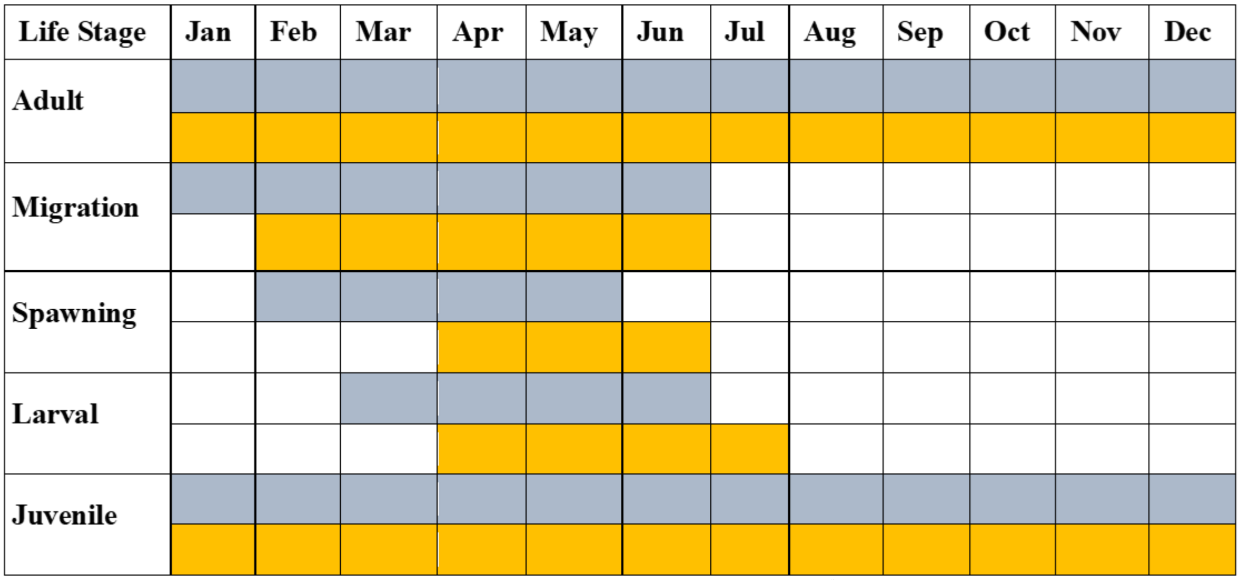


Figure 10. Life Stage Diagram (Reiser et al. 2001). LRS are represented by grey and SNS are represented by orange.

5.2.1 Migration

LRS and SNS require distinct growth and spawning habitats to complete their life cycle. Growth occurs in the lakes of the Upper Klamath Basin, and spawning habitat is typically found in the tributary rivers to these lakes. However, a subset of LRS use lakeshore groundwater upwelling areas (springs) as their spawning habitat in UKL. Small numbers of SNS are also detected at these lakeshore sites (Hewitt et al. 2017 p. 24), but the low numbers suggest that they are likely just vagrant individuals not attempting to spawn. Because most individuals utilize distinct growth and spawning habitats, they must complete a spawning migration to reproduce.

Adult LRS and SNS in UKL appear to strongly cue on water temperature to initiate spawning migrations up the Williamson River, which is the only tributary to UKL with large spawning populations of LRS and SNS. Migrations begin only after appropriate water temperatures have been achieved: 50°F for LRS and 54°F for SNS (Hewitt et al. 2017 pp. 11, 24), and decreasing temperatures can reduce numbers of individuals migrating upstream (Hewitt et al. 2014 pp. 36-37). Migration into Willow Creek, which is believed to contain the only spawning habitat available from Clear Lake, appears to be triggered by a general rise in stream temperatures rather than exceedance of a specific temperature threshold (Hewitt and Hayes 2013a).

Successful migration to spawning habitats can be limited by hydrologic conditions. In UKL, access to the Williamson River does not appear to be affected by river flows or lake elevations, but access to and/or suitability of the lakeshore springs habitat can be reduced by shallow depths or dewatering at springs due to low lake elevations (Burdick et al. 2015c entire). Access to spawning habitat into Willow Creek, which is the only spawning habitat available from Clear Lake, can be limited by shallow water near the mouth or low flows within the stream (Hewitt and

Hayes 2013a p.7). Access to spawning habitats based on various hydrologic conditions are discussed below in Section 5.2.2.

5.2.2 Spawning

Spawning occurs from February through May (Figure 10). In the Lost River drainage, the bulk of upstream migration occurs in March and April (Hewitt and Hayes 2013a pp. 13, 15). In UKL, some spawning occurs in March, but the bulk occurs in April and early May (Hewitt et al. 2014 p. 9). As suckers spawn, fertilized eggs quickly settle within the top few inches of the gravel substrate until hatching, around one week later.

Generally, individuals of both species spawn every year in UKL, although data from the 2018 spawning season suggested that some individuals may have skipped spawning. In Clear Lake and Gerber Reservoir, suckers skip spawning in some years due to limited access. Spawning activity is typically observed over mixed gravel or cobble substrates in depths typically less than 1.5 ft. ranging from 0.4 to 2.3 ft. in rivers and shoreline springs. Gravel is rock ranging in size from 0.8 – 2.5 in. in diameter, and cobble ranges in size from 2.5 – 10 in. in diameter.

Eggs require flowing water and relatively open substrate that permits sufficient aeration (both from ambient dissolved oxygen (DO) levels and from removal of silt and clays that can smother the egg). These conditions are also important for the elimination of waste materials from the egg during incubation. LRS were observed to spawn at water velocities of 0.49 - 2.69 ft./sec (Coleman et al. 1988 p. iv). Eggs also require appropriate temperatures to support timely development. Coleman et al. (1988 p. iv) observed that LRS eggs hatched eight days after fertilization at 56.3°F. Colder temperatures (45°F) were observed to delay egg development by at least two weeks (J.E. Rasmussen, USFWS, unpublished data). Eggs also need some protection, such as small spaces in gravel, against potential predators and disease, although there are no data to clarify what conditions are optimal. The small spaces between gravel pieces in the substrate help to restrict access from potential predators and limit the number of eggs that can randomly clump together, which could reduce the spread of diseases such as certain fungi that can grow on developing eggs. An analysis of effects of the PA on shoreline spawning in UKL is contained in Section 7.1.3.1.1.

5.2.3 Larvae

Larvae emerge from the gravel approximately 10 days after hatching at about 0.2 to 0.6 in total length and are still mostly transparent with a small yolk sac (Coleman et al. 1988 p. 27). Generally, LRS and SNS larvae spend little time in rivers after swim-up, drifting downstream to the lakes at about 0.55 in. in length around 20 days after hatching (Cooperman and Markle 2003 pp. 1146-1147). In the Williamson and Sprague Rivers (UKL population) and Willow Creek (Clear Lake Reservoir population), larval drift downstream from the spawning grounds begins in April and is typically completed by July with the peak in mid-May (Scoppettone et al. 1995 p. 19). Most downstream movement occurs at night near the water surface (Ellsworth et al. 2010 pp. 51-53). Little is known about the drift dynamics of the larvae hatched at the eastern shoreline springs in UKL.

Once in the lake, larvae tend to inhabit near-shore areas (Cooperman and Markle 2004, entire, Erdman et al. 2011 pp. 476-477). Larval density is generally higher within and adjacent to emergent vegetation than in areas devoid of vegetation (Cooperman and Markle 2004 p. 370). Emergent vegetation provides cover from non-native predators (such as non-indigenous fathead minnows; *Pimephales promelas*) and habitat for prey items (Cooperman and Markle 2004 p. 375, Crandall 2004 p. 3). Such areas may also provide refuge from wind-blown currents and turbulence, as well as areas of warmer water temperature which may promote accelerated growth (Crandall 2004 p. 5, Cooperman et al. 2010 p. 36). These areas of emergent vegetation tend to occur along the fringes of the lakes in shallower areas. However, the two species appear to have slightly different habitat usage as larvae; SNS larvae predominantly use nearshore areas adjacent to and within emergent vegetation, but LRS larvae tend to occur more often in open water habitat than near vegetated areas (Burdick and Brown 2010 p. 19).

5.2.4 Juveniles

Larvae transform into juveniles in mid-July at 0.8-1.2 in. in total length and transition from predominantly feeding at the surface to feeding near the lake bottom (Markle and Clauson 2006 p 496). In UKL, some juvenile suckers continue to use relatively shallow (less than approximately 3.9 ft.) vegetated areas, but overall juveniles are found in a wide variety of habitats including deeper, un-vegetated offshore habitat (Buettner and Scoppettone 1990, Hendrixson et al. 2007, Burdick et al. 2008, Bottcher and Burdick 2010, Burdick and Brown 2010). One-year-old juveniles occupy shallow habitats during April and May but have been found in higher concentrations in deeper areas along the western shore of UKL as the summer progresses until DO levels become reduced (Bottcher and Burdick 2010 p. 17, Burdick and Vanderkooi 2010 pp. 10, 11, 13). Once DO levels in this deeper area become suboptimal, juveniles appear to move into shallower areas throughout the rest of the lake.

5.2.5 Adults

Adult LRS and SNS use the lakes of the Upper Klamath Basin as their primary habitat for feeding and growing; they migrate to spawning habitats during spring as described in Sections 5.2.1 and 5.2.2. In their growth habitat, adult suckers require adequate food, water quality, and refuge from predation. Both spawning subpopulations of LRS in UKL have experienced an average annual survival rate of around 90 percent between 2002 and 2019 (range: 80-96 percent across locations and sexes; Hewitt et al. 2018 pp. 12 & 17, Krause et al. 2023). SNS experienced average annual survival rates of 82 percent between 2001 to 2019 (range: 74-95 percent; Hewitt et al. 2018 p. 21, Krause et al. 2023). However, there has been a recent downward trend in survival estimates from 2016 to 2019 for all species (Krause et al. 2023). The trend is most pronounced for LRS and has continued since 2019 (Krause and Paul-Wilson 2024). Although adult suckers are hardier than juveniles and larvae, they are still susceptible to poor water quality, which can be associated with die-offs (see Section 5.4). Thus, adult suckers require adequate water quality, or at least refugia from poor water quality conditions, within their growth habitat.

Adult LRS and SNS are distributed throughout the northern portion of UKL during summer (Banish et al. 2009 p. 160), but in the spring, congregations form in the north-east quadrant of the lake prior to moving into tributaries or shoreline areas for spawning. There is no information on their distribution in the lake during fall and winter. Less is known about populations in Gerber and Clear Lake Reservoirs because they have been studied much less (Leeseberg et al. 2007, entire). However, in Clear Lake adults appear to inhabit the western lobe of the reservoir more so than the eastern lobe (Barry et al. 2009 p. 3), which is probably due to its greater depth.

Based on radio-telemetry studies of suckers in UKL, adults of both species tend to avoid depths of less than 6.6 ft. and most individuals are found at depths of 6.6-13.1 ft. (Banish et al. 2007 p. 10, 2009 pp. 151-161). An exception to these patterns occurs during poor water quality conditions when suckers tend to seek refuge from stressful conditions in the shallow habitats in and around spring-fed areas such as Pelican Bay (Banish et al. 2009 pp. 159-160). These spring-dominated sites likely provide better water quality conditions because the water is typically cooler (cooler water can hold more oxygen than warmer water) and clearer because of the flowing nature of area. Selection of deeper than average habitats may reflect the distribution of their prey, or it may confer protection from avian predators, which can consume suckers as large as 28.7 in. (Evans et al. 2016 p. 1262).

In 2021, USGS began deploying PIT tag arrays in Pelican Bay annually, to learn more about when and why LRS and SNS use this habitat. The monitoring data shows that a significant proportion of the adult population is detected in Pelican Bay after spawning but then detections seem to taper off in September, when water quality in the lake decreases (J.R. Krause, USGS, personal communication October 18, 2024). LRS and SNS from the sucker assisted rearing program have also been detected on the Pelican Bay PIT tag arrays during this time (April to October; unpublished data, FASTA slides October 3, 2024). There is still no clear indication as to why LRS and SNS leave Pelican Bay when the water quality in the lake decreases but the number of detections suggest that this is an important habitat for adult and juvenile suckers.

The limited available data on adult LRS and SNS diets, which come from Clear Lake, suggest that LRS tend to feed directly from the lake bottom whereas SNS primarily consume zooplankton from the water column (Scoppettone et al. 1995p. 15). This diet difference aligns with the mouth morphology of the species; SNS have terminal or subterminal (forward-facing) mouths whereas LRS have more ventral (bottom-facing) mouths (Miller and Smith 1981 pp. 1, 7).

5.3 Range and Distribution

5.3.1 Historical Distribution

LRS and SNS are endemic to the upper Klamath Basin, including the Lost River sub-basin (Figure 1). Documented historical occurrences of one or both species include UKL (Cope 1879 pp. 784-785) and Tule Lake (Bendire 1889 p. 444, Eigenmann 1891 p. 667), but the species likely occupied all of the major lakes within the upper Klamath Basin, including Lower Klamath Lake, Lake Ewauna, and Clear Lake. In addition to inhabiting the lakes throughout the upper basin, the species historically utilized all major tributaries to the lakes for spawning and rearing. For example, the species ascended the Williamson River in the thousands and were "taken and dried in great numbers by the Klamath and Modoc Indians" (Cope 1879 p. 785). Historically, large sucker spawning migrations also occurred from Tule Lake up the Lost River to near Olene and Big Springs near Bonanza (Bendire 1889, entire). Suckers were also known to spawn in great numbers at several springs and seeps along the eastern shoreline of UKL, including Barkley (Bendire 1889 p. 444) and likely spawned at other spring-dominated areas in the northwestern corner of the lake, including Harriman, Crystal, and Malone Springs.

At the time of listing (1988), LRS and SNS were known to occupy UKL and its tributaries and outlet (Klamath Co., Oregon), including a "substantial population" of SNS in Copco Reservoir (Siskiyou Co., California), as well as collections of both species from Iron Gate Reservoir (Siskiyou Co., California) and J.C. Boyle Reservoir (Klamath Co., Oregon) (Figure 11). Remnants and/or highly hybridized populations were also documented to occur in the Lost River system (Klamath Co., Oregon, and Modoc and Siskiyou Co., California) including both species in Clear Lake Reservoir (Modoc Co., California), but it was apparently presumed that LRS populations in Sheepy Lake, Lower Klamath Lake, and Tule Lake (Siskiyou Co. California) had been "lost" (USFWS 1988). Although not stated explicitly, SNS within Gerber Reservoir (Klamath Co., Oregon) were likely part of the "highly hybridized populations" in the Lost River Basin referenced in the listing.

Historically, a population of SNS and LRS suckers existed in the various hydropower reservoirs in the Klamath River. In the main stem hydropower reservoirs on the Klamath River, a two-year effort in 1998-1999 produced 240 adult captures, 99 percent of which were SNS (Desjardins and Markle 2000 pp. 14-15). The sizes of catches given the effort suggests that these populations contained very few individuals. This population was also very likely a sink, with new individuals generally being spawned elsewhere in the system, such as UKL. None of these sink populations are thought to contribute significantly to maintaining and recovering LRS and SNS because they had extremely low resiliency due to a combination of degraded habitat, low numbers, and restricted access to suitable spawning habitat (Desjardins and Markle 2000 pp. 14-15, Hodge and Buettner 2009 pp. 4-6, Kyger and Wilkens 2011 p. 3).

The Klamath River Renewal Corporation (KRRC) initiated decommissioning and removal of the four Lower Klamath Hydroelectric Project dams (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) in 2023 on the Klamath River. Copco No. 2 diversion dam was removed in the summer of 2023. Power generation at J.C. Boyle, Copco No. 1, and Iron Gate powerhouses ceased January 2024. The removal of the remaining three dams began in spring 2024 and was completed in September 2024, removing the main stem hydropower reservoirs on the Klamath River below Keno Dam. With the completion of dam removal, the Klamath River has been restored to a free-flowing condition from the prior upstream extent of J.C. Boyle Reservoir in Oregon through the location of Iron Gate Dam in California. In 2023, prior to draw down and dam removal, KRRC removed 132 adults and 137 juvenile suckers from the four hydroelectric reservoirs; these populations consisted of LRS and SNS that washed down from the Keno impoundment. These fish were relocated to the Klamath National Fish Hatchery. LRS and SNS are lake dwelling suckers and will likely not persist in the Klamath River below Keno dam after drawdown, dam removal, and restoration of the hydroelectric reach.

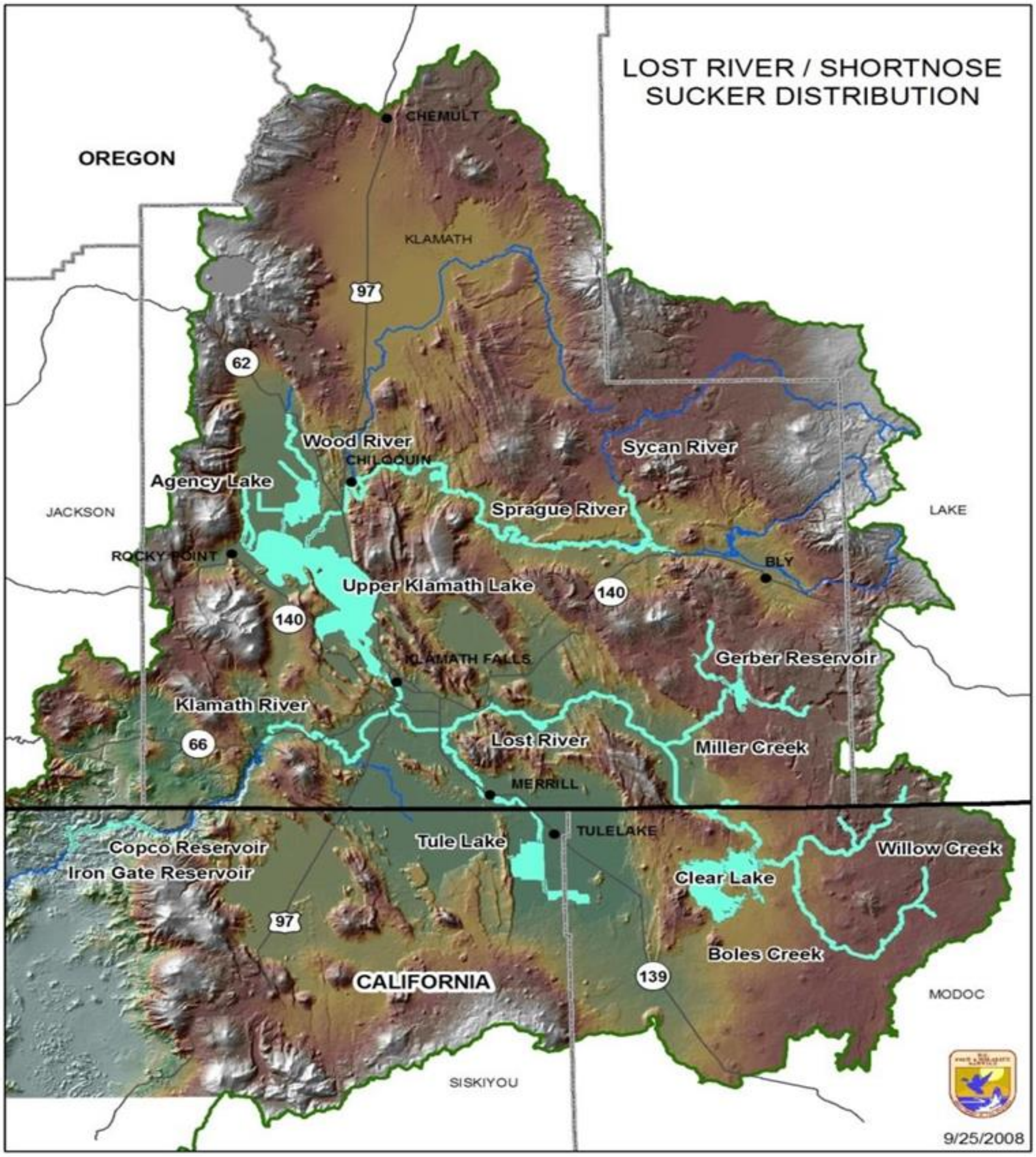


Figure 11. The Lost River and SNS are endemic to the lakes and rivers of the Upper Klamath Basin in south, central Oregon and north, central California. Lower Klamath Lake and Sheepy Lake are not depicted on the map because populations no longer occur there.

5.3.2 Current Distribution

UKL

UKL is the largest remaining contiguous habitat for endangered suckers in the Upper Klamath Basin at approximately 64,000 acres (26,000 hectares). UKL is a natural lake that was dammed in 1921 to allow for management of lake elevations both higher and lower to support irrigation deliveries. Approximately 70 percent of the original 50,400 acres (20,400 hectares) of wetlands surrounding the lake, including the Wood River Valley, was diked, drained, or significantly altered between 1889 and 1971 (Gearhart et al. 1995 p. 7). Spawning aggregations at numerous locations within the UKL system have disappeared, but LRS continue to use two spawning locations in relatively large numbers: the Williamson River and the eastern shoreline springs in UKL, and UKL contains the largest remaining population of LRS by far. SNS are only known to spawn in significant numbers in the Williamson River.

Spawning in the Williamson River and the Sprague River, its major tributary, occurs primarily in a 4.8-mile stretch continuing from the Williamson River downstream of the confluence with the Sprague to the historical Chiloquin dam site on the Sprague River. Although the Chiloquin dam was removed in 2008, only small numbers of suckers migrate beyond the historical dam site to spawn (Martin et al. 2013 p. 10).

Clear Lake

The present-day Clear Lake Reservoir ranges from 8,400 to 26,000 acres (3,400 to 10,400 hectares), depending on lake elevation. Clear Lake is a natural lake that was greatly increased in size after damming in 1910. It is a shallow, turbid lake with little wetland vegetation. The primary inflow to Clear Lake comes from Willow Creek, which is characterized by relatively flashy hydrology. Willow Creek and its major tributary, Boles Creek, contain the only known spawning habitat available to SNS and LRS in Clear Lake. There are approximately 27 miles of stream spawning and migratory habitat utilized by LRS and 65 miles utilized by SNS in this watershed. Due to the flashy hydrology, access to the spawning habitat can be reduced in years without significant snowpack to support sustained spring run-off.

Gerber Reservoir

Gerber Reservoir is only inhabited by SNS and the non-listed KLS. The dam built on Miller Creek in 1925 created Gerber Reservoir with a maximum surface area of 3,830 acres (USBR 2000a p. 12). There are two spawning tributaries, Barnes Valley Creek, and Ben Hall Creek, which combined have roughly 20 miles of potential habitat (spawning or migratory).

Other Bodies of Water

Both SNS and LRS are found in Lake Ewauna (Kyger and Wilkens 2011 p. 3), Tule Lake (Hodge and Buettner 2009 p. 4), Lower Klamath National Wildlife Refuge Unit 2, and the Lost River proper (Shively et al. 2000a pp. 82-86).

Tule Lake was extensively diked, and its volume has been greatly reduced through evaporation related to retention of water above dams and irrigation as well as diversion of water to the Klamath River as well as to Lower Klamath National Wildlife Refuge through the D Pump. The remaining lake habitat, referred to as Sump 1A and Sump 1B, is approximately 9,081 acres and 3,259 acres, respectively. Hundreds of individuals of both species were captured in Tule Lake Sump 1A prior to going dry in 2020 to 2021 (Hodge and Buettner 2009 p. 3). Spawning is not known to occur in Sump 1A; however, spawning aggregations have been observed nearby in the Lost River below Anderson Rose dam. Locations in the Lost River where historical spawning was documented, such as Olene, are inaccessible from Tule Lake due to multiple dams and inundation behind dams.

Suckers were also reintroduced into historical habitat at Lower Klamath Lake in 2023, which was disconnected from the Klamath River by railroad construction in the late 1800s and drained for agriculture in subsequent decades. Though this population is small, thanks to water deliveries to Lower Klamath National Wildlife Refuge's Unit 2 in spring 2023, there is evidence that some individuals have persisted. Suckers have also been released in other locations in the Upper Basin, such as ponds on Lakeside Farms and Westside Improvement District, both of which would have been in historical sucker habitat (UKL lake-fringe wetland and Tule Lake, respectively) before diking and draining of lakes and wetlands. However, none of these populations currently contribute meaningfully to sucker persistence or recovery.

5.3.3 Population Abundance and Dynamics

Starting in the late 1800s, large areas of sucker habitat were converted to agriculture and barriers were created that isolated populations from spawning grounds. Although there are no survey records until the 1900s, it is likely that these once superabundant species began to decline in numbers around the turn of the 20th century concurrent with significant destruction and degradation of sucker habitat. Later, from the 1960s to the early 1980s, recreational harvests of suckers in UKL progressively decreased (Markle and Cooperman 2001 pp 7-8), which reflected further declines in the LRS and SNS populations. The declines in the species' populations led to their listing under the ESA in 1988. From 1995 to 1997, water quality-related die-offs killed thousands of adult suckers in UKL (Perkins et al. 2000a pp. 11-13). Over that 3-year period, more than 7,000 dead suckers were collected, and many other suckers likely died but were not detected.

The wide-ranging behavior, expansive habitat, and rarity of these species make obtaining accurate population estimates challenging. However, long-term monitoring using capture-recapture methods provide accurate information on relative changes in abundance (Hewitt et al. 2018b, entire), and abundance can be roughly estimated for some populations based on the size of catches and the proportion of individuals that are tagged in annual sampling.

Effective population size and composition for contribution to overall resiliency and recovery of the species is also a consideration. Given the dire state of sucker populations, any additional suckers on the landscape can provide bulwark against species loss due to a catastrophic event. However, populations of at least 300 individuals comprised of half female and half male provide adequate genetic diversity to constitute an effective population (unpublished data). Given current sex distribution of the remaining suckers in the Upper Klamath Basin, it is likely that a larger number of individuals would be needed to achieve an appropriate ratio of males to females. Carrying capacity is not likely a limitation in most instances, with wild suckers likely occurring at a density of approximately 200 individuals per acre in ideal habitat (Mark Yost, personal communication, November 8, 2024). Diversity in age class is also likely a consideration, though exact proportions of any given age class within a population will vary by year, location, and survival of individuals interannually.

UKL

UKL likely contains the largest remaining populations of both LRS and SNS, though the SNS population in Clear Lake may be similar in size. Although robust abundance estimates are difficult for this population due to low recapture rates of tagged fish, these recapture rates can be used to obtain rough estimates of abundance. Capture-recapture analysis results and size composition data show that the abundance of both LRS and SNS has decreased since the early 2000s the continuing decreasing trends in UKL have been document previously (Hewitt et al. 2011, 2012, 2014, 2017, and 2018). The estimates from capture-recapture methods show that both species have experienced some years of relatively poor survival. Approximately a decade ago, abundance estimates were roughly 100,000 adult LRS river-spawners, 8,000 adult LRS shoreline-spring-spawners, and 19,000 adult SNS (Hewitt et al. 2014). However, USGS data (Krause and Paul-Wilson 2024) were used to estimate the following abundance estimates of adult suckers participating in spawning aggregations in spring 2023: 16,000 adult LRS river-spawners, 2,400 adult LRS shoreline-spring-spawners, and 5,000 adult SNS. These estimates may not reflect the true population size due to the statistical challenges of estimating abundance from the available data, particularly if some individuals skipped spawning as happened in 2018. Overall, the populations in UKL are characterized by high annual survival of adults (Hewitt et al. 2018 pp.12, 17, 21). These adults spawn successfully and produce larvae, but few juveniles survive their first year, and captures of individuals 2-6 years old is exceedingly rare (Burdick and Martin 2017 p. 30). Similarly, there has not been evidence of significant numbers of new individuals joining the adult spawning populations since the late 1990s (Hewitt et al. 2018b p. 24), and the lack of significant recruitment has led to sharp declines in population sizes (Hewitt et al. 2018b pp. 14, 20, 24).

Survival differences exist among the sucker populations in UKL. Shortnose suckers have a more variable annual survival and lower average survival than both spawning populations of LRS (Hewittt et al. 2018b, Krause et al. 2023, Krause and Paul-Wilson 2024). Adult LRS in UKL average approximately 90 percent survival annually and adult SNS is 82 percent (Krause et al. 2022 pp. 1426-1429). However, there has been a recent downward trend in survival estimates from 2016 to 2019 for all species (Krause et al. 2022 p. 1425). The trend is most pronounced for LRS and has continued since 2019 (Figure 12) (Krause and Paul-Wilson 2024). The most recent estimates of survival in 2022 had survival of 0.79 for LRS shoreline spring spawners and 0.83 for LRS river-spawners (Figure 12) (Krause and Paul-Wilson 2024). The decline in survival may be attributable to senescence as fish reach their maximum known ages (Krause et. al 2022 p. 1429). Although estimates of 2023 are not available because survival and detection probability are confounded in the last year's estimates within a

Cormack-Jolly Seber model, special concern is warranted for both LRS spawning populations as remote and physical detections on the spawning grounds have been more than halved between 2023 and 2024. Approximately 9,000 adult LRS river-spawners were detected in 2023 and only 4,000 in 2024 and 1,800 adult LRS adult shoreline-spring-spawners were detected in 2023 and only 800 in 2024 (Krause and Paul-Wilson 2024).

On January 6, 2023, USGS published a paper entitled *Water and Endangered Fish in the Klamath River basin: Do Upper Klamath Lake Surface Elevation and Water Quality Affect Adult Lost River and Shortnose Sucker Survival?* (Krause et al. 2022). This study looks at the relationship between UKL elevation and water quality and the survival of adult suckers in UKL. Using a statistical model and the long-term data adult sucker data set for UKL used for other studies (e.g., Hewitt et al. 2017, Hewitt et al. 2018b), the study found no significant relationship between interannual adult survival and water quality or lake surface elevation (Krause et al. 2022, pp. 1425-1426). The study goes on, though, to highlight the decreasing abundance and age of adult populations, owing largely to a consistent lack of recruitment of juvenile suckers into the adult population (Krause et al. 2022, p. 1429). The authors suggest that a shift in focus to the causes of poor recruitment and new conservation strategies, such as employment of captively-reared fish and conservation reintroductions (Krause et al. 2022, p. 1429).

Juvenile mortality and the resulting lack of recruitment of new individuals into the adult populations have led to steep declines in LRS and SNS populations in UKL. Although there is uncertainty about the rates of decline, the best available estimates indicate that the LRS lakeshore springs spawning population declined by approximately 56 percent for females and 64 percent for males between 2002 and 2015 (Hewitt et al. 2018b p. 10), but it is likely that the population dynamics are similar to those of the shoreline springs population. The SNS population in UKL has also declined substantially percent of males between 2001 and 2016 (Hewitt et al. 2018b p. 20).

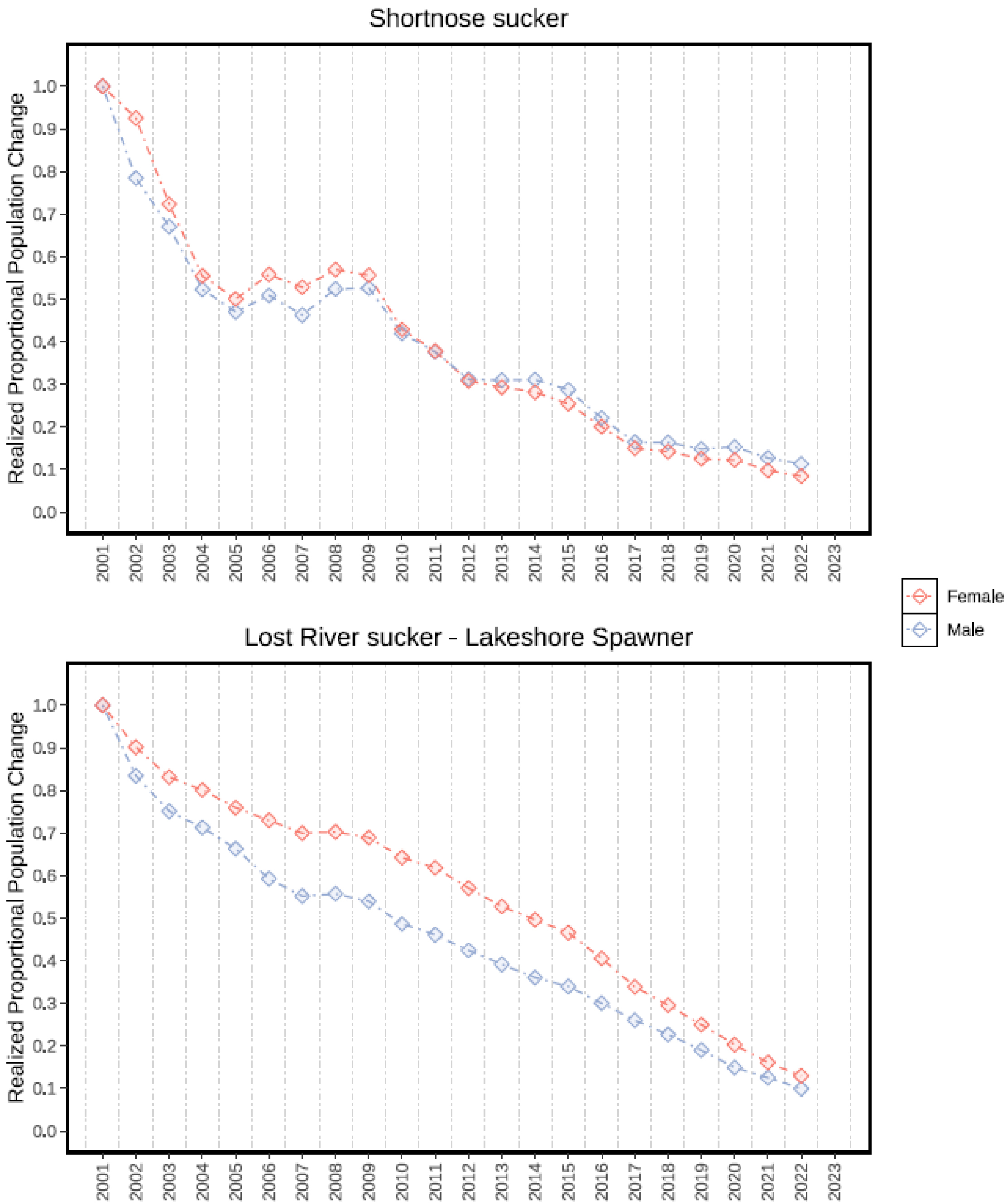


Figure 12. Annual realized proportional change in the size of the shortnose suckers and lakeshore spawning subpopulation of Lost River suckers from 2000 to 2022. Annual changes are based on λ estimates derived from separate models of annual apparent survival (Cormack-Jolly-Seber [CJS] likelihood) and seniority (reverse time CJS likelihood) probabilities, using both physical and remote encounters for survival estimates and physical captures only for seniority estimates (Krause and Paul-Wilson et 2024).

Recent LRS and SNS size distribution trends reveal that the adult spawning populations within UKL are composed of similar-sized, similar-age, relatively old individuals. Median lengths of individuals of both species in UKL generally increased between the 1990s and 2010, but since about 2010 size distributions have been more or less stable among years (Hewitt et al. 2018b pp 19, 22-23, 27, 29). This indicates that few new individuals are joining the adult populations. The fish recruited in the 1990s are now approximately 34 years old and are well beyond the average survival past maturity of 12 years for the SNS and equal to that of 20 years for the LRS.

The effects of senescence on the survival and reproduction of these two species are unknown at present, but the populations in UKL are clearly aging (Hewitt et al. 2018 pp. 15, 18, 21, Krause and Paul-Wilson. 2024 entire). The low recent survival rates could be an early signal that senescence is leading to increased mortality rates and accelerated population declines. Additional years of survival data will help to resolve whether the low survival reveals increased mortality of aging individuals or unique environmental conditions to that year.

Conservation Efforts to Improve Recruitment in UKL

Both species spawn successfully in the Williamson and Sprague rivers, producing larvae that drift downstream to UKL. Captures of 1,000s to 10,000s of larvae from the Sprague and Williamson Rivers (Cooperman and Markle 2003 pp. 1146-1147 Ellsworth and Martin 2012 p. 32) conservatively suggest that combined larval production of both species is on the order of 1,000,000s; note that these numbers are rough estimates and not a characterization of inter-annual variation, which is also substantial. Successful spawning in the Williamson and Sprague suggests that the needs of both species for spawning access and suitable egg incubation habitat are at least minimally met, although available information does not permit comparisons with historical conditions.

Larval collection efforts for hatchery rearing have been variable in recent years. During the Spring of 2023, the Klamath Falls National Fish Hatchery staff collected a total of 6,036 larval sucker from the lower Williamson River, near the town of Chiloquin, Oregon. Staff spent a total of 19 collections days on the river between the dates of May 8th and June 12th, collecting a mix predominantly of LRS and SNS with some potential for limited numbers of Klamath Largescale sucker. By contrast, in 2024, collection numbers were up from the previous year with 30,150 larvae collected despite a second year of depressed spawning numbers. It is believed that a combination of factors, such as a late and colder than normal spring, a very wet winter and spring leading to increased flows and turbidity in the river, followed by sporadic water temperature fluctuations that quickly warmed more than normal, and reduced numbers of returning adults, all contributed to a poor spawning year and thereby reduced numbers of larval fish available for collections in 2023. It is noteworthy that during 2023, larval suckers were in limited supply in the Williamson River and staff could not collect the desired number of larvae to meet the target collection goal of at least 40,000 fish.

LRS also spawn successfully at groundwater seeps along the UKL shoreline. No robust estimates of larval production at these sites exist but given the number of LRS females and average fecundity, it is likely that millions of larvae hatch annually, even with the expected high mortality of eggs. There is typically access to these areas between February and May; however, lake elevations above approximately 4,141.4 to 4,142.0 ft. are unlikely to limit the number of spawning individuals and the amount of time spent on the spawning grounds (Burdick et al., 2015b, pp. 487). The range of elevations reflects the reality that shoreline spawning occurs across a number of weeks in the spring, and the start and end dates of spawning also vary interannually. This variance is due to multiple factors, such as lake elevation, temperature, and fish behavior (Burdick et al., 2015b, p. 483). Due to this temporal variability, suckers may experience a range of elevations as spring snowmelt runoff raises lake elevations between the start and end of spawning.

Although numerous larvae are produced annually, the number of juveniles captured during sampling efforts is low and typically decreases to nearly zero in late summer. Very few individuals are captured as age-1 or older (Burdick and Martin 2017 p. 30), suggesting complete cohort failure each year. The declines in captures commonly occur during the periods with the most degraded water quality conditions in UKL, but a clear empirical link between water quality parameters and mortality rates has not been established. One prominent hypothesis is that water quality is directly responsible for the unnaturally high levels of juvenile mortality. Another is that water quality interacts with other sources of mortality by causing chronic stress that renders the individuals more susceptible to forms of predation or infection (USFWS 2019 pp. 21-41). The specific causes of repeated cohort failure at the juvenile stage are a critical uncertainty challenging recovery because juvenile mortality is the primary factor that contributes to the low resilience of both LRS and SNS populations in UKL.

Even though viable eggs and larvae are produced each year, there is a lack of recruitment of new adults into UKL sucker populations, which continue to exist only because of their long life. Although we do not know specifically how this current uniform age distribution compares to historical conditions, healthy adult populations of long-lived species should generally possess multiple reproducing year-classes. Both species are expected to become extirpated from UKL without significant recruitment, but the current dynamics are particularly untenable for the SNS. Six years ago, it was posited that without substantial recruitment in the next decade, the SNS population will be so small that it is unlikely to persist without intervention (Rasmussen and Childress 2018 p. 586). Recent population data suggest that both sucker populations have seen considerable declines during the ensuing period (Krause and Paul-Wilson., 2024, entire), highlighting the importance of the captive rearing and captive breeding programs at Klamath Falls National Fish Hatchery and the Klamath Tribes rearing facility to overcome the ongoing lack of recruitment in UKL.

The Service started the sucker assisted rearing program for LRS and SNS in 2015 to augment populations in UKL. The program has expanded, and in 2021, the rearing facility received designation as the Klamath Falls National Fish Hatchery. Since 2018, the Service has released approximately 74,018 production size (age 2 + suckers that are approximately 200 mm) suckers into UKL. Juvenile suckers grow rapidly until reaching sexual maturity sometime between four and nine years of age for LRS and between four and six years of age for SNS (Perkins et al. 2000b pp. 21-22). Less than 5,000 juvenile suckers were released each year, during the first few years (2016 to 2018) of the rearing program but production numbers have grown to over 15,000 juveniles released in 2020. It takes LRS and SNS more than four years to reach sexual maturity therefore, juveniles released during the early years of the rearing program have only recently been encountered on the Williamson and Sprague Rivers PIT tag arrays. Preliminary data suggest a 1.4 percent return on the juvenile sucker year classes, released during 2016 to 2020, of approximately 42,000 juvenile suckers (M. Yost, USFWS, personal communication October 24, 2024). Therefore, approximately 580 of the 42,000 suckers released from the rearing program have been encountered on the Williamson and Sprague Rivers PIT tag arrays during spawning migration.

Clear Lake

Data for the Clear Lake populations are very limited compared to those in UKL, but generalizations have been made below based on best available information. Clear Lake currently supports the largest populations of both suckers in the Lost River drainage. SNS and LRS survival rates in Clear Lake vary considerably among years and appear to be lower than conspecifics in UKL and more variable with some annual estimates as low as 47 percent (Hewitt et al. 2021), but the estimates are somewhat uncertain given the low detection probabilities. Hewitt et al. (2021, p. 20) found that LRS survival was much lower in 2009, 2013, and 2015 indicating that approximately 40 percent of the individuals larger than 300 mm fork length died in those years. Detections were particularly low in those years when flows were low in Willow Creek and in years when access to Willow Creek through the east lobe was limited by low reservoir surface elevations below 4,524 ft. (Hewitt et al. 2021 pp. 1,11). Size distributions of LRS in Clear Lake have few year classes represented, whereas the SNS population exhibits relatively broad representation across adult sizes (Hewitt and Hayes 2013a pp. 14, 16). The most substantial new cohort for both LRS and SNS were spawned in 2023 (first major cohort since 2016 and 2017), only 2 out of 583 samples were identified as LRS from the 2023 cohort samples (J.R. Krause, USGS, personal communication October 18, 2024) however, the SNS population in Clear Lake Reservoir is highly introgressed with KLS (Tranah and May 2006 p.313, Dowling et al. 2016 pp. 10-11), as described below in Sections 5.4.2 and 5.5.5.

Despite the inability to accurately estimate absolute abundance of the populations due to the lack of robust data, the low numbers of captures and recaptures suggests that these populations are smaller than those in UKL. This is particularly true for LRS. In Clear Lake, SNS are more abundant than LRS. During the spawning run of 2019 a total of 3,901 tagged SNS were detected; slightly more than 1,104 tagged LRS that were detected during the same time period (Hewitt et al. 2021 p. 17). Although reliable estimates of total population numbers are unavailable, the data suggest it is unlikely that more than 10,000 adult SNS and 5,000 adult LRS occur in Clear Lake. Between 2004 and 2010, only 1,360 individual LRS were captured in Clear Lake Reservoir for all years combined (Hewitt and Hayes 2013a p.6). In comparison, captures in UKL of LRS averaged over 2,000 individuals annually with more than 12,000 individuals captured during this same time period (Hewitt et al. 2017). Clear Lake is sampled in the fall whereas UKL is sampled in spring while the fish are congregated in preparation for spawning migrations, but the magnitude of the difference suggests that the LRS population in Clear Lake Reservoir is much smaller than the LRS population in UKL. The Clear Lake LRS population also appears to be much smaller than the Clear Lake SNS population. Over the 2004 to 2010 period, 4.5 times as many individual SNS (6,240 individuals) were captured in Clear Lake Reservoir compared to LRS (Hewitt and Hayes 2013a). The average annual captures of individual SNS in Clear Lake Reservoir (1,040 per year) is comparable to UKL rates (1,350 individuals), which may suggest that the population sizes are similar.

One important source of larval mortality in Clear Lake Reservoir is predation by several native or non-native aquatic species, including blue chub, fathead minnow, Sacramento perch, or bullfrog. Also, entrainment by flows through the Clear Lake dam into the Lost River appears to be a significant impact to suckers and juveniles. Although a fish screen was installed when Clear Lake dam was replaced in 2003, it is estimated around 270,000 larval and 3,600 juvenile suckers were entrained through the dam in 2013 (Sutphin and Tyler 2016). Nevertheless, when spawning conditions are suitable for producing strong annual cohorts—estimated to be slightly less than half of the years (Hewitt and Hayes 2013a)—juveniles, particularly SNS, can survive to recruit to the adult population. Evidence for this is seen in the multiple age classes of juveniles captured during sampling (Burdick and Rasmussen 2013), as well as the diverse size class distributions of adults (Hewitt and Hayes 2013a). LRS adults in Clear Lake Reservoir exhibit more restricted size class distributions and less consistent recruitment (Hewitt and Hayes 2013a). For example, a cohort that appeared in the trammel net sampling in 2007 was not evident in sampling in subsequent years, but the drivers of this mortality and the more tenuous status of Clear Lake LRS are unknown.

Gerber Reservoir

Spawning surveys of the SNS population in Gerber Reservoir in 2006 detected approximately 1,700 of the nearly 2,400 SNS that had been tagged the previous year (Barry et al. 2007 p. 7). Based on mark-recapture data from 2004 (Leeseberg et al. 2007, entire), 2005, and 2006 (Barry et al. 2007, entire), the population of SNS may have been as high as 42,000 individuals. In 2015 and in 2022, drought conditions reduced water levels within the reservoir to approximately one percent of the maximum storage. In both cases, water levels in the reservoir rebounded in the following year(s) with sufficient inflows from a normal snowpack. This undoubtedly reduced SNS numbers because of the limited available habitat, specific data is not available to accurately estimate the extent of this reduction, although Reclamation initiated population monitoring work in 2018. Similarly, due to a lack of robust data, the Service is not able to estimate survival rates.

In 2023, Reclamation adult sucker monitoring program set 40 nets over five days and handled 79 suckers, of which 5 were recaptures from past PIT-tagging efforts. USGS maintained and operated remote antenna arrays in Ben Hall and Barnes Valley tributaries to Gerber Reservoir and detected 1,168 PIT tagged suckers. Therefore, if the trammel netting recapture rate (6.329 percent) is representative of the total population, Reclamation estimated that 18,454 adult suckers reside in Gerber Reservoir (USBR 2024b, pp. 117, 121-122). Additional years of monitoring the adult sucker spawning population will better refine this estimate.

The outlet of Gerber Reservoir does not have a fish screen, so suckers are vulnerable to entrainment downstream into Miller Creek, which historically connected to the Lost River, but is now completely blocked and diverted for irrigation purposes. Small numbers of juvenile suckers (approximately 10s to 100s per year) have been caught in Miller Creek using nets, traps and electrofishing (Shively et al. 2000a p.89, Hamilton et al. 2003a pp. 3-4), but the proportion of juveniles entrained and the population impacts of entrainment are largely unknown.

Other Lakes and Bodies of Water

Insufficient monitoring data are available to determine trends for other LRS and SNS populations. For populations that rely on LRS and SNS populations in UKL as their source, the Service expects the trends in those populations to be similar to the declining populations in UKL. However, this relationship may not exist for LRS and SNS populations that have their source in other systems (i.e., the Lost River).

Data on LRS and SNS populations in Keno Reservoir, Tule Lake, Lower Klamath Wildlife Refuge Unit 2, and the Lost River are limited. Limited monitoring of these populations indicates low numbers of each species.

Lake Ewauna probably functions as a subpopulation to UKL to some degree. Hundreds of listed suckers (both species) have been captured, tagged, and translocated to UKL from Lake Ewauna since 2010 (Kyger and Wilkens 2011, USBR 2018a). The fish ladder at Link River Dam provides connectivity between Lake Ewauna and UKL. However, only small numbers of individuals have been documented using it. Although water quality conditions are consistently quite poor during late summer and early fall, small numbers of endangered suckers apparently persist in Lake Ewauna, perhaps by using the Link River as a refuge from poor water quality conditions (Piaskowski 2003 p. 9). Successful spawning in the Link River, which is the only potential spawning habitat below Link River Dam, has not been documented, though there is an anecdotal report of spawning behaviors in the river (Smith and Tinniswood 2007 p. 1).

The Klamath Basin experienced three consecutive years (2020-2022) of drought. These hydrologic conditions observed in the Klamath Basin during 2020-2022 resulted in the reduction and loss of sucker habitat including Tule Lake Sump 1A and Sump 1B. Starting in the early spring of 2021 the water from Tule Lake Sump 1A was slowly lowered and moved into Tule Sump 1B to allow access to the sump bed so that maintenance could be performed, and because the drought was making it difficult to maintain water levels in both Tule Lake Sump 1A and Sump 1B. As water levels dropped, an effort was made to capture and translocate resident suckers to other locations, ultimately resulting in the release of these individuals into UKL. The drought conditions that dried the Tule Lake sumps resulted in the loss of a LRS and SNS redundant population. In 2024, the Tule Lake sumps began refilling thanks to improved hydrologic conditions and management decisions related to the removal of Klamath River dams. Though no concerted effort was made to reestablish the Tule Lake population, suckers from the Lost River system moved volitionally into the sumps and were observed, indicating that there is once again a population of suckers in the Tule Lake sumps. Though the size and composition of this population is unknown, monitoring work in the coming months and years may illuminate the situation.

Additionally, in 2023, a small cohort of larval and juvenile suckers was released into Unit 2 at Lower Klamath National Wildlife Refuge. This included 4,003 fish from the sucker assisted rearing program's 2022-year class and approximately 13,000 larvae collected in spring 2023 from UKL. Monitoring data through the summer and fall of 2023 suggests that hundreds of these fish persisted in Unit 2, suggesting that survival and growth were possible. Provision of water for Unit 2 in 2024 has allowed habitat to persist, though it is unknown how many of the suckers released in 2023 have survived through the summer of 2024.

While there remain questions about water reliability, water management, water quality, and predation in Lake Ewauna and the refuges, it is apparent that suckers can survive in these locations. The preliminary evidence, particularly from Unit 2 at Lower Klamath National Wildlife Refuge, suggests that the factors that result in persistent mortality of juvenile suckers in UKL may not be present in other locations outside of UKL. Given the ongoing lack of recruitment in UKL and inability to pinpoint its cause, these redundant populations in other locations have taken on increased importance for the survival of the species.

5.4 Reasons for Listing and New Threats

5.4.1 Reasons for Listing

The LRS and SNS were listed because of declines in the number of populations and individuals, lack of recruitment, and loss of habitat (USFWS 1998 pp. 27130-27132). Of the populations of the LRS and the SNS that remain, most are restricted in distribution and some lack the ability to successfully reproduce.

Suitable habitat for the LRS and the SNS was drastically reduced in extent and functionality due to the historical conversion of wetlands to agricultural use and construction of irrigation and hydroelectric facilities, which drained lakes and wetlands, created barriers to spawning habitat, and caused mortality by entraining fish. The Chiloquin Dam on the Sprague River was cited as the most influential barrier at the time of listing because it blocked access to approximately 95 percent of potential river spawning habitat for UKL populations of the LRS and the SNS (USFWS 1988 p. 27131). Despite the removal of the dam in 2008, very few suckers have migrated to upstream spawning habitat (Martin et al. 2013 pp. 26-27). Many other significant physical barriers persist throughout the range of these species, limiting the ability of populations to reproduce or disperse, such as the Tule Lake populations (National Research Council 2004 pp. 53-56).

Overharvesting of adult LRS and SNS potentially contributed to declining population levels in UKL, especially for the LRS, but harvest has not been authorized since 1987 (USFWS 1988 p. 27132). Entrainment of larval and juvenile suckers into irrigation and hydroelectric structures was also cited as a threat at listing, and this loss of young fish continues to threaten these species, though several major improvements to key structures (e.g., the A Canal fish screen) have been implemented.

Nonnative fishes were identified as a potential threat to the LRS and the SNS at the time of their listing because of potential competition and predation. This threat continues to persist across the range of the species to varying degrees, and little is known about the effects of specific nonnative species.

Lastly, natural die-off events resulting from blue green algae (*Aphanizomenon flos-aquae*; AFA) blooms and subsequent degradation of water quality contribute to population declines (USFWS 1988 p. 27131). As AFA increasingly dominates the system, the frequency of extreme fish die-off events has also increased in UKL (National Research Council 2004 pp. 237-240). Although water quality conditions are most severe in UKL and Keno Reservoir, listed suckers throughout the Klamath Basin are vulnerable to water quality-related mortality (USFWS 2007a pp. 17-19, 2007b pp. 16-18).

5.4.2 New Threats Identified Since Listing

Hybridization and Introgression

Hybridization is a single interbreeding event between individuals of two species. Introgression is the subsequent incorporation of genetic materials into the genome of the species resulting from numerous hybridization events (i.e., back crossing). Introgression is common among suckers in general and well documented among the Klamath catostomids, particularly between SNS and Klamath largescale sucker (KLS; *Catostomus snyderi*) and especially in the Lost River drainage (Dowling et al. 2016 p. 3). Ongoing introgressive hybridization is generally viewed as a negative because it potentially reduces diversity as the genes of the less numerically dominant species are replaced by the alternate species. Additionally, this process may also reduce fitness if individuals are less adapted phenotypically to exploit specific niches within an environment. Depending on the degree of this reduction, it could result in lower survival rates and reduced population resiliency. It is also possible that introgression increases diversity by introducing new and beneficial mutations into species genomes. This would possibly increase diversity both within and among populations (Dowling et al. 2016 p. 2), but for rare species it is more likely that introgression will result in a reduction of the integrity of the genome as genes from more common species overwhelm the rare species (Rhymer and Simberloff 1996 p. 83).

Climate Change

Climate variability, such as fluctuations between wet and dry periods, is part of natural processes; however, climatic models suggest that much of the recent trends in climate are driven by anthropogenic causes (Barnett et al. 2008 p. 1082). Annual average temperatures in the Upper Klamath Basin have already risen 1° to 2.7° F since 1895 depending on the dataset (Halofsky et al. 2022 p. V) and are expected to rise 2.1 to 3.6 °F from the 1960-1990 baseline by the decade of 2035-2045 due to climate change (Barr et al. 2010 p. 8, Risley et al. 2012 p. 4). At present, air temperatures that primarily drive water temperature conditions lethal to suckers do not occur, but stressful water temperatures for suckers occur with regularity, particularly in late summer and early fall (see Section 5.5.3). Climate change may increase the frequency and duration of these stressful temperature events and is likely to make high stress events more common.

Future changes in precipitation are highly uncertain. Due to the geography of the Upper Klamath Basin, annual precipitation may increase or decrease overall under climate change (Barr et al. 2010 p. 8, Risley et al. 2012 p. 4). However, climate models consistently predict that a larger proportion of annual precipitation and run-off will occur as rain events in the winter (Barr et al. 2010, Risley et al. 2012). Warmer temperatures during the winter are also projected to reduce the proportion of precipitation falling as snow (McCabe et al. 2018 p. 812).

Precipitation in the form of snow acts as a reservoir within a hydrologic system, storing water in the form of snowpack and providing more gradual and manageable input into the lakes than rain. Altered precipitation has been observed in the basin over the past several years relative to historical observations, with overall average snowpack at or below median in the last 3 out of 5 winters.

It is difficult to predict the long-term effects of precipitation changes to suckers, but it is expected that the dynamics of spring flows will be altered. Potential changes include a reduction in volume of snowmelt runoff and a shift in the start and peak timing of snowmelt runoff entering the system (Fritze et al. 2011 p. 1004). Models of the basin indicate a reduction in summer and fall flows ranging from 17 percent in the Sprague to 26 percent in the Williamson Basin (Aldous et al. 2011a p. 226). The potential changes in volume and timing of snowmelt runoff are of largest concern for suckers during the spawning season because low inflows or altered timing of inflows can impact lake elevations necessary to provide spawning and rearing habitat, alter flow timing and temperature signals for adult spawners, and/or shift water quality dynamics in UKL. Shifts in both flow timing and volume may also restrict access to spawning areas in smaller watersheds, such as those entering Clear Lake and Gerber Reservoir, and reduce reproductive success.

In the near-term, the previous drought may give us some indication of how climate change may affect suckers. Limited water supply in 2020, 2021, and 2022 led to a failure to meet UKL elevations necessary for spawning and rearing and resulted in decreased spawning and rearing habitat in UKL. During this period, access to spawning was restricted in Clear Lake as well, due to low lake elevation and low tributary flow limiting access up and into Willow Creek. This decrease in habitat may have been associated with decreased spawning vigor in UKL, but there are other factors that may also have contributed to reduced vigor (e.g., water temperature, flow conditions; Burdick et al. 2015c). Drought was also the primary factor behind the complete loss of habitat in the Tule Lake sumps from 2021 to 2024, though Reclamation has proposed a direct allocation of 23,000AF of water for the Tule Lake sumps to restore habitat and ensure habitat loss does not occur again. The continued impacts to suckers under an altered climate regime are unclear, but it is worth noting these potential impacts to the species and potential remedies.

Predation, Parasitism, and Disease

Although not mentioned at the time of listing as a threat, several bird species prey on LRS and SNS, but the ultimate effect to the status of the species from these avian predators is currently unknown. See Section 5.5.9 for a detailed discussion of avian predation. Similarly, parasites were not identified as a threat at the time of listing, but new information suggests they could be a threat to the suckers. See Section 5.5.10 for a detailed discussion of parasitism of LRS and SNS.

Microcystin, an algal toxin that can affect the liver, as well as other algal toxins are another possible threat that was not considered during the listing process. In UKL microcystin concentrations tend to be highest in August and September but can show substantial variation across sites and among years (Caldwell Eldridge et al. 2012, 2013). In a 2007 survey, 49 percent of a sample of juvenile suckers (n = 47) collected at 11 shoreline sites exhibited indications of microcystin exposure (VanderKooi et al. 2010, entire). However, these data were preliminary, and further research on this hypothesis failed to provide confirmation (Martin et al., 2019, entire). Nevertheless, one hypothesis is that the toxin is indirectly ingested when suckers consume midge larvae (Chironomidae), which feed on the algae (Burdick and Martin 2017 p.2). Juvenile LRS fed microcystin toxins through various means in a controlled experiment consistently failed to show acute mortality within the 96-hour observation period and exhibited relatively few histological abnormalities (Burdick and Martin 2017 p.8). These latter results suggest that microcystin in UKL may not be a significant source of mortality to juvenile LRS.

5.4.3 Recovery Needs

The 2013 revised recovery plan for the LRS and SNS (USFWS 2013) describes recovery objectives for the LRS and SNS:

Threat-based Objectives

- Restore or enhance spawning and nursery habitat in Upper Klamath Lake and Clear Lake Reservoir systems.
- Reduce negative impacts of poor water quality
- Clarify and reduce the effects of non-native organisms on all life stages
- Reduce the loss of individuals to entrainment
- Establish a redundancy and resiliency enhancement program

Demographic-based Objectives

- Maintain or increase larval production
- Increase juvenile survival and recruitment to spawning populations
- Protect existing and increase the number of recurring, successful spawning populations.

5.4.3.1 Recovery Units

The 2013 revised recovery plan for the LRS and the SNS identified two recovery units for both of the sucker species, and both recovery units have four management units (USFWS 2013 pp.40-41). Recovery cannot occur without viable populations in each recovery unit; however, this does not mean that each management unit has equivalent conservation value or is even necessary for species recovery. Viable populations are ones that are able to complete their life cycle regularly with recruitment and diverse age composition of the adult population.

The UKL Recovery Unit is subdivided into four management units:

(1) UKL river-spawning individuals;

(2) UKL spring-spawning individuals (LRS only);

(3) Keno Reservoir Unit, including the area from Link River Dam to Keno Dam; and

(4) Reservoirs along the Klamath River downstream of Keno Dam, known as the Klamath River Management Unit. This Recovery Unit no longer exists as of February 2024 due to dam removal on the Klamath River.

The Lost River Recovery Unit is also subdivided into four management units:

(1) Clear Lake;

(2) Tule Lake;

(3) Gerber Reservoir (SNS only); and

(4) Lost River proper (mostly SNS).

The 2013 LRS and SNS Recovery Plan provided criteria to assess whether each species has been recovered are focused on reduction or elimination of threats, and demographic evidence that sucker populations are healthy (USFWS 2013). The threats-based criteria for down-listing include: (1) restoring and enhancing habitats, including water quality; (2) reducing adverse effects from nonnative species; and (3) reducing losses from entrainment. To meet the population-based criteria for delisting each species must exhibit an increase in spawning population abundances over a sufficiently long period to indicate resilience, as well as establish spawning subpopulations within UKL.

5.5 Environmental Baseline of LRS and SNS in the Action Area

The Endangered Species Act regulations define the environmental baseline as "the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the PA. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline" 50 CFR 402.02. The environmental baseline analysis provides a reference point for the Service to assess the potential effects of the PA on listed species.

For section 7 consultations on continuing actions, such as Project operations, separating baseline effects from the anticipated effects of the PA can be difficult. Operations of existing structures, such as dams and associated infrastructure, are integrally related to the existence of the structures themselves; however, the structures are already present when new operations are proposed and therefore are part of the environmental baseline. For example, on the east side of the action area, Clear Lake and Gerber Reservoir Dams exist to maintain storage in these water bodies independent of this action. Because these dams are already present, their existence is not an effect of the action (i.e., proposed project operations); rather it is part of the environmental baseline. The effects of the PA are the effects of operating the existing structures to store, deliver, and drain water.

5.5.1 Habitat Characteristics of the Action Area

The action area encompasses the Klamath Basin's hydrologic system that consists of a complex of interconnected rivers, canals, lakes, marshes, dams, diversions, wildlife refuges, wilderness areas, and agricultural lands in Klamath County, Oregon, and Siskiyou and Modoc Counties, California. The volume of water available in the action area at any one time depends on a variety of weather and climate factors including the amount and timing of precipitation, the percentage of precipitation occurring as snow versus rain, snow-water equivalent, air temperature, wind speed and direction, relative humidity, and other factors. Water quantity can affect the amount of available habitat in the Klamath Basin's hydrologic system and the connectivity among habitats. The action area is a highly altered system that consists of a complex network of water storage, diversion, and conveyance features including reservoirs, lakes, dams, diversion dams, canals, laterals, and drains. This water conveyance system provides water for agricultural use to approximately 230,000 acres of farmland conveyed through approximately 675 miles of canals and laterals (USBR 2024, p.3). Irrigation return flows and local runoff is collected from irrigated lands through approximately 545 miles of drains (USBR 2024, p.3). Approximately 50 separate pumps are used to convey irrigation and drainage water to different portions of the Project (USBR 2024, p.3).

The Klamath Basin experienced severe drought conditions for three consecutive years 2020-2022. The hydrologic conditions observed in the Klamath Basin, during drought years, resulted in the reduction and loss of sucker habitat during this multi-year drought period including, lower elevations in UKL during spawning and rearing periods that limited habitat availability and access for life stages, limited to no spawning access to Willow Creek from Clear Lake Reservoir, and the loss of sucker habitat in Tule Lake Sump 1A and Sump 1B until 2024. Recent hydrologic conditions in the Klamath Basin have been drier than normal with seven of the last ten years having below median total inflow to UKL and 2020, 2021, and 2022 ranking as the fifth, second, and fourth driest years, respectively, by total inflow in the last forty years. The three consecutive years of drought conditions resulted in the Tule Lake sumps going dry, resulting in the loss of a LRS and SNS redundant population. The Tule Lake sumps are refilled, however decomposing terrestrial vegetation combined with sediment nutrient flux associated with re-wetted peat soils will result in altered water quality (specifically dissolved oxygen, pH, and nutrient levels) for several years. The Service expects water quality and aquatic habitat conditions to improve over time as the sump remains wetted.

The Klamath River Renewal Corporation initiated construction and removal of the four Lower Klamath Hydroelectric Project dams (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) in 2023 on the Klamath River. Copco No. 2 diversion dam was removed in the summer of 2023. Power generation at J.C. Boyle, Copco No. 1, and Iron Gate powerhouses ceased January 2024. The removal of the remaining three dams began in spring 2024 and was fully completed on September 30, 2024, resulting in a free-flowing Klamath River from Keno Dam to the mouth of the river.

Additionally, wetland restoration on Upper Klamath National Wildlife Refuge started in the summer of 2024 (USFWS 2023b p. 1) and additional restoration is scheduled to be implemented in the fall 2024. The restoration scheduled in the fall of 2024 will reconnect Agency-Barnes to Upper Klamath Lake. The ensuing wetland restoration will restore a full gradient of wetlands (open water, submergent, emergent, and seasonal fringe) by reconnecting more than 14,000 acres of these units to Upper Klamath and Agency lakes and increase the amount of rearing habitat available to LRS and SNS in Upper Klamath Lake.

Existing Conditions in the Action Area

As discussed in the status of the species section above, the current available habitats for LRS and SNS in the action area include three spawning populations located in UKL, Clear Lake Reservoir, and Gerber Reservoir. UKL is the largest remaining contiguous habitat for endangered suckers in the Upper Klamath Basin, at approximately 64,000 acres. The eastern shoreline springs in UKL contains the remaining spawning aggregations for a sub-population of LRS shoreline spawners. LRS and SNS river spawning in the Williamson River and Sprague River, its major tributary, occurs primarily in a 4.8-mile stretch continuing from the Williamson River downstream of the confluence with the Sprague to the historical Chiloquin dam site. Clear Lake Reservoir ranges from 8,400 to 26,000 acres, depending on lake elevations. Willow Creek and its major tributary, Boles Creek, contain the only known spawning habitat available to SNS and LRS in Clear Lake Reservoir. There is approximately 27 miles of stream spawning and migratory habitat utilized by LRS and 65 miles utilized by SNS in this watershed. Gerber Reservoir is only inhabited by SNS and the non-listed KLS and has a maximum surface area of 3,830 acres. Gerber Reservoir has two spawning tributaries, Barnes Valley Creek, and Ben Hall Creek, which combined have 20 miles of potential spawning and migratory habitat.

Other waterbodies that contain small populations of both LRS and SNS are found in Lake Ewauna, Tule Lake sumps, Lower Klamath National Wildlife Refuge Unit 2, and the Lost River proper. Lake Ewauna is approximately 350 acres in size, and it is the headwaters of the Klamath River, fed by the Link River from UKL. It is a constant level throughout the year, controlled by releases from Keno Dam, approximately 18 miles south. Tule Lake Sump 1A and Sump 1B, is approximately 9,081 acres and 3,259 acres respectively. Spawning aggregations have historically been observed nearby in the Lost River below Anderson Rose dam. Locations in the Lost River where historical spawning was documented, such as Olene, are inaccessible from Tule Lake due to multiple dams and inundation behind dams. Though in accessible due to multiple dams, both LRS and SNS are found in the Lost River proper. In 2023, LRS and SNS were reintroduced into historical habitat at Lower Klamath National Wildlife Refuge's Unit 2 as an auxiliary population.

Loss and alteration of habitats (including spawning and rearing habitats) were major factors leading to the listing of both species (USFWS 1988 pp.27131-27132) and continue to be significant challenges to recovery. Both species utilize a spectrum of aquatic habitats during some stage of the life cycle, including river or stream habitats, open-water lake habitats, and wetland areas along banks and shores. However, alterations or total loss of habitats have occurred throughout the species' range. The most dramatic examples of wholesale habitat loss include Tule Lake (roughly 89,000 acres lost) and Lower Klamath Lake (roughly 100,500 acres lost) (National Research Council 2004 p.53). These two lakes were both terminal bodies with a single major tributary, which were dammed in 1910 or diked in 1917 (respectively) to completely block inflows (National Research Council 2004 pp. 55-56). This resulted in a loss of approximately 151 mi^2 or 88 percent of Tule Lake and 140 mi^2 or 95 percent of Lower Klamath Lake (National Research Council 2004 p.96). As the lake levels receded, the exposed lake bottoms were converted to agricultural uses. Prior to damming, Tule Lake hosted what was probably the largest population of LRS (Bendire 1889 p.444). Anecdotal reports suggest that populations of LRS also occurred in Lower Klamath Lake (Cope 1879 p.72), although the Service is not aware of any pre-1917 reports on scientific fish surveys of the Lower Klamath Lake. Notable habitat loss also occurred in UKL. Approximately 70 percent of the original 50,400 acres of wetlands surrounding the lake, including the Wood River Valley (Figure 13), was diked, drained, or significantly altered between 1889 and 1971 (Gearhart et al. 1995 p.5). Even with this habitat loss, UKL is the largest remaining contiguous habitat for suckers in the Upper Klamath Basin at approximately 64,000 acres (26,000 hectares). Additional habitat suitable for suckers was created in the action area when reservoirs were created behind Gerber Dam and enlarged behind Clear Lake Dam.

Barriers that limit or prevent access to spawning habitat were also identified as threats when the species were listed. Chiloquin Dam was cited as the most influential barrier because it restricted access to potentially 95 percent of historic river spawning habitat in the Sprague River for the populations in UKL (USFWS 1988). However, this dam was removed in 2008, improving access to approximately 120 km (75 mi) of river for spawning. Both species have been detected upstream of the dam site during the spawning season, albeit in very small numbers (Martin et al. 2013). Additionally, several dams or water control structures hinder or completely impede movements of the species throughout their historic range. These include Gerber Dam, Clear Lake Dam, Anderson Rose Dam, Harpold Dam, Lost River Diversion Dam, Malone Dam, as well as numerous smaller check dams and the like (USBR 2000b). All of the more substantial dams (i.e., the named ones above) were installed approximately 100 years ago, and none of them, except Link River Dam, have structures that would permit volitional fish passage. For example, suckers attempting to run up the Lost River from Tule Lake Sump 1A are only able to travel 12 km (7.5 mi) before the Anderson-Rose Dam blocks migration. The connection between UKL and downstream environments was questionable for many decades because of a dilapidated fish passage ladder on the Link River Dam. This condition improved with the completion of a sucker-friendly fish ladder in 2005.

Another equally important type of barrier is limited hydrologic connection to spawning or rearing habitat. This can be due to natural climatic patterns or result from human actions, such as water management for agricultural irrigation. For example, low lake levels in Clear Lake Reservoir can limit adult sucker access to Willow Creek (Hewitt and Hayes 2013a), the only known spawning tributary (Buettner and Scoppettone 1991b). When conditions permit access, adults ascend Willow Creek, the single major tributary flowing into Clear Lake Reservoir, spawn successfully, and produce juvenile cohorts in Clear Lake Reservoir (Buettner and Scoppettone 1991b, Sutphin and Tyler 2016). The amount of suitable shoreline spawning habitat in UKL is also affected by changes in lake elevation (Burdick et al. 2015c). Several spring-spawning populations, including Tecumseh Springs, Big Springs, and Barkley Springs, have been extirpated, in part due to reduced connectivity.

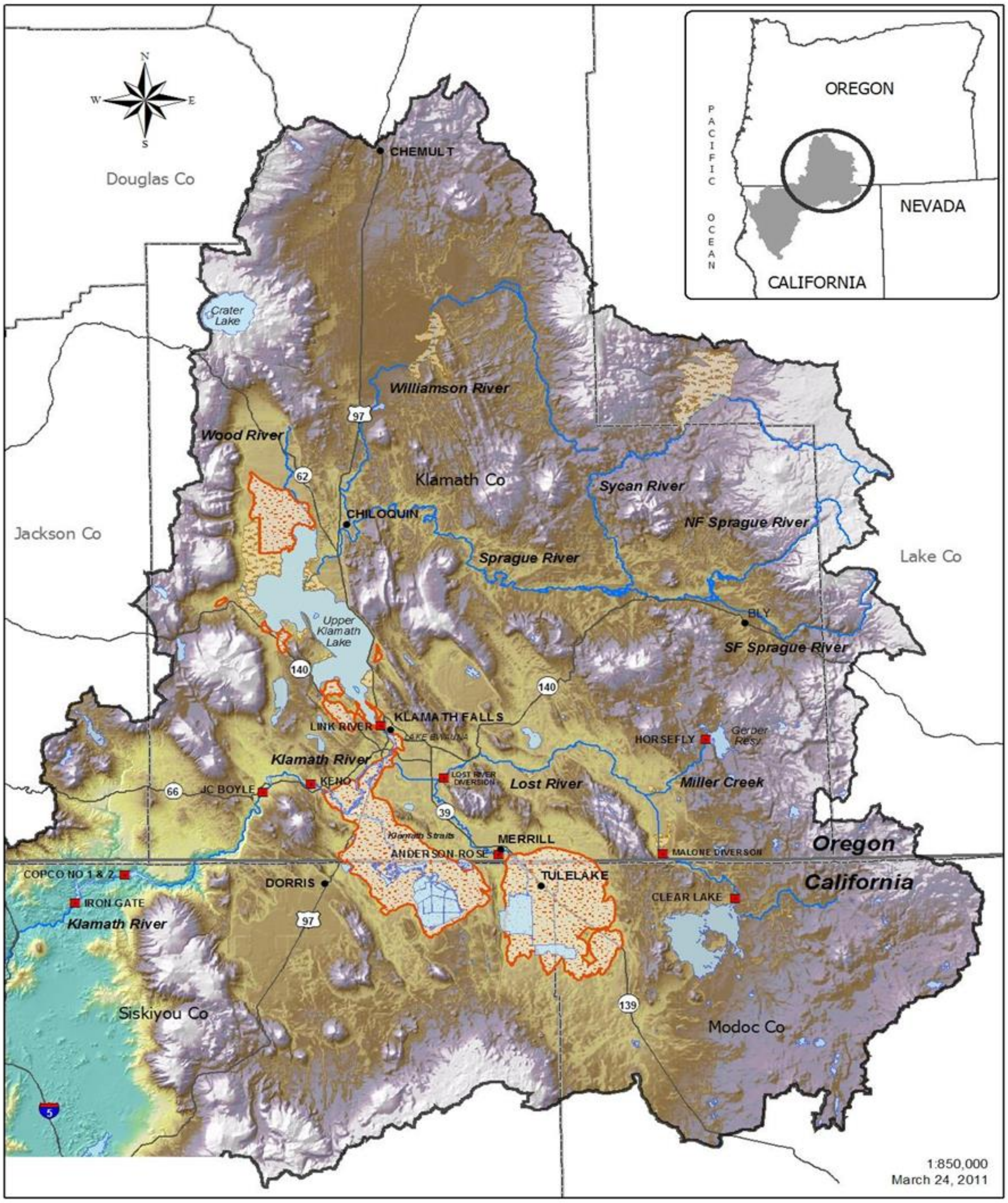


Figure 13. The upper Klamath Basin indicating areas of lost aquatic and wetland habitat that have been lost since 1900 with current conditions overlain. The lost areas are outlined in orange.

Historically, wetlands comprised hundreds of thousands of hectares throughout the range of the species (Akins 1970, Gearhart et al. 1995, Bottorff n.d.), some of which likely functioned as crucial habitat for larvae and juveniles. Other wetlands may have played vital roles in the quality and quantity of water. Loss of ecosystem functions such as these, due to alteration or separation of the habitat, is as detrimental as physical loss of the habitat. For example, increases in sediment input to the lake and occurrence of AFA coincide with loss of riparian and wetland areas associated with agricultural development above UKL (Bradbury et al. 2004). Higher inundation of fringe wetland habitats has been associated with higher larval survival in UKL (Cooperman et al. 2010). Of the approximately 39.3 mi^2 of wetlands still connected to UKL, relatively little functions as rearing habitat for larvae and juveniles, partly due to lack of connectivity (e.g., hydrologic, migratory movement) with current spawning areas and habitat alterations.

5.5.2 Water Quantity

The volume of water available in the action area at any one time depends on a variety of weather and climate factors including the amount and timing of precipitation, the percentage of precipitation occurring as snow versus rain, snow–water equivalent, air temperature, wind speed and direction, relative humidity, and other factors. Water quantity can affect the amount of available LRS and SNS habitat and the connectivity among habitats used in different seasons. In UKL, anthropogenic actions such as groundwater pumping and surface water diversions in areas tributary to the lake, or from the lake itself, also affect the available volume of water. For the purposes of this Opinion, these factors are not described individually because they are expressed jointly as the net inflow of water to UKL. Direct measurement of flow into UKL is not possible; therefore, net inflow is calculated based on the change in storage in the lake (change in the volume of water in the lake) and measured outflow.

Net Inflow = Change in lake storage + measured outflow

Annual net inflow to UKL during the POR (1991-2022) ranged from a low of 592,932 AF (1992) to a high of 1,759,714 AF (1999). The average and median annual net inflows during the POR are 1,070,092 and 980,688 AF, respectively. Approximately 48 percent of the annual inflow occurs between October and February, 44 percent between March and June, and 8 percent between July and September.

The change in storage is calculated based on a weighted average of lake surface elevation at three widely spaced gages and an elevation-capacity relationship (USBR 2018b app. C). Outflow from the lake is measured on the Klamath River below the Link River Dam and at the A Canal diversion. Losses from evaporation and gains from direct precipitation and groundwater discharge into the lake are not measured; however, these losses and gains are manifested in the change in storage.

The primary subbasins draining into UKL are the Sprague, Williamson, and Wood River basins. The Sprague River flows into the Williamson River near Chiloquin, Oregon, several miles above the point where the Williamson River flows into UKL. Each basin displays a distinct hydrologic flow regime and a varied hydrologic type. The Sprague River demonstrates a mixture of spring snowmelt with a small groundwater supplementation (Aldous et al. 2011b pp. 225-226). The Upper Williamson River shows a strong groundwater connection, with greater than 70 percent of annual discharge coming from subsurface flows (Gannett et al. 2007 pp. 27-28). The Wood River, originating in the watershed of Crater Lake, is not snowmelt dominated, but remains nearly 100 percent groundwater supplied through the geology and high volume of water that falls and infiltrates into the aquifer(s) of the Cascade Range (Gannet et al. 2007, pp. 29-31).

There is a very strong relationship between flow in the Williamson River below its confluence with the Sprague River and net inflow to UKL (Garen et al. 2011 p. 11). Therefore, evaluation of trends in net inflow is enhanced by understanding trends in flow in the Williamson River below the confluence with the Sprague. Additionally, because the Williamson is largely disconnected from the primary snowmelt-runoff production of the Cascade Mountain range the flows demonstrated at Williamson River outlet are a reasonable indicator of hydrology for a majority of the Upper Klamath Basin.

Evaluation of baseline hydrology involved the analyses of flow data for the Lower Williamson River (used as a proxy for total UKL inflow) and surface elevation data for Clear Lake and Gerber Reservoir. Though the PA was based upon a POR spanning water years 1981 through 2022 consideration of baseline hydrology extends to the broadest period of reliable data available for these sites. Williamson River flow data exists from water years 1918 through 2023; Clear Lake data encompass water years 1905 through 2023; and Gerber Reservoir data run from water year 1926 through water year 2023.

Williamson River flow data were taken from USGS gage 11502500 Williamson River below Sprague near Chiloquin, OR at a daily time step. All data are labeled as approved for publication by USGS. Daily flow data in cfs were converted to a daily volume in TAF. Daily volumes were summed for each water year to give a total annual volume of water passing by the USGS gage site and plotted by water year (Figure 14). As these annual data are highly variable, a locally estimated scatterplot smoothing (LOESS) technique was applied to the data to illustrate trends across the observed POR.

Flow volumes were at their lowest in the last century during the 1917 to 1937 period, with annual flow volume hovering around 600 TAF. A marked increase in flow volume occurred during the 1940s and peak Williamson flow volumes for the observed period occurred in the mid-1950s. Since this time, a general downward trend has been observed. In the last decade, flow volume has trended toward levels not seen since the driest period on record. Also of note is the persistence of hydrologic trends across the POR. Flow trends do not alter rapidly. The most rapid change observed was the ascendant arc of flows from lows in the 1930s to peak values in the mid-1950s; this change manifested over the course of 20 years. The current downward trend has lasted approximately 50 years with 2021 being the second driest year in the by total inflow to UKL and the driest by precipitation for the year.

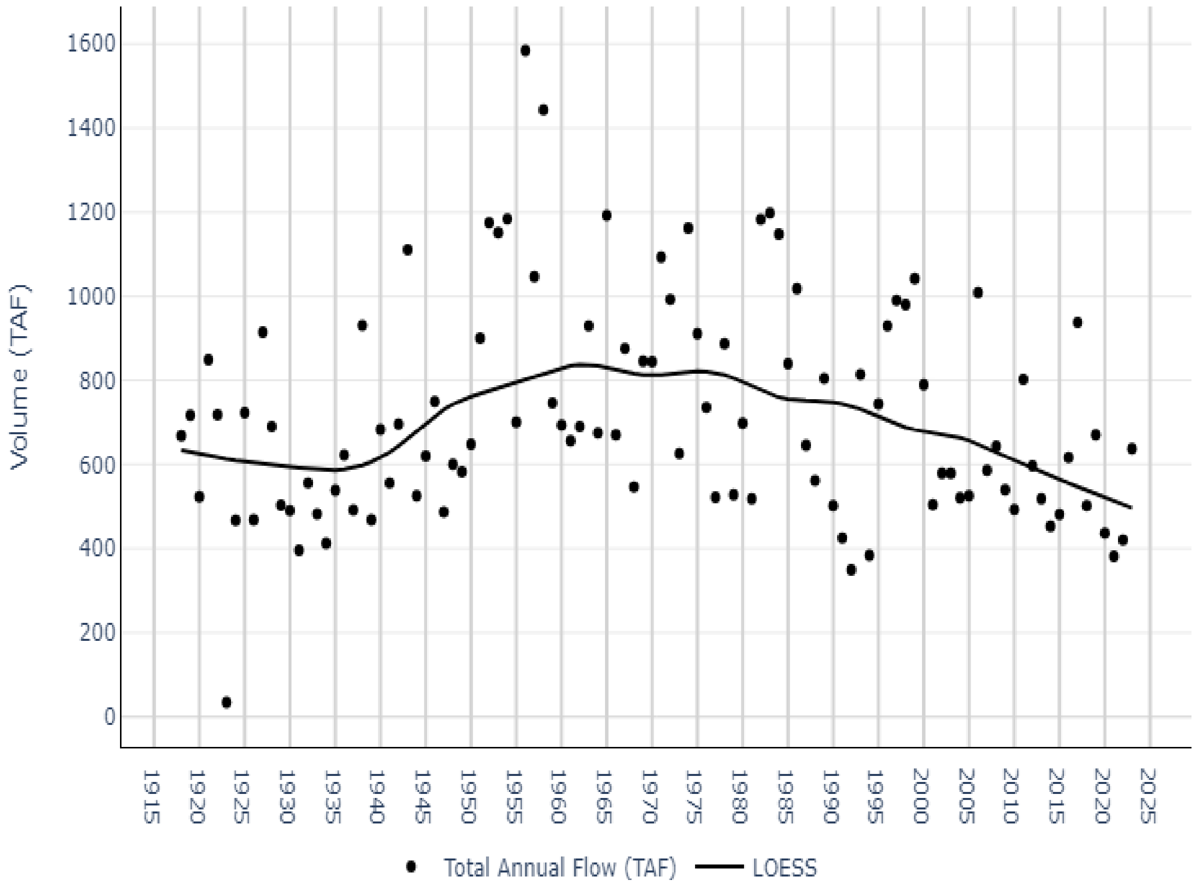


Figure 14. Total volume recorded annually at USGS gage 11502500 Williamson River below Sprague River near Chiloquin, OR for water years 1918 – 2023 and a LOESS smooth of these data. Note the outlier year of 1923; a gage malfunction resulted in the loss of flow data from 10/1/1922 through 8/30/1923.

The Williamson River, which includes flows from the Sprague and Sycan Rivers, constitutes approximately half of the total inflow to UKL, making it a reasonable proxy for UKL inflow (Perry et al. 2005, Stannard et al. 2013). Additional inflow sources are the Wood River, Cascade Mountain snowmelt runoff via streams and subsurface throughflow, and numerous springs and groundwater seeps. These additional sources of inflow have short or nonexistent periods of recorded flow and are unlikely to increase in magnitude by enough to make up for any shortfall in Williamson River contribution. Figure 14 illustrates the past 100 years of recorded Williamson flows and points to several trends. Currently, Williamson River flow volume indicates an ongoing 50 year decreasing trend. This trend is unlikely to alter significantly in the next 5-10 years. Assuming that Williamson River flow volume is still indicative of overall UKL inflow, this suggests that UKL inflow is also likely to trend downward for the next decade.

In addition to indicating trends in UKL inflow, the Williamson River flow volume may also be a bellwether for overall hydrology across the Upper Klamath Basin. The downward trend in Williamson River flow volume may be a symptom of drier hydrology: less precipitation, lesser and more ephemeral snowpack, and less interannual groundwater recharge. Hydrographs of the Upper Williamson River, Sprague River and data from Clear Lake and Gerber Reservoir show similar trends. Though these are water surface elevations from reservoirs, they also point to a recent period of interannual decline in basin-wide hydrology. This maybe the beginning of diverging hydroclimates between the Wood River sub-basin and Williamson and Sprague sub-basins, as predicted by some climate change models that indicate that the western side of the Klamath Basin (located in the Oregon Cascades) may be less affected by rising temperatures. Research has shown that due to higher elevation, topography and geographic location, snowpack in the Oregon Cascades may be less affected by climate change than lower elevations on the eastern side of the Upper Klamath Basin (Mayer and Naman 2011).

Clear Lake is a large, shallow lake situated south and east of UKL, within the closed Lost River basin. It was dammed and enlarged beyond its historic footprint by the Bureau of Reclamation to act as an evaporative lake and reservoir, removing water from the Lost River system in times of high flows and providing irrigation water in the spring and summer. Clear Lake has a single major tributary, Willow Creek, with a short period of recorded flow (since 2012). Likewise, Gerber Reservoir, the only true reservoir managed by the Klamath Project, is utilized for storage and delivery of irrigation water. Gerber Reservoir was created by impounding Miller Creek, an ungauged stream. Both of these reservoirs, though very different from the Williamson River, show signs of drier hydrology in recent years.

Lake surface elevation data for Clear Lake and Gerber Reservoir were provided as end of month values by the U.S. Bureau of Reclamation Klamath Basin Area Office. These monthly data were averaged to an annual mean value for their respective periods of record. A LOESS trend line was fitted to the data. The pattern of the trend line for Clear Lake surface elevation shows broad similarity to the Williamson River flow volume data (Figure 15). A period of low surface elevations accompanies the drier 1920s and 1930s, followed by a general rise in surface elevations coinciding with wetter conditions through the 1940s and 1950s. Clear Lake shows relative stability with a gradual increasing trend through the late 1970s. Thereafter, average annual Clear Lake surface elevations exhibit a gradual downward trend that steepens noticeably in 1993.

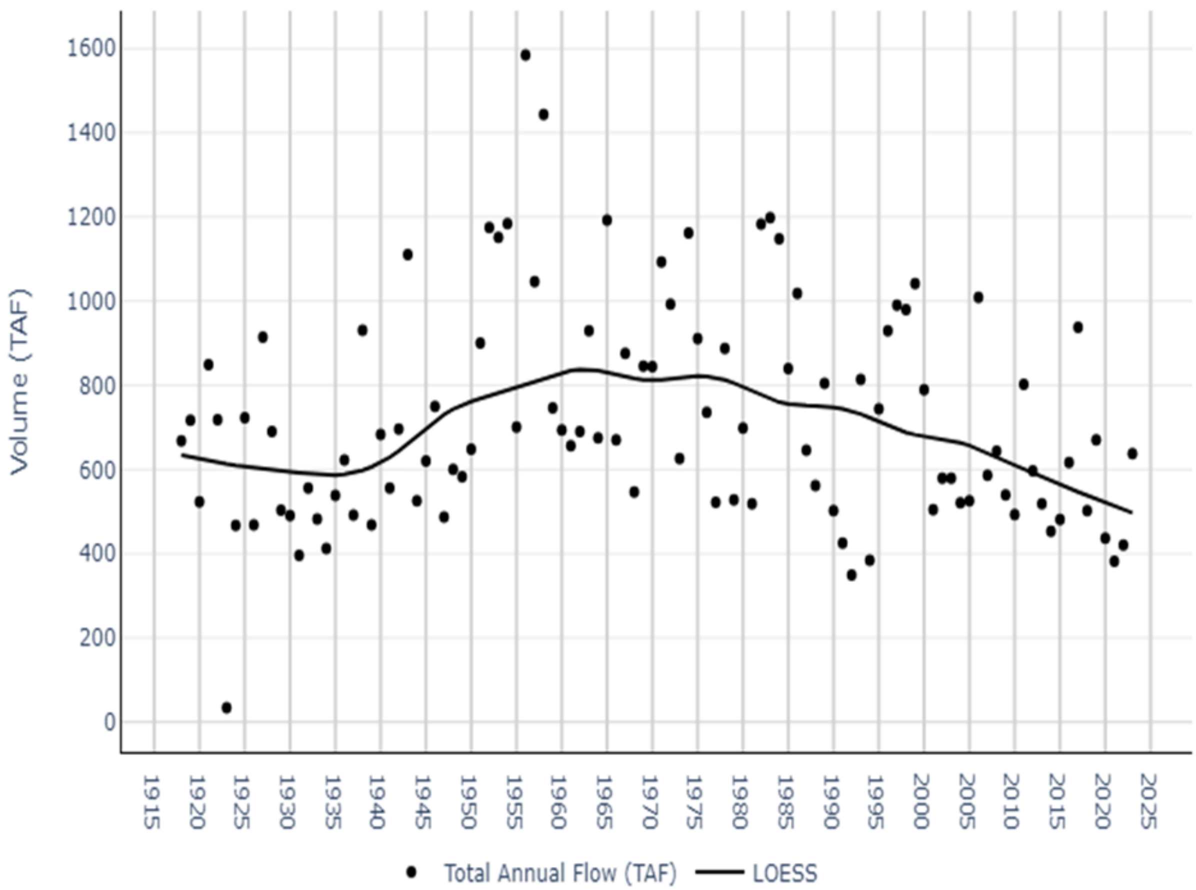


Figure 15. Average annual Clear Lake surface elevations for water years 1905 – 2023.

Gerber Reservoir surface elevations show less obvious similarity to the Williamson River, though this is likely due to it being a true reservoir and being operated as such (Figure 16). The hydrologically dry period during the 1920s and 1930s show a steady increase in reservoir storage, as might be expected during drought. A decline in the 1950s indicates less need for stored water and the need to maintain freeboard for additional flood storage. Surface elevation then increases through the 1970s and stabilizes through the 1990s. However, there is a marked and steep decrease in annual surface elevations beginning in 2003 and continuing through the present. Though this decline in Gerber Reservoir surface elevations differs in timing and duration from those observed in Clear Lake and the Williamson River, it nonetheless indicates a current period of drier hydrology and declining water storage.

Figure 16. Annual average Gerber Reservoir surface elevations for water years 1926 – 2023.

Consideration of data from across the Upper Klamath Basin for the last century or more points to the likelihood of a continuing trend of drier hydrology for the next 5-10-year period. The Williamson River, Clear Lake, and Gerber Reservoir have all experienced the effects of declining flows for at least the past decade, if not longer. Even if these trends begin to alter in the near term, hydrologic evidence suggests that this alteration will not occur rapidly enough to have a significant impact on hydrology in the next decade. The data indicates that planning for continued dry hydrology, with the possibility of increasingly dry conditions, is warranted.
Of note for this discussion is the impact of climate change on future hydrology. Climate change and its impacts are very difficult to predict, with models returning widely varying results as to the timing and magnitude of precipitation and runoff and the changes in temperature. However, there is general agreement that temperatures will increase, particularly in summer months (Barr et al. 2010 p. ii). This is likely to result in increased evapotranspiration and greater demand on water supplies during irrigation seasons. It also appears likely that there will be a shift in the ratio of winter precipitation types, with a greater proportion of precipitation falling as rain rather than snow (USBR 2016). This is likely to increase winter runoff and decrease snowmelt percolation through the system into the spring months, further stressing water supplies in a basin with limited interannual storage. While the full effect of climate change may be unknown at this time, climate modelling suggests that hydrology may be significantly altered from what has been observed in the past.

5.5.3 Water Quality

Water quality is a complex and important factor for sucker survival and vigor. Many elements contribute to water quality including temperature, dissolved oxygen, ammonia toxicity, pH, algae, and nutrient loading. Varied levels of detail are available on the ways in which these parameters may affect suckers. Kann and Walker (2020) analyzed the effects of water level fluctuation in UKL on four water quality elements (phytoplankton biomass as Chlorophyll a, pH, un-ionized ammonia, and dissolved oxygen) drawing from a long-term (1990-2016) dataset by using cross-tabulation contour and conditioning probability analyses to detect effects. These elements are described below to provide a general understanding of how these water quality elements and suckers interact.

Cyanobacteria

Cyanobacteria, such as AFA, are relevant to the sucker environmental baseline because the massive annual bloom and subsequent crash dynamics are the primary driver of most water quality dynamics in UKL and Keno Reservoir during the high stress period of the summer months. Summertime blooms of AFA dominate Upper Klamath Lake phytoplankton communities due to excessive phosphorus loading linked to watershed development. Water quality dynamics in Keno Reservoir/Lake Ewauna are largely due to cyanobacterial biomass imported into the system from UKL in summer.

Cyanotoxins represent a potentially direct effect from cyanobacteria to suckers in UKL, in particular microcystin, a liver toxin produced by the cyanobacterium *Microcystis aeruginosa*. Microcystin may enter suckers orally through the gut as they consume midge larvae containing the toxin, rather than exposure to dissolved toxins in the gills (VanderKooi et al. 2010 p. 2). Due to the limited capacity of fish to detoxify microcystins, fish suffer from sub-lethal effects or succumb to the toxic effects of elevated microcystin concentrations. Because microcystin is a highly stable compound, persisting in situ for months, it potentially could accumulate in fish tissues and in aquatic biota. However, direct consumption of cell-bound microcystin by suckers in UKL during the mesocosm study did not explain mortality or directly impact survival in those fish (Burdick et al. 2020 p. 261).

Dissolved Oxygen

Dissolved oxygen (DO) concentrations within water depend on several factors, including water temperature (colder water absorbs more oxygen), water depth and volume, atmospheric pressure, salinity, photosynthesis, and the activity of organisms that depend upon dissolved oxygen for respiration. In UKL, dissolved oxygen available for respiratory consumption by suckers is strongly influenced by the bloom and crash dynamics of phytoplankton communities, which in turn depend largely on availability of nitrogen and phosphorus. Within UKL, low DO concentrations occur most frequently in August, the period of declining cyanobacterial blooms with associated decomposition and warm water temperatures in the lake. Downstream in Keno Reservoir, DO typically reaches very low levels from July through October as cyanobacteria transported from UKL settle out of the water and decay; these low-DO events can last for extended periods. Organic matter and nutrient inputs, which promote primary productivity, from the Lost River basin via the Klamath Straits Drain and the Lost

River Diversion Channel also contribute to low DO levels in this reach. Low DO does not appear to be a major threat in Clear Lake (previously, due to a general lack of cyanobacterial blooms) and Gerber Reservoir (unpublished data). Conversely, relatively low water levels, combined with concomitant warm water temperatures in summer, may result in low dissolved oxygen concentrations in Lower Klamath National Wildlife Refuge (unpublished data). In summer 2024, Service staff also observed hypoxic conditions, including at the surface, in Tule Lake sump 1A (unpublished data). This is likely due to the presence of terrestrial vegetation, and subsequent decomposition, when the sump was reflooded.

Ammonia Toxicity

Low DO events are often associated with high levels of un-ionized ammonia, which can be toxic to fish. Ammonia toxicity is complex because it is a function of total ammonia nitrogen concentration, pH, and temperature. The toxic form, ammonia, is most prevalent at higher pH. Ammonia concentrations in UKL can be high enough to threaten suckers (Burdick et al. 2015a p. 6). Total ammonia nitrogen concentrations in the Keno Reservoir frequently exceed Oregon's chronic criteria from June to September and can exceed the acute criteria in both June and September (ODEQ 2017 p. 48). These degraded conditions can occur throughout much of the 20-mile-long reservoir, with better conditions only in the uppermost and lowermost reaches. Note that it appears cyanobacterial blooms may be increasing in frequency and intensity in Clear Lake and Gerber Reservoir (unpublished data), and these blooms may result in elevated unionized ammonia concentrations in the future. The Service continues to assess and monitor these emerging issues.

pH

In the Upper Klamath Basin, summertime pH levels are elevated above neutral. Extended periods of higher pH are associated with large summer cyanobacterial blooms in UKL. Generally, pH in the reach from Link River Dam through the Keno Reservoir increases from spring to early summer and decreases in the fall; however, there are site-dependent variations in the observed trend. Note that it appears cyanobacterial blooms may be increasing in frequency and intensity in Clear Lake and Gerber Reservoir (unpublished data), and these blooms may result in elevated pH in the future. The Service continues to assess and monitor these emerging issues.

Water Temperature

Water temperatures in the Klamath Basin vary seasonally and by location. In the Upper Klamath Basin, water temperatures are typically very warm in summer months as ambient air temperatures heat surface waters. Both UKL and Keno Reservoir/Lake Ewauna may undergo periods of intermittent, weak summertime thermal stratification, but water temperatures in these water bodies are predominantly similar throughout the water column. Clear Lake typically exhibits slightly higher temperatures than UKL. Although maximum water temperatures do not typically exceed the acute thermal tolerance of endangered suckers in either lake, they may cause stress to suckers in the hottest months leading to reduced growth and/or increased susceptibility to other stressors. Increasing temperature has many potential indirect effects, including reducing DO concentrations, increasing total ammonia-nitrogen, increasing growth rates of pathogens, and requiring greater energy demands from fish, and thus is an exacerbating factor.

Nutrients

Concentrations of primary plant nutrients, including nitrogen and phosphorus, in lakes are affected by the geology of the surrounding watershed, upland land uses, and physical processes within the lake and its tributaries. The ability of riparian and floodplain habitats to retain or alter nutrients throughout the system is degraded as a result of ditches, dikes, and levees that promote drainage or prevent overbank flows. UKL was eutrophic prior to settlement by Anglo-Americans but is now hypereutrophic due to human modifications to the environment. The relatively high levels of phosphorus present in the Upper Klamath Basin's young volcanic rocks and soils are a major contributor to phosphorus loading to the lake. Land use within the watershed increases inputs through soil erosion, pasture runoff, and irrigation return flows. UKL is a major source of nitrogen and phosphorus loading to the Klamath River, primarily due to nitrogen fixation by AFA. Nutrient and organic matter inputs from the Lost River Basin via Klamath Straits Drain and the Lost River Diversion Channel are also an important source of nutrients to the Keno Reservoir and Klamath River below.

5.5.4 Die Off Events

Large fish die-off events, although uncommon, can have a pronounced effect on population resiliency by killing numerous individuals. Typically, adults have been the only life stage encountered during sucker die-offs in UKL, but it is likely any juveniles present would also be impacted but remain undetected because of their smaller body size. For example, three consecutive fish die-offs in UKL (1995–1997) possibly involved tens of thousands of adult suckers (Perkins et al. 2000a). Multiple factors were likely to blame, but low DO concentrations and perhaps high total ammonia-nitrogen concentrations were implicated in the die-offs (Perkins et al. 2000a). During the die-off period in 1996 there was concurrently a *Microcystis aeruginosa* bloom, which may have also been a contributing factor.

Other reported die-offs in UKL occurred in 1986 (Coleman et al. 1988). Since the die-offs of the late 1990s, such events have been relatively rare with observations of sucker die-offs in 2003 and 2017. During August and September of 2017, 490 LRS and 9 SNS carcasses were observed, predominantly in the northwest area of UKL (M. Buettner, The Klamath Tribes, personal communication, January 2, 2018). The data are not sufficient to conclusively implicate low DO concentrations as the primary factor, but the highest numbers of carcass detections were coincident with the lowest DO levels of the summer, as occurred in each of the late-1990s events. It is possible that other die-off events went undetected or are under-reported in the literature. Nevertheless, it seems that widespread die-offs in UKL have occurred in roughly 1 out of 10 years.

5.5.5 Genetic Introgression

Hybridization is a single interbreeding event between individuals of two species. Introgression is the subsequent incorporation of genetic materials into the genome of the species as a result of numerous hybridization events (i.e., back crossing). Introgression is common among suckers in general and well documented among the Klamath Catostomids, particularly between SNS and Klamath largescale sucker (KLS; *Catostomus snyderi*) (Dowling et al. 2016).

Hybridization and introgression between shortnose sucker and Klamath largescale sucker are well documented and evidenced by phenotypic intermediates in morphology (Markle et al. 2005) and lack of discrimination among molecular markers (Dowling et al. 2016). However, morphological distinctiveness of the species varies by location (Markle et al. 2005), and the two species' spawning is partially isolated temporally and spatially (Markle et al. 2005). In UKL, morphological attributes of both species are more or less maintained, while other populations such as Gerber and Clear Lake reservoirs show a spectrum of morphological intermediates (Dowling 2005).

Genetic diversity is lower for both species in Clear Lake Reservoir as compared to conspecifics in UKL. In this reservoir, both species have little genetic variability compared to conspecifics in UKL (Smith and VonBargen 2015). Lower genetic diversity could be due to the population being derived from a limited number of individuals trapped when the dam was installed (i.e., founder effects) or simply due to genetic drift associated with small population size. Additionally, lack of connectivity with other populations also further depresses genetic diversity via reduced gene flow. Of more importance, the shortnose sucker population in Clear Lake Reservoir is highly introgressed with Klamath largescale sucker (Tranah and May 2006, Dowling et al. 2016). Shortnose sucker are more genetically similar to Klamath largescale within the same subbasin than they are to conspecifics from the other subbasin (Smith and VonBargen 2015), in the Lost River subbasin, shortnose sucker and Klamath largescale sucker can be difficult to distinguish morphologically. This can potentially erode species distinctiveness (genetic representation) within the population as well as reduce the abundance of phenotypic shortnose sucker (i.e., abundance of individuals that possess the morphology associated with shortnose sucker) and thereby reduce population resilience. Genetic representation within the Gerber Reservoir population is very similar to that of Clear Lake Reservoir. The shortnose sucker are highly introgressed with Klamath largescale, and the population is completely disconnected from other populations.

Unlike the shortnose sucker, hybridization and introgression involving the endangered Lost River sucker does not appear to be extensive (Dowling et al. 2016). At present, both endangered suckers in UKL are characterized by population sizes large enough to maintain genetic diversity and prevent the negative effects of inbreeding. Similar conclusions about other populations cannot be made because accurate estimates of population sizes are not available.

The historical draining of Tule Lake and Lower Klamath Lake and the construction of dams and irrigation structures have isolated the populations such that there is no exchange of individuals between the major remaining populations in UKL, Gerber Reservoir, and Clear Lake, and the system no longer functions as a metapopulation. This reduction of redundancy and connectivity could also have negative impacts on representation of diversity within the species.

Maintenance of ecological and phenotypic distinction between shortnose sucker and Klamath largescale in UKL suggests that introgression between these species does not threaten the resiliency of that shortnose sucker population. However, the resiliency of the shortnose sucker populations in Clear Lake Reservoir and Gerber Reservoir may be compromised by dilution of the distinct genetics and ecology of the species through hybridization and introgression.

5.5.6 Harvest

Migrating suckers were a historically important food source for the Klamath Tribes and were harvested in large numbers during the spring months (Bendire 1889, Evermann and Meek 1897). Settlers of European descent also utilized sucker migrations as a source of food and fish oil, including some commercial harvest. Historical accounts of sucker harvest from the late 19th century describe a large fishery on the Lost River for fish migrating upstream from Tule Lake (Bendire 1889, Gilbert 1897). The construction of dams on the Lost River and the draining of Tule Lake for agricultural purposes eliminated this fishery. However, a large recreational fishery for suckers developed in the Williamson and Sprague Rivers. In 1967, the Klamath Falls fisheries agent for the Oregon Fish and Game Commission was quoted in the newspaper as stating, “we’ve estimated that about 100,000 pounds—that’s 50 tons—of mullet [suckers] were snagged out of the two rivers in a three-week period” (Cornacchia 1967). This snag fishery, which targeted primarily LRS but included SNS (Bienz and Ziller 1987), existed in the Williamson and Sprague Rivers up to 1987 when the Oregon Fish and Game Commission outlawed harvest of both species.

Until 1987, fishing pressure during the spawning migration likely contributed to population declines in LRS and SNS in the Williamson and Sprague Rivers, but the magnitude of the effect is difficult to discern due to a lack of data on population sizes and harvest quantities during most of the 20th century. At present, some LRS and SNS are inadvertently captured while anglers target other species in UKL; however, the numbers are likely small, and anglers are required by law to immediately release the sucker.

5.5.7 Climate

The climate of the Klamath Basin is classified by the Köppen-Geiger system as temperate with dry, warm summers, also known as a warm-summer Mediterranean climate (Peel et al. 2007). With this climate most of the precipitation falls in the form of snow during the winter. The climate of the Klamath Basin naturally fluctuates between wet and dry periods over a scale of years to decades. Droughts are of particular interest because of their influence on lake and reservoir elevations, which can affect suckers in a variety of ways (See Section 5.5.3).

The years 1992, 1994 and 2021 are the three driest years in the POR. Additionally, the POR contains two three-year drought cycles, 1990 – 1992 and 2020 – 2022, that rank among the driest three-year periods in the past 120 years. The three-year period from 2020 through 2022, was drier by any metric when compared to the 1990 through 1992 time period.

For longer-term droughts (6-20 years), the decade of the 1930s ranks among the driest in nearly 500 years (Malevich et al. 2013). It is unclear how longer-term droughts affect the species, but these have the potential of affecting population-level dynamics such as persistent reduction in spawning production or other broad habitat modifications.

Prolonged drought conditions are becoming more frequent across the western U.S., (Detting et al 2015, Mote et al. 2018, Overpeck and Udall 2020) and these droughts create situations in which antecedent dryness can contribute to declining trends in overall hydrology across any given hydrologic basin. In the Klamath Basin, sufficient winter snowpack and runoff are relied upon to ensure refill of UKL, a shallow lake that the Project and the Klamath River rely upon as their primary sources of water supply. Across the POR, the average volume of water stored between October 1 and April 1 is approximately 275,000 acre-feet; equivalent elevation difference varies depending on starting point, but this volume results in an elevation increase of 3.21 ft. – 3.62 ft. In water year 2021, the driest year in the last 40 years, a mere 188,000 acre-feet of water was stored in UKL between October 1 and April 1, raising lake elevation from 4138.29 ft. to 4140.84 ft. (+2.55 ft.) across a six-month period. These droughts create situations in which antecedent dryness can contribute to declining trends in overall hydrology across any given hydrologic basin. In the Klamath Basin, sufficient winter snowpack and runoff are relied upon to ensure refill of UKL, a shallow lake that the Project and the Klamath River rely upon as their primary sources of water supply.

5.5.8 Environmental Contaminants

Contaminants from agricultural application of pesticides or other industrial practices could have affected sucker populations. Some of these compounds can remain bioavailable in the environment for decades. However, specific data regarding the historic or modern effects of contaminants on individuals and populations of these species are very sparse and inadequate to draw any definitive conclusions.

Organochlorine pesticides, such as DDT, were used extensively in the Klamath Basin (particularly the Tule Lake Basin) from 1940 through 1960 (Eagles-Smith and Johnson 2011). Acute mortality to fish from DDT usually occurs at very low levels of concentration(U.S. Environmental Protection Agency 1975). Eggs are especially vulnerable because the compound tends to accumulate in fatty areas, such as egg yolks (U.S. Environmental Protection Agency 1975). In 1988, 15 years after DDT was banned, the sediments near the mouth of the Link River possessed the highest concentrations of various organochlorine pesticides of a broad survey of 25 aquatic sites in the Upper Klamath basin (Sorenson and Schwarzbach 1991). Similarly, samples of suckers at the Link River mouth and in UKL all contained organochlorines (Sorenson and Schwarzbach 1991). The Service is unaware of data regarding subsequent trends of concentrations in suckers, but significant declining trends in concentrations in birds of the Klamath Basin suggest these lingering compounds are less prevalent since the 1980s (Eagles-Smith and Johnson 2011). An evaluation of modern pesticide use on Tule Lake National Wildlife Refuge concluded that the type and concentration of chemical applications were unlikely to harm suckers in Tule Lake (Haas 2007).

The processing of lumber products also provided a potential source of relevant environmental contaminants over the last century. For example, a mill located at the confluence of the

Williamson and Sprague Rivers operated for 70 years – closing in 1988 (Parker 2008). Contamination of the site included numerous petroleum-based chemicals, pentachlorophenal, metals, and dioxins (Parker 2008), all of which are toxic to fish under certain conditions. Its location near the upstream terminus of the only sucker river spawning habitat for both species presented a possible risk if harmful chemicals leached into the hydrological system. Dioxins are especially harmful to eggs since they bind with fat and oils, such as the yolk. The site has been "cleaned" and remediated for human health objectives by removing most of the petroleum-based chemicals, pentachlorophenal, and decaying wood that was mobilizing toxic metals. The dioxins were buried under a layer of protective soil. A minimal survey for dioxins in the nearby rivers during the spawning season indicated that current levels were likely not harmful (Burdick 2020). Nevertheless, it is not clear whether what impacts this and other similar sites have affected sucker populations.

Mercury deposited from the atmosphere can be highly toxic to fish and wildlife when it is converted into methylmercury. Methylation is stimulated by repeated inundation and drying, which occurs in the wetlands around Upper Basin Lakes as well as on the lands of Tule Lake and Lower Klamath National Wildlife Refuges where lands are rotated between agricultural use and wetland habitat for waterfowl (Eagles-Smith and Johnson 2011). However, mercury concentrations measured in suckers and other fish from the Upper Klamath Basin in 1988-1989 were below the national average for all fish (Sorenson and Schwarzbach 1991). Overall, there is not strong evidence that contaminants have contributed substantially to the decline of sucker populations in the Upper Klamath Basin.

5.5.9 Predation

LRS and SNS evolved with substantial predation pressure on larvae and juveniles from native fish species, including redband trout (*Oncorhynchus mykiss newberrii*), blue chub (*Gila coerulea*), and Tui chub (*Gila bicolor*), as well as predation pressure on all life stages from numerous bird species. Non-native fishes introduced to the system also potentially impact suckers through predation. Approximately 20 fish species were introduced accidentally or deliberately into the upper Klamath Basin. These comprised about 85 percent of fish biomass in UKL when the suckers were listed (Scoppettone and Vinyard 1991, Council 2004). The introduced fish species most likely to affect LRS and SNS are the fathead minnow (*Pimephales promelas*) and yellow perch (*Perca flavescens*). Additional exotic, predatory fishes found in sucker habitats, although typically in relatively low numbers, include bullheads (*Ameiurus* species), largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis* species), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), and Sacramento perch (*Archoplites interruptus*) (Koch et al. 1973, Logan and Markle 1993). These fish may prey on young suckers as well as compete with them for food or space (Markle and Dunsmoor 2007).

Fathead minnows were first documented in the Klamath Basin in the 1970s and are now the most numerous fish species in UKL (Simon and Markle 1997). Laboratory experiments have demonstrated that adult fathead minnows prey on sucker larvae (Markle and Dunsmoor 2007). In UKL, higher fathead minnow abundances were associated with lower sucker survival rates

(Markle and Dunsmoor 2007). Likewise, as indirect evidence, higher larval sucker survival rates were also associated with greater water depth and shoreline vegetative cover, habitat that helps larvae avoid predation (Markle and Dunsmoor 2007). Nonetheless, suckers outgrow fathead minnow's gape limitation quickly, and spatial and temporal overlap with other non-native predators (such as yellow perch) may be limited.

Several species of birds can prey on LRS and SNS. Bald eagles frequent sucker spawning sites, such as Ouxy Springs and the Sprague River near the Chiloquin Dam site, during the spawning season. White pelicans (*Pelecanus erythrorhynchus*) and double-crested cormorants (*Phalacrocorax auritus*) can also target juveniles and adults. There are also numerous other species of piscivorous birds, including terns, grebes, and mergansers, that may prey on juvenile and larval suckers throughout their range. Avian predation can be responsible for mortality of at least 8.4 percent of juveniles and 4.2 percent of adults annually in Clear Lake (Evans et al. 2016). Predation on spawning adults may increase mortality rates of this life stage and alter behavior during this critical period. For example, predation on adults, or the threat of predation, at spawning sites may limit the amount of time spent on the spawning ground, affecting overall reproductive outputs. It is difficult to determine whether avian predation has increased or decreased relative to historic levels. However, bird populations in general in the Klamath Basin have declined from historic numbers, so it is assumed the amount of predation has also diminished.

5.5.10 Disease and Parasites

Numerous types of diseases and parasites infect LRS and SNS, some of which are associated with morbidity and mortality. Infections can cause physiological stress, blood loss, decreased growth rates, reduced swimming performance, lower overwinter fitness, and mortality, especially in small fish (Marcogliese 2004, Kirse 2010). Additionally, parasites may provide a route for other infectious pathogens by creating a wound in the skin, or they can make fish more susceptible to predation by modifying their behavior (Robinson et al. 1998, Marcogliese 2004).

The LRS and the SNS are hosts to various species of bacteria, protozoa, myxozoa, trematodes, nematodes, leeches, and copepods (Foott 2004, Janik 2017). These can infect the eye, gills, kidney, blood, heart, muscle, skin, and gut. Many of these are pathogenic and can be associated at times with morbidity in suckers (Foott 2004, Foott and Stone 2005, Foott et al. 2010, Burdick et al. 2015a, Hereford et al. 2016).

It is likely that most of the parasites currently able to infect Klamath suckers share an evolutionary history with suckers, suggesting that it is unlikely that native parasites cause the annual loss of juvenile cohorts. It is possible that the advent of a hyper-abundant introduced species has also increased the number of parasite hosts in the system. This could then theoretically increase the total number of parasites in the system, which could increase the infection rates of suckers. Furthermore, *Lernaea cyrpinacae* (anchor worms) are likely introduced and consistently parasitize sucker juveniles (Janik et al. 2018). While it is clear that parasites and disease affect individual survival, there is currently not enough information to assess accurately the degree to which these negatively affect sucker population survival and viability.

5.5.11 Previous Consultations in the Action Area

This section describes the effects of past and ongoing actions known to occur within the action area and which affected or are affecting LRS and SNS. The Service reviewed records of past and ongoing consultations and provides summaries of formal and informal consultations that are most relevant in describing the environmental baseline for the subject action.

5.5.11.1 The Klamath Project

The Bureau of Reclamation manages several reservoirs in the upper Klamath Basin to provide water for the 250,000-acre Klamath Project, which was established in 1905 as the second federal water project in the nation. The Bureau of Reclamation has consulted with the Service multiple times on the Klamath Project operations since 1991, including the current PA. As the Klamath Project is operated through recurring actions that affect water management in the Klamath Basin in similar ways, the potential for effects from water management activities and its associated infrastructure to listed suckers is not entirely different between past and current consultations. The effects of this PA are described in Sections 7 and 8 of this Opinion. However, some of the past actions included aspects that resulted in adjustments on the landscape, and those elements are described here. The Service has analyzed levels of lethal and non-lethal take for all life stages (30,000 eggs, 171,913 Larvae, 2,909 juveniles, and 259 adults) of LRS and SNS as a result of past and ongoing activities associated with the Klamath Project and concluded that these levels did not cause jeopardy. Accordingly, the Service issued incidental take statements for these levels of take to Reclamation.

Most of the physical structures that are part of the Klamath Project (e.g., dams, canals, diversion points, etc.) were created prior to passage of the ESA and listing of the SNS and LRS. Those physical structures altered the nature of the habitat both upstream and downstream. For example, habitat below Clear Lake Dam no longer functions as a migration corridor for spawning individuals because of impassable barriers and does not provide optimal habitat for out-migrating larvae given the unnatural flow patterns through the system. Conversely, the habitat above the dam has changed from a system with a large, vegetated wetland associated with open water prior to the dam to a nearly homogenous open-water system with few emergent plants in most years.

A number of conservation actions have been undertaken as part of Reclamation’s project operations such as screening of irrigation diversions, installation of a fish ladder at Link River Dam, and assisted rearing of LRS and SNS. These actions and their effects are described below in the Conservation Efforts section.

5.5.11.2 PacificCorp HCP

PacifiCorp finalized a Habitat Conservation Plan (HCP) for LRS and SNS in November 2013 (PacifiCorp 2013) in accordance with section 10(a)(1)(B) of the ESA. In response to this plan, the Service conducted an intra-service consultation (08EKLA00-2013-F-0043) on the effects to suckers of the authorization of the plan.

The HCP addressed direct effects to suckers, including entrainment at project diversions, false attraction at Project tailraces, ramp rates, lake level fluctuations, migration barriers, loss of habitat, and water quality, as well as effects to sucker critical habitat (PacifiCorp 2013). Additionally, the Plan proposed the shutdown of the East Side and West Side facilities to reduce sucker mortality resulting from entrainment into the canals (PacifiCorp 2013). PacifiCorp established a Sucker Conservation Fund to support sucker conservation goals and objectives, and committed to continue support of the Nature Conservancy’s Williamson River Delta Restoration Project (PacifiCorp 2013). These commitments included $100,000 to the fund and annual funding of about $20,000 to the Nature Conservancy over the next 10 years, as well as in-kind costs to implement management actions and monitoring (PacifiCorp 2013). This funding was provided and expended on priority projects identified in coordination with PacifiCorp and federal and state agency experts.

Implementation of the HCP required an Incidental Take Permit (Permit No. TE 52096A-0) from the Service under the ESA. PacifiCorp operations at numerous facilities along the Link and Klamath Rivers were covered. There was a partial transfer and extension of this Incidental Take Permit and the associated HCP in 2023 to the Klamath River Renewal Corporation as part of the transfer and surrender of the Lower Klamath Hydroelectric Project license. The permit called for authorization of lethal take of both species over the next 10 years, including 10,000 eggs, 66,000 larvae, 500 juveniles, and five adults. Additionally, harassment of 1,400,000 larvae, 6,700 juveniles, and 25 adults was included. However, much of the take was eliminated when PacifiCorp ceased operation of the East Side and West Side facilities. The Service determined that issuance of the Incidental Take Permit for the HCP was not likely to jeopardize the continued existence of the LRS or SNS and was not likely to destroy or adversely modify critical habitat for the species.

5.5.11.3 Surrender and Decommissioning of the Lower Klamath Hydroelectric Project No. 14803

The KRRC began the decommissioning and removal of the Lower Klamath Hydroelectric Project dams (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) in 2023. The Lower Klamath Project consists of removing four of the mainstem Klamath River hydroelectric facilities, as well as the associated buildings and other infrastructure. The removal of the four hydroelectric dams was completed fall of 2024. The Klamath River is now free flowing from Keno Reservoir in Oregon through the former location of Iron Gate Dam in California to the mouth at the Pacific Ocean. Prior to the start of dam removal, NMFS and the Service completed ESA section 7 consultations (08EYRE-2021-F-0127) with the Federal Energy Regulatory Commission on the separate action of dam removal in the Klamath River and produced non-jeopardy biological opinions, accompanied by associated incidental take statements. The Service estimated that the PA would result in the incidental take of 5,540 adults, 2,825 juveniles, and 365,229 larval LRS and SNS and the removal of 107,470 acre-feet of occupied reservoir habitat.

The PA included a conservation measure of translocating adult sucker prior to reservoir drawdown and dam removal. Prior to dam removal, the KRRC, with logistical support from the Service, CDFW, ODFW, and the Klamath Tribes, mounted a capture and translocation efforts in the hydroelectric reach. Translocation efforts recovered 132 adult and 137 juvenile (< 350 mm) suckers ahead of the drawdown (215 shortnose suckers and 54 Lost River suckers). The recovered fish were transported to two locations: two ponds at the Lower Klamath National Wildlife Refuge and the Klamath Tribes Aquaculture Facility. There were 84 adult and 97 juvenile suckers transported to the Lower Klamath National Wildlife Refuge ponds, of which 180 were shortnose and 1 Lost River suckers, with the remaining individuals being transported to the Klamath Tribal Facility. The fish in the Lower Klamath National Wildlife Refuge ponds and the Klamath Tribes Aquaculture Facility were re-patriated to the Sprague River and UKL in 2023.

LRS and SNS are lake dwelling suckers and will likely not persist in the Klamath River below Keno Dam now that dams have been removed, and the restoration of the hydroelectric reach has begun. Spawning by listed suckers below Keno dam is not known or documented, therefore, any suckers that may have been in the reservoirs prior to dam removal, or who might enter the river after dam removal, very likely originated upstream of Keno Dam will likely not persist in the Klamath River below Keno Dam. These reservoirs were considered population sinks for these species because they lack spawning habitat, and the LRS and SNS that inhabited the reservoirs did not represent self-sustaining populations. Reservoir habitat has been removed along with the dam removal. The remaining occupied habitat in the Upper Klamath Recovery Unit, and the range of the species, will not be impacted by this project and will remain available for the foreseeable future. These upstream habitats provide suitable conditions and opportunities for spawning and rearing that contributes to the survival and recovery of the species.

5.5.11.4 Agency-Barnes Wetland Restoration Project

Upper Klamath National Wildlife Refuge has begun construction but not yet completed, the enhancement of up to 14,000 acres of wetlands associated with Upper Klamath National Wildlife Refuge and adjacent private lands in the Upper Klamath Basin, including the reconnection of Agency-Barnes to Upper Klamath Lake and Agency Lake (collectively as Upper Klamath Lake). Informal consultation was completed August 31, 2023 (2023-0026819) the Service concurred that the PA may affect, but not likely to adversely affect listed species. The project will improve both aquatic resource functions and services and will expand the water storage capacity of Upper Klamath Lake. The project includes site restoration (i.e., removal of infrastructure, grading, internal levee removal or breaching); the construction of wetland habitat enhancement features (i.e., wave attenuation slopes, levee enhancement areas, islands); repair a portion of the southern levee (Agency Lake Unit A); installation of overflow weirs along the perimeter levee with Upper Klamath Lake; and the breach of the perimeter levee (Agency Lake Unit C) that separates the project area from Upper Klamath Lake. To the extent possible, construction activities within the perimeter levee will be completed when work areas are dry and prior to breaching the perimeter levee.

The perimeter levee in Agency Lake Unit C is scheduled to be breached in December 2024 in two locations to connect the work area to Upper Klamath Lake; this is a key assumption in both the PA and this Opinion. The two breach locations will align with historic tidal slough in the adjacent marsh. Each perimeter levee breach will be approximately 20 feet wide and excavated to a depth of 4136.5 feet NAVD88 to ensure positive drainage from the site to Upper Klamath Lake. Once complete, the project would restore about 9,700 acres of lake-fringe wetlands in the project area, including about 314 acres of open water and 6,892 acres of submerged aquatic habitat would be perennially available of LRS and SNS. The expanded open and shallow water wetland habitats would effectively double the area of rearing habitat available to LRS and SNS in Upper Klamath Lake, a limiting factor for recovery of the species in the basin. The reestablishment of wetland vegetation within the site would also improve habitat and water quality conditions by filtering nutrients. The Agency-Barnes Wetland Restoration Project is expected to have beneficial effects to LRS and SNS by improving water quality, providing forage resource, providing rearing habitat, and providing refuge from predation.

5.5.11.5 Grazing

The Bureau of Land Management and U.S. Forest Service consulted with the Service on the effects of grazing related actions to LRS and SNS. These grazing actions are outside the action area for the current PA, but they could have effects to the same individuals or populations because suckers migrate from the current action area into the action areas for these grazing actions during spawning. The most recent consultations on these actions are summarized below.

The Klamath Falls Resource Area of the Lakeview District Bureau of Land Management completed formal consultation with the Service in 2014 on the effects of grazing related actions to shortnose suckers for the period of December 2014 through December 2024 (08EKLA00-2013-F-0023). The action described lethal and non-lethal adverse effects from changes to habitat suitability and displacement of individuals. The allotments and pastures consulted on are hydrologically connected to Gerber Reservoir. The amount of incidental take (lethal harm) of SNS anticipated for this PA was 14 adults, 10,892 juveniles, and 790,171 eggs and larvae. The number of eggs and larvae appear quite large; however, the life history strategy of fish is many eggs are laid to increase the potential number that reach maturity. The number of impacted individuals is expected to be smaller as the Service assumes lethal harm as there is a lack of information to indicate which proportion of these individuals may actually survive or avoid lethal trampling.

The Fremont-Winema National Forest completed formal consultation with the Service in 2017 on the effects of grazing related actions to shortnose suckers for the period of May 2017 through May 2027 (08EKLA00-2017-F-0099). The action described lethal and non-lethal adverse effects from trampling and displacement of individuals. The allotments and pastures consulted on are hydrologically connected to Gerber Reservoir and Clear Lake Reservoir. The amount of incidental take (lethal harm) of SNS anticipated for this PA is 16 adults, 1,857 juveniles, and 5,544,504 eggs and larvae. The number of eggs and larvae, in particular, appear quite large; however, the life history strategy of fish is many eggs are laid to increase the potential number that reach maturity. The number of impacted individuals is expected to be smaller as the Service assumes lethal harm as there is a lack of information to indicate which proportion of these individuals may actually survive or avoid lethal trampling. The total number of adults harmed in Gerber Reservoir is 2.1 percent of the population and this population is considerable smaller than that of Clear Lake Reservoir. The proposed action will harm and harass shortnose suckers; as indicated above, the overall effect at the range-wide scale is very small (less than 1 percent in many cases).

The Modoc National Forest completed formal consultation with the Service in 2021 on the effects of grazing related actions to Lost River suckers and shortnose suckers for the period of March 2021 through March 2031 (08EKLA00-2020-F-0105). The action described lethal and non-lethal adverse effects from trampling and displacement of individuals. The allotments and pastures consulted on are hydrologically connected to Clear Lake Reservoir and including the Willow Creek watershed. The amount of incidental take of LRS and SNS anticipated for this PA is 139 adults, 1,715 juvenile, and 21,134,805 eggs and larvae. The number of eggs and larvae, in particular, appear quite large; however, the life history strategy of fish is many eggs are laid to increase the potential number that reach maturity. The number of impacted individuals is expected to be smaller as the Service assumes lethal harm as there is a lack of information to indicate which proportion of these individuals may actually survive or avoid lethal trampling.

5.5.11.6 Highway 140 Widening Project

In 2023, the Western Federal Land Highway Division of the Federal Highway Administration, in cooperation with the Oregon Department of Transportation, started the construction project to widen a 5.6-mile section of Oregon State Route 140 (OR-140) between mile post 57 and mile post 63, located northwest of the city of Klamath Falls (08EKLA00-2019-F-0002). Approximately two miles of the action area is located along the western edge of Howard Bay in Upper Klamath Lake and approximately four miles are upland of the lake. Because of impacts associated with this project, in 2022, the Federal Highway Administration completed construction of a 10.4-acre wetland mitigation site on a 45-acre parcel, as part of the PA, including a 0.25-acre pond, located approximately three miles east (across the lake) from the southern end of the project’s action area (mile post 63).

Widening OR-140 will include expanding existing travel lanes from 11-feet to 12-feet, widening road shoulder to 6-feet, realigning roadway, constructing new embankment along Howard Bay, constructing stormwater treatment features, and clearing and grubbing upland areas. Highway widening along Howard Bay requires adding fill material to the lake to construct new embankments and create minor realignments to the roadway. Fill material will modify approximately 9.7 acres of LRS and SNS critical habitat. However, upon completion of the project the current shoreline will have a net increase of 60 linear feet of shallow water habitat. Approximately 780 LRS and SNS juvenile sucker could be taken from the alteration of habitat structure, function, and diversity as well as exposure to construction-related disturbance, turbidity, and sedimentation. The wetland construction component of the project has the potential to restore natural wetland habitat functions and connectivity over the long-term by slowing down water currents and decreasing wave action. Best management practices and minimization measures are being implemented to reduce impacts to LRS and SNS. Take estimates are likely to be high as juvenile suckers present in Howard Bay are likely to avoid the area of disturbance due to noise and activity. The Highway 140 construction project will harm approximately 780 juvenile LRS and SNS, the overall effect at the range-wide scale is very small (less than one percent).

5.5.11.7 Scientific Research

In 2024, the Service consulted (2024-0132350) on the effects to LRS and SNS of issuing scientific permits for the purpose of promoting recovery of the species under section 10(a)(1)(A) of the ESA. The consultation addressed purposeful take of the species using a variety of scientific collection techniques, marking, transport and relocation, and biological sampling. Incidental take authorized as part of scientific research includes purposeful lethal take of 10 adults, 100 juveniles, 10,000 larvae, and 10,000 eggs per species. Additionally, non-lethal harm of 20 adults, 40 juveniles, 5,000 larvae, and 10,000 eggs pre species was authorized in a single year. The Service considered the effects of the issuance of scientific permits (as currently proposed) on the reproduction, abundance, and distribution of the species, as well as how the aggregation of these effects will affect the overall survival and recovery of the species. The Service determined that the action was not likely to jeopardize the continued existence of the LRS and SNS, nor adversely modify the designated critical habitat of the species.

5.5.11.8 Klamath Tribes Sucker Rearing

Included in the programmatic consultation on the issuance of recovery permits for actions involving LRS and SNS (2024-0132350) is assisted rearing, which allows for the collection of up to 160,000 wild-hatched larvae from the UKL system. The Klamath Tribes established a rearing program in 2018, and the first collections under the program were performed in spring 2018. Since 2021, 4,393 production size fish have been released from the Klamath Tribal Hatchery. Additionally, the Klamath Tribal Hatchery released 147 suckers that were salvaged from J.C. Boyle Reservoir in 2023. In 2024, no production fish were released however, 15,102 larvae were collected from the Williamson River and approximately 46,260 fertilized eggs from the East Side Springs of UKL were brought into the facility for rearing (C. Sharpes Barrera, personal communication, October 28, 2024). Although the scale of release and specific effects of this action are unknown at present, it may result in additional recruitment to populations of LRS and SNS in UKL.

5.5.11.9 Summary of Incidental Take from Prior Consultations

The Service has previously consulted on a number of projects in the action area including, the Klamath Project, PacifiCorp habitat conservation plan, decommissioning of the Lower Klamath Hydroelectric project, Agency-Barnes wetland restoration, livestock grazing, Highway 140 project, scientific research, and Klamath Tribes sucker rearing. The prior incidental take for these actions has contributed to the condition of the species in the action area. The Agency-Barnes wetland restoration consultation did not have incidental take associated with the action however, the action will increase the amount of available sucker rearing habitat in UKL benefiting the LRS and SNS environmental baseline. The Klamath Tribes sucker rearing program, and scientific research under the ESA section 10(a)1(A) recovery permit, may result in take. However, these projects are benefiting suckers through population augmentation that bridges the recruitment bottleneck and provides information to assist in the recovery of LRS and SNS. Approximately 580 captively reared suckers have been detected on PIT tag arrays in Pelican Bay and the Williamson River during spawning migration.

The decommissioning and removal of the four Lower Klamath Hydroelectric project dams resulted in the removal of those populations. Those populations were likely sinks, with new individuals generally being spawned elsewhere in the system, such as UKL. None of these sink populations were thought to have contributed significantly to maintaining and recovering LRS and SNS because they had extremely low resiliency due to a combination of degraded habitat, low numbers, and restricted access to suitable spawning habitat (Desjardins and Markle 2000 pp. 14-15, Hodge and Buettner 2009 pp. 4-6, Kyger and Wilkens 2011 p. 3). The Klamath Project, the PacifiCorp HCP, the Highway 140 widening project and livestock grazing have all contribute LRS and SNS population abundance. However, the decreasing abundance and increasing age of the adult population in UKL is consistent with a lack of recruitment of juvenile suckers into the adult population (Krause et al. 2022, p. 1429). Although numerous larvae are produced annually, the number of juveniles captured during sampling efforts is low and typically decreases to nearly zero in late summer. Very few individuals are captured as age-1 or older (Burdick and Martin 2017 p. 30), suggesting complete cohort failure each year. Recruitment failure is the cause of LRS and SNS population declines in UKL and not the result of past incidental take.

5.5.12 Conservation Efforts

5.5.12.1 Klamath Basin Sucker Assisted Rearing Program

The Service started an assisted rearing program for LRS and SNS in 2015 to supplement populations in UKL through augmentation. The primary target of the effort is SNS, but the lack of an effective way to identify live larvae and juveniles means that both species, as well as a conspecific, the Klamath largescale sucker (*Catostomus snyderi*), are collected and reared before repatriation to Upper Klamath Lake. In 2013, the Bureau of Reclamation agreed to fund such a program to assist with sucker recovery with a 10-year target of releasing a total of 8,000 to 10,000 suckers with lengths of at least 200 mm annually. The Service has expanded funding of the program, and in 2021, the rearing facility received designation as a national fish hatchery. Construction is currently underway on an expansion and modernization of the facility with an expected completion date of 2026, at which time the facility would be capable of producing 60,000 captively-reared LRS and SNS annually and maintain broodstock for captive propagation. Since 2018, the Service has released approximately 74,018 production sized suckers into Upper Klamath Lake.

The program was designed to maximize retention of genetic diversity and maintain natural behaviors post-release as much as possible (Day et al. 2017). Larvae are collected as they drift downstream in the Williamson River, so the effects of artificial breeding are avoided during this process. Collection efforts are currently spread across the drift season to maximize the genetic variability. Juveniles are stocked into semi-natural ponds and growth depends on a combination of natural and artificial feed. The program has been stocking juvenile suckers into net pens in UKL and Gerber Reservoir for and extended grow out period prior to being stocked into UKL. The Gerber net pen successfully raised 1,317 juvenile suckers in 2024 with a survival rate of over 96 percent. Additionally, the program has been conducting experimental incubation trials of collected and fertilized gametes from wild adult LRS spring spawners. In 2024, a total of twelve female LRS were crossed with four males each and one female was crossed with only two male LRS, for a total of 50 family groups collected overall. The Klamath Falls National Fish Hatchery (KFNFH) and the Klamath Tribal Hatchery collected and fertilized a total of 78,435 eggs were collected for production and 56,458 fry were hatched for broodstock and production fish (M. Yost, USFWS, personal communication October 24, 2024). The successful efforts of the hatchery experimental incubation have helped to standardized methods for captive spawning and incubation.

Another component of the program is seasonally rehabilitating salvaged suckers that were entrained in the forebay of the A-Canal headworks and other unscreened diversions and canals of the Klamath Project. Reclamation salvages suckers from canals and transports them to the Services hatchery, where they are placed in temporary isolation, treated using chemical therapeutants, scanned for a PIT tag, PIT-tagged if untagged, and weighted and measured to length. These wild, salvaged suckers were repatriated back to Upper Klamath Lake by hatchery staff. Since 2018, the Service has treated and repatriated a total of 7,224 salvaged suckers. This cooperative effort is important since these wild fish are some of the few suckers aged 0-2 that have survived until the late summer, fall, or early winter of each year and were encountered and found. It may be that these fish have a greater likelihood of surviving into adulthood and rehabilitating them may represent an important sucker conservation measure.

Development of a captive broodstock program began in 2017 to address the possibility that assisted spawning will be necessary in the future. Each year from 2017 to 2023, a random sample of juveniles were selected and are being maintained at the hatchery as broodstock. A genetic management plan is currently being produced to address any concerns with future genetic diversity of broodstock being held at the Klamath Falls National Fish Hatchery (KFNFH).

The first release of reared suckers into UKL occurred in spring 2016, and the proportion of released individuals that will join the spawning population is being analyzed. Less than 5,000 juvenile suckers were released each year, during the first few years (2016 to 2018) of the rearing program but production numbers have grown to over 15,000 juveniles released in 2020. It takes LRS and SNS more than four years to reach sexual maturity therefore, juveniles released during the early years of the rearing program have only recently been encountered on the Williamson and Sprague Rivers PIT tag arrays. Preliminary data suggest a 1.4 percent return on the juvenile sucker year classes, released during 2016 to 2020, of approximately 42,000 juvenile suckers (M. Yost, USFWS, personal communication October 24, 2024). Therefore, approximately 580 of the 42,000 suckers released from the rearing program have been encountered on the Williamson and Sprague Rivers PIT tag arrays during spawning migration. Thus, the assisted rearing program is likely to be a source of recruitment for both SNS and LRS in UKL, but the specific impact on population trajectories will be uncertain until information on survival and recruitment probabilities of released individuals has been fully analyzed.

5.5.12.2 Habitat Restoration

Numerous agencies and organizations have restored important components of habitat to reduce threats to these species over the last 20 plus years. Major sucker recovery-oriented projects completed include screening of irrigation diversions, eliminating barriers to fish passage, and restoration of rearing and spawning habitat (Table 1). For example, restoration of the Williamson River Delta by The Nature Conservancy, with substantial support from PacifiCorp and other organizations, has provided approximately 2,500 hectares (~6,000 acres) that can serve as rearing habitat for the largest spawning populations of both species despite much of the area being deeper than it was historically due to subsidence. The removal of Chiloquin dam in 2008 opened approximately 120 kilometers (75 miles) of potential spawning and migration corridor. Additionally, screening the A-canal in 2002 reduced entrainment of fish greater than 30 millimeters (1.2 inches) into the irrigation systems of the Klamath Project canal system. Prior to placement of the screen, up to hundreds of thousands of juveniles were estimated to be entrained into the irrigation canals at this point each year (Gutermuth et al. 2000a).

Table 1. Summary of Major Restoration Projects Benefitting Lost River Sucker and Shortnose Sucker Populations.

Project	Year Completed	Potential Benefits
Reducing Entrainment		
A-Canal Screen	2002	Retain more larvae and juveniles in Upper Klamath Lake by limiting entrainment into the canal
Clear Lake Dam Screen	2003	Retain more larvae, juveniles, and adults in Clear Lake Reservoir by limiting entrainment into the canal
Modoc Irrigation District Williamson River Diversion Screen	2007	Reduce larval mortality due to entrainment
Geary Canal Screen	2009	Retain more larvae and juveniles in Upper Klamath Lake by limiting entrainment into the canal
Eliminating Barriers		

Project	Year Completed	Potential Benefits
Link River Dam Fish Ladder	2004	Restore connectivity of sucker populations in Upper Klamath Lake and Lake Ewauna by allowing for adult passage upstream, which may then contribute to spawning populations.
Chiloquin Dam Removal	2008	Opening 120 km (75 mi) of historic migration, rearing, and spawning habitats in the Sprague River
Providing Habitat		
Williamson River Delta Restoration	2008	Provide ~2,500 hectares (6,000 acres) of potential rearing habitat for larvae and juvenile suckers in Upper Klamath Lake
Agency-Barnes Wetland Restoration	2024	Create an additional 1200 acres of submerged wetland habitat and 670 acres of emergent wetland habitat in Upper Klamath Lake

In addition to these major accomplishments, private landowners, the ODFW, Reclamation, NRCS, and the Service, have realized countless other smaller projects that can benefit LRS and SNS populations. Hundreds of on-the-ground restoration projects, wetland, riparian, in-stream, upland, and fish passage projects have been implemented in the Upper Klamath Basin that directly or indirectly benefit suckers. Many of the projects included elements of more than one category of restoration project type taking a holistic or ecosystem approach based on the assumption that restoration of natural ecosystem functioning will ultimately benefit multiple species, including listed suckers.

In most instances, considerable time is necessary to determine the efficacy of these restoration actions because of the time needed for the habitat to achieve full functioning and the subsequent time needed for a long-lived species to respond with improved demographics. For example, actions to increase reproduction and recruitment into adult populations require at least five years for SNS and nine years for LRS to achieve minimal functioning.

5.6 Status of Lost River and Shortnose Sucker Critical Habitat

In this section, the range-wide condition of LRS and SNS designated critical habitat is assessed, including describing factors relating to the condition of the physical and biological features (PBFs) necessary for the survival and recovery of the species. The environmental baseline of the designated critical habitat, against which the effects of the proposed action will be assessed, is also included.

Designated critical habitat for LRS and SNS includes areas that are inside and outside of the action area. The areas of critical habitat inside the action area are primarily the lakes and reservoir rearing habitats for all life stages. The action area also includes the Link River, Keno Reservoir to Keno Dam, and the lower reaches of the Williamson and Wood Rivers. The areas of designated critical habitat outside of the action area are tributaries to UKL, Clear Lake, and Gerber Reservoir. These contain most of the designated spawning habitat. Only the impacts to designated critical habitat are analyzed; however, this analysis also includes impacts from upstream activities that could influence downstream critical habitat. For example, operations of a dam (e.g., Link River Dam) upstream of critical habitat that affects flows into downstream critical habitat (e.g., Lake Ewauna) are analyzed below.

5.6.1 Legal Status

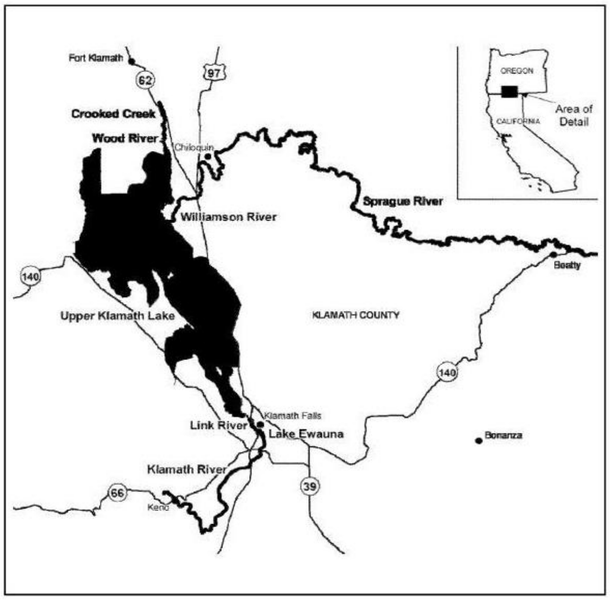
The Service proposed designation of critical habitat for the LRS and the SNS on December 1, 1994 (USFWS 2012a). A revised proposal was published that included critical habitat in Klamath and Lake Counties, Oregon, and Modoc County, California (USFWS 2011) on December 7, 2011. Designation of critical habitat for the LRS and the SNS was finalized on December 11, 2012, with publication of the final rule (USFWS 2012b). Critical habitat contains those areas that are essential to the conservation of the species. The role of LRS and SNS critical habitat is to "support the life-history needs of the species and provide for the conservation of the species" (USFWS 2012b).

5.6.2 Critical Habitat Description

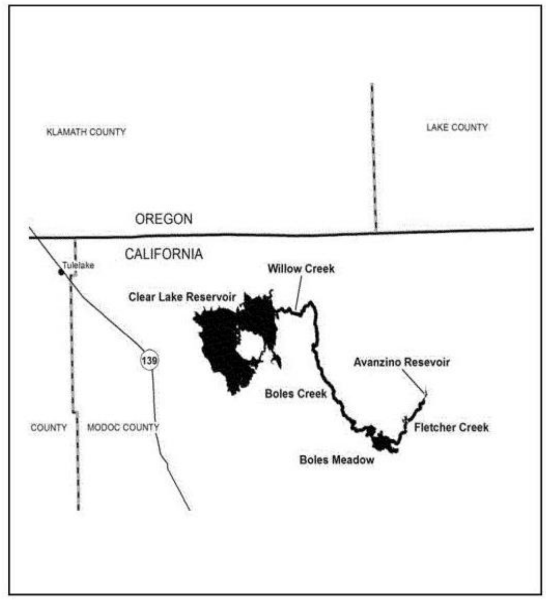
The critical habitat designation for LRS and SNS established two critical habitat units (CHUs) for each species, including a mix of Federal, State, and private lands (Figure 17). These critical habitat units include important water bodies and tributaries that support LRS and SNS life stages.

Critical Habitat Unit 1 is located in Klamath County, Oregon, includes UKL and Agency Lake, the Link River, and Keno Reservoir to Keno Dam, as well as portions of the Williamson and Sprague Rivers, for a total of approximately 90,000 acres and 119 river miles. Unit 1 is the same for both species with the exception that, for the LRS, the unit extends up the Sprague River to the Beatty Gap east of Beatty, Oregon (approximately river mile 75), whereas for the SNS, Unit 1 extends up the Sprague River only as far as the Braymill area near river mile 8.

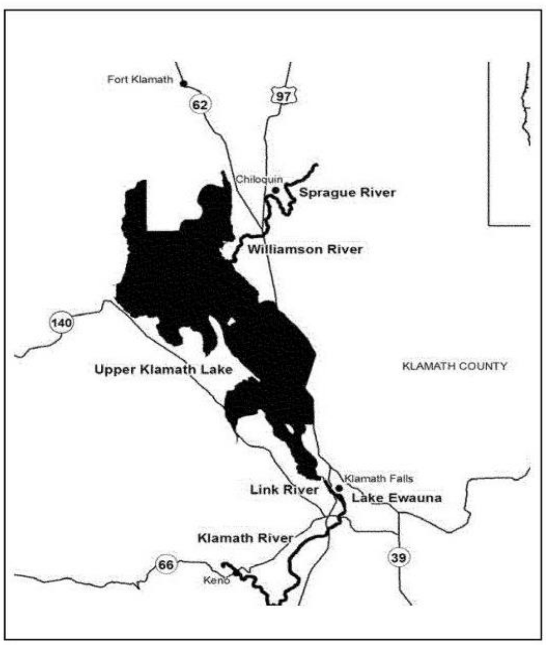
Critical Habitat Unit 2 (the Lost River Basin) is located in Klamath and Lake Counties, Oregon, and Modoc County, California (Figure 17). It includes Clear Lake Reservoir and its main tributary, Willow Creek as well as portions of Boles Creek, for both the LRS and the SNS. For the LRS, critical habitat includes Willow Creek to its confluence with Boles Creek and Boles Creek upstream to Avanzino Reservoir. For the SNS, critical habitat extends up Willow Creek beyond the Boles Creek confluence to include portions of the North and East Forks of Willow Creek, Fourmile Creek, and Wildhorse Creek in California. It also includes Boles Creek, Fletcher Creek, Willow Creek, and an unnamed tributary to Fletcher Creek. Gerber Reservoir and its main tributaries (Ben Hall and Barnes Valley Creeks) are also designated critical habitat in Unit 2 for SNS only. The total area for Unit 2 incorporates approximately 33,000 ac and 89 river miles of reservoir and stream habitat.



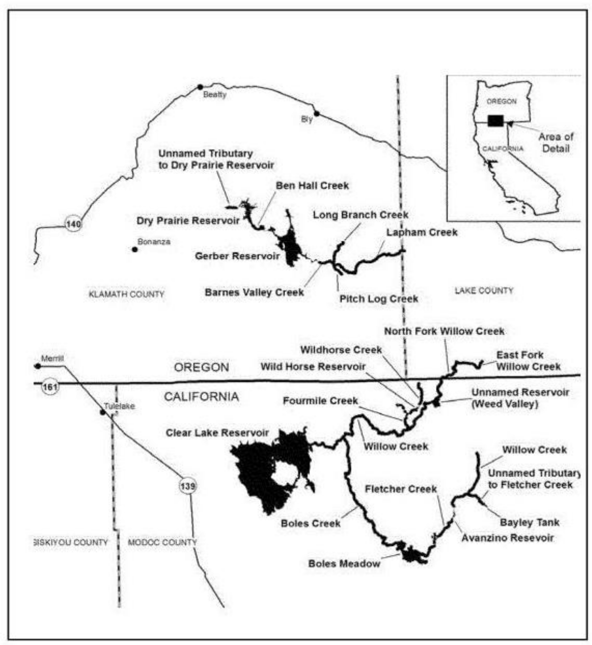
Lost River Sucker Critical Habitat Unit 1



Lost River Sucker Critical Habitat Unit 2



Shortnose Sucker Critical Habitat Unit 1



Shortnose Sucker Critical Habitat Unit 2

Figure 17. Designated CHUs for the LRS and SNS (USFWS 2012)

5.6.3 Conservation Role of Critical Habitat

Critical habitat contains those areas that are essential to the conservation of the species. The role of LRS and SNS critical habitat is to "support the life-history needs of the species and provide for the conservation of the species" (USFWS 2012).

5.6.4 Physical or Biological Features

When designating critical habitat, the Service considers physical or biological features (PBFs) "essential to the conservation of the species and which may require special management considerations or protection" (USFWS 2012). "These include, but are not limited to: 1) space for individual and population growth and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, or rearing (or development) of offspring; and 5) habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of a species" (USFWS 2012). The final critical habitat rule identified "accessible lake and river spawning locations that contain suitable water flow, gravel and cobble substrate, and water depth (as well as flowing water) that provide for larval out-migration and juvenile rearing habitat" as the essential PBFs for both LRS and SNS (USFWS 2012).

Based on the current knowledge of the habitat characteristics required to sustain the species' life-history processes, the Service has determined the PBFs essential for conservation of LRS and SNS are:

- **PBF 1—*Water.*** Areas with sufficient water quantity and depth within lakes, reservoirs, streams, marshes, springs, groundwater sources, and refugial habitats with minimal physical, biological, or chemical impediments to connectivity. Water must have varied depths to accommodate each life stage: Shallow water (up to 3.28 ft.) for the larval life stage and deeper water (up to 14.8 ft.) for older life stages. The water quality characteristics should include water temperatures of less than 82.4 °F; pH less than 9.75; dissolved oxygen levels greater than 4.0 mg per L; low levels of microcystin; and un-ionized ammonia (less than 0.5 mg per L). Elements also include natural flow regimes that provide flows during the appropriate time of year or, if flows are controlled, minimal flow departure from a natural hydrograph.
- **PBF 2—*Spawning and Rearing Habitat.*** Streams and shoreline springs with gravel and cobble substrate at depths typically less than 4.3 ft. with adequate stream velocity to allow spawning to occur. Areas containing emergent vegetation adjacent to open water provides habitat for rearing and facilitates growth and survival of suckers, as well as protection from predation and protection from currents and turbulence.
- **PBF 3—*Food.*** Areas that contain abundant forage base, including a broad array of Chironomidae, crustaceans, and other aquatic macroinvertebrates.

5.6.5 Special Management Considerations

When designating critical habitat, the Service and NMFS assesses whether the specific areas within the geographical area occupied by the species at the time of listing contain features that are essential to the conservation of the species and which may require special management considerations or protection (USFWS 2012 p. 73750). The final critical habitat rule for LRS and SNS identifies several special management considerations or protections for PBFs (USFWS 2012 pp. 73750–73756). Both critical habitat units contain the same considerations/protections for both species and are as follows:

- Maintain water quality by preventing the deleterious effects of nuisance algal blooms, increased sedimentation, excess nutrients, and other factors affecting water quality.
- Maintain water quantity to prevent reductions in water levels that may limit access to spawning locations or refugia and reduce the depth of water used as cover and cause a lack of access to essential rearing habitat (i.e., marsh and wetland areas).
- Maintain gravel and cobble substrata to prevent the degradation of spawning, rearing, and adult habitat caused by past land management practices.
- Protect the forage base by management of nonnative fish to reduce competition for available forage with LRS and SNS and minimize predation on LRS and SNS.

5.6.6 Current Condition of Lost River and Shortnose Sucker Critical Habitat in the Action Area

Designated critical habitat for LRS and SNS includes areas that are inside and outside of the action area. The areas of critical habitat inside the action area are primarily the lakes and reservoir rearing habitats for all life stages. The action area also includes the Link River, Keno Reservoir to Keno Dam, and the lower reaches of the Williamson and Wood Rivers. The areas of designated critical habitat outside of the action area are tributaries to UKL, Clear Lake, and Gerber Reservoir. These contain most of the designated spawning habitat. Only the effects of the PA to designated critical habitat are analyzed. However, this analysis also includes impacts from upstream activities that could influence downstream critical habitat within the action area. For example, operations of a dam (e.g., Link River Dam) upstream of critical habitat that affects flows into downstream critical habitat (e.g., Lake Ewauna) are analyzed in the Effects section below.

Much of the information regarding the environmental baseline for the critical habitat for LRS and SNS is similar to that presented in Section 5.5 – The Environmental Baseline for the species. The sections covering habitat characteristics (5.5.1), water quantity (5.5.2), water quality (5.5.3), climate (5.5.7), environmental contaminants (5.5.8), predation (5.5.9), and disease and parasites (5.5.10) are directly applicable to specific aspects of critical habitat.

Overall, the habitat of the species has been lost or degraded in numerous ways that are likely to reduce the capacity of the habitat to support the life history and provide for the conservation of LRS and SNS. In Critical Habitat Unit 1, the environmental baseline of poor water quality is of particular note because it creates stressful conditions for juvenile and adult suckers annually in late summer. Additionally, low inflow in drier years, reduces surface elevation in the lake reducing spawning habitat availability and function at groundwater seeps along the eastern shoreline of UKL. In Critical Habitat Unit 2, water quantity as it relates to spawning access is especially important, particularly in Clear Lake. Low streamflow and/or lake elevations during the spawning season can limit access to spawning habitat.

5.6.6.1 Physical or Biological Features in the Action Area

PBF 1 (Water)

This physical or biological feature can be summarized as sufficient water quantity and suitable water quality necessary to support the life history and to provide for the conservation of the species. Water quantity and water quality vary within and among sites and across multiple time scales. In general, the climate in recent years has been drier than average, which can limit the water needed to meet the needs of the species (see Section 5.5.2), including connectivity to spawning areas, particularly the UKL shoreline springs (Burdick et al. 2015c) and tributaries to reservoirs in the Lost River Basin (Hewitt and Hayes 2013a). Water quality is poorer for UKL and Lake Ewauna compared to other designated critical habitat (Clear Lake Reservoir and Gerber Reservoir), though data for the latter are comparatively sparse (see Section 5.5.3).

PBF 2 (Spawning and Rearing Habitat)

Spawning habitat exists at the UKL shoreline springs, Williamson River, Sprague River, Willow Creek, Boles Creek, Barnes Valley Creek, and Ben Hall Creek (see Sections 5.2 and 5.3). Of these, only the UKL shoreline springs spawning habitat occur within the action area. As discussed above, the UKL shoreline springs may also become desiccated to some degree if lake levels drop substantially during the spawning season. Overall, spawning habitat has decreased compared to historical conditions, in terms of either actual spatial extent or functionality.

Rearing habitat is present within UKL, Clear Lake Reservoir, and Gerber Reservoir, as well as their tributaries, and the majority of rearing habitat occurs within the action area. Limited documentation of rearing of suckers in the tributaries indicates this can occur (Hayes and Rasmussen 2017, entire), but it is unclear to what extent this occurs in any of the populations. Larvae and juveniles primarily utilize vegetated areas along the fringes of UKL until they move into the deeper areas of the lake as they grow (see Sections 5.2.3 and 5.2.4). However, in Gerber and Clear Lake Reservoirs very little of this type of habitat exists in some years; nevertheless, juveniles are able to survive to recruit to adults with regularity. It is unknown whether the scarcity of emergent vegetated habitat affects the proportion of individuals that rear in the tributaries or whether the fish simply exploit other niches within the lake.

It is difficult to quantify the extent and quality of existing rearing habitat. Conversion of wetlands for agriculture since the turn of the 20th century has reduced the volume of littoral wetland habitat as by as much as 66 percent and much of the remaining areas have been modified (Natural Resource Council, 2004 pp. 72-73) so that the habitat is not functioning in the same ways it did historically (see Section 5.5.1).

PBF 3 (Food)

Very little empirical data exists on the quantity, quality, and availability of food throughout the designated critical habitat, but the available data suggest large quantities of food (including zooplankton, macroinvertebrates, and periphyton) are available (Stauffer-Olsen et al. 2017).

6 STATUS AND ENVIRONMENTAL BASELINE OF THE NORTHWESTERN POND TURTLE

6.1 Legal Status

The Service was petitioned to list western pond turtle (*Actinemys marmorata*) as threatened or endangered under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531–1543), in July 2012. On April 10, 2015, the Service published a 90-day finding that the petition presented substantial scientific or commercial information indicating that listing may be warranted for the western pond turtle (80 FR 19262–19263; subsequently split into two separate species, the northwestern pond turtle (*Actinemys marmorata*) and southwestern pond turtle (*Actinemys pallida*).

The Service issued a proposal to list the northwestern pond turtle (hereafter NWPT or turtle) as threatened and to establish a 4(d) rule on October 3, 2023 (88 FR 68370). The Service reopened the comment period on the proposed rule on April 4, 2024 (89 FR 23534) and anticipates a final listing determination in fall 2024. Critical habitat for northwestern pond turtle is not proposed at this time and thus will not be discussed further.

6.2 Life History

The range of the northwestern pond turtle includes populations from the San Joaquin Valley north, all populations in California north of the middle of Monterey Bay, the Coastal and Cascade Ranges of Oregon and Washington State, and an outlying population in Nevada (Figure 18) (Shafer and Scott 2022). Western pond turtles tend to prefer elevations no higher than 1,500 meters (4,921 ft) above sea level (Holland 1994). NWPT populations need a network of functional, appropriate aquatic breeding, feeding, and basking habitat that has sufficient upland nesting and overwintering/aestivation sites that are connected by suitable habitat (USFWS 2023a; Table 2). Functional, appropriate habitats are suitable habitats that can be reasonably assumed accessible by turtles.

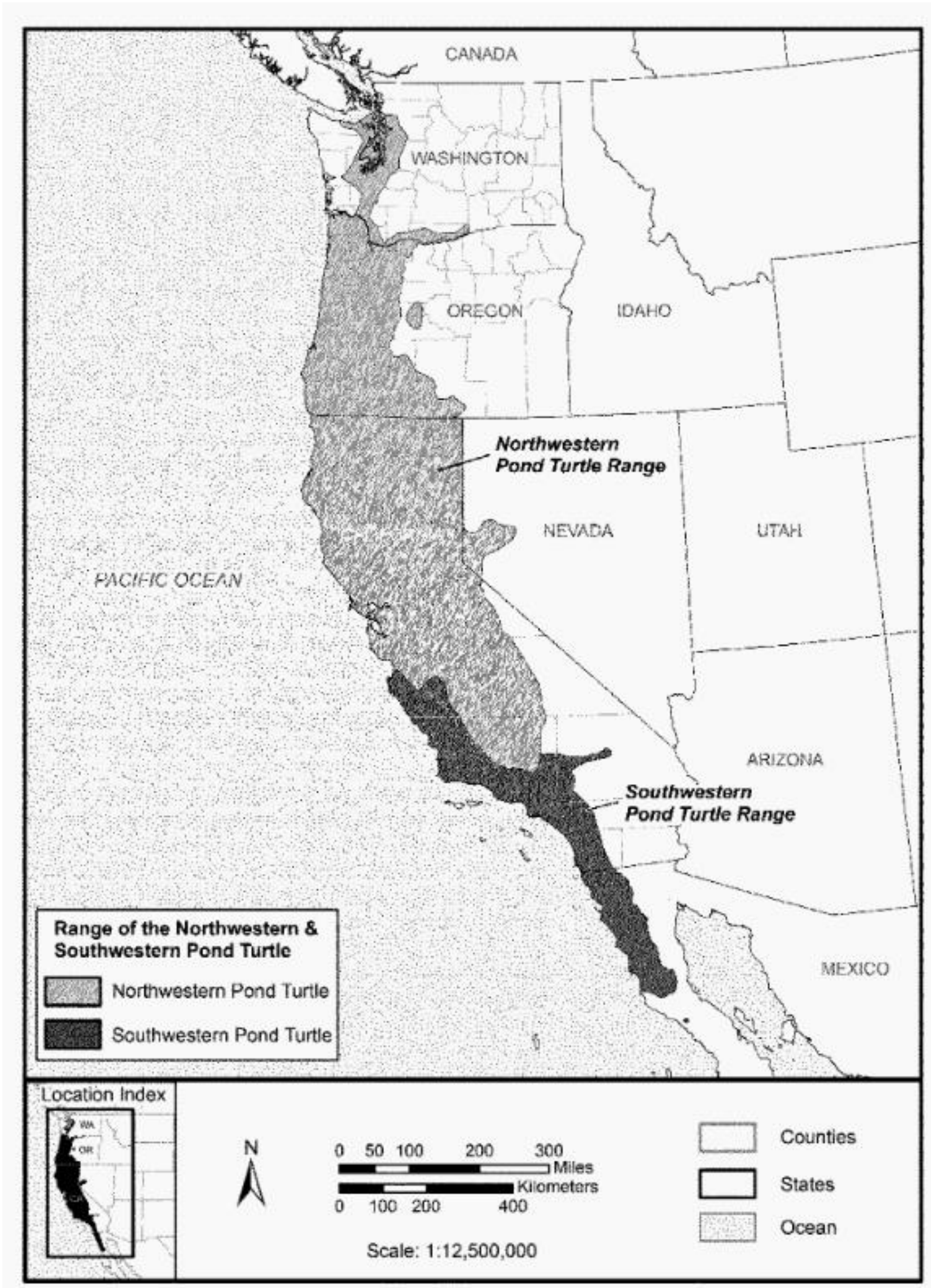


Figure 18. Range of the northwestern and southwestern pond turtle (Service 2023)

Table 2. Description of suitable northwestern pond turtle habitats.

Habitat Type	Description	Distance from Suitable Aquatic Habitat
General Aquatic Habitat	Aquatic conditions with abundant basking sites, underwater shelter sites (undercut banks, submerged vegetation, mud, rocks, and logs), and standing or slow- moving water (can be slack water areas of faster moving rivers)	In and immediately adjacent
Nesting	Compact, dry soils, usually with composed of high clay or silt content (not rocky/gravelly/sandy soils), but loose enough to allow for excavation of chamber for egg laying; close proximity to aquatic habitat; above the annual high-water line; short (less than 1 meter), sparse, or no vegetation (bare ground); and little or no canopy cover to allow for exposure to direct sunlight.	100 meters or less
Overwintering	Generally, occurs in forested upland locations above ordinary high-water lines or beyond the riparian zone; forested areas with leaf litter/duff layer; but can also include the bottom of muddy ponds and undercut banks.	500 meters or less
Aestivation	When intermittent streams/ephemeral waterbodies are present and subject to late summer drying, turtles may move into upland habitat to moist forests, shrubby areas, or under wood or duff layers, but can also include the bottom of muddy ponds and undercut banks.	150 meters or less
Dispersal	All of the above habitats may be used for dispersal.	N/A, will travel in aquatic and upland habitats

Preferred aquatic conditions are those with abundant basking sites, underwater shelter sites (undercut banks, submerged vegetation, mud, rocks, and logs), and standing or slow-moving water (Holland 1992, Reese and Welsh 1998, Hays and McAllister 1999, Bury and Germano 2008, Earnest and Lovich 2009). The few hatchlings (Table 3) that have been observed in the aquatic environment were in shallow and slow-moving waters, typically with emergent vegetation (Buskirk 2002). In streams and rivers, adult turtle most frequently occupy low-velocity waters and particularly deep pools (Evenden 1948, Holland 1994, Reese and Welsh 1998, Earnest and Lovich 2009). Turtles may also occupy faster moving waters with these same features when slack water pools (e.g., side eddies) are also available (Department of Defense (DOD) 2020).

Table 3. Definition of NWPT Life Stage Classes (Service, 2024, p. 141).

Classification	Age	Size	Sexually Mature
Hatchling	0-1 year	Small	No
Juvenile	1-7 years	<120 mm	No
Adult	7+ years	>120 mm	Yes

Despite their ability to use a wide range of aquatic and terrestrial habitat, suitable aquatic habitats are relatively rare across much of the range, exacerbated mostly by past land use changes. In areas associated with agriculture and urbanization, upland land conversion and draining of the extensive wetlands or channeling of streams have resulted in the decline and extirpation of many populations and left the remaining western pond turtle populations within these areas disjunct, scattered, and isolated from each other with little upland habitat available for nesting (Holland 1992, Reese and Welsh 1998)

The NWPT is omnivorous and considered a dietary generalist (Holland 1994), consuming a wide variety of food items including small aquatic invertebrates, with small vertebrates (fish, tadpoles, and frogs), carrion, and plant material (Bury 1986, Holland 1994). Food captured or scavenged on land must be brought back to water for consumption, as they appear to be unable to swallow in the air (Holland 1994).

Courtship behaviors have been observed from April through November, with mating observed in May through September (Holland 1992). These behaviors appear to occur underwater, although this is based on very few observations (Holland 1992, Goodman 1997, Ashton 2007, Bettelheim 2009). In northern California, mating has been observed in the spring (Reese 1996). Oviposition usually occurs from late May through July, with northern populations depositing eggs later in the season than those in the south. Gravid female turtles generally leave the water in the late afternoon or early evening and move into upland habitats to excavate a nest (Holland 1994). Nests are typically constructed in compact, dry soils, usually with high clay or silt content but loose enough to allow for excavation of chamber for egg laying, close proximity to aquatic habitat, above the annual high water line, and are typically characterized as having sparse vegetation with short grasses and forbs (bare soil is preferred) and little or no canopy cover to allow for exposure to direct sunlight (Storer 1930, Holland 1994, Holte 1998, Rathbun et al. 2002, Rosenberg et al. 2009, Riensche et al. 2019).

Nest sites most commonly occur on south or west facing aspects with slopes less than 15 percent (Holland 1994, ODFW 2015, Riensche et al. 2019, Davidson and Alvarez 2020). Females excavate nests 3 to 500 m from water (Storer 1930; Holland 1994; Holte 1998) with the majority of nesting sites in Oregon located within 100 m (328 ft) of water (ODFW 2015). Females may be out of the water for a few hours to several days with nest completion taking anywhere from 2 to more than 10 hours. Females may make several forays into the upland prior to actual oviposition, and sometimes make false scrapes where they abandon the nest prior to laying eggs, potentially as a result of hitting rocks or roots or because of disturbance, to which western pond turtles are extremely sensitive (Holland 1994; Bury and Germano 2008). Nests are shallow and generally occur between 9 to 12 cm below the surface (Holland 1994). After the nest is excavated and eggs deposited, females use surrounding material such as mud, dry soil, and vegetation to form a plug that closes off the neck of the nest chamber (Holland 1994). Incubation time is approximately 80 to 126 days (Holland 1994).

Little is known about upland habitat requirements of hatchlings after emerging from the nest. In the northern parts of the range (e.g., Oregon and Washington), hatchlings overwinter in the nest (Holland 1994, Reese and Welsh 1998). Primary habitat for hatchlings and young juveniles is shallow water with dense submerged vegetation and logs, which most likely provides shelter, prey, and thermoregulatory requirements or other functions for survival (Holland 1994, Rosenberg and Swift 2013). In western Oregon, hatchlings delayed emergence until spring, and typically remained within 2 m of nests for as long as 59 days after initial emergence (Rosenberg and Swift 2013). During migration from their nests to aquatic habitat, hatchlings embedded themselves in soil for up to 22 days at stop-over sites. Hatchlings entered aquatic habitat on average 49 days after initial emergence and traveled an average of 89 m from their nest site. Hatchlings detected in water were always within 1 m of shore and in areas with dense submerged vegetation and woody debris (Rosenberg and Swift 2013).

The amount of time spent in upland habitats for overwintering and/or aestivating varies geographically and within populations and is likely influenced by climate and hydrological conditions. In a study in northern California, radio-tagged males used terrestrial habitat in at least ten months of the year, emphasizing the importance of upland habitat in addition to aquatic habitat (Reese and Welsh, Jr. 1997). Overwintering/aestivation habitat generally occurs in forested upland locations above ordinary high-water lines or beyond the riparian zone, although understanding of specific microsite conditions is limited (Reese and Welsh 1998, Rathbun et al. 2002, ODFW 2015). While vegetation communities differ from site to site, forested areas with leaf litter/duff layer were present at most overwintering sites; open areas were avoided for overwintering (Reese and Welsh 1998, Rathbun et al. 2002). However, some turtles will overwinter in the bottom of muddy ponds or in undercut banks (ODFW 2015).

NWPT inhabiting intermittent streams may respond to late summer drying and winter flooding by moving into upland habitat to aestivate within 150 m of aquatic features in moist forest, shrubby areas, under wood or duff layers, bottom of muddy ponds, or in undercut banks (Rathbun et al. 2002; ODFW 2015). However, in perennial streams and rivers, turtles may remain active until fall/winter storms increase stream flows and reduce water temperatures (Belli 2016). In northern California, beginning in September, NWPT spent seven months of the year away from the Trinity River to overwinter in uplands, while others moved to nearby lentic bodies of water (lake and slough) as far as 500 m from the river (Reese and Welsh, Jr. 1997). The majority of overwintering sites in Oregon occur within 500 meters (1,640 feet) of suitable aquatic habitat (ODFW 2015). The Service recognizes other studies from other parts of the range document overwintering sites within a narrower distance (Reese and Welsh 1998, Zaragoza et al. 2015

Dispersal of NWPT between populations/watersheds is generally not well understood. Within aquatic habitat, a dispersal distance of 7 km upstream was observed (5 km overland distance) (Holland 1994). During an extreme drought, Purcell et al. (2017) documented a 2.6 km straight-line distance movement overland in a radio-tagged turtle, with a minimum total distance of 3.3 km moved before the individual found water.

6.3 Threats

The Service identified the following threats to the NWPT and southwestern pond turtle in their species status assessment (USFWS 2023): (1) habitat loss and fragmentation; primarily from urbanization and agricultural conversion, (2) disturbance via recreational activities such as fishing, boating, and off-highway vehicle use, (3) alteration of natural hydrology through dam building, water diversions, stream channelization, etc., (4) predation by native and nonnative species (e.g., bullfrogs, largemouth bass), (5) competition with nonnative turtle species such as the red-eared slider (Trachemys scripta elegans), (6) roadkill mortality, (7) diseases including respiratory disease and shell disease, (8) commercial and private collection as pets and food, (9) toxicants such as pesticides, herbicides, and heavy metals, and (10) climate change impacts including increasing temperatures, drought, extreme flood events, and high severity wildfire.

6.4 Environmental Baseline of Northwestern Pond Turtle in the Action Area

Within the action area, NWPT have been observed within the Miller Island Wildlife Management Area, the Klamath River below the old J.C. Boyle Dam, the Lower Klamath Lake National Wildlife Refuge, the Tule Lake National Wildlife Refuge, and the Upper Klamath National Wildlife Refuge and are also known to exist within the project area, primarily in project canals. However, little is known about the species' distribution and abundance and survey data does not exist. Reports of anecdotal observations are from personal communications with the local Bureau of Land Management, U.S. Forest Service, Oregon Department of Fish and Wildlife, U.S. Bureau of Reclamation, and the Klamath Basin National Wildlife Refuge Complex and iNaturalist reports. Within the iNaturalist database (viewed 8/8/24) there are 72 research grade reports of NWPT observations within the action area (Table 4).

Table 4. Number of iNaturalist Research Grade NWPT Reports by Project County and State.

County	State	# Research Grade Reports
Klamath	Oregon	30
Lake	Oregon	1
Modoc	California	1
Del Norte	California	0

County	State	# Research Grade Reports
Siskiyou	California	8
Trinity	California	20
Humboldt	California	12
Total:		72

The extent of northwestern pond turtle nesting and overwintering habitat within the action area is unknown, although it is assumed that suitable nesting and overwintering habitat conditions exist, because NWPT observations have been documented within the action area. It is similarly assumed that the quality of the habitat varies across the action area, depending upon local conditions including soil and vegetation composition, permanent versus ephemeral water, and anthropogenic factors such as recreation, irrigation, grazing, etc.

Across its range, seasonal timing of NWPT's life history events, and therefore that of turtle habitat usage, varies between geographical regions, elevations, and individual turtles. As precipitation and temperatures also vary across this large action area, so will timing of turtle seasonal activities (e.g., hatching emergence and nesting are likely influenced by snow and ice cover in higher elevations and more easterly areas). Seasonal timing in the project area is likely to follow those identified in Figure 19, which are based largely on ODFW 2015 but are also supported by other literature/scientific reports (e.g., Rosenberg et al. 2009, Veseley 2009, Yarnal 2019, WPT RCC 2020, DOD 2020, and Service 2023).

<table>
<tr><th>NWPT</th><th>JAN</th><th>FEB</th><th>MAR</th><th>APR</th><th>MAY</th><th>JUN</th><th>JUL</th><th>AUG</th><th>SEP</th><th>OCT</th><th>NOV</th><th>DEC</th></tr>
<tr><td rowspan="2">Season and Habitat</td><td colspan="2">WINTER</td><td colspan="3">SPRING</td><td colspan="3">SUMMER</td><td colspan="3">AUTUMN</td><td>WINTER</td></tr>
<tr><td colspan="2">Overwintering/Inactive Season. In forested uplands or aquatic soft substrate.</td><td colspan="3">Breeding Season. Split between upland and water.</td><td colspan="3">Active Season. Split between upland and water.</td><td colspan="3">Dispersal Season. Dispersing or traveling to overwintering sites.</td><td>Inactive Season. Hibernating in forest or pond mud.</td></tr>
<tr><td>Activity</td><td colspan="2">Overwintering, when turtles hibernate in the forest or pond mud and are inactive. Duing spells of unseasonably warm and sunny weather, some emerge to bask. They then return to their overwintering locations.</td><td colspan="2">In early spring, turtles that overwintered on land and hatchlings that have emerged from the nest move toward aquatic habitats. Sensitive time for hatchlings.</td><td colspan="4">Females lay eggs, peak activity is June and July. In hot and dry conditions some turtles enter aestivation in the bottom of wetlands and other waterbodies or on land in cool forested or shrubby habitats under leaf litter and decayed logs. Sensitive nesting season.</td><td colspan="2">Eggs typically hatch in September and October but hatchlings don't leave the nest until the falling spring. Juveniles and adults move to hibernation habitats in mid to late fall.</td><td colspan="2">Overwintering, when turtles hibernate and are inactive. During spells of unseasonably warm and sunny weather, some emerge to bask. They then return to their overwintering locations.</td></tr>
</table>

Figure 19. General seasonal timing of NWPT's life history stages and habitat usage within the Upper Klamath Basin and action area (ODFW 2015).

6.4.1 Previous Consultations in the Action Area

The previous consultations in the action area described in Section 5.5.11 only covered LRS and SNS and were completed prior to the proposed listing of NWPT. Conferencing for NWPT has not been completed for any of these projects and has only been initiated for the Lower Klamath dam removal projects. Based on the project descriptions in Section 5.5.11 the restoration projects are expected to have beneficial effects to NWPT by improving water quality, providing forage resources, providing overwintering habitat, and providing refugia from predation. The potential effects from the other types of projects are unknown without additional analysis that will occur during project specific conferencing.

7 EFFECTS OF THE ACTION

The implementing regulations for section 7 define “effects of the action” as “all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action” (50 CFR 402.02).

7.1 Lost River and Shortnose Sucker

This analysis considers factors such as previous consultations, 5-year reviews, published scientific studies and literature, professional expertise of Service personnel, information obtained from researchers or experts dealing with aspects directly related to LRS and SNS, species threats, and other related documents in determining whether effects are reasonably certain to occur.

7.1.1 Analytical Approach

Use of the Period of Record Hydrograph as a Tool to Analyze Project Effects

The following analysis relies on the findings presented in Section 5, the *Status and Environmental Baseline of the Lost River Sucker and Shortnose Sucker* above for the LRS and SNS, especially with respect to their conservation needs, to express the significance of anticipated effects of the PA on these species.

The primary purpose of the PA is storage and delivery of water for Project uses; as such, analyzing hydrologic data, such as water levels in LRS and SNS habitats, is essential to the effects analysis. However, because there is no way to know with certainty what future water conditions will be; for the purpose of this analysis, the Service has relied upon historical data (i.e., the POR) in simulations to understand the likely range and distribution of elevations in Project reservoirs over the proposed term of Project operations. To be useful, the POR needs to be sufficiently long to capture a broad range of conditions and needs to include recent data to capture any current trends. For this consultation, the POR hydrology data selected for Clear Lake Reservoir and Gerber Reservoir were for water years 1911 through 2023 and 1925 through 2023, respectively. However, the analysis for each of these reservoirs gives more weight to conditions observed over the last few decades, which are more likely to be representative of condition over the term of this opinion. The POR hydrology data set for UKL relied upon in this analysis is the 32-year period between October 1, 1991, and September 30, 2022. The shorter time period for the UKL POR was chosen to be more consistent with recent climatic trends and current water-use conditions, while also including a broad distribution of dry, average, and wet years.

Other waterbodies are used primarily to pass water through, such as Keno Reservoir, or serve as a catchment for return flows, such as Tule Lake. These waterbodies are managed in relatively narrow depth ranges that depend less on hydrologic conditions. Because of the reduced variability, the effects analysis does not depend on hydrologic conditions in an observed POR but simply the specific reservoir elevations and operations in the PA.

Use of the KRM as a Tool to Analyze Project Effects on Water Levels

To analyze potential effects of the PA, Reclamation and the Service used the KRM to identify Klamath River and UKL hydrographs that would have occurred if the PA had been implemented at the start of the 1991 water year. The hydrographs and other modeled outputs are also used by the Service to anticipate likely future lake and river conditions in water years similar to those occurring in the POR. Similar to previous model versions used for the last 15 years, the KRM is based on the Water Resources Integrated Modeling System software (WRIMS), a broadly accepted, generalized water-resources modeling software designed of evaluating river-basin scale water management alternatives. KRM was developed jointly by Reclamation, the Service, and NMFS, specifically for the consultation analyzing project operations. A similar model is not available for the east side of the Project (i.e., Clear Lake and Gerber Reservoir), so reservoir-specific water balance models based on the POR were used instead. For a detailed description of the KRM, see Appendix C in the 2024 Assessment (USBR 2024).

This effects analysis explicitly considers the PA, as provided to us on June 14, 2024, and with the addendum provided on August 27, 2024, and all provisions therein. The Service and NMFS actively participated in the development of this PA. This effects analysis is based upon KRM output data and reservoir-specific water balance models and fully considers their implications for listed suckers.

The central pillar of the PA is that water management decisions are linked directly to real-time hydrologic and water use conditions. For the hydrologic and water use conditions experienced in the POR, the model simulates water management decisions under the PA and provides a reasonable approximation of outcomes for the different components of the system. A critical assumption of the effects analysis in this Opinion is that it includes the modeled hydrologic conditions and resulting ecosystem effects. These provide the basis for the simulation of the PA and therefore of the effects analysis. The hydrologic conditions and ecosystem effects considered here include a broad distribution of dry, average, and wet years. This assumption has helped inform the Service’s consideration of the likely conditions that may occur over the term of this Opinion.

For this Opinion, the Service assumes that the POR for the hydrology of the three primary Project reservoirs represents the range and distribution of elevations that may occur over the term of this Opinion (November 15, 2024, to October 31, 2029). The Service assumes the following regarding the volume and timing of hydrologic data critical to the KRM and implementation of the PA.

- Flow in the Williamson River and net inflow to UKL will be similar in magnitude, pattern, and sequence to that observed in the POR.
- Flow (return flow or direct release) from the east side to the west side of the Project will be within the ranges observed during the POR, and appropriate for water year conditions.
- Accretions to the Klamath River between Link River Dam and the USGS gauge below the former Iron Gate Dam will be within the ranges observed during the POR and appropriate for water year conditions.
- Although the volume of Project water use may be different from the POR, particularly in years drier than average, the pattern of water use will be similar to the pattern observed during the POR.

7.1.2 Key Assumptions for the Effects Analysis

This analysis relies on several key assumptions as derived from the Assessment. If these assumptions prove false or warrant changes during Project implementation, it could affect the validity of this analysis and potentially trigger re-initiation of ESA Section 7 consultation if it results in effects that were not considered herein.

The following assumptions were used in completing this analysis:

- Reclamation will operate the Klamath Project and implement conservation measures according to the description of the PA presented in the Assessment and subsequent addendum.
- Reclamation will supply 43,000 AF of water to Lower Klamath and Tule Lake National Wildlife Refuges in the months of April through October.
- Reclamation will ensure that appropriate coordination and oversight occurs with operators of Project facilities, including irrigation and drainage districts, so that water levels in UKL and other Project reservoirs will exhibit the pattens and magnitudes expected for particular hydrologic and operational conditions modeled and described in the BA and this Opinion. Furthermore, the Service assumes Clear Lake and Gerber Reservoirs will be operated within the historic ranges observed during the POR and analyzed in this Opinion.
- Reclamation will ensure that hydrologic data used to manage Project reservoirs are accurate. This specifically includes UKL bathymetry data, especially bottom elevations in areas frequented by adult suckers, such as Pelican Bay, and the elevation-capacity relationship that Reclamation uses to determine the storage in UKL associated with

elevations greater than 4,136.00 ft. Additionally, the Service assumes that water-balance models for Clear Lake, and Gerber Reservoir, provide reasonable simulations of the physical processes they simulate.

- The POR for the hydrology of the three primary Project reservoirs represents the range and distribution of elevations that are reasonably likely to occur over the term of this consultation.
- Reclamation will compute daily and monthly exceedances using the 1991-2022 POR. This 30-year period is more consistent with current climatological data and acknowledges the declining trend in overall inflow to UKL and other Project reservoirs in recent decades.
- Reclamation will provide the staff and funding necessary to implement the conservation measures proposed in the BA and addendum.
- Implementation of Reclamation's adaptive management process and structured decision-making framework will prioritize research and monitoring efforts but will not change the PA therefore no effects analysis is needed.

The foundation of an ESA Section 7(a)(2) analysis is an accurate characterization of the PA and the effects it is likely to have on listed species and their critical habitat. For ongoing water projects, such as the Klamath Project, determining the effects of the PA on listed species and their critical habitat is complex. Project-affected lakes and reservoirs experience varying water levels and water quality conditions as a result of Project-related discretionary management actions, natural and unrelated anthropogenic changes in inflows and outflows, and pre- existing infrastructure that have collectively altered the hydrology of the action area. Currently, best available information and the Service's technical capability are insufficient to precisely distinguish between the effects likely to be caused by the PA to water levels and quality in the action area and such effects caused by other factors, such as climate, wetland alterations, water diversions by non-Project users, and pre-existing water management infrastructure. For those reasons, a more generalized approach has been used to complete the following effects analysis that reflects the focus of Project-related water management on storage from October to April and delivery from April to October. In general, Project operations are expected to result in a period of increasing water storage in the October through April period as reservoirs refill due to natural hydrology and operations to increase storage for spring and summer releases for river flows and Project deliveries. This will result in higher water levels in the spring relative to other times of the year, and a commensurate increase in the quantity and quality of sucker habitat in Project lakes and reservoirs. Water levels, and the quantity and quality of sucker habitat, will decrease throughout the summer as operational water releases are made and natural hydrologic and climatic conditions drive decreased inflow and increased evapotranspiration. These trends in water storage and associated sucker habitat will, in general, repeat interannually, except in water years with an exceptional snowpack and relatively cool, wet summers or in water years with exceptionally dry conditions.

A number of large-scale restoration efforts (e.g., removal of the four Lower Klamath Hydroelectric Project dams [J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate] and reconnection of Agency-Barnes to Upper Klamath Lake) are underway in the Klamath Basin and they will create ecosystem level changes to the environment. These restoration efforts are conservation-oriented restoration, aimed at restoring ecological functions that provide for anadromous fish passage, improvement in stream and wetland habitat quantity, quality, and complexity for both anadromous fish and endemic sucker species. The reconnection of Agency-Barnes to Upper Klamath Lake will fundamentally change the surface area of the lake and the amount of water needed to reach full pool; however, it will also increase wetland and sucker rearing habitat. It will take time for the ecosystem to stabilize following restoration. The increased surface area, the decrease in net inflows to Upper Klamath Lake, and the lack of any major improvement to LRS and SNS status, have led to a paradigm shift in the approach to the effects analysis.

The analysis that follows is generally qualitative. Knowledge of currently available scientific information can provide basic information but may not enable prediction of how a species will respond to changes in its environment, particularly aggregate effects of multiple factors because aggregate and cumulative impacts are difficult to predict. This is because aggregate and cumulative impacts usually require a time component such as sequential exposure to a stressor. The cumulative nature of change in the Klamath Basin involving restoration, and decades of water operations layered on top of other stressors makes it difficult to distinguish the long-term effects of water operations from the effects that may arise from implementation of the PA.

7.1.3 Effects of the Proposed Action on LRS and SNS by Recovery Units

The Revised Recovery Plan for the LRS and the SNS (USFWS 2013a) identifies two recovery units for both species: (1) the UKL recovery unit; and (2) the Lost River sub-basin recovery unit. The effects analysis is organized by recovery units because the effects of the action tend to be .similar within recovery units and because the Klamath project is managed differently in the two recovery units. This analysis relies on the survival and recovery function assigned to each of these units to express the significance of anticipated effects of the proposed Project on these species.

7.1.3.1 Effects of the Proposed Action on LRS and SNS in the UKL Recovery Unit

The UKL recovery unit for the LRS and the SNS consists of Upper Klamath Lake, its tributaries, Keno Reservoir along the Klamath River, and Lower Klamath National Wildlife Refuge. The proposed Project operations are likely to affect habitat availability for most LRS and SNS life-history stages, including embryos, larvae, age-0 juveniles, older juveniles, and adults.

As described in the *Status and Environmental Baseline of the Lost River Sucker and Shortnose Sucker* section above, the UKL recovery unit supports a population of SNS and the largest LRS population. The PA is likely to affect habitat availability for all SNS and LRS (sucker) life-history stages, including embryos, pre- and post-swim-up larvae, age-0 juveniles, older juveniles, and adults. Each sucker life stage has specific habitat needs and specific seasonal time periods when those habitats are used (see Section 5.2). This analysis evaluates the effects that the proposed management of UKL surface elevations and the resultant water depths are likely to have on the quality and quantity of habitat for each LRS and SNS life-history stage in UKL, Keno Reservoir, and Lower Klamath National Wildlife Refuge. The analysis, and the supporting figures and tables, in this section focuses on specific effects to LRS and SNS.

7.1.3.1.1 Effects to LRS Shoreline Spawning Habitat

A subset of LRS in UKL spawn at shoreline springs along the east side of the lake beginning as early as March and extending through May, with a peak in April (Buettner and Scoppettone 1990, pp. 17– 19; Barry et al. 2007, pp. 18–28; Janney et al. 2009, pp. 7–8; Burdick et al. 2015b, p. 484; Hewitt et al. 2018, pp. 10, 12). In 2010, observed end-of-month lake elevations were 4,140.49 ft. in March, 4,141.00 ft. in April, and 4,141.28 ft. in May (Figures 20 and 21). At the same time there were 14 percent fewer females and 8 percent fewer males detected at the spawning sites when compared to years with higher lake elevations, which is likely to result in reduced reproductive output. In 2022, observed end-of-month lake elevations were 4,140.89 ft. in March, 4,140.77 ft. in April, 4,140.74 ft. in May. The 2022 data shows a similar trend to the 2010 data with a decline in the number of LRS detected at the spring spawning sites when compared to years with higher lake elevations (Kause et al. 2023). Individuals that were detected spent less time on the spawning grounds (36 percent less for females, 20 percent less for males) and visited fewer spawning areas. The time that individual LRS spent on the spawning grounds was also reduced at low, but less extreme, elevations. Consequently, low lake surface elevations may result in less spawning activity at the shoreline springs (Figure 21) (Burdick et al. 2015b, pp.483, 487–488).

However, Burdick et al. (2015b., p. 488) also observed that spawning activity at shoreline springs is not negatively impacted when UKL elevation is greater than range of 4,141.4 ft. to 4,142.0 ft., assuming a normal increase in lake elevation driven by average hydrology during the springtime shoreline spawning period. Average spring hydrology in the months of March and April generally includes an increasing trend in UKL elevation due to spring runoff and minimal demand from Project irrigators. Across the POR, the PA provides UKL elevation at or above 4,141.4 ft. at the end of March in 86 percent of years, at or above 4,141.8 ft. at the end of March and April in 69 precent of years, at or above 4,142.0 ft. at the end of April and through May 15 in 67 percent of years, and at or above 4,142.0 ft. at the end of May in 59 precent of years. This suggests that the PA will provide adequate shoreline spawning habitat with a high frequency, though LRS spawning may be adversely affected due to reduction in habitat in approximately one-third of years. Further, based on observations in a study on other long-lived catostomids, skipped spawning in shallow areas is not uncommon and may correlate to increased fecundity following a no-spawn year (Scoppettone et al., 2000, p. 667). Recent trends in shoreline spawning show year over year reductions in spawning numbers for over a decade, despite meeting or exceeding 4,142.0 ft. for all or most of the March through April time frame in seven of the last 10 years. This suggests that factors other than lake elevation are also impacting shoreline spawning.

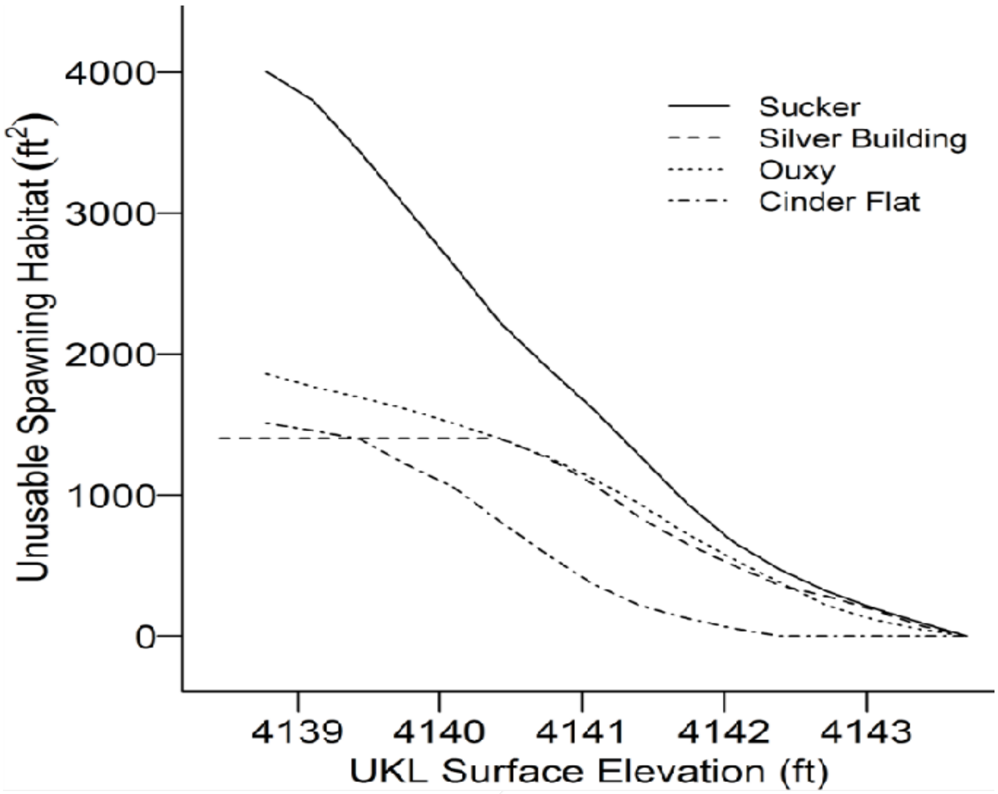


Figure 20. Area of unusable spawning habitat at the UKL shoreline springs at varying lake surface elevations (data from Burdick et al. 2015b, p. 485).

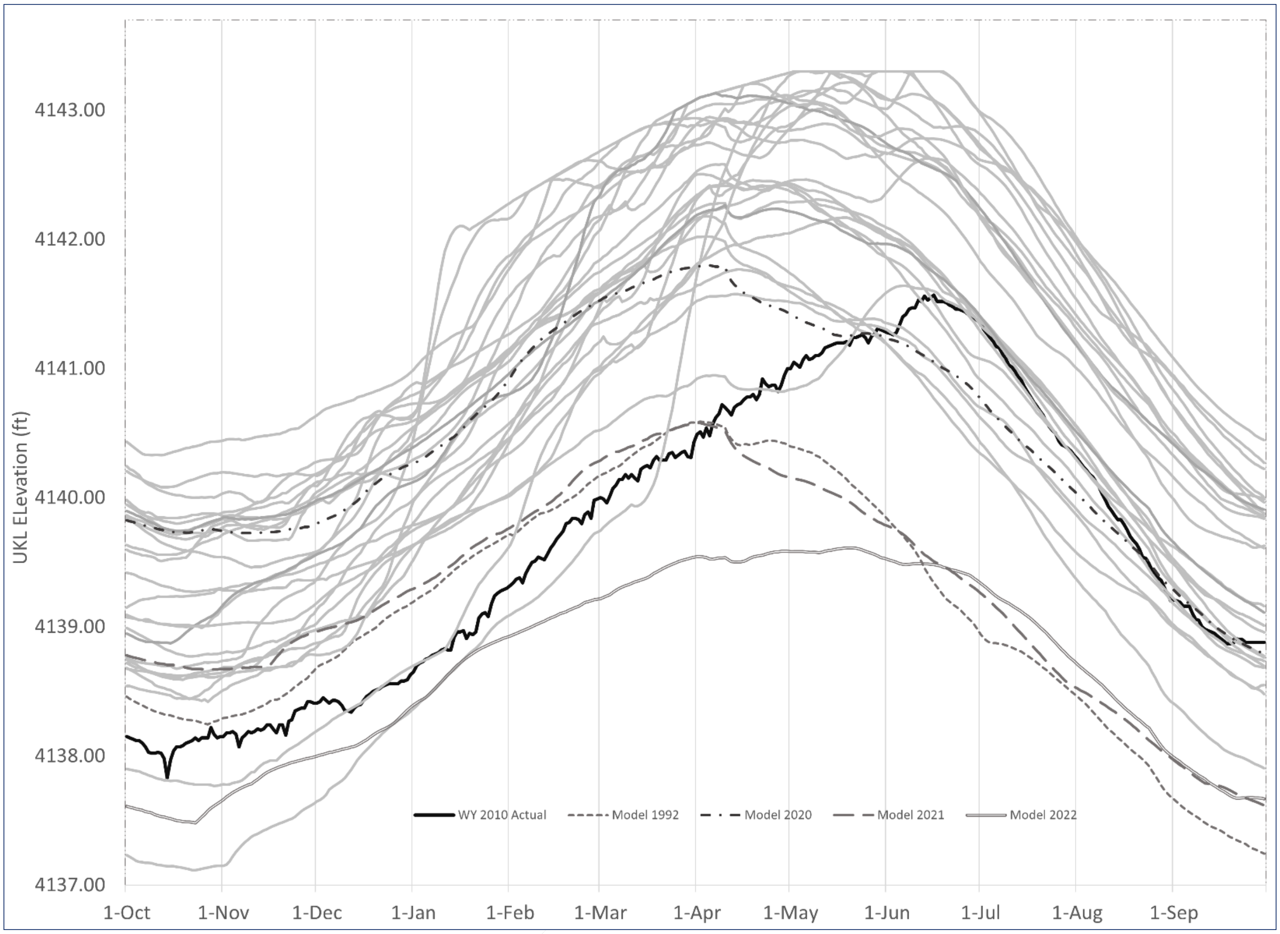


Figure 21. Annual modeled Upper Klamath Lake surface elevation for the POR (gray lines), the observed lake surface elevation in 2010 when spawning at the shoreline springs was reduced by lake elevations (bold line).

The Service concludes that the PA is likely to result in adverse effects when spring lake levels go below 4,141.40 ft. on March 15 with an increasing or steady trend in UKL elevation through April 30, due to reduced habitat availability for shoreline spawning LRS. If UKL elevations fluctuate below 4,141.40 ft. during April or May, spawning could be considerably reduced because adults either do not spawn, spend less time spawning, or spawn in unsuitable habitat, which results in low reproductive output (i.e., death of embryos or pre-swim-up larvae).

7.1.3.1.2 Effects of the Proposed Action to LRS and SNS Embryos, Pre-swim-up Larvae, and Habitat at Shoreline Springs in UKL

LRS embryos and pre-swim-up larvae are expected to be present in the gravel at the shoreline springs for a maximum of 3 weeks following spawning and fertilization (Coleman et al. 1988, p. 27). For example, larvae from LRS eggs fertilized in late April would be in the spawning gravel in mid-May, and larvae from eggs fertilized in late May would still be present in the gravel in mid-June. If rapid decreases in lake elevation occur during egg deposition and larval swim-up time period, embryos or larvae would be exposed to the air and will die from desiccation, so adverse effects could result from rapid decreases in lake elevation between egg deposition and larval swim-up.

The minimum observed spawning depth for LRS is 0.60 ft. (Buettner and Scoppettone 1990, p. 20). Under simulated model runs of the KRM with the pulse flow, the maximum elevation decrease within 3-weeks of any date in March to May from the model POR (1991-2022) was 0.46 ft. The maximum drop within 3-weeks of any March-May date was less than 0.40 ft. in 98 percent of cases, with a 73 percent chance of UKL elevation increasing during this critical period. Changes greater than 0.6 ft have the potential to dewater LRS embryos deposited at the shallowest observed spawning depth (Figure 22). Based on the model POR utilized, the Service does not expect consistent dewatering of embryos or pre-swim-up larvae unless there are surface elevation changes greater than 0.60 ft. within 3-weeks. The PA does not anticipate a day-to-day lake surface elevation change greater than 0.60 ft. in March to May. However, even with a decrease in UKL surface elevation of 0.60 ft. within a 3-week period between March to May, only eggs spawned at the minimum depth (0.60 ft) of LRS spawning habitat would be affected. Based on simulated model runs of the KRM of the maximum elevation decrease and the minimum spawning depth, impacts to embryos and pre-swim-up larvae may occur under the PA, but the probability of dewatering or desiccating eggs and larvae are minimal as the modeled operations do not decrease lake elevation more than 0.6 ft. during any time period between April and May.. The PA anticipates a lake elevation in April and May at or above 4,141.40 ft. in most years and that UKL operations will not lower elevations more than 0.60 ft. within a 3-week period. If these elevations are realized, habitat conditions should provide for the annual production of millions of LRS and SNS eggs and larvae in UKL. Therefore, the Service concludes that the PA is likely to result in discountable effects as UKL operations will not lower lake elevations more than 0.60 ft. within 3-week period in March to May.

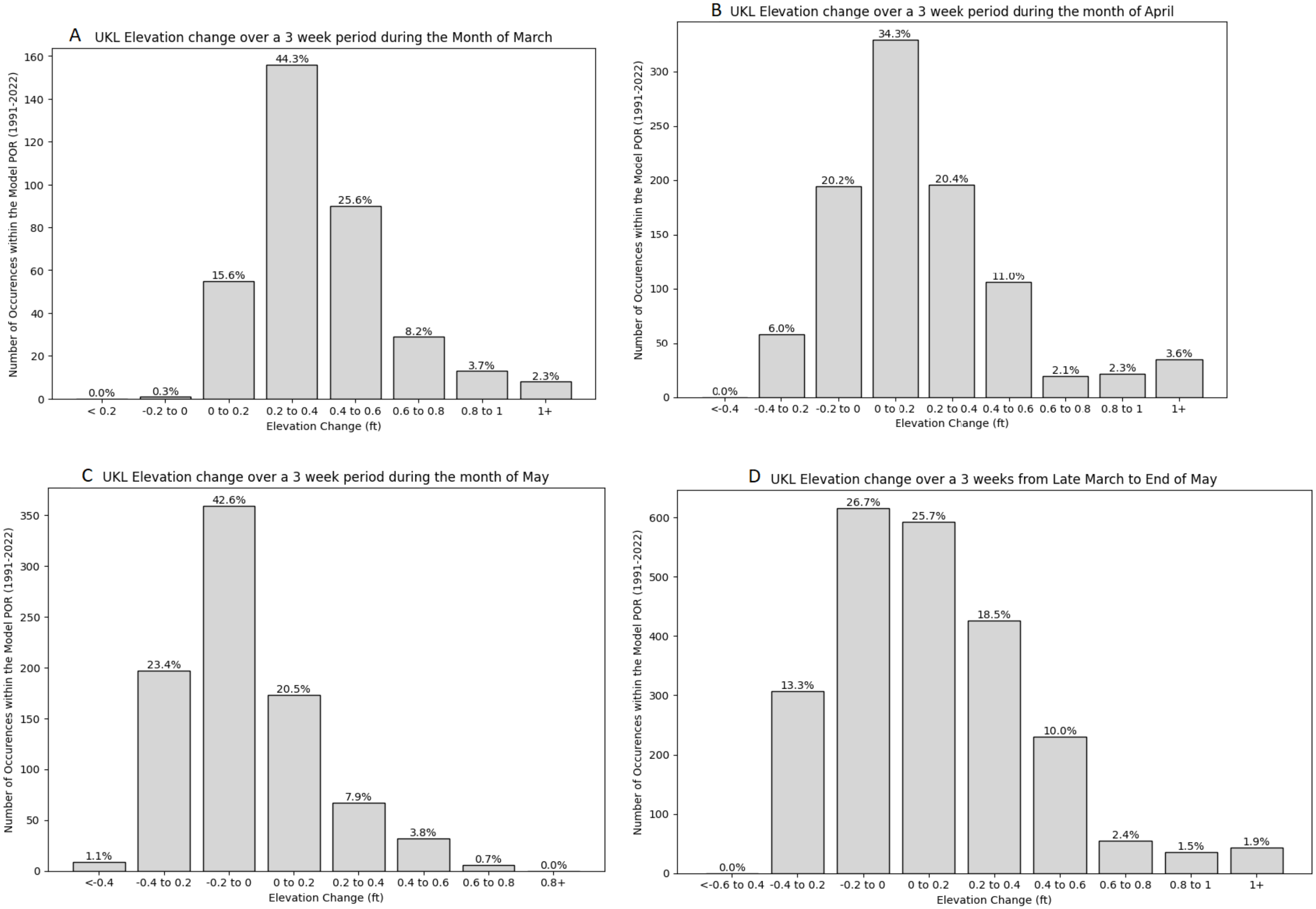


Figure 22. Frequency of maximum changes in UKL surface elevation within three weeks of potential egg deposition dates (March-May) for the modeled PA (POR years 1991-2022). Changes greater than 0.6 ft. have the potential to dewater LRS embryos deposited at the shallowest observed spawning depth.

7.1.3.1.3 Effects to Larval Sucker Habitat in UKL

Mobile, free-swimming larval suckers begin appearing in UKL in late-March or April and usually peak in abundance from mid-May to mid-June; by mid- to late-July they transform to age-0 juveniles (Cooperman and Markle 2003, Markle and Clauson 2006). Although larval suckers use many habitat types, they are found at higher densities in shallow, nearshore areas with emergent vegetation (Cooperman and Markle 2004). These vegetated areas likely provide larval suckers protection from predators (Markle and Dunsmoor 2007), possibly more diverse food resources (Cooperman and Markle 2004), protection from turbulence during storm events (The Klamath Tribes 1996), and hydraulic roughness that could reduce the numbers of larvae transported out of the lake by currents (Strayer and Dudgeon 2010). As larvae transform into juveniles in mid-July, the importance of emergent wetland habitat becomes less certain.

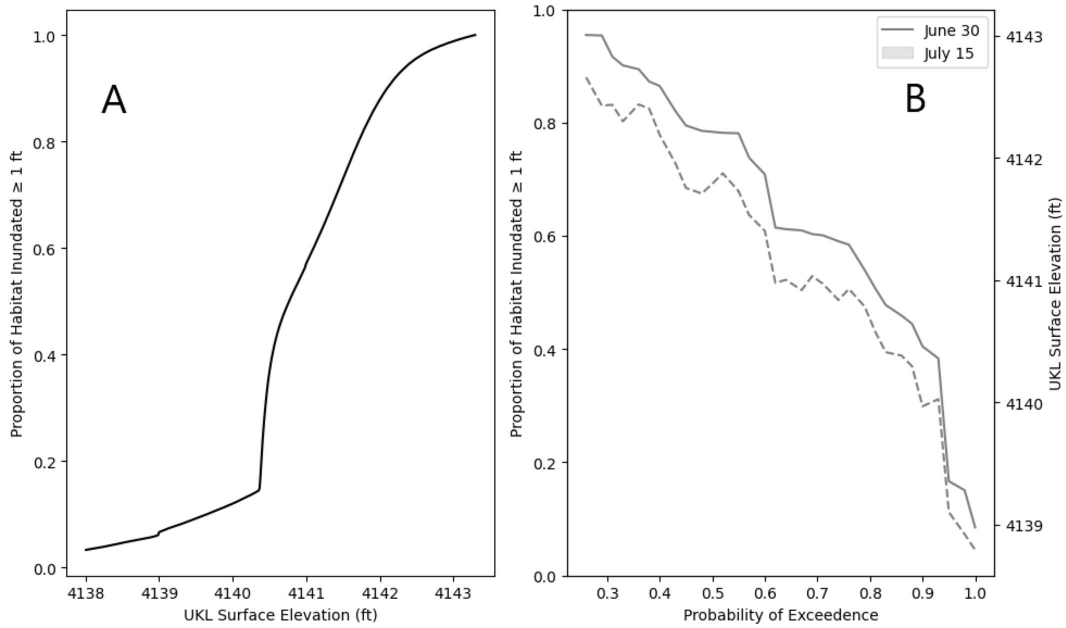


Figure 23. Proportion of wetland Habitat inundated at various elevations and the probability of exceeding said elevation. Data from the pulse flow model run is used as a worst-case scenario.

The reconnection of the Agency-Barnes units of Upper Klamath NWR to UKL is a presumption of the new PA and should be considered when discussing available nearshore emergent habitat. Existing emergent habitat in UKL is of relatively low quality and abundance, due to the diking and draining of wetlands along the fringe of UKL and historic water management that was not conducive to the health and maintenance of lake-fringe wetlands. The reconnection of Agency-Barnes effectively doubles emergent wetland habitat availability in UKL, adding 3,584 acres of submergent, emergent, obligate, and facultative wetland types across elevations ranging from 4139.0 ft. to 4143.3 ft. Most of this wetland habitat (approximately 1,956 acres), is submergent and emergent vegetation. The dynamics of this habitat vary with elevation, like other wetland habitat; however, the properties of the site mean that at an elevation of 4140.8 ft., approximately 90 percent of emergent and submergent wetland habitat remains inundated to a depth of approximately 1 ft. or deeper (Dunsmoor 2022, p. 6). However, the location of this habitat may prove of limited benefit for wild larval use due to the direction of the UKL gyre and the inability of larvae to actively move toward that habitat. Much remains to be learned about the value of the Agency-Barnes habitat for larval suckers, though strategic relocation and release of wild larvae is a valid option to maximize the benefit of this habitat during the key late spring and early summer developmental period.

As UKL elevations decrease through the summer, so does the area of inundated emergent vegetation, so that at an elevation of 4,140.8 ft., approximately 70 percent of the emergent wetland habitat remains and below 4,139.6 ft., approximately 20 percent of wetland edge habitats remain inundated to a depth of approximately 1 ft. (Figure 23). Thus, UKL elevation influences larval suckers' access to and use of nursery habitat (Dunsmoor et al. 2000, Terwilliger 2006, Markle and Dunsmoor 2007). If the area of inundated emergent vegetation declines substantially, it is likely to reduce larval survival by exposing larvae to predators, reduced food availability, or by exposing larvae to lake currents that could carry them to the outlet of the lake where they could be entrained.

When lake elevation is below 4,140.8 ft., approximately 70 percent of wetland edge habitat inundated to a depth of 1 ft. is available, making larvae more vulnerable to starvation, predation, and entrainment at the outlet of the lake, though the magnitude of specific effects is difficult to determine. UKL surface elevations are below 4,140.8 ft. on July 15 in 33 percent of years based on the modeled POR. Project operations and winter inflows into the lake are expected to provide sufficient larval rearing habitat in the majority of years. Therefore, the availability of rearing habitat anticipated under this action would in the majority of years not be expected to preclude recruitment of larvae to juvenile and adult life stages; however, if UKL elevations are not at or above 4,140.8 ft. by July 15, the effects described above for lower lake elevations may occur. Despite the potential adverse effects of reducing wetland inundation, variability in UKL surface elevations is likely to provide some benefits by maintaining marsh habitats and potentially promoting marsh development. Variability is important for wetlands because flooding disperses seeds, but germination is poor under water (Middleton 1999).

Based on the analysis presented above, the Service concludes that, as proposed, Project operations are likely to provide adequate inundation of emergent vegetation for larval sucker rearing habitat needs, during the April to July period, at surface elevation at or above 4,140.8 ft. The recent 3-year drought illustrated that it is possible that lake elevations may fall below 4,140.8 ft., decreasing the larval rearing habitat needed for LRS and SNS larval populations in UKL. Therefore, the Service concludes that the PA likely to result in adverse effects to larval suckers in dry years due to a decrease in habitat availability. However, larval suckers would still have access to some proportion of the rearing habitat when the elevation is below 4,140.8 ft. in mid-July. The reduction in available habitat would reduce the likelihood of many larval and juvenile suckers accessing and utilizing rearing habitat, thus reducing, though not eliminating, the likelihood of recruitment in that year. Further, though Agency-Barnes increases the size and quality of emergent lake-fringe wetland habitat, outstanding questions about utilization and a settling period for the newly restored area suggest a conservative approach and higher lake elevation are more protective of larval suckers in UKL.

As a note of interest, natural lake elevations would be expected to vary seasonally even without Project facilities and operations due to natural variation in inflows, making it difficult to tease apart the effects of the PA from the environmental baseline. For example, before the construction of Link River Dam (1905-1921), UKL surface elevations in mid-July ranged from 4,139.96 ft. to 4,141.66 ft., largely overlapping the range of conditions expected under the PA; however, approximately 35,000 acres of additional UKL-adjacent wetlands existed during that time, as well as increased sucker populations that were more than an order of magnitude greater than the current populations.

7.1.3.1.4 Effects Age-0 Juvenile Habitat in UKL

Sucker larvae transform into age-0 juveniles typically by late July, and they utilize a variety of habitats but appear to prefer shallow water (Buettner and Scoppettone 1990, Burdick et al. 2008). Although some authors have reported movement of age-0 juveniles from nearshore areas to offshore areas as the lake elevation is nearing its annual minimum (Terwilliger 2006), this pattern has not been supported by more recent juvenile sampling. Age-0 juveniles appear to use diverse habitats including vegetated and unvegetated areas and all substrates (Hendrixson et al. 2007, Burdick et al. 2008). There are conflicting reports on habitat selection with some studies providing weak evidence for the selection of sandy, vegetated habitats (Hendrixson et al. 2007, Burdick et al. 2008), rocky substrates (Terwilliger et al. 2004), and mud or sand (Buettner and Scoppettone 1990), but none of these studies has found a strong association between juvenile sucker distribution and vegetation or substrate type. In general, more complex habitat structure (e.g., vegetation or rocky substrates) is thought to provide more cover for fish, and it often increases growth or survival (Strayer and Findlay 2010). Additionally, water quality might differ among substrates because of the presence or absence of currents and the DO demand by organic-rich sediments, which vary by location in UKL (Wood 2001). In general, rocky substrates in UKL are found nearshore where sediments are swept away by waves and currents (Eilers and Eilers 2005), and increased circulation and lower levels of organics in these substrates, rocky areas would be expected to increase DO relative to areas where mud predominates. Due to the uncertainty in habitat preferences and the influence of habitat availability on growth and survival, lake elevations that provide access to diverse habitats would be most protective of age-0 juvenile suckers.

Lake elevations in UKL influence habitat diversity and complexity. Prior to the restoration and reconnection of Agency-Barnes, when lake levels drop below 4,140.8 ft., approximately 30 percent of wetland edge habitat become dewatered, and below 4,139.6 ft., approximately 80 percent of wetland edge habitats become dewatered (Figure 23). As the lake recedes below 4,138.0 ft., rocky substrates become increasingly scarce as nearshore habitats transition to mud (Simon et al. 1995, Eilers and Eilers 2005). Thus, as lake levels recede below 4,139.6 ft., and especially below 4,138.0 ft., age-0 juveniles could have fewer available habitats and could be forced to move into areas where conditions (e.g., food, water quality, or predation) are less favorable, which could have negative effects on their fitness and survival.

The 13,887 acres of reconnected wetlands of Agency-Barnes will support areas of inundation between 0.5 ft. and 2.5 ft. of water depth at a minimum lake elevation of 4,137.10 ft. The restoration of over 7,200 acres of open and shallow water habitats along the lake fringe of UKL will greatly increase the rearing habitat available to age-0 and older juvenile LRS and SNS. Of this, over 1,200 acres of wocus and emergent wetland is expected to be available as nursery habitat between the elevation of 4,139.0 ft. and 4,140.0 ft. Between the elevations of 4,140.0 ft. and 4,141.0 ft. another 670 acres of emergent wetland is expected to develop as part of the restoration (Dunsmoor 2022 p. 6). The reconnection will be excavated to a depth of 4,134.5 ft. to ensure positive drainage from the site to UKL along the historic tidal slough.

Over the term considered in this Opinion, when lake elevation is in excess of 4,140.8 ft. by July 15, an adequate amount of habitat diversity and complexity occur during the mid-summer period for age-0 juveniles to survive in UKL. The additional wetland habitat from the reconnection of Agency-Barnes will increase habitat diversity available to LRS and SNS and offer opportunity for age-0 juveniles to survive in UKL. Based on the KRM output using the POR (1991-2022) data with the Pulse flow, the lake elevation on July 15 stays above or equal to 4,140.8 ft. in 68 percent of years. The eight driest years in the POR are below 4,140.8 ft.by July 15. However, under the PA, elevations stay above 4,140.8 ft. in 22 of the 30 years of the modeled POR, indicating that habitat diversity for juvenile suckers is available in most years under the PA. The Service concludes that the PA is likely to result in adverse effects to age-0 juvenile suckers in years when elevations are below 4,140.8 ft. on July 15 due to decreased habitat diversity and complexity available to suckers.

7.1.3.1.5 Effects to Habitat of Older (Age 1+) Juveniles and Adults in UKL

Data on older juvenile suckers in UKL are sparse, largely due to their scarcity. The data that are available suggest that juvenile habitat selection is more similar to that of adults than that of larvae (Burdick et al. 2009, Burdick and Vanderkooi 2010). Preliminary data and analysis for radio- telemetry of captively reared juvenile suckers in UKL during 2018 and 2019 suggests that juveniles were actively selecting northern portions of the lake inclusive of Pelican Bay, Ball Bay, and the Williamson River Delta (USFWS unpublished data 2018, 2019). Juvenile suckers used in this study were age-2, approximately 200 mm total length, and were mostly located in near shore areas. The 2019 telemetry effort included random open water surveys however, none of the radio tagged suckers were contacted in open water areas. During late summer, the months of July through September, tagged suckers were detected in Pelican Bay in both years. These preliminary findings suggest that in general juvenile habitat selections are similar to adults except that the juveniles in this study were not detected in or did not prefer, open water areas. However, this was a limited study with a small sample size that only looked at open water during the 2019 surveys. Therefore, the majority of available data suggests that older juvenile habitat needs are similar to adults.

Radio-telemetry studies have shown that adult suckers primarily use the north end of UKL above Bare Island from June to September (Peck 2000, Banish et al. 2007, 2009). During this period, adult suckers are found in open water areas of the lake, most frequently at depths greater than 10 ft., and they tend to avoid depths less than 6.6 ft.; in general, LRS are found farther offshore than SNS (Peck 2000, Banish et al. 2009). Neither LRS nor SNS adults were observed using depths less than 3 ft. (Banish et al. 2007 pp. 10–11). Adult suckers were mostly located at water depths greater than the mean depth available in the area of the lake where they occur, which suggests they were actively selecting for relatively deep water, but the data do not indicate where the fish were distributed in the water column. However, neither species was found at depths greater than

25 ft. (Banish et al. 2007 pp. 10–11). Depths up to about 40 ft. or more occur along the east side of Eagle Ridge.

The model output for the POR was combined with a bathymetry layer that combines data from multiple sources to evaluate the availability of habitat within the preferred depth ranges of adult suckers. These bathymetry data are considered as the best available information on the depth of UKL for the analysis of habitat (Shelly et al. 2019). The area was evaluated within relevant depth ranges available across varying UKL surface elevation and restricted the analysis to the northern third of the lake (north of latitude 24°24’47” N) inclusive of all of Ball Bay, Shoalwater Bay, and the Williamson River Delta. The area was restricted based on radio-telemetry data demonstrating that LRS and SNS primarily use this area during the summer months (Banish et al. 2009). As noted above, LRS and SNS appear to avoid depths less than 6.6 ft., and especially less than 3.3 ft., and primarily utilize water between 6.6-13.1 ft. during summer months (Banish et al. 2009).

Under the PA, the modeled lowest anticipated UKL surface elevation at the end of September is 4,137.23 ft. At an elevation of 4,138.0 ft. prior to the reconnection of Agency-Barnes, there was approximately 8,344 ac (29 percent) of available habitat in the northern portion of UKL at depths of 5.8 ft. or greater (Figure 24). With the reconnection of UKL to Agency-Barnes, even at the lowest elevation contemplated in the PA, there is anticipated to be approximately 7,200 acres habitat available during late summer and through the end of September. The PA is likely to result in UKL elevation higher than 4,137.23 ft. at the end of September in over 95 percent of years and should provide more preferred habitat for adult suckers. Given the relatively low abundance of suckers in UKL, this habitat is expected to be sufficient to avoid adverse effects from crowding.

However, the above considers only the variable of depth, but other variables likely affect where suckers occur; for example, radio-tracking shows that adult suckers occur seasonally in limited areas of the lake and those areas are sometimes species-specific. Areas of high seasonal use by adult suckers include Ball Bay, and the areas north of Ball Point, between Ball Bay and Fish Banks, and between Eagle Ridge and Bare Island (Banish et al. 2009). SNS, especially, show a preference for Ball Bay, whereas LRS were frequently located off of Ball Point (Banish et al. 2009; Figure 2). Additionally, both species used the area of the lake north of Ball Bay to the mouth of Pelican Bay. Based on tagging studies the Service presumes this distribution is due to selection of habitats beneficial to the LRS and the SNS for additional reasons, such as abundant food, fewer predators, and better water quality.

It is unclear how seasonal changes in lake levels affect the distribution of adult suckers, but low lake levels in very dry years could reduce use of shallow areas such as in Ball Bay. Thus, low lake levels (i.e., those below 4,138.0 ft.) in September potentially could adversely affect adult suckers by limiting their access to some preferred habitats. Studies show that older juvenile suckers use nearshore shallow habitats with some frequency along the western lakeshore and near the Williamson River Delta (Bottcher and Burdick 2010, Burdick and Vanderkooi 2010).

The studies suggest that low lake levels could also affect older juvenile sucker distribution if they show habitat preferences to nearshore shallow habitats.

Because adult suckers redistribute throughout the lake after water quality improves and lake elevations increase through the winter, it appears that UKL surface elevations are less critical during November through February (Banish et al. 2007). In some lakes, ice cover can reduce atmospheric exchange of oxygen and create stressful conditions for fish. However, the limited water quality data available from winter months suggests that this is not a major issue in Upper Klamath Lake, though occasional low DO levels have been observed (USBR 2012).

In addition to the area of habitat within preferred depth ranges, access to water quality refugia during episodes of poor water quality that are common in UKL from mid-July through September (Banish et al. 2009) is another concern for adult suckers. An important location that suckers can use for refuge from poor water quality is Pelican Bay. The depth at the entrance to Pelican Bay is relatively shallow, and it could limit access at low lake elevations. Pelican Bay itself is deeper than its restricted entrance, likely providing sufficient depth for adult suckers once they have entered the bay.

Navigating through shallow water to enter and exit Pelican Bay could also expose suckers to increased avian predation. American white pelicans are depth-limited predators that can prey on adult suckers up to 28.7 in. in length (Evans et al. 2016a). In general, white pelicans rarely dive for prey and are restricted to foraging in shallow waters or within the top 4.1 ft. (1.25 m.) of deep water areas (Anderson 1991 p. 166, Findholt and Anderson 1995a p. 65, 1995b p. 55). Pelican foraging does occur in deeper water but is likely a result of prey species coming to the water surface for their own feeding behaviors (Findholt and Anderson 1995a). Cooperative foraging strategies by white pelicans may increase the success rate of capturing fish (Anderson 1991, McMahon and Evans 1992b, 1992a); however, individual white pelicans are also quite capable of successfully capturing fish (Anderson 1991, McMahon, and Evans 1992a). Fish, as prey species, are more vulnerable to predation by white pelicans in shallow waters (Findholt and Anderson 1995a, Scoppettone et al. 2014), and water depths of over 3.3 ft. were recommended by Scoppettone et al. (2014) as a means to reduce pelican foraging success on suckers.

Bathymetric data is available for Upper Klamath Lake. Recent surveys performed by Reclamation with higher resolution confirms that the area surrounding Pelican Bay, has a bottom elevation of 4,134.5 ft. (Table 5) (Shelly et al. 2019, Reclamation, 2023). To protect against pelican predation, the PA attempts to keep the lake above 4,138.0 ft., in all but the driest years, in order to provide a depth of approximately 3.5 ft. at the entrance of Pelican Bay. Since this is deeper than 3.3 ft., it should reduce the most severe impacts due to pelican predation (Scoppettone et al. 2014). Depths at the entrance to Pelican Bay are expected to be between 4 and 6 ft. during August and September in all but the wettest years. However, the depth at the entrance to Pelican Bay even in wet years is shallower than the habitats they typically select (6.6 ft. to 9.8 ft.; Figure 25), which could increase predation exposure. LRS and SNS that are unable to enter Pelican Bay could be at a higher risk from the effects of adverse water quality if conditions occur similar to those in the 1990s that led to catastrophic die-offs of adult suckers (Perkins et al. 2000a). Under the PA, lake elevation is under 4,138.0 ft. in 13 percent of years (4 out of 32 years).

Although Pelican Bay is an important water quality refuge, suckers do use other areas, such as the Williamson River and the area along Fish Banks, in smaller numbers. The depths along Fish Banks are similar to those at the entrance to Pelican Bay, so the effects of lake elevation on access to these areas would be similar to those analyzed for Pelican Bay. The mouth of the Williamson River is somewhat deeper, and the PA is not expected to limit access.

While Pelican Bay can be an important water quality refuge, suckers seem to use this habitat more frequently than previously thought and for other purposes as well. In 2021, USGS began deploying PIT tag arrays in Pelican Bay annually, to learn more about when and why LRS and SNS use this habitat. The monitoring data shows that a significant proportion of the adult population is detected in Pelican Bay after spawning but then detections seem to taper off in September, when water quality in the lake decreases (J.R. Krause, USGS, personal communication October 18, 2024). LRS and SNS from the sucker assisted rearing program have also been detected (68 individuals in 2024) on the Pelican Bay PIT tag arrays during this time (April to October, unpublished data FASTA slides October 3, 2024). There is still no clear indication as to why LRS and SNS leave Pelican Bay when the water quality in the lake decreases but the number of detections suggest that this is an important habitat for adult and juvenile suckers. Access to Pelican Bay will rarely be limited during spring and mid-summer under the PA.

As discussed above, the Service concludes that the proposed Project operations are likely to provide adequate habitat for older juvenile and adult suckers during most years because there will be sufficient water depths. This suggests that lake elevations within the range expected under the PA could impact adult behavior, but they would not be likely to result in a measurable difference in survival. Adverse effects to these age classes beyond those analyzed here may occur if UKL levels fall below the minimum elevation observed in the KRM output.

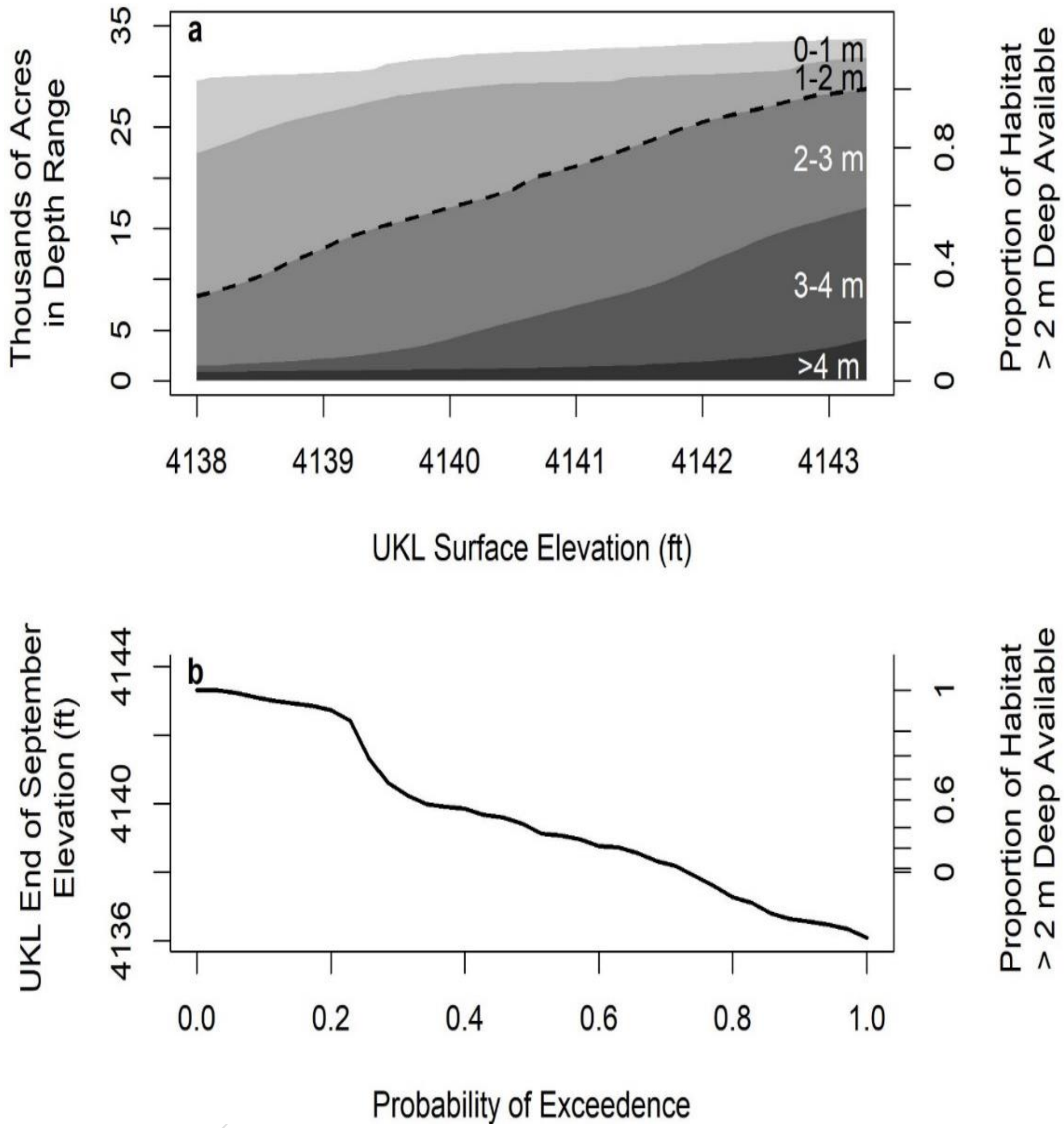


Figure 24. Availability of habitat various depths in UKL north of latitude 24°24’47” N— including all of Ball Bay, Shoalwater Bay, and the Williamson River Delta—at varying surface elevations based on UKL bathymetry (Shelly et al. n.d.). LRS and SNS tend to avoid depths less than 2 m, except when seeking refuge from poor water quality conditions. Shaded areas representing the area in depth categories are stacked, and the dashed line represents the available area (or proportion) of habitat deeper than 2 m relative to availability at full pool. b) The expected frequency of lake elevations and the associated proportion of habitat deeper than 2 m that is available under the PA based on the model POR (USBR 2024, p. 179).

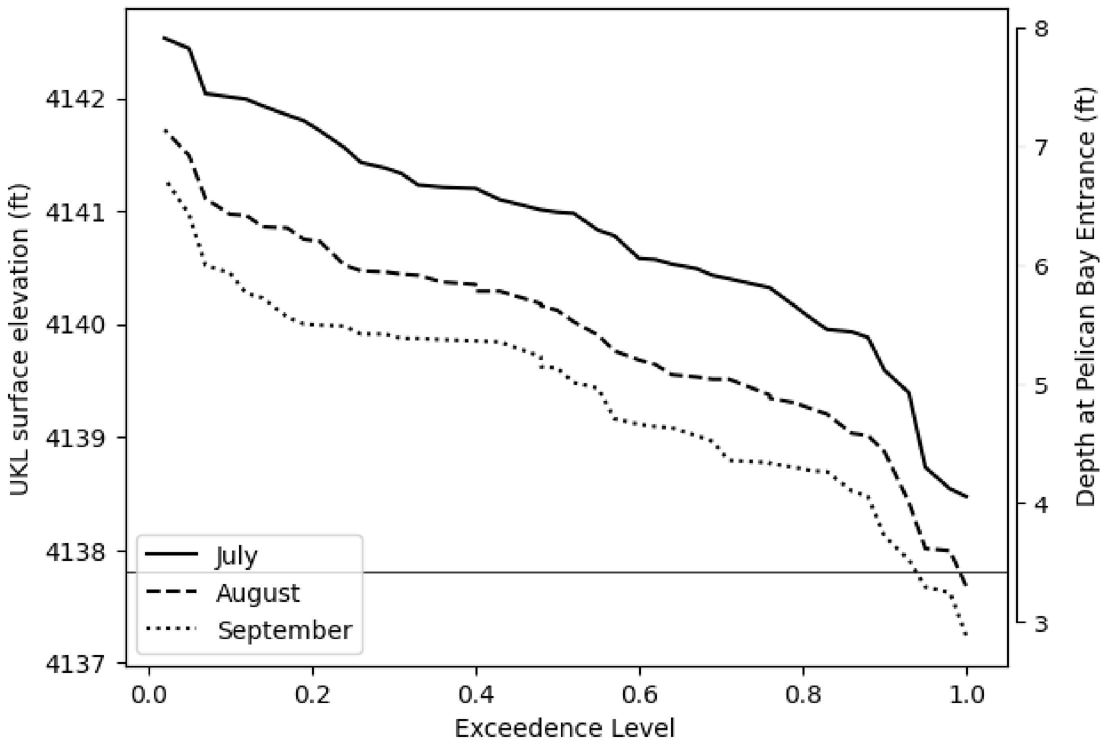


Figure 25. Probability of exceedance of monthly minimum UKL surface elevation in July (solid line), August (long dashes), and September (short dashes) for the model POR (1991-2022) and the associated depth at the entrance to water quality refuge contained in Pelican Bay. Suckers are expected to avoid depths shallower than 1 m (3.3ft)

Table 5. Water Depths at the Entrance to Pelican Bay at Various UKL Elevations. The Minimum Bottom Elevation at the Entrance to the Bay is Approximately 4134.5 ft. (Shelly et al. 2019).

Lake Surface Elevation (ft.)	Depth of Entrance to Pelican Bay (ft.)
4,143.0	8.5
4,142.5	8.0
4,142.0	7.5
4,141.5	7.0
4,141.0	6.5
4,140.5	6.0
4,140.0	5.5
4,139.5	5.0
4,139.0	4.5
4,138.5	4.0
4,138.0	3.5
4,137.5	3.0
4,137.0	2.5

7.1.3.1.6 Effects to UKL Water Quality

UKL has experienced extremely poor water quality events in the past that have resulted in massive fish die-offs, including thousands of LRS and SNS, as well as pronounced redistribution of fish (Buettner and Scoppettone 1990, Perkins et al. 2000a, Banish et al. 2007, 2009). In UKL, water quality impacts to fish are greatest from July to mid-October, but especially late July and August (Wood et al. 1996, 2006, Kann 1997, Perkins et al. 2000a, Loftus 2001, Welch, and Burke 2001, Morace 2007). A recurring question related to Reclamation's management of UKL is: how do lake levels affect water quality? A number of possible mechanisms relating lake depth to water quality have been proposed, including hypotheses that suggest that either high or low elevations could increase the probability of poor water quality. Most empirical analyses of water quality data from UKL indicate no clear and statistically significant connection between UKL levels and water quality over the range at which the lake is usually managed (4,138.00 to 4,143.30 ft.; Wood et al. 1996, Morace 2007). However, Jassby and Kann (Jassby and Kann 2010) documented a statistically significant association between chlorophyll-*a* levels in UKL and water elevations for the months of May and June, though the authors note the analyses are exploratory and that this particular result was driven by a few influential data points.

Wood et al. (1996) concluded that there was no evidence of a relationship between any of the water quality variables considered (i.e., chlorophyll-*a*, DO, pH, total phosphorus) and lake depth based on an analysis of the seasonal distribution of data or a seasonal summary statistic. The analysis found that low DO, high pH, high phosphorus concentrations, and heavy AFA blooms were observed every year regardless of lake depth. Morace (2007) repeated this analysis using 11 additional years of data from UKL, and also did not detect a statistically significant relationship between lake depth and water quality. The National Research Council (Council 2004) also did not identify a quantifiable relationship between UKL depth and extremes in DO, pH, and chlorophyll-*a*, although their analysis was considerably less robust than that of Wood et al. (1996) or Morace (2007). These analyses do not preclude the possibility that lake elevations have some influence on water quality; however, they suggest that any effect, if present, is not strong enough to be clearly discernable among the other factors, such as wind and temperature (Kann and Welch 2005), that influence water quality.

Kann and Walker (2020) delved more deeply into the link between water quality and lake elevation. Kann and Walker (2020) concluded that various aspects of water quality can be correlated to a select range of lake elevations within the context of seasonality, by looking at the frequencies of chlorophyll-a, pH, un-ionized ammonia, and dissolved oxygen using a 27-year dataset (1990-2016). The study used cross-tabulation contour and conditioning probability to explore water quality conditions with water level fluctuations. The cross-tabulation contour plots indicate select ranges of lake elevation between the months of July to September may increase the likelihood of good water quality in UKL (see Table 1 in Kann and Walker 2020). However optimal lake elevations differed among the four water quality parameters measured (Kann and Walker 2020 p.1862). Lake elevations would be expected to vary seasonally even without the impacts of Project diversions due to natural variations in inflows. This makes it difficult to infer the effects of the PA from the environmental baseline. Lake level management may not prevent all water quality problems, but this study offers seasonally based lake elevation windows that may reduce the likelihood and/or severity of poor water quality events.

Water quality in the lake varies due to interactions between climate and external factors including solar radiation, air temperature, wind, and external nutrient loading. Unfortunately, these external factors interact with lake elevation to stochastically impact water quality, making it difficult to predict, especially during the spring and summer months (Kann and Walker 2020). Lake elevation is one of many variables that could affect water quality. All variables need to be examined and addressed, a process that is occurring through efforts to recover suckers by the Service, the Klamath Tribes, and other groups. Water quality analyses to date have focused on twice monthly sampling starting in the early 1990s (Wood et al. 1996, Morace 2007, Jassby and Kann 2010). These data are valuable for evaluating general seasonal patterns and inter-annual differences, particularly for parameters such as nutrient concentrations. The water quality variables that are most likely to directly impact suckers, such as pH and DO, can vary widely at the hourly and daily scales, making it more challenging to discern their dynamics from infrequent samples.

Additionally, the best available information for consideration suggests that the proposed Project operations may be one of many factors that contribute to UKL water quality under normal operating ranges. However, at this time, complicated nutrient dynamics and climate factors continue to affect water quality in UKL in ways that are yet unknown and require further study. For example, it is not fully understood how the storage of winter inflows increases residence time of the stored water, which could increase nutrient retention rates. Conversely, it is also not fully understood how the diversion of water through the irrigation season exports nutrients, especially phosphorus and nitrogen contained within AFA colonies, out of the lake (Kirk et al. 2010). The Service concludes that the PA is likely to result in insignificant effects to water quality in UKL the period of this consultation as water quality is likely to provide acceptable conditions for LRS and SNS.

7.1.3.1.7 Entrainment Losses of LRS and SNS from UKL

The PA is likely to adversely affect all life stages (other than embryos) through entrainment at the A Canal and Link River Dam. The numbers of suckers at each life stage entrained by the Project are likely to vary annually depending on multiple factors including the volume and timing of flow through the A Canal and Link River Dam, the number of adults in the spawning populations, annual larval production, water quality, wind speed and direction, and other factors. For example, larval densities in UKL can vary by several orders of magnitude across years (Simon et al. 2014), and this variability is likely to have an effect on entrainment rates.

Additionally, estimated numbers of suckers entrained are based on only a few years of data obtained in the late 1990s by Gutermuth et al. (Gutermuth et al. 2000b, 2000a). Because entrainment estimates require extrapolations from short sampling times to longer periods and from small samples to larger samples, they include substantial uncertainty.

Larval suckers have limited swimming ability and are surface oriented, making them vulnerable to down-lake transport by currents. Vulnerability of larval suckers to entrainment at Klamath Project water management structures in UKL likely depends on lake currents that are a function of wind patterns, especially the clockwise gyre that extends as far north as the shoreline between Agency Strait and Pelican Bay, and as far south as Buck Island (Wood et al. 2014). A study that evaluated potential entrainment by modeling passive movement of particles from sucker spawning grounds suggested that under some conditions, large proportions of the sucker larvae could be transported out of UKL (Wood et al. 2014). However, a different conclusion was reached in a study examining larval sucker catches in UKL and Lake Ewauna (Simon et al. 2014), suggesting that larvae may not behave as passive particles. Although extrapolating larval samples to obtain estimates of lake-wide larval population size and the proportion of larvae entrained at Link River Dam and the A Canal involves substantial uncertainty, the best available data suggest that entrainment affects a relatively small proportion of sucker larvae (Simon et al. 2014).

Sucker entrainment losses at Link River Dam and A Canal resulting from the PA can be estimated using the limited available information and calculating from modeled output. Specifically, flows were derived through Link River Dam and the A Canal from the model POR, used estimates of entrained sucker densities by life history stage (Gutermuth et al. 2000b, 2000a), and applied assumptions to account for changes since the Gutermuth et al. (Gutermuth et al. 2000a, 2000b) research efforts (e.g., construction of A Canal fish screen and bypass, reduced sucker populations in UKL etc.).

Due to the limited information available on sucker entrainment, a number of assumptions were required to obtain a rough quantitative estimate of entrainment at the A Canal and Link River Dam:

1. Based on estimated changes in LRS and SNS population sizes (Krause and Paul-Wilson 2024) and assuming no recruitment, the total number of adult LRS and SNS in UKL has likely declined by about 75 percent and 64 percent, respectively, since 2010. Therefore, numbers of larvae present in the lake and entrained at the A Canal are assumed to have also likely decreased by similar percentages because fewer adult females are now present and available to spawn.
2. Due to the reduction in spawning effort and adult populations, the Service calculates the density of suckers of each life stage in water passing through the A Canal and Link River Dam is equal to 20 percent of the observed densities in Gutermuth et al. (Gutermuth et al. 2000a, 2000b), except for juvenile suckers at the A Canal for which density estimates were used based on catches at the A Canal Fish Evaluation Station (USBR 2018b).
3. Larvae are vulnerable to entrainment from April 1 to July 14, after which they are considered juveniles; juveniles are vulnerable to entrainment from July 15 to October 31; and adults are vulnerable year-round, but the period relevant to this action occurs between April 1 and October 31.
4. The Service assumes the density of vulnerable life stages in water passing through the A Canal and Link River Dam are constant within and among years because sufficient information is not available about within- and among-year variation in entrainment for most life stages. The exception to this is entrainment of juveniles at the A Canal for which seasonal variation was estimated based on catches at the FES.
5. The A Canal is equipped with a state-of-the-art fish screen meeting the Service criteria, which was shown to screen about 80 percent of larvae at 10 mm and more than 90 percent of larvae at 16 mm; all fish larger than 20 mm are expected to be diverted (Simon et al. 2014). Sucker larvae emerge from the gravel at around 10 mm (Cooperman and Markle 2003). Based on this information, the Service assumes a minimum of 80 percent of larvae that encounter the fish screen are diverted and 20 percent pass into the A Canal, and all juveniles and adults are prevented from entering the A Canal. The 80 percent of larvae that are screened from entering the A Canal are expected to be discharged into the Link River through the gravity-operated flume because the pumped by-pass does not operate until juveniles are expected in the system,
6. The Service assumes suckers passing through the gravity-operated flume and Link River Dam experience a disruption to their normal behaviors, such as feeding and predator avoidance. Additionally, based on a review of the literature on the effects of dams on fish that have documented injuries resulting from physical strikes with objects and pressure changes associated with passing through spillways, two percent of suckers likely will be killed (Whitney et al. 1997, Muir et al. 2001).
7. Fish that are screened from the A Canal are bypassed back to UKL by a pump (typically from mid-July through October) or discharged by a gravity-operated flume

to below the dam (typically April through July). The pump bypass system uses a hidrostal pump that causes minimal injuries to fish (Marine and Gorman 2005). Therefore, it is likely that kill and injury rates would be less than or equal to the 2 precent that are expected to be injured or killed as they pass through a dam spillway, as described above. The outlet of the pump-bypass flume is about 0.3 mi from the Link River Dam. If the suckers move at random upon exiting the pump-bypass flume, half would be expected to move “upstream” back into the main body of UKL and half would be expected to be entrained at Link River Dam. Therefore, it is likely that 50 percent of suckers that are bypassed are subsequently entrained at the Link River Dam.

8. Although 100 percent of juvenile suckers should be screened from entrainment into the A Canal, the pumped bypass could injure or kill some individuals as described above. Adult suckers should not be entrained at the A Canal because they should be excluded by the trash rack, which has 2 in openings; this is confirmed by no observations of adult suckers during FES sampling.
9. As part of the PA, some suckers that enter the Project irrigation canals will be salvaged in the fall during canal drawdown. The number of suckers salvaged annually averaged 243 from the canal system and 805 from the A Canal forebay between 2008 and 2017 (USBR 2018b, USBR 2019, 2020, 2022, 2023, appendix C). These efforts help to minimize the effects of entrainment into the A Canal, but the number of suckers salvaged in each year varies widely. Therefore, the Service conservatively assumes that all of the sucker larvae entrained into the A Canal are killed by adverse water quality, passing through pumps, and being discharged onto agricultural fields, or desiccation at the end of the irrigation season when irrigation canals are drained.

Applying seasonal occurrences of sucker life history stages, based on Gutermuth et al. (Gutermuth et al. 2000a, 2000b), to the volume of water that Reclamation anticipates delivering through the Link River and A Canal using the assumptions described above, the PA yields estimates of average annual entrainment of approximately 1.7 million larval suckers, 15,003 juvenile suckers, and 44 adult suckers at either Link River Dam or A Canal fish screen and bypasses (Table 6). The Service assumes that all entrained fish experience disruption of normal behaviors, such as feeding and sheltering, with a small proportion injured or killed, as described in the assumptions above. Entrainment has adverse impacts to larvae, juveniles, and adults of both species of suckers. Sucker entrainment at Link River Dam and A Canal will continue under the PA. Under the PA, continued operation of the A Canal fish screen, fall canal salvage efforts, captive sucker rearing, and support for studies and recovery actions to reduce juvenile mortality in UKL collectively minimize the impacts of entrainment at project facilities and provide benefit to suckers.

Table 6. Adverse Effects of Entrainment at the A Canal and Link River Under the PA Averaged over the Model POR.

	Disrupt Behavior	Kill
Adults at A Canal	0	0
Adults at Link River	0	2
Juveniles at A Canal	5,661	113
Juveniles at Link River	4,813	96
Larvae at A Canal	320,538	69,236
Larvae at Link River	872,215	17,445

Summary of Effects to LRS and SNS Populations in UKL

Based on the above analysis the Service concludes that the PA is likely to result in potential adverse effects to LRS and SNS populations from (1) decreased access to shoreline spawning habitat in years with poor hydrology and the lowest water levels; (2) decreases in larval and age-0 juvenile habitat between July and October; (3) decreased availability of habitat with adult suckers' preferred depths at the lowest water levels; and (4) substantial entrainment of larvae and age-0 juveniles at the A Canal and Link River Dam. The PA is also likely to result in insignificant effects to water quality as it is likely to provide acceptable conditions for LRS and SNS. UKL operations will not lower lake elevation more than 0.6 ft. within a 3-week period in March through May, resulting in discountable effects to LRS and SNS embryos, pre-swim-up larvae, and their habitat at shoreline springs.

7.1.3.1.8 Effects of Water Deliveries to Lower Klamath National Wildlife Refuge

Lower Klamath National Wildlife Refuge Unit 2 encompasses Sheepy Lake, Sheepy Creek, and the inundated wetlands associated with these water bodies. LRS and SNS are native to Lower Klamath National Wildlife Refuge, and it is within their historic range. The habitat in Unit 2 consists of inundated tule, bullrush, and other emergent wetland plants. There are several deep channels and deep pools, with shallow wetland and marsh areas around the larger prominent body of water, Sheepy lake. Unit 2 contains valuable habitat that juvenile LRS and SNS are associated with, including nearshore, shallow water, and emergent vegetation (Burdick et al. 2008). However, a lack of consistent water deliveries to Unit 2 have resulted in poor water quality and habitat conditions during the summer. The PA provides consistent water supply to Unit 2, and it was evaluated for potential effects to habitat for larvae and age-0 juveniles, habitat for juvenile and adults, and water quality of this auxiliary population of LRS and SNS.

In 2023 larval and juvenile LRS and SNS were released into Unit 2, in an effort to establish an auxiliary population, as part of Recovery Action 5 (Establish a redundancy and resiliency enhancement program) of the Service's LRS and SNS recovery plan (USFWS 2013).

Preliminary monitoring data through fall of 2023 show that hundreds of these fish persisted in Unit 2, suggesting that LRS and SNS survival and growth are possible.

The PA dedicates a supply of 43,000 AF of water between April and October to National Wildlife Refuges for the purpose of keeping Lower Klamath National Wildlife Refuge Unit 2 and Tule Lake National Wildlife Refuge Sump 1A with enough water to maintain adequate elevations in both refuges for sucker habitat. Of the 43,000 AF approximately 21,000 AF of supply is reserved for maintaining 30 TAF in Lower Klamath National Wildlife Refuge Unit 2, which is an elevation of 4,087.4 ft. The remaining 22,000 AF are provided to Tule Lake Sump 1A to maintain an elevation of 4,034.0 ft. throughout the summer; this is discussed further below in Section 7.1.3.2.3. These volumes of water are sufficient to overcome evaporative losses in dry years, and the elevations provided should maintain a diversity of habitat sufficient to sustain all life stages of suckers present at these sites in all water year types. Further, provision of these flows, and additional water in the winter and spring from Project facilities during accrual of Project credit in UKL, will allow water management conducive to maintaining redundant populations of both sucker species. Over the life of this Opinion, the Service anticipates a population of at least 1,000 individual suckers, composed of multiple age classes, can be established, and supported at Unit 2, creating an effective population that can contribute meaningfully to sucker redundancy, resiliency, and recovery.

Provision of a consistent, certain water supply for Lower Klamath National Wildlife Refuge will ensure that habitat for suckers is maintained across year types, supporting redundant populations of LRS and SNS should the populations in UKL continue to decline or become extirpated. Lower Klamath’s Unit 2 provides an opportunity to create redundancy for the genetically distinct UKL populations in a location where there is minimal risk of the introgression, particularly between SNS and KLS, that has been observed in Clear Lake and Gerber Reservoir populations. However, these water deliveries may also result in conditions, particularly in the driest of years in the POR, where UKL elevations may drop to levels that could have negative impacts to suckers in UKL, as described above. Due to the continued lack of recruitment and significantly declining adult populations of both species in UKL, the Service has determined that the creation of redundant populations in historic habitat is most protective of the species. Further, the ongoing support for captive rearing efforts and restoration activities set forth in the PA will mitigate for many of these impacts in UKL, lending further support to a strategy that increases the number of suckers occupying habitat across their entire historic range, including Lower Klamath and Tule lakes.

7.1.3.1.8.1 Effects to LRS and SNS Larvae and Age-0 Juvenile Habitat in Unit 2

The wetland area of Unit 2 provides habitat for larvae and young juveniles, that utilize nearshore and vegetated habitats in and around Sheepy Lake, similar to suckers in UKL (Markle and Dunsmoor 2007). The persistence of juvenile sucker through the summer and fall of 2023, following a spring release, suggests available habitat supported survival and growth. Further, these are larvae and juveniles that would not have survived in UKL, as evidenced by the near total loss of the 2023 year class monitored by USGS (Krause et al. 2024, FASTA October 30, 2024, unpublished data). The dedicated deliveries maintain the elevation of 4,087.4 ft. in Unit 2, to overcome evaporative and other losses, and these deliveries should ensure adequate habitat for larval and juvenile LRS and SNS life stages because the proposed water levels will inundate hundreds of acres of emergent marsh habitat. Therefore, the Service concludes that the PA is likely to result in beneficial effects to larval and age-0 juvenile habitat at Lower Klamath National Wildlife Refuge Unit 2.

7.1.3.1.8.2 Effects to Habitat for Older Juveniles and Adult LRS and SNS in Unit 2

Water depth as cover for older juveniles and adults is limited to the deeper channels and pools of Sheepy Lake in Unit 2, which are assumed to be less than 4 ft. One reason for the shallow depth in Unit 2 is inconsistent water deliveries that have resulted in evaporative losses resulting in diminishing water levels, an issue directly addressed by the consistent deliveries provided by the PA.

The dedicated delivery of 21,000 AF of water should maintain 30 TAF of water and a surface elevation of 4,087.4 ft in Unit 2, providing areas with water depth greater than 3.3 ft for older juveniles and adults to reduce avian predation. As discussed above, sucker vulnerability to American white pelican predation is expected to be increased in water depths of less than 3.3 ft (1 m) (Evans et al., 2021), and there is continued concern about the possibility of decreasing water depths in the future due to continued evaporative and other losses. The Service concludes that the proposed Project operations are likely to result in beneficial effects to the persistence of LRS and SNS juvenile and adult habitat in Unit 2.

7.1.3.1.8.3 Effects to LRS and SNS in Unit 2 from Water Quality

The PA is likely to contribute to improving water quality in Unit 2, because dedicated annual flows will combat evaporative losses and maintain 30 TAF of water at an elevation of 4,087.4 ft. Lower Klamath National Wildlife Refuge can receive Project water from UKL and the Klamath River, as well as water from Tule Lake sumps through pumping D Plant. Further, the PA provides incentive, in the form of Project Credit accrual for offsetting water needs to benefit listed species, for a continuous flow of water through Unit 2 in most years, which is likely to result in overall improvement of water quality relative to the stagnant conditions that are the baseline for habitat in Unit 2.

Water provided to Unit 2 will pass through Ady Canal or as water pumped from Tule Lake National Wildlife Refuge's Sump 1A through D Plant and the P Canal. As such, some proportion of these water deliveries may be agriculture tailwaters and return flows which could have negative impacts on water quality in Unit 2. These impacts may include high nutrient concentrations of inflows and pesticide contamination, as discussed in the *Environmental Baseline*. However, relative to water conditions in UKL, it is unlikely that water quality conditions in Unit 2 will be significantly worse than those in UKL, particularly when considering the possibility of a portion of the water in Unit 2 that will be water delivered from UKL. Therefore, the Service concludes that the proposed Project operations are likely to result in insignificant effects to water quality, as the PA is not likely to limit the persistence of LRS and SNS in Unit 2 due to water quality conditions. It will be important to monitor water quality conditions in a manner similar to the monitoring that occurs at UKL.

7.1.3.1.8.4 Summary of Effects to LRS and SNS Populations in Unit 2

Based on the above analysis, the Service concludes the PA likely has beneficial effects to suckers in Lower Klamath National Wildlife Refuge Unit 2, as the proposed delivery of 21,000 AF should maintain diverse sucker habitats and provide areas with sufficient water depths that may reduce predation risk. The additional water which may also include tailwaters should not limit the persistence of LRS and SNS in Unit 2. Therefore, the PA will have beneficial effects to LRS and SNS present and beneficial effects to larvae, age-0 juveniles, older juveniles, and adult sucker habitat in Unit 2. The PA is likely to have insignificant effects to water quality but is not likely to limit the persistence of LRS and SNS due to water quality conditions.

7.1.3.1.9 Effects to LRS and SNS Populations in the Keno Reservoir

Small numbers of the LRS and the SNS reside in the Keno Reservoir (Desjardins and Markle 2000, Korson et al. 2008, Kyger and Wilkens 2011a). Poor habitat conditions, nonnative fishes, and a lack of successful reproduction are thought to be responsible for the small numbers of LRS and SNS present in the Keno reservoir (Desjardins and Markle 2000, Piaskowski 2003).

The potential effects of the PA on LRS and SNS in the Link River and Keno Reservoir are entrainment, impaired water quality, and alterations to habitat. Entrainment in Project facilities is a concern because Reclamation diverts water at the Lost River Diversion Channel, and North and Ady Canals. Also, there are approximately 50 smaller diversions, some of which are part of the Project; most of these lack appropriate screens. Sampling in the Lost River Diversion Channel and near the Ady and North Canals indicates that juvenile suckers are present in low numbers near both locations during the summer where they could be vulnerable to entrainment (Phillips et al. 2011), and small numbers of suckers have been captured in the Lost River Diversion Channel (Foster and Bennetts 2006). The number of suckers entrained at facilities downstream from Link River Dam is thought to progressively decrease downstream because some die and others likely remain in the reservoir, so fewer are dispersing downstream (USFWS 2007c). Thus, entrainment is expected to be substantially lower in the Keno Reservoir diversions than at Link River Dam.

Water quality may also be reduced in Keno Reservoir by nutrient-rich agricultural return flows entering the reservoir at the Straits Drain and from the Lost River Diversion Channel in winter/spring (Kirk et al. 2010). However, overall, the diversion of water from UKL through the Project results in a net reduction of nutrients entering Keno Reservoir from UKL (Kirk et al. 2010). Therefore, the effects of Project operations on water quality in Keno Reservoir above and beyond the conditions described in the environmental baseline are expected to be minimal, meaning no additional impact to suckers or their habitat beyond that considered in the environmental baseline.

Habitat effects to LRS and SNS may include alterations to spawning habitats, fish passage, and rearing habitats. No known sucker spawning habitat exists in the Klamath River between the mouth of the Link River and Keno Dam (Buchanan et al. 2011). However, there is an anecdotal report of sucker spawning activity in the lower Link River, upstream from the west side hydropower facility (Smith and Tinniswood 2007). It is unclear how the proposed Project operations affect upstream passage of suckers in the Link River; both high and low flows could restrict upstream passage, but intermediate flows might improve passage (Mefford and Higgs 2006). The proposed Project operations include ramping rates and minimum flows downstream from the Link River when suckers are present to reduce stranding that should eliminate nearly all of the adverse effects from ramping and low flows on affected individuals.

Larval and age-0 juvenile suckers enter Keno Reservoir after entrainment or dispersal from UKL. More age-0 juvenile suckers were captured in trap nets fished close to the shoreline near emergent vegetation than in open water areas in Lake Ewauna (Phillips et al. 2011). Furthermore, sampling in a reconnected wetland bordered by North and Ady canals captured more age-0 juvenile suckers in transition zones near emergent vegetation than in open water or in vegetation (Phillips et al. 2011). These data suggest that wetland habitat availability may be important for juvenile suckers in Keno Reservoir. The proposed Project operations maintain a surface elevation in the Keno Reservoir of 4,086.5 ft., except for the possibility of several days during the spring when the surface elevation may be drawn down 2 ft. to facilitate maintenance of irrigation facilities. Stable surface elevations in the Keno Reservoir could inhibit development of additional wetland habitats and degrade the quality of existing wetlands (Middleton 1999); however, they do provide for consistent inundation of available wetland habitat and are thought to be similar to those that occurred naturally due to the reef at the present-day Keno Dam site that controlled water levels (Weddell 2000).

Summary of Effects to LRS and SNS Populations in Keno Reservoir

In summary, the PA could have a variety of adverse effects to the LRS and the SNS in Keno Reservoir, including entrainment into Project facilities and suboptimal water quality. The effects of reduced water quality to the LRS and the SNS are not fully understood, and while important to consider, they are not likely to be the primary factor limiting survival and viability of the small number of suckers likely present in Keno reservoir. The PA could also have beneficial effects for the suckers in the Keno Reservoir that may help them to persist, including maintenance of inundated habitat and flows at Link River Dam that could be seasonally conducive to migration back to UKL. However, the relative value of the small population of suckers in Keno Reservoir to the overall survival and recovery of the species is not currently well understood and unlikely to be significant given current knowledge.

7.1.3.1.10 Summary of Effects of the Proposed Action to the UKL Recovery Unit

The UKL recovery unit is essential for the survival and recovery of the LRS and the SNS because the UKL recovery unit contains one of only two LRS populations with successful reproduction and contains the largest LRS population remaining within its range. The UKL recovery unit contains one of only three SNS populations known to successfully reproduce. Adverse effects to LRS and SNS populations in the UKL recovery unit as a result of the PA are likely to include: (1) decreases in larval and age-0 juvenile habitat between July and October; (2) decreased availability of habitat with adult suckers' preferred depths at the lowest water levels; (3) decreased access to shoreline spawning habitat in years with poor hydrology and the lowest water levels; and (4) substantial entrainment of larvae and age-0 juveniles at the A Canal and Link River Dam. The PA is also likely to result in insignificant effects to water quality as it is likely to provide acceptable conditions for LRS and SNS. UKL operations will not lower lake elevation more than 0.6 ft. within a 3-week period in March through May, resulting in discountable effects to LRS and SNS embryos, pre-swim-up larvae, and their habitat at shoreline springs.

As described above, the PA is also likely to have beneficial effects to the LRS and SNS populations in the UKL recovery unit. These are likely to include, but not limited to: (1) water storage in winter in UKL that results in increases in spawning habitat and young-of-the-year nursery habitat in most years, (2) lake level variations that could help maintain marsh vegetation that requires air exposure for seedling growth, (3) establishment of an auxiliary sucker population by maintaining habitats in Lower Klamath National Wildlife Refuge Unit 2 through consistent annual delivery of 21,000 AF of water, and (4) increased juvenile survival through assisted rearing (described below).

Proposed Project operations are compatible with the annual production of millions of LRS and SNS eggs and larvae at UKL by the sucker populations spawning in the Williamson and Sprague Rivers. Proposed Project operations are likely to cause seasonal habitat losses in UKL, potentially affecting embryonic, larval, juvenile, and adult suckers, as well as entrainment of larvae, juveniles, and adults. The significance of those effects is magnified by the lack of recruitment into the adult breeding populations which are aging and in decline.

Project-related effects at UKL that are most likely to rise to a population-level are entrainment of juvenile suckers because of the large numbers entrained and the relative importance of juveniles in terms of likely contributing to recruitment. If there is a small level of recruitment occurring in UKL, which is possible (Hewitt et al. 2018), then any loss of young suckers by entrainment or other actions resulting from Project operations would reduce recruitment. Given the lack of substantial recruitment into the adult populations of the LRS and the SNS at UKL since the late 1990s (Hewitt et al. 2018), recruitment at UKL during the near term (i.e., 10 years) is essential to the survival and the recovery of the LRS and the SNS because of the important role that UKL plays in the conservation of these species (Hewitt et al. 2018, Rasmussen and Childress 2018). The Service anticipates, and data recently collected suggest, that adverse effects to the declining sucker populations in UKL as a result of Project operations will be minimized through the assisted rearing program, and the recovery team participation in beneficial actions, both of which are discussed below.

7.1.3.2 Effects of the Proposed Action on LRS and SNS in the Lost River Subbasin Recovery Unit

The Lost River Subbasin recovery unit for the LRS and the SNS consists of the following water bodies: (1) Clear Lake and tributaries; (2) Tule Lake; (3) Gerber Reservoir and tributaries; and (4) the Lost River (USFWS 2013a). This analysis relies on the survival and recovery function assigned to each of these units to express the significance of anticipated effects of the proposed Project operations on these species. The proposed Project operations are likely to affect habitat availability for most LRS and SNS life-history stages, including larvae, age-0 juveniles, older juveniles, and adults. There is no known shoreline spawning in any of the water bodies in this recovery unit, so embryos and pre-swim-up larvae will not be affected in Clear Lake, Tule Lake, and Gerber Reservoir waterbodies. Additionally, because there is essentially no emergent wetland vegetation in Clear Lake or Gerber Reservoir, the PA will not affect wetland vegetation in either of these waterbodies. High turbidity in Clear Lake and Gerber Reservoir likely provides cover to early sucker life-history stages similar to that provided by wetland vegetation in UKL.

7.1.3.2.1 Effects to LRS and SNS in Clear Lake

Clear Lake has populations of both LRS and SNS. The SNS population is likely larger than to the one in UKL based on similar annual catch rates, while the LRS population is likely much smaller than that in UKL (Hewitt et al. 2021, Krause and Paul-Wilson 2024). Management of Clear Lake under the PA will continue to provide an annual minimum surface elevation of not less than 4,520.60 ft. on September 30 of each year (USBR 2018a pp. 37-42). It should be noted that low water levels in Clear Lake were likely normal prior to the construction of the Clear Lake Dam. In fact, much of the east lobe was a meadow that was used to grow hay (USBR 2000). Reclamation's 1905 map of Clear Lake shows that the deeper area of the east lobe was a marsh. Thus, historically, LRS and SNS in Clear Lake apparently adapted to varying water levels.

Under the PA, Reclamation plans to estimate irrigation water supplies and ensure lake levels stay above the minimum using a method similar to the process used for past Project operations. Beginning about April 1 of each year, the April through September inflow forecast, current reservoir elevation, estimated leakage and evaporative losses, and an end-of-September minimum elevation of 4,520.60 ft. are used to predict available irrigation supplies for Clear Lake (USBR 2018a pp. 37-42). The estimated water supply is frequently updated based on revised inflow forecasts and changes in surface elevations through the irrigation season. In-season updates inform the decisions to curtail or terminate irrigation deliveries to avoid going below the minimum surface elevation (USBR 2018a). For example, deliveries were curtailed in 2013 and eliminated in 2014 and 2015 due to low surface elevations and projected inflow (J. Cameron, USBR, personal communication, October 3, 2024). However, water deliveries re-started in 2016 and continue to present day within the acceptable ranges. Proposed operations were evaluated for potential effects to adult sucker spawning and migration, habitat for larvae and age-0 juveniles, habitat of older juveniles and adults, water quality, and the likelihood for entrainment and stranding.

7.1.3.2.1.1 Effects to Adult Sucker Spawning and Migration

Water management at Clear Lake resulting in low lake levels could adversely affect the LRS and the SNS spawning migrations by limiting access to Willow Creek during drought conditions (Hewitt and Hayes 2013 pp. 4–5; Hewitt et al. 2021, p. 11). The magnitude of this impact to suckers in Clear Lake is difficult to evaluate due to the combined effects of the proposed Project operations, the high seepage and evaporative losses, lack of a long-term dataset of sucker migrations, and the sporadic nature of Willow Creek discharges. Nevertheless, adult sucker access to the tributary appears to depend on a combination of Willow Creek discharge and a lake elevation of at least 4,524.00 ft. (Barry et al. 2009 pp. 5–6, 8, Hewitt and Hayes 2013; Hewitt et al. 2021 pp 33-55). The spawning season varies among years; it can begin as early as the end of January and extend through May (Hewitt and Hayes 2013 p. 15; Hewitt et al. 2021 pp. 31). Thus, in years when lake levels are low prior to the spawning season and/or there are not substantial inflows, spawning migrations contain few individuals.

Based upon hydrologic conditions observed between 1986 and 2023, the period for which inflow estimates are available, the proposed target elevation of 4,524.00 ft. during the spawning season would allow access to spawning habitat in Willow Creek and provide a modicum of protection from avian predation (Hewitt et al. 2021 p 35). The lowest allowed lake elevation under the Opinion is 4,520.60 ft. at the end of September. When Clear Lake elevation is below 4,520.60 ft., the probability of fall and winter inflows raising the lake elevation at or above 4,524 ft. during the following spawning season is greatly decreased. Based on the POR, every year with an EOS elevation below 4,520.60 ft. results in Clear Lake elevations below 4,524 ft. in the following January and/or February, with a 50 percent likelihood of being under 4,524 ft. in March as well, significantly limiting access to spawning habitat in Willow Creek. Fortunately, this is a rare event and has only occurred in 8 percent of years since 1911 (Table 7).

In water years 1911 through 2023, lake elevation was less than 4,524 ft. at the end of September in 35 percent of years (Table 7). However, between 1999 and 2023, lake elevation at the end of September was below 4,524 ft. in 64 percent of years, indicating that dryer conditions and the associated lower inflows are becoming more common. Since 2016, BOR has managed to keep the end of September elevation above 4,520.60 ft. by (at minimum) 0.90 ft. (with the exception of WY 2022) to facilitate filling of Clear Lake and increase the likelihood of access to spawning habitat in Willow Creek despite the dryer hydroclimate. But the overall average elevation has been lower as Reclamation balances project needs against lower inflows into the reservoir. This balancing act makes it important to understand the potential impacts of the Project with regards to accessibility of spawning habitat. Based on the POR in Table 7 (1911-2023), the probability of lake levels below the desired elevation of 4,524.00 ft. is 18 percent at the end of February, 12 percent at the end of March, and 11 percent at the end of April. Similar to the patterns described above, these conditions are more frequent in the 1999-2023 period, with 36 percent of years below 4,524.00 ft. at the end of February, 28 percent of years at the end of March and 24 percent at the end of April.

Based on the best available information and the stated considerations, the Service expects that operations will allow for successful spawning because lake elevations are likely to stay at levels that allow for refill that will then accommodate spawning in moderately wet years. Spawning in drier years will likely be restricted by streamflow, so lake elevations may not be as important for upstream migration in dry years but would be important for fish accessing Willow Creek from the west lob of the lake. A synthesis of hydrologic and sucker spawning data from Clear Lake has been completed as of 2021 to help refine the understanding of Project impacts to spawning access.

There is a better understanding of how lake elevation and stream-inflows can impact spawning (Hewitt et al. 2021) based on estimated stream-inflows, end of month reservoir elevation levels at the Clear Lake Reservoir Dam, and number of adults detected moving past the Willow Creek PIT tag array. The analyses indicate that not only does low stream inflow reduce access to spawning habitat, but that reservoir elevations below 4,524.00 ft. have a direct impact on access from the west lobe of Clear Lake Reservoir to the east lobe, preventing access to Willow Creek for spawning (Hewitt et al. 2021 p. 11). This information is important when considering that stochastic high inflows from Willow Creek, which promote spawning, might not raise reservoir levels fast enough for a fish in the west lobe to be able to access and navigate through the east lobe and into Willow Creek for successful spawning (Hewitt et al. 2021 pp. 11, 31). Therefore, the Service concludes that the proposed Project operation will result in adverse effects to sucker spawning and migration when reservoir elevations are below 4,524.00 ft. during spawning.

7.1.3.2.1.2 Effects to Habitat for Larvae and Age-0 Juveniles

At Clear Lake, larval and age-0 juvenile suckers likely use shallow nearshore areas just as they do in UKL, but they do not use emergent wetland vegetation because it does not exist in Clear Lake. Because Clear Lake is large and shallow, it has little substrate diversity compared to UKL, so the reduction in water depth due to the combined effect of irrigation diversions and evaporation and leakage is unlikely to limit the availability of habitat for larvae or age-0 juveniles, except at the lowest water levels. Further, successful spawning only occurs at higher lake elevations and stream inflows, as described above, and thus years with substantial larval production are likely to coincide with lake elevations that are relatively high due to large inflows, and thus, young-of-the-year habitat is not likely to be limiting when larvae and age-0 juveniles are present. While water releases for agricultural purposes may negatively impact lake elevations, the releases proposed under this action will not overcome periodic favorable hydrology over the term of this Opinion that will result in higher lake elevations and stream inflows. Therefore, the Service concludes that the proposed Project operations effects on larval and age-0 juvenile habitat are insignificant.

7.1.3.2.1.3 Effects to Habitat of Older Juveniles and Adults

The limited available data suggest that older juvenile (including sub-adults) and adult suckers in Clear Lake use habitats that are shallower than the preferred habitats in UKL (Scoppettone et al. 1995 pp. 34-35). However, this conclusion is based on catch data, and variation in capture efficiency with depth could drive the observed pattern. Although the west lobe of Clear Lake has water depths greater than 20 ft. during wet periods, much of the lake is shallow, especially the east lobe, which has a bottom elevation of about 4,520.00 ft. and is effectively unavailable to adult suckers when water levels are less than about 4,523.00 ft. Based upon the full POR, there is a 33 percent probability that lake levels will reach 4,523.00 ft. or less during the year; however, these conditions occurred in 64 percent of years since 1999. Thus, conditions that are likely to cause adult suckers to avoid the east lobe of the lake are expected to occur during the term of this Opinion.

The proposed minimum surface elevation at the end of September is 4,520.60 ft. in the west lobe. At this elevation, most of the east lobe is dry, except for the deeper pool nearest the dam into which Willow Creek flows. Based on the POR, elevations this low should be rare, because they occurred in the POR at a frequency of 8 percent. However, the current cycle of drier conditions is reasonably likely to continue, and the incidence of low lake levels is likely to be greater during the term of this Opinion than the full POR suggests.

During droughts, the PA at Clear Lake could impact older juvenile and adult suckers by reducing habitat availability, particularly lake surface area and depth. Higher catch rates of adult SNS and LRS in Clear Lake at low lake elevations suggest that suckers do become concentrated as the available habitat area decreases (Hewitt and Hayes 2013 p. 4; Hewitt et al.2021 pp. 11). The effects of crowding on parasite levels and growth rates are not known, but limited data available suggest that low lake levels in 1992 were followed by slight reductions in condition factor and increases in afflictions the following spring that were no longer apparent by summer (USBR. 1994). Suckers in Clear Lake are also vulnerable to avian predation, which may be exacerbated during low lake elevations, particularly as they congregate in preparation for the spring spawning migration (Evans et al. 2016a). However, the details of the potential relationship between avian predation and lake elevations are not currently understood nor is the relationship between lake elevations and annual survival rates more broadly. The dynamics of bird colonies at Clear Lake could drive either an increase or a decrease in mortality with increasing lake elevation. For example, low lake elevations could make suckers more vulnerable to avian predation due to shallower depths; however, the bird colonies tend to be smaller at low lake elevations because land predators have access to the available nesting sites (Evans et al. 2016a). Therefore, based on the available information, the Service does not expect that extent of reduced habitat availability under the PA will amount to adverse effects to adult or older juvenile suckers.

The minimum lake elevation being proposed for Clear Lake (i.e., 4,520.60 ft.) has not changed from minimums previously consulted on. Current monitoring data for SNS and LRS exhibit broader size distributions than those in UKL and include multiple, distinct size classes, especially for SNS, indicating at least intermittent recruitment (Hewitt and Hayes 2013, J. Krause and Paul-Wilson 2024). Therefore, based on the best available information, it does not appear that the lake elevations under the PA will result in adverse effects to adult suckers due to changes in habitat availability. The Service concludes that the PA will likely result in insignificant effects to older juvenile and adult sucker habitat availability.

Table 7. Clear Lake Surface Elevation Probability of Exceedance in ft. for the Period of 1911 through 2023 (USBR 2024, personal communication, 2 July 2024).

Prob. Exceed.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
95%	4,797.94	4,797.90	4,800.22	4,800.49	4,804.73	4,809.11	4,808.99	4,807.65	4,804.25	4,801.46	4,798.79	4,798.17
90%	4,800.68	4,802.42	4,804.37	4,805.28	4,807.28	4,811.15	4,814.19	4,812.20	4,809.88	4,806.92	4,803.80	4,800.75
85%	4,803.33	4,804.68	4,806.81	4,807.61	4,808.47	4,813.88	4,817.72	4,817.47	4,814.87	4,810.74	4,806.57	4,803.33
80%	4,805.70	4,806.47	4,808.62	4,810.07	4,811.89	4,816.41	4,819.52	4,818.90	4,816.17	4,812.28	4,808.96	4,805.42
75%	4,806.91	4,807.42	4,809.19	4,811.99	4,814.17	4,818.10	4,821.30	4,819.81	4,816.83	4,813.31	4,809.76	4,806.84
70%	4,808.27	4,809.28	4,811.36	4,813.43	4,815.30	4,819.68	4,821.89	4,820.48	4,817.71	4,814.68	4,811.63	4,808.45
65%	4,810.47	4,810.86	4,812.77	4,814.41	4,816.55	4,821.06	4,822.93	4,821.22	4,818.94	4,815.38	4,812.91	4,810.36
60%	4,812.10	4,811.96	4,814.25	4,816.17	4,817.52	4,822.05	4,824.74	4,822.87	4,820.26	4,816.92	4,814.02	4,811.82
55%	4,813.72	4,814.06	4,815.32	4,816.65	4,818.01	4,823.36	4,825.83	4,825.00	4,822.33	4,819.37	4,816.34	4,813.95
50%	4,814.57	4,815.20	4,817.02	4,817.40	4,819.92	4,824.58	4,827.30	4,825.90	4,823.28	4,820.69	4,817.84	4,815.26
45%	4,816.72	4,816.63	4,818.32	4,817.90	4,820.79	4,825.35	4,828.31	4,826.99	4,824.47	4,821.14	4,818.66	4,817.16
40%	4,817.65	4,817.69	4,820.06	4,820.34	4,821.61	4,826.04	4,829.23	4,827.86	4,825.53	4,822.69	4,820.38	4,818.38
35%	4,819.56	4,819.82	4,820.63	4,820.76	4,822.97	4,826.86	4,830.13	4,829.29	4,827.65	4,824.87	4,821.86	4,819.77
30%	4,820.56	4,820.60	4,821.50	4,821.45	4,823.43	4,828.31	4,831.62	4,830.75	4,829.27	4,826.32	4,823.31	4,820.70
25%	4,821.04	4,821.69	4,822.43	4,823.17	4,824.78	4,830.55	4,832.13	4,831.89	4,829.72	4,826.77	4,823.52	4,821.23

Prob. Exceed.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
20%	4,821.98	4,822.49	4,823.04	4,824.29	4,826.36	4,831.66	4,834.07	4,832.97	4,830.41	4,827.26	4,824.51	4,822.48
15%	4,822.81	4,822.95	4,824.08	4,825.67	4,828.35	4,832.59	4,834.94	4,833.60	4,831.17	4,828.06	4,825.25	4,823.47
10%	4,824.21	4,824.41	4,825.29	4,826.86	4,830.74	4,834.42	4,835.51	4,834.39	4,832.20	4,829.49	4,826.88	4,824.47
5%	4,825.46	4,825.54	4,827.52	4,829.67	4,833.09	4,835.63	4,835.80	4,834.86	4,833.15	4,830.73	4,827.97	4,825.72

7.1.3.2.1.4 Effects to the LRS and SNS in Clear Lake from Water Quality

Water-quality monitoring at Clear Lake over a wide range of lake levels and years documented conditions that were adequate for sucker survival during most years (USBR 1994, USBR 2001a, 2007, 2009). In October 1992, the water surface elevation of Clear Lake was as low as 4,519.40 ft. before the onset of a hard winter, and no fish die-offs were observed. Although preliminary data suggested that fish exhibited poor body condition the following spring, condition factors had more than rebounded by summer, suggesting that any effects were ephemeral (USBR. 1994). It is uncertain what caused the poor condition, but it could be related to reduced water quality, crowding and competition for food, parasites, or a combination of these were responsible. Based on this, very low winter lake levels in Clear Lake could pose a potential risk to listed suckers from adverse water quality. However, under reservoir management consistent with the PA, the water quality conditions have been within the range that is tolerated by suckers. Therefore, the Service concludes that the effects are insignificant as water quality conditions are not a limiting factor for persistence of SNS and LRS in Clear Lake.

7.1.3.2.1.5 Effects of Entrainment and Stranding Losses of LRS and SNS at Clear Lake

The outlet at Clear Lake Dam is screened against fish entrainment. The screen was designed for a fish approach velocity not to exceed 0.75 feet per second, and with a mesh size no larger than 0.25 in. The required total area of the fish screens was determined based on a flow of 200 cfs and the above screening criteria. With full screen submergence and a discharge of 200 cfs, the screen approach velocity is approximately 0.53 ft./s. However, Reclamation estimated that about 270,000 larval suckers and about 3,700 juvenile suckers passed through or around the fish screen into the Lost River at Clear Lake Dam in 2013 (Sutphin and Tyler 2016). There are no available estimates of larval production in Clear Lake, making it difficult to infer population level impacts of larval entrainment for suckers in Clear Lake. Entrainment is likely variable between years and dependent on annual larval and juvenile production, timing of larval outmigration from Willow Creek, juvenile sucker distribution within the East and West lobes, and the timing and magnitude of irrigation releases.

The 2013 study is used for entrainment estimates for the period with robust dam release data (1986-2018) because it is the best available information available on larval densities and entrainment from Clear Lake. The years with flood-control releases (1998 and 1999) and 2000 were excluded due to drawdown prior to reconstruction of the dam in 2001. Flood-control releases are not within Reclamation’s discretion, and drawdown for construction similar to what happened in 2000 is not expected under the PA. The Service assumed that entrainment was proportional to the volume of water released from the dam based on the Gutermuth et al. (Gutermuth et al. 2000a, 2000b) studies. Larval sucker entrainment was concentrated in the spring with the bulk of the catch coming between the last week of April and mid-May, but some larval entrainment was observed into June (Sutphin and Tyler 2016). The timing of larval drift is likely to vary among years. The larval entrainment period is assumed to occur between April 1 and June 30 in all years, based on the timing of adult migration relative to the run in 2013 (Hewitt and Hayes 2013). The year 2013 was considered to be representative of larval densities in Clear Lake because information on the interannual variation in larval abundance is not available. Therefore, larval entrainment was estimated by multiplying average larval densities between April 22 and June 30, 2013 (22.3027 larvae/AF), by the volume of water released from Clear Lake in April through June for each water year between 1986 and 2021 (excluding the water years mentioned above). Estimated larval entrainment ranged from 0 in years with no deliveries from Clear Lake to around 574,000 in 2001, when higher than normal deliveries were made from Clear Lake due to the shutdown of deliveries from UKL. The mean estimated larval entrainment over that period was 241,000.

Juvenile sucker entrainment was estimated in a similar manner except there was no apparent seasonal pattern in juvenile sucker entrainment during the 2013 study, and the Service assumed juvenile entrainment is constant across the year. Thus, the average density of juvenile suckers from the 2013 study (0.1867 juveniles/AF) was multiplied by the total releases for the water year. The mean estimate was 5,050 and estimates ranged from 0 to 12,200. No adults are expected to be entrained due to the fish screen at Clear Lake Dam.

Suckers entrained at Clear Lake Dam are lost from the spawning population because there is no upstream passage at Clear Lake Dam or Gerber Reservoir Dam nor is there substantial spawning habitat further downstream in the Lost River system. Therefore, these individuals would most likely not be able to complete their lifecycle through reproduction, and entrainment is an adverse effect. Additionally, the Service expects up to 2 percent of the entrained individuals could be killed as they pass through the dam, as described above for Link River Dam (Whitney et al. 1997, Muir et al. 2001).

Total larval and juvenile production in Clear Lake is not known. If the numbers of entrained individuals are a substantial proportion of the number available in any year, then there is likely an adverse impact to sucker populations at Clear Lake resulting from entrainment losses that result from the PA. Still, the PA for Clear Lake is consistent with the historical operations at the reservoir, therefore the potential entrainment impacts are not anticipated to be greater than those in the recent past, which have allowed for recruitment of multiple cohorts.

During droughts, the risk of stranding of juvenile suckers is increased at Clear Lake. For example, in 2009, the pool of water near the dam became disconnected from the east lobe of Clear Lake in July when the lake reached a surface elevation of about 4,522.0 ft.; 48 juvenile suckers were captured in the forebay of the dam and moved to the west lobe of Clear Lake and two adult suckers were found dead (USBR, 2020). The pool nearest the dam is the only known area at Clear Lake that poses a stranding risk and given the low numbers of suckers observed in 2009, it is not likely that the level of adverse effects from stranding in the forebay represents a significant limiting factor to the persistence of LRS and SNS in Clear Lake.

Therefore, the Service concluded the PA is likely to result in adverse effects from sucker entrainment at Clear Lake Dam and stranding of LRS and SNS when the dam area becomes disconnected from the east lobe of Clear Lake.

7.1.3.2.1.6 Summary of Effects to LRS and SNS in Clear Lake

Based on the analysis presented above, the PA will have adverse effects to suckers in Clear Lake that likely include: (1) entrainment of larval and juvenile suckers at Clear Lake Dam; (2) stranding of juveniles and adults at low lake levels; and (3) reduced adult sucker spawning and migration at elevations below 4,524 ft. The action is unlikely to affect spawning under the wettest conditions because lake levels will rise rapidly allowing spawning access even if lake elevations are low in the fall. However, uncertainty remains about Project impacts during moderately wet years when lake elevations are low. Spawning in drier years will likely be restricted by streamflow for upstream migration that could prevent fish from accessing Willow Creek from the west lobe of the lake when lake elevations are low.

7.1.3.2.2 Effects to the SNS in Gerber Reservoir

Only SNS, not LRS, occur in Gerber Reservoir. The PA at Gerber Reservoir, which is unchanged from past operations identified in previous Project consultations, is designed to ensure that the surface elevation is at or above 4,798.10 ft. on September 30 (USBR 2018a). Table 8 shows the Gerber Reservoir end-of-month elevations over the 1925-2023 POR.

Annual water supply projections are made for Gerber Reservoir in a similar way to those for Clear Lake. As described in the PA, on approximately April 1 of each year, the current April through September inflow forecast, current reservoir elevation, estimated leakage and evaporative losses, and an end-of-September minimum elevation of 4,798.10 ft. are used to determine available irrigation supplies from Gerber Reservoir. The available water supply is updated with new inflow forecasts and surface elevations as the irrigation season progresses. In-season updates inform the decisions to curtail or terminate irrigation deliveries to avoid going below the minimum end-of-September surface elevation. The adequacy of proposed operations relative to the surface elevation of Gerber Reservoir and SNS life history requirements are discussed below.

Table 8. Probability of Exceedance for End of Month Surface Elevations at Gerber Reservoir 1925-2023 in Feet Above Mean Sea Level, Reclamation datum (USBR 2024 personal communication, 2 July 2024).

Prob. Exceed.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
95%	4,519.08	4,519.08	4,519.30	4,519.96	4,521.23	4,521.85	4,522.27	4,521.70	4,520.99	4,520.22	4,519.60	4,519.20
90%	4,520.94	4,520.85	4,521.10	4,521.69	4,521.90	4,523.66	4,524.06	4,523.98	4,523.22	4,522.18	4,521.46	4,521.13
85%	4,521.60	4,521.78	4,522.05	4,522.84	4,523.40	4,525.24	4,525.58	4,525.06	4,524.14	4,522.99	4,522.09	4,521.59
80%	4,522.22	4,522.26	4,523.08	4,523.67	4,524.44	4,525.87	4,526.18	4,525.87	4,524.83	4,523.79	4,522.73	4,522.13
75%	4,523.53	4,523.57	4,524.40	4,524.70	4,525.60	4,526.59	4,527.43	4,526.84	4,525.94	4,524.74	4,523.60	4,522.96
70%	4,524.28	4,524.40	4,525.13	4,525.62	4,526.29	4,527.20	4,528.55	4,527.96	4,527.27	4,526.10	4,525.02	4,524.28
65%	4,525.54	4,525.72	4,526.05	4,526.52	4,527.02	4,528.06	4,528.87	4,528.90	4,528.08	4,527.05	4,526.20	4,525.66
60%	4,526.02	4,525.96	4,526.65	4,527.00	4,527.68	4,529.21	4,529.90	4,529.49	4,528.85	4,527.85	4,526.83	4,526.34
55%	4,526.85	4,526.86	4,527.20	4,527.93	4,528.95	4,530.29	4,531.05	4,530.58	4,529.90	4,528.84	4,527.89	4,527.17
50%	4,527.61	4,527.54	4,528.20	4,528.69	4,529.79	4,530.70	4,531.65	4,531.36	4,530.44	4,529.36	4,528.36	4,527.78
45%	4,529.00	4,528.97	4,529.40	4,529.84	4,530.48	4,531.35	4,532.32	4,532.17	4,531.32	4,530.80	4,529.96	4,529.16
40%	4,529.65	4,529.66	4,529.81	4,530.63	4,531.53	4,532.10	4,533.46	4,533.22	4,532.39	4,531.38	4,530.57	4,529.91
35%	4,530.40	4,530.47	4,530.58	4,531.25	4,532.23	4,533.52	4,534.10	4,533.62	4,533.13	4,532.16	4,531.26	4,530.55
30%	4,531.13	4,531.12	4,531.37	4,532.00	4,533.38	4,533.93	4,534.83	4,534.49	4,533.82	4,532.65	4,531.91	4,531.16
25%	4,531.50	4,531.53	4,531.97	4,533.20	4,533.74	4,535.00	4,535.35	4,534.95	4,534.37	4,533.32	4,532.38	4,531.61
20%	4,532.97	4,533.02	4,533.16	4,533.94	4,534.32	4,535.71	4,536.60	4,536.12	4,535.45	4,534.68	4,533.85	4,533.22
15%	4,533.48	4,533.52	4,533.78	4,534.41	4,535.60	4,536.82	4,537.52	4,537.43	4,536.56	4,535.57	4,534.61	4,533.71
10%	4,534.09	4,533.96	4,534.16	4,535.06	4,536.17	4,537.82	4,538.29	4,537.84	4,536.98	4,535.94	4,535.03	4,534.34
5%	4,534.99	4,534.89	4,535.31	4,536.08	4,537.10	4,538.71	4,539.19	4,539.00	4,538.41	4,537.44	4,536.10	4,535.45

7.1.3.2.2.1 Effects of Proposed Operations to Gerber Reservoir Adult SNS Spawning and Migration

Access to Ben Hall and Barnes Valley Creeks, which are the main Gerber Reservoir tributaries where SNS spawning occurs, requires a minimum surface elevation of about 4,805.00 ft. based on the reservoir bathymetry (USBR 2018a), and the spawning season extends from February through May. During very dry years, both Barnes Valley and Ben Hall Creeks typically have low spring flows that are unlikely to provide adequate upstream passage for spawning adults, regardless of lake elevations (USBR 2001b). During these conditions, spawning cues are also unlikely to be present.

Although observed Gerber Reservoir surface elevations at the end of September have been below the proposed minimum elevation of 4,798.10 ft., in 5 years of the POR (1931, 1960, 1961, 1991, and 1992). Surface elevations of at least 4,805.00 ft. were reached in these years the following spring by the end of March (USBR 2018a).

Based on surface elevations from the POR for Gerber Reservoir, the PA, which maintains the current lake management of a minimum surface elevation of 4,798.10 ft. at the end of September, will likely maintain access to spawning habitat during spring the following year when inflows provide adequate upstream passage. Gerber Reservoir has continued to stay above minimum surface elevation during the recent drought by limiting deliveries. Therefore, the Service concludes that the PA is likely to result in insignificant effect as it provides adequate access to spawning habitat and provides for the annual production of SNS larvae, and the annual production of larvae is not likely to be a limiting factor for SNS in Gerber Reservoir.

7.1.3.2.2.2 Effects to Gerber Reservoir Habitat for All SNS Life Stages

The effects of low water levels in Gerber Reservoir on SNS habitat use, population size, age-class distribution, recruitment, or decreased body condition are not well understood. However, available information indicates that the Gerber Reservoir SNS population has remained viable, showing regular recruitment under the current management regime (Barry et al. 2007, Leeseberg et al. 2007, USBR 2018a). Because the PA is unchanged from past operations, low lake elevations resulting from proposed Project operations are unlikely to limit the persistence of SNS in Gerber Reservoir. Therefore, the effects of the water levels provided in the PA on all life stages of SNS in Gerber Reservoir are insignificant.

7.1.3.2.2.3 Effects to SNS in Gerber Reservoir as a Result of Water Quality

Water quality monitoring in Gerber Reservoir over a wide range of lake levels and years have documented conditions that are periodically stressful, but typically adequate, for sucker survival. Stressful water quality conditions were limited to hot weather conditions that created high water temperatures (USBR 2001a, 2009, Piaskowski and Buettner 2003). Although periodic stratification during summer and fall in the deepest portion of Gerber Reservoir can result in DO concentrations that are stressful to suckers, stratification in Gerber Reservoir has been observed persisting for less than a month and is confined to the deepest water in a small portion of the reservoir nearest the dam (Piaskowski and Buettner 2003). This low DO condition is likely more the result of climatological conditions, such as high air temperatures and low wind speeds, than lake surface elevations because shallower depths would likely increase mixing of bottom waters, and this would increase DO concentrations.

Blooms of blue-green algae can also reach densities in the fall and winter high enough to prompt advisories by the State of Oregon, but it is unknown if these blooms are directly or indirectly impacting SNS in this reservoir or if Project operations affect the blooms. The minimum proposed elevation for the end of September of 4,798.1 ft. in Gerber Reservoir will likely provide adequate water depths for protection against winter kill of SNS, which has apparently not occurred in the past during cold weather events where this elevation was maintained (USFWS 2008).

Based on the apparent stability of the SNS population in Gerber Reservoir, and the fact that proposed Project operations will be unchanged from past operations, adverse effects to SNS from water quality are not likely to limit the persistence of SNS in Gerber Reservoir.

7.1.3.2.2.4 Effects of Entrainment Losses of SNS at Gerber Reservoir

Sampling and salvage efforts in Miller Creek, which is downstream from Gerber Dam, have captured several hundred age-0 and older juvenile suckers that were presumably entrained at the dam as a result of Project operations (Hamilton et al. 2003). Because the PA is consistent with past operations, the scale of adverse effects is expected to be comparable as well. Larval suckers are also likely entrained, but this has not been studied.

The PA includes opening Gerber Dam frost valves at the end of the irrigation season, which allows for a flow of approximately 2 cfs (0.06 m3/sec) into Miller Creek. Downstream accretions from seeps and storm runoff increase the actual instream flow within Miller Creek. This flow may not be sufficient to allow for stream pool connectivity, but it is believed to prevent mortalities among fish stranded in stream pools by maintaining sufficient water depth at the end of the irrigation season (USBR 2018a).

There is likely to be entrainment losses of larval, juvenile, and adult suckers as a result of the PA at Gerber Reservoir. However, available information indicates that the Gerber Reservoir SNS population has remained moderately large and has frequent recruitment under the current management regime (Barry et al. 2007, 2009, Leeseberg et al. 2007). The Service anticipates this will continue under the PA. Thus, levels of entrainment that are likely to occur with implementation of the PA and the resulting adverse effects to SNS are unlikely to occur at a level that limits the persistence of SNS in Gerber Reservoir.

7.1.3.2.2.5 Summary of Effects to SNS in the Gerber Reservoir

The Service concludes that there are a number of potential impacts that could affect SNS and their habitats as a result of the PA to SNS in Gerber Reservoir. Entrainment is likely to be the most significant adverse effect to SNS. Based on the apparent stability of the SNS population in Gerber Reservoir, and the fact that proposed Project operations will be unchanged from past operations, the overall adverse effects are unlikely to occur at a level that limits the survival and persistence of SNS in Gerber Reservoir.

7.1.3.2.3 Effects to LRS and SNS in Tule Lake Sump 1A

Tule Lake National Wildlife Refuge encompasses a portion of the historic Tule Lake, a shallow lake that was likely primary habitat for LRS and SNS in the Lost River system, as well as other sucker and aquatic species, prior to being drained for agricultural use in the early 20th century. A population of LRS and SNS persisted in Sump 1A (Hodge and Buettner 2009) until the sumps were drained due to drought in 2020 and 2021. Tule Lake consists of two sumps: Sump 1A (9,000 ac) and Sump 1B (4,000 ac). Only a few suckers have ever been documented in Sump 1B, despite the historical access to Sump 1B from Sump 1A (Freitas et al. 2007). It is unknown why suckers have not inhabited Sump 1B, but in an effort to better understand this situation, 18 radio-tagged suckers were experimentally moved from Sump 1A into Sump 1B in 2011 to assess their movements and survival. All of these suckers returned to Sump 1A when access became available in 2012, confirming that, for unknown reasons, suckers prefer Sump 1A.

Due to the drought that began in 2020 and continued through 2022, water consumption and re-use patterns by irrigators shifted, resulting in the refuge receiving less tailwater from the project. This shift and the extended drought conditions resulted in Tule Lake Sump 1A going dry in 2021 followed by Sump 1B going dry in 2022. In both years, 2021 and 2022, fish salvage operations were conducted by Reclamation and USFWS staff. Tule Lake sumps refilled in 2024 and suckers have been observed in Sump 1A. The Tule Lake populations appear to be maintained by emigration from populations in UKL, Gerber Reservoir, and/or Clear Lake Reservoir through Project facilities. Since going dry it is likely the sumps have experienced some subsidence resulting in potential changes to bathymetry in the sumps.

The PA dedicates a supply of 43,000 AF of water to National Wildlife Refuges for the purpose of keeping Lower Klamath National Wildlife Refuge Unit 2 at or above 4,087.4 ft. and Tule Lake National Wildlife Refuge Sump 1A at or above 4,034.0 ft. to maintain sucker habitat. Of the 43,000 AF approximately 22,000 AF of supply is reserved for Tule Lake National Wildlife Refuge. The PA delivers 22,000 AF of water to the refuge from April to October to overcome evaporative and other losses to maintain Tule Lake Sump 1A surface elevation (4,034.0 ft.) and provide habitat with areas of greater water depth for older juveniles and adult suckers during summer months. These volumes of water are sufficient to overcome evaporative losses in dry years, and the elevations provided should maintain a diversity of habitat sufficient to sustain all life stages of suckers present at this site in all water year types. Further, provision of these flows, and additional water in the winter and spring from Project facilities during accrual of Project credit in UKL or high-inflow spill from UKL or the Lost River, will allow water management conducive to maintaining redundant populations of sucker species. Over the life of this Opinion, the Service anticipates a population of at least 1000 individual suckers, composed of multiple age classes, can be established and supported at Sump 1A, creating an effective population that can contribute meaningfully to sucker redundancy, resiliency, and recovery.

Provision of a consistent, certain water supply for Tule Lake National Wildlife Refuge will ensure that habitat for suckers is maintained across year types, supporting redundant populations of LRS and SNS should the populations in UKL continue to decline or become extirpated. However, these water deliveries may also result in conditions, particularly in the driest of years in the POR, where UKL elevations may drop to levels that could have negative impacts to suckers in UKL, as described above. Due to the continued lack of recruitment and significantly declining adult populations of both species in UKL, the Service has determined that the creation of redundant populations in historic habitat is most protective of the species. Further, the ongoing support for captive rearing efforts and restoration activities set forth in the PA will mitigate for many of these impacts in UKL, lending further support to a strategy that increases the number of suckers occupying habitat across their entire historic range, including Lower Klamath and Tule lakes.

Proposed operations were evaluated for potential effects to adult sucker spawning and migration, habitat for larvae and age-0 juveniles, habitat for older juveniles and adults, water quality, and the likelihood of entrainment. Sucker relocation was also evaluated due to the three consecutive years of drought conditions that resulted in the Tule Lake sumps going dry, resulting in the loss of a LRS and SNS redundant population.

7.1.3.2.3.1 Effects to Adult LRS and SNS Spawning and Migration in Tule Lake Sump 1A

In a previous Opinion (USFWS 2020), a minimum surface elevation of 4,034.0 ft. in Sump 1A was thought to provide sucker access to spawning areas below Anderson Rose Dam during spring migration. Therefore, if the delivery of 22,000 AF of water maintains a surface elevation of 4,034 ft. then suckers should have access to spawning areas below Anderson Rose Dam. Although LRS and SNS adults have been observed migrating into the lower Lost River during the spring spawning season, it appears that successful reproduction is limited by a lack of suitable substrates and flows at the dam (Hodge and Buettner 2009 pp. 5–6, 9). However, anecdotal evidence exists (Buettner 1992; Buettner 1995) that suggests sucker spawning below the dam is possible if the right conditions are provided. Since going dry it is likely the sumps have experienced some subsidence resulting in uncertainty in the sumps' bathymetry. Reclamation managed Sump 1A for a surface elevation of at least 4,034.0 ft. year-round in the past, which indicates that access to the Lost River is not a limitation on spawning. However, the Tule Lake population has not successfully reproduced, though efforts to support successful spawning (e.g., habitat restoration, flow management below Anderson-Rose Dam) have not been fully explored. The PA provides for Tulelake Irrigation District (TID) to capture and manage all flow from the Lost River when they have storage capacity within the district, opening the possibility of working with TID to manage flows in the spring during sucker spawning to provide conditions conducive to spawning. Additionally, the Service concludes that a dedicated delivery of 22,000 AF of water to Tule Lake National Wildlife Refuge for wetland habitat each irrigation season can ensure that adult suckers present in Sump 1A can access the Lost River during these flow events resulting in beneficial effects.

It is not clear to what degree Project operations are responsible for the variable flows in the Lost River because flows are affected by run-off; however, flows are regulated by Anderson Rose Dam, which is part of the Project. Thus, past Project operations are in-part responsible for variable flows and the loss of spawning substrate. Proposed Project operation will provide more consistent inflows to maintain elevation that can support access to areas that historically were used for spawning. Lack of suitable substrate due to past habitat alterations and past operational flows continues to limit the ability of LRS and SNS populations in Tule Lake to spawn. Unless the four Lost River dams are removed, flows are regulated, and significant habitat restoration efforts are implemented, lack of suitable substrate will remain an issue.

7.1.3.2.3.2 Effects to LRS and SNS Larvae and Age-0 Juvenile Habitat in Tule Lake

The wetland area of Tule Lake Sump 1A near the Lost River outlet likely provides habitat for larvae and young juveniles, assuming that larval and age-0 juvenile suckers occur in Tule Lake and utilize nearshore and vegetated habitats similar to suckers in UKL (Markle and Dunsmoor 2007). Given spawning and rearing success in both Clear Lake and Gerber Reservoir, it is reasonable to assume that larvae and juveniles may be entrained in flows from those locations and end up in Tule Lake Sump 1A when flows from the Lost River are diverted to the sump. The PA provides dedicated deliveries of 22,000 AF annually to overcome evaporative loss and maintain the minimum surface elevation of 4,034.0 ft., therefore, the Service concludes that the Project should result in insignificant effects as it provides adequate habitat for larval and juvenile LRS and SNS life stages because the proposed water levels will inundate hundreds of acres of emergent marsh habitat. Therefore, the PA at Tule Lake is unlikely to limit larval and age-0 juvenile habitat.

7.1.3.2.3.3 Effects to Habitat for Older Juveniles and Adult LRS and SNS in Tule Lake

Water depth as cover for older juveniles and adults is limited due to the shallow depth of Tule Lake sump 1A, which is assumed to be less than 4 ft. One reason for the shallow depths is Tule Lake is the terminus of the Lost River and sediment is transported downstream and collects there. The source of the sediment is unknown, but likely is in part from runoff, some of which could come from lands that use Project water. However, the recent drying of the sumps due to drought has resulted in subsidence of an estimated 3 – 6 ft. on average, though it could be locally greater (John Vradenburg, personal communication, October 31, 2024), greatly increasing the depth of available habitat for adults and juveniles. For example, the “donut hole” in Sump 1A is estimated to have increased in depth by 8 ft. since desiccation.

The PA provides dedicated delivery of 22,000 AF annually to overcome evaporative loss and maintain the minimum surface elevations in Tule Lake Sump 1A of 4,034.0 ft. Therefore, the PA should provide areas in the sump with water depth greater than 3.3 ft. for older juveniles and adults, particularly with the increased sump floor depth due to subsidence. As discussed above, sucker vulnerability to American white pelican predation is expected to be increased in water depths of less than 3.3 ft (1 m) (Scoppettone et al. 2014 p. 65, Evans et al. 2021), and future sedimentation altering the depth dynamics is a possibility. However, maintaining higher lake elevations in Tule Lake is not feasible because of the need to maintain certain maximum elevations to prevent flooding of surrounding areas in wetter periods and to support feasible Project operations. Overall, the Service concludes that the proposed Project operations are not likely to limit the persistence of populations of SNS and LRS suckers in Tule Lake Sump 1A and are likely to benefit the populations.

7.1.3.2.3.4 Effects to LRS and SNS in Tule Lake from Water Quality

The refilling of the sumps will result in decomposition of the terrestrial vegetation established when sumps were dry. This vegetation will be replaced by aquatic vegetation over time altering water quality, specifically dissolved oxygen, pH, and nutrient levels. The PA is likely to contribute to improving water quality over time in the sumps, because dedicated annual flows combat evaporative and other losses, allowing for the establishment of appropriate wetland plant communities and associated water quality dynamics. However, these improvements may be offset by the high nutrient concentrations of inflows and pesticide contamination of water reaching the sumps from tailwaters and return flows, as discussed in the *Environmental Baseline*. Poor water quality in Tule Lake may reduce the body condition and survivorship of individual suckers. Although the physical condition of adult suckers in Sump 1A was generally good (Hodge and Buettner 2009 p. 8), the Service assumes adverse effects of poor water quality are more likely to affect young suckers because of their higher metabolic rates. However, adverse effects to young suckers are dependent on them being present. Young suckers are likely entering the sump from upstream areas though habitat management and restoration over the life of this Opinion increases the potential for future spawning below Anderson-Rose Dam and improves the future likelihood of diverse year class cohorts in Sump 1A. The Service concludes that, at least small numbers of young suckers likely occur in the sump and any that are present are likely to be negatively affected by adverse water quality that is partially a result of Project operations. However, there is no evidence that these effects will limit the persistence of the LRS and SNS in Tule Lake.

7.1.3.2.3.5 Effects of Entrainment Losses of LRS and SNS in Tule Lake

There are five federally owned unscreened diversions from the Tule Lake sumps (R pump, R Canal, Q Canal, D Pumping Plant, N-12 Lateral Canal). These diversions could pose a threat to suckers in Tule Lake Sump 1A because of entrainment. However, this risk is low because there are few young suckers present in the sumps (Hodge and Buettner 2009 pp. 5–6, 9). Adult suckers are less likely to be entrained because of their better-developed avoidance behavior and distribution in the sumps, which is mostly in offshore areas. Thus, the Service concludes the PA likely will result in adverse effects due to entrainment. However, the levels of entrainment that would likely occur as a result of the PA in Tule Lake are likely so small that it is not limiting the persistence of LRS and SNS in Tule Lake.

7.1.3.2.3.6 Effects of Possible Sucker Relocation from Tule Lake Sumps

With the delivery of 22,000 AF of water to Tule Lake annually, the Service does not expect the sumps to go dry and require the need to relocate suckers. However, in the unlikely event that drought conditions with significant reductions in available surface water result in elevations in the Tule Lake sumps receding to levels that may adversely impact suckers in the sumps, relocation may become necessary. If Reclamation and the Service deem it necessary to relocate suckers from Tule Lake, Reclamation and the Service will coordinate on a proposal to relocate suckers from the Tule Lake sumps before seasonally stressful water conditions develop. The Service concludes that the potential relocation of suckers from Tule Lake sumps in drought conditions would have beneficial effect to that population.

7.1.3.2.3.7 Summary of Effects to LRS and SNS Populations in Tule Lake Sump 1A

Based on the above analysis, the Service concludes the PA has minimal adverse effects to suckers in Tule Lake Sump 1A. The primary concern is that the PA may increase risk of pelican predation on adult suckers. However, the proposed delivery of 22,000 AF should maintain some areas with sufficient water depths that reduce predation risk. Water quality is likely impacted by return flows from the Project, but the existing water quality conditions, which are not likely to significantly change, will limit the persistence of the LRS and SNS in Tule Lake. The Project may also result in small amounts of entrainment losses, which is not likely to impact the populations.

7.1.3.2.4 Effects to LRS and SNS in the Lost River

In the Lost River, SNS occur in small numbers, while LRS are present but very rare (Shively et al. 2000). Between June and October 1999, USGS made 141 collections at 36 stations using a variety of gear types and obtained 87 SNS and one LRS (Shively et al. 2000). Most of the adult sucker observations in the Lost River are from the upper Lost River above Bonanza, Oregon. There are very few age 1+ juvenile or adult suckers residing in the lower Lost River below Wilson Dam (USBR 2001b). No adult suckers were captured in the USGS 1999 effort below Wilson Dam.

Proposed operations were evaluated for potential effects to adult sucker spawning and migration, habitat for larvae and age-0 juveniles, habitat of older juveniles and adults, water quality, and the likelihood for entrainment.

7.1.3.2.4.1 Effects to Adult LRS and SNS Spawning and Migration in the Lost River

Much of the fish habitat, including spawning habitat, in both the upper and lower Lost River is fragmented by dams and the irregular flows that affect adult sucker passage between habitats (Shively et al. 2000, USBR 2009, Kirk et al. 2010). Poor water quality also contributes to loss and fragmentation of habitat in the Lost River (USBR 2009). The PA, which will result in seasonally variable flows in the Lost River, may cause adverse impacts by changing the amount of habitat; however, flows during the spring spawning season are expected to be relatively high due to spring run-off at the beginning of the irrigation season. The primary impediment to migration during the spring is likely to be impoundments rather than flows. Additionally, since the Service has determined that the LRS and the SNS in this area are not necessary for recovery (USFWS 2013a), the proposed Project operations in the Lost River would have insignificant effects to the survival and recovery of the species.

7.1.3.2.4.2 Effects to LRS and SNS Larval and Age-0 Juvenile Habitat in the Lost River

Larval and age-0 juvenile suckers are likely present in the Lost River in low numbers because of limited spawning and rearing habitats and lack of upstream passage past dams, as well as adverse water quality in the summer. As a result of water management under the proposed Project operations during summer and fall, sucker habitat is likely increased in the Lost River by an unknown amount. However, during the rest of the year the PA will cause habitats to be fragmented as flows downstream of Clear Lake and Gerber Reservoir are reduced or halted and discharges in the Lost River decline. The reduction of flows in both the upper and lower Lost River caused by the PA is likely to cause stress to affected suckers from crowding, lack of food and cover, increased predation and disease, and increased risk of poor water quality (USBR 2007, 2009).

Based on this analysis, the Service concludes it is likely that the PA will contribute to poor habitat conditions in the Lost River for larval and age-0 suckers. However, since the Service has determined that the LRS and the SNS in the Lost River are not necessary for recovery, the proposed Project operations in the Lost River would have insignificant effects to the survival and recovery of the species.

7.1.3.2.4.3 Effects to Habitat for Older LRS and SNS Juveniles and Adults in the Lost River

Older juvenile and adult suckers, mostly SNSs, reside in impounded areas or deep pools in the Lost River (Shively et al. 2000), except during the spring spawning period when they migrate upstream to the Big Springs area, Miller Creek, or above Malone Dam (USBR 2001a, Sutton and Morris 2005).Adult sucker habitat is fragmented within the Lost River because of dams and historical channelization that reduced connectivity and habitat quality (USBR 2009). As with earlier life stages, seasonal flow diversions under the PA, particularly flow reduction at the end of the irrigation season in the Lost River, will have negative impacts on suckers in the Lost River.

Reduced Lost River flows at the end of the irrigation season could increase crowding of adult suckers into remaining available habitat, at either the impoundments or deep pools following reduced flows at the end of the irrigation season. Inflows from groundwater and local runoff during weather events in the fall and winter periodically likely lessen the impacts of reduced habitat during the fall and winter months by reconnecting isolated areas of habitat (i.e., reservoirs and deep pools). Based on this analysis, the Service concludes it is likely that the PA will influence habitat conditions in the Lost River for older juveniles and adult suckers, contributing to lake elevation fluctuation and impacting water quality beyond conditions that would occur in the absence of the Project. However, Project operations are expected to have insignificant effects since, individual adult suckers because they reside primarily in the reservoirs and deep habitats (Shively et al. 2000) that will be maintained even in low water conditions.

7.1.3.2.4.4 Effects to LRS and SNS from Water Quality in the Lost River

Agricultural runoff and drain water that enter the Lost River are likely to contain nutrients, organics, pesticides, and sediment; these are likely to degrade sucker habitat through deteriorating water quality (USBR 2009, Kirk et al. 2010). The effects of the quality of this water on suckers would most likely be due to low DO concentrations, resulting from the nocturnal respiration or decay of organic matter, as well as ammonia which is a byproduct of decomposition (USFWS 2008). Pesticides are also likely present, at least in low or trace concentrations in agricultural runoff and drain water, and they have been detected in the lower Lost River (Cameron 2008).

Adverse effects to LRS and SNS from Project runoff and drainage are most likely to occur in the middle and lower Lost River because water quality in the river is worse in the downstream areas (USBR 2009, Kirk et al. 2010). Sucker habitats in the lower river are downstream from large areas of agriculture, including much of the Project service area. Because water quality conditions in the Lost River are due to both Project and non-Project effects, it is difficult to determine what effects are due solely to the Project. However, the Service concludes that periods of adverse water quality, regardless of the source in the Lost River, are likely to negatively impact suckers.

7.1.3.2.4.5 Effects of Entrainment Losses in the Lost River

Reclamation documented 130 diversions in the Lost River area; most are small, pumped diversions (USBR 2001b). The Service assumes some of these diversions use Project water and, therefore, are part of the Project. Unscreened Project diversions in the Lost River pose an unquantified threat to suckers, but this risk is likely small because of the low numbers of suckers in the Lost River, especially young suckers that are most vulnerable to entrainment. Additionally, any sucker entrained from these diversions would have been previously entrained into the Lost River or canal system and would have been considered to be harmed and lost from the spawning populations upon initial entrainment. Based on this understanding of the system, the PA will likely contribute to adverse effects to sucker from entrainment in the Lost River, but the effects will be minimal because of the low numbers of suckers present.

7.1.3.2.4.6 Summary of Effects to LRS and SNS Populations in the Lost River

Based on the above analysis, the Service concludes the PA likely has adverse effects to suckers in the Lost River. Primarily, the action is expected to negatively affect the habitat conditions for all life stages of suckers through alterations to the natural variability of flows and by continuing to contribute to poor water quality conditions. Entrainment is also likely to occur but at a low level based on the low sucker densities. Since the Service has determined that the LRS and the SNS in the Lost River are not necessary for recovery, the impacts from proposed Project operations in the Lost River would still be considered within the bounds of what will allow survival and recovery of the species as a whole.

7.1.3.2.5 Summary of Effects of the Proposed Action to LRS and SNS in the Lost River Subbasin Recovery Unit

The Lost River Subbasin recovery unit is essential for the survival and recovery of the LRS and SNS because it contains Clear Lake Reservoir, self-supporting LRS and SNS population; Gerber Reservoir, a self-supporting SNS population; and Tule Lake Sump 1A, an important site for reestablishment of sucker populations in their historic range. This unit provides resiliency and redundancy, two factors that are essential to maintaining and recovering imperiled species.

As described above, the PA is likely to have a variety of effects to the LRS and SNS populations in the Lost River subbasin recovery unit. Adverse effects of the PA on LRS and SNS that could affect survival and recovery in the Lost River Subbasin recovery unit include: (1) entrainment of suckers that likely occurs at Clear Lake Dam, Gerber Dam, and along the Lost River; (2) stranding of suckers at low lake levels in Clear Lake; and (3) agricultural return flows from the Project that likely reduce water quality in Tule Lake.

Some elements of the PA that will likely minimize adverse effects include: (1) minimum elevations in Clear Lake, Gerber Reservoir, and Tule Lake Sump 1A will minimize adverse effects of low lake levels; (2) the Clear Lake Dam fish screen will likely reduce entrainment of juvenile and adult suckers; and (3) the 2 cfs (0.028 m3/sec) flow below Gerber Dam during the non-irrigation season is likely to reduce mortality due to flow reductions at the end of the irrigation season.

Some beneficial effects of the PA are likely to include: (1) water storage in Clear Lake and Gerber Reservoir will provide habitat for LRS and SNS in most years; (2) any increase in flows in the Lost River during the irrigation season will provide additional habitat, and (3) maintaining habitats in Tule Lake National Wildlife Refuge through consistent annual delivery of 22,000 AF of water to support sucker populations.

Based on the best available information analyzed above, the Service concludes adverse effects from the PA to the LRS and SNS in Lost River Basin are likely to occur as a result of poor water quality, entrainment, and stranding. These effects are unlikely to limit the persistence of LRS and SNS in the Lost River Basin because the events that cause these effects are rare, occur at an insignificant level, or are part of operations that have not limited LRS and SNS persistence in the past and are therefore not expected to limit persistence in the future.

7.1.4 Effects of Proposed Project Operation and Maintenance Activities

Reclamation, and its designees (i.e., the irrigation and drainage districts) perform annual, seasonal, and daily operation and maintenance (O&M) activities to operate the Project. For example, gates at Gerber Dam, Clear Lake Dam, Link River Dam and fish ladder, Keno Dam, and fish ladder, Wilson Dam, the Lost River Diversion Channel, and A Canal are exercised by moving them up and down to be certain the gates are properly working before and after the irrigation season. The exercising of irrigation gates will likely cause avoidance by any juvenile and adult suckers in the immediate vicinity of the dam during the operations due to disturbance. However, a small number of suckers could be entrained through the gates and injured during exercises. The component of the PA that includes O&M activities of Project facilities related to dam and diversion gates is anticipated to possibly have low levels of adverse impacts to suckers, largely through displacement; therefore, the Service concludes that this proposed activity is compatible with the conservation needs of the species. This is explained below in detail.

Effects of Clear Lake Dam Maintenance

Reclamation states in their BA that each year before the start of irrigation season in March or early April, gates at Clear Lake Dam are typically opened to flush sediment that accumulates in front of the fish screen and dam (USBR 2024). This activity creates a maximum release of 200 cfs and lasts for approximately 30 minutes. Periodically during the irrigation season, the fish screens at Clear Lake Dam are manually cleaned depending on the likely amount of clogging. During the cleaning, one of the two fish screen sets is always in place to prevent entrainment of juvenile and adult fishes.

Sudden opening of the Clear Lake Dam gate could entrain individual juvenile and adult suckers, but it is anticipated that most suckers will move away from the disturbance created by the open gate before the velocity is great enough to entrain them. The downstream transport of sediment into the Lost River during gate openings is temporary; most of the sediment settles in pools in the upper Lost River between Clear Lake and Malone Reservoir, and thus is only expected to result in temporary and localized reductions in water quality. Manual cleaning of the fish screens at Clear Lake Dam is anticipated to have insignificant impacts to suckers and therefore is not a limiting factor to the persistence of SNS and LRS in Clear Lake.

Effects of A Canal Headworks Maintenance and Canal Salvage

Gates at the A Canal are only operated and exercised with the fish screens in place (USBR 2024). If the A Canal fish screens become inoperable during irrigation season, Reclamation states that it is likely that all flows will need to be temporary halted to replace or repair the screen (USBR 2024). These activities at A Canal are not anticipated to affect suckers.

At the end of the irrigation season, the A Canal gates are closed and the forebay between the trash rack and head gates is slowly dewatered to allow contained fish to escape (Taylor and Wilkens 2013). Annual fish salvage occurs within the dewatered forebay in late October or early November. During the fish salvage, up to 1,500 age-0 and older juvenile suckers are captured through seining and electrofishing (Kyger and Wilkens 2011b, USBR 2018b). Continued monitoring (and fish salvage when fish are observed) in the A Canal forebay during the week following initial salvage indicates very few fish remain in the forebay (Kyger and Wilkens 2011b). Salvaged suckers were typically measured, tagged, and returned to UKL. Since 2016, salvaged suckers have been treated for inflictions by the Service prior to tagging and releasing to UKL.

Adverse impacts to several hundred juvenile suckers due to stress are anticipated every year during this salvage process, as well as from electroshocking, which is known to cause injuries (Snyder 2003). However, observed mortality of salvaged suckers has been low (Korson et al. 2011), and mortality due to stranding would be expected in the absence of salvage.

Stranding of suckers in canals prior to or in absence of fish salvage likely results in additional mortality (Kyger and Wilkens 2011a), and because fish are crowded before and during salvage and thus stressed, additional undetected mortality is likely. Mortality is likely to be highest in years when sucker and other fish production is high; presence of more fish causes crowding stress and makes it difficult to capture all of the suckers. However, it is anticipated that the adverse effects of these operations will be minimized by salvage operations in which suckers will receive treatment prior to relocation to UKL. Additional detail on these effects is also provided above in Section 7.1.3.1.7.

Effects of Lost River Diversion Channel Maintenance

Inspection of the gates and canal banks within the Lost River Diversion Channel occurs once every 6 years (USBR 2024). Inspections require a drawdown of water within the channel and can occur at any time of the year. According to the BA, a drawdown of the channel is coordinated with Reclamation fish biologists to ensure adequate water remains in pools during short periods of low water levels, and pools are monitored to prevent stress to stranded fish until flows return. When practical, to reduce impacts to suckers, Reclamation will draw down the Lost River Diversion Channel during late fall through early winter when fewer suckers are likely present. During the drawdown of the channel, some adverse impacts to LRS and SNS are likely, including an increase in predation by gulls as suckers are concentrated in shallower water with increased stress; if prolonged, these conditions could affect survival. However, adverse effects will likely be temporary (USBR 2018a). Although temporary, the losses of habitat as a result of this draw-down of the Lost River Diversion Channel will likely result in adverse impacts to LRS and SNS in the channel and therefore are contrary to the conservation needs of the species. Suckers can only enter the Lost River Diversion Channel through entrainment into the headworks of the channel. The effects of entrainment on LRS and SNS were analyzed above under the analysis of entrainment in the UKL recovery unit (Section 7.1.3.1.7).

Effects of Keno and Link River Dam Fish Ladder Maintenance

As described in the PA, gates to the fish ladder are exercised twice each year: once between January and April, and again between October and December. While the gates are exercised, the fish ladder is often dewatered, and the entire structure is inspected. Fish are salvaged from the ladder while dewatered and returned to either the Link River, UKL, or Lake Ewauna. These activities have a short-term, temporary impact to suckers in and adjacent to the ladder that are expected to be insignificant. No more than five suckers of any life history stage have been encountered in the fish ladder during previous fish ladder inspections.

Effects of Maintenance to Other Project Canals, Laterals, and Drains

Nearly all Project canals, laterals, and drains are dewatered at the end of irrigation season, as late as November for canals in California (USBR 2024). Canals remain dewatered until the following spring (as early as late March) except for the input of localized precipitation-generated runoff. Reclamation has proposed a conservation measure for salvaging suckers at specific locations, as described in Section 4.5.1 of the BA (USBR 2024 pp. 82-83), in an effort to minimize effects associated with dewatering canals. Past efforts have shown that salvage is practicable in some locations, but numbers of salvaged suckers are highly variable among years and sites (Taylor and Wilkens 2013). Some canal maintenance occurs during the irrigation season, such as removal of vegetation from trash racks at water control structures, but these temporary activities are only anticipated to cause short-term avoidance responses by suckers (USBR 2018a).

Most canal, lateral, and drain maintenance occurs while canals are dewatered, and includes removal of sediment, vegetation, concrete repair, and culvert/pipe replacement (USBR 2018a). Gates, valves, and equipment associated with canals and facilities are exercised before and after the irrigation season (before April and after October). In the past, these activities have typically occurred after dewatering the canals and fish salvage of Project canals. Some activities, such as culvert and pipe replacement, may temporarily increase sediment transportation. Based on the presence of suckers in some Project canals (Kyger and Wilkens 2011b, USBR 2018b), adverse impacts to suckers are anticipated as a result of seasonal canal dewatering and routine maintenance on canal infrastructure. Most impacts, such as increased sedimentation, are temporary and result in stress for fish. Other impacts include mortality through long-term stranding, such as when canals are dewatered, and pools become disconnected. Fish salvage of the remaining pools following dewatering has prevented mortality losses of approximately 100 to 1,000 juvenile suckers yearly since 2008 (Kyger and Wilkens 2011b, Taylor and Wilkens 2013, USBR 2018b).

Fish salvage likely removes a fraction of the LRS and SNS that remain in canals that are dewatered at the end of the irrigation season, especially when the canals are drained late in the season and become covered by ice. Additionally, large numbers of gulls forage in the canals once water levels are low, and small suckers are likely among the prey caught by the birds. Therefore, there is likely to be substantial mortality of suckers associated with dewatering the canals. It is also anticipated that the adverse effects of these operations will be minimized by salvage operations where suckers are moved to waters where they are likely to survive, and treatment of fish at the Service rearing facility will increase the likelihood of survival of salvaged suckers. These effects are included in the discussion of entrainment in the UKL recovery unit above (Section 7.1.3.1.7).

Effects of Right-of-way and Access Maintenance

Gravel is periodically added to roadbeds or boat ramps (e.g., at Clear Lake), and roadbeds are periodically graded (USBR 2018a). Right-of-way and access maintenance may temporarily cause sedimentation into adjacent waterways, principally canals. When these activities occur, seasonal consideration and soil retention cloth are used to mitigate sedimentation of waterways. The effects of sedimentation and noise from these activities are likely to have an insignificant, temporary effect on individual suckers occupying adjacent waters.

Effects of Water Measurement Gage Maintenance

Water-measurement gages require annual maintenance to flush sediments from stilling wells, replace faulty gages, or modify/replace supporting structures (USBR 2018a). Flushing the stilling wells occurs during the irrigation season (April through October) and temporarily increases sedimentation downstream from the gage. The amount of sedimentation is often small, and the sediment settles a short distance downstream, therefore, its effect is likely small. In some instances, when a large amount of sediment is present, the sediment is removed from the stilling well and deposited at a nearby upland site. Other activities, such as replacement or repositioning of a measurement device and associated infrastructure, could be conducted during low-flow periods or require construction of a small coffer dam.

Gages need to be replaced or repaired once every 5 to 10 years. If construction of a coffer dam is required, then fish will be salvaged from behind the dam prior to replacement of infrastructure. Replacing or repositioning a site will have short-term adverse impacts to suckers. Suckers will likely avoid the disturbance during activity but may need to be captured and moved to a location away from the impacted area. Replacement of equipment and flushing of stilling wells will have temporary impact to suckers present in the immediate area of the gage. Most of these impacts are anticipated to cause nonlethal stress, which occurs briefly during site activity (USBR 2018a). The Service concludes effects of disturbance and temporary sedimentation from these activities are likely to have an insignificant effect on individual suckers occupying adjacent waters.

Summary of Effects of Proposed O&M Activities to LRS and SNS

O&M activities described above, including maintenance of infrastructure associated with dams, canals, rights-of-way, and water measurement gages, are likely to have a range of effects such as stranding, physical disturbances, and decreases in water quality that are most likely to be limited in magnitude and duration. The major effect of the O&M will be the result of lowering water levels in the Lost River Diversion Channel, which because of its size could potentially contain hundreds of suckers. It is anticipated that the adverse effects of these operations will be minimized by salvage operations where suckers are moved to waters where they are likely to survive, and treatment of fish at the Service rearing facility will increase the likelihood of survival of salvaged suckers. The adverse effects associated with dewatering of the Lost River Diversion Channel and other Project canals are considered in the effects of entrainment above.

7.1.5 Effects of the Proposed Conservation Measures

As part of the PA, Reclamation proposes to implement three conservation measures for the LRS and the SNS: (1) canal salvage; (2) assisted rearing; and (3) participation in sucker monitoring and the LRS and SNS Recovery Program. The effects of these measures on the LRS and the SNS are analyzed below.

7.1.5.1 Effects from Canal Salvage

Reclamation proposes to continue to salvage suckers in Project canals, consistent with the salvage efforts that have been occurring in Project canals since 2005 (USBR 2018b). Reclamation's fish salvage efforts will focus on the A Canal forebay, C4, D1, and D3 Canals within the KID, and the J Canal within the TID. Other salvage locations recommended by the Service will be considered by Reclamation as requested.

The effects of canal salvage will minimize entrainment effects on suckers by relocating them to permanent waterbodies. The numbers of suckers salvaged annually is highly variable. For example, in 2006, 1,200 suckers were salvaged, whereas in 2009, fewer than 100 were salvaged (Kyger and Wilkens 2011b, Taylor and Wilkens 2013). In recent years, from 2018 through 2023, the number of suckers salvaged from Klamath Project canals was approximately 2,321 fish but declined significantly in 2021 due to low deliveries due to drought (USBR 2021 Appendix C). The ultimate fate of most salvaged suckers is unknown, but several lines of evidence suggest some survive and recruit into the adult population. Small numbers of salvaged and PIT- tagged suckers have been subsequently detected, mostly in the Williamson River. Additionally, beginning in November 2011, suckers salvaged in the Tule Lake area were put into an experimental pond on Lower Klamath National Wildlife Refuge. Sampling in that pond showed that many of these suckers live and show good growth and body condition.

Based on this, canal salvage will minimize entrainment losses, especially when it is done prior to ice cover and when suckers are put in appropriate habitats. Additionally, since 2016 salvaged suckers have been taken to the sucker rearing facility where they receive treatment for any disease and parasites prior to release into a permanent waterbody, increasing the likelihood of survival post-release. Although salvage is not without risks, especially because much of it is done by electroshocking, which can injure fish (Snyder 2003), those fish would not be expected to survive over winter in the dewatered canals without salvage.

The Service concludes that proposed canal salvage will minimize the loss of young suckers that are entrained. Returning suckers to safe habitats will improve their survival and is compatible with the conservation needs of the species.

7.1.5.2 Effects from Assisted Rearing

Reclamation is providing funding to the Service to support assisted rearing of the LRS and the SNS with the purpose of increasing the number of suckers reaching maturity in UKL. As discussed above in this Opinion, there has not been significant recruitment into the UKL adult population of the LRS and the SNS since the late 1990s. The current adult breeding population of suckers is aging and is nearing the end of their expected life span. The low detections and presumed mortality of juvenile suckers from UKL beginning in August and extending into fall accounts for the lack of juvenile sucker recruitment. An assisted rearing effort is needed to prevent extinction and stabilize the two species until the causes of juvenile mortality are addressed (Burdick et al. 2018, Hewitt et al. 2018).

Specifically, Reclamation proposes to continue providing financial support to the Service that would be used for capital and operating costs associated with an assisted rearing program. This will support the Service's recovery goal of rearing and re-patriating approximately 60,000 captively reared LRS and SNS annually and will support the development of a hatchery propagation program using captive broodstock for spawning. Oversight of the assisted rearing program will continue to be provided by the Service with input from the Klamath Sucker Recovery Program and the Klamath Tribes, in coordination with Reclamation.

Reclamation's support of the assisted rearing program will continue for the term of this consultation (November 15, 2024, to October 31, 2029). Assisted rearing was listed as a necessary action in the original LRS and SNS recovery plan developed by the Service and was also identified as a need in the 2013 Revised Recovery Plan (USFWS 1993, 2013a). The Revised Recovery Plan recommends the development of an assisted rearing program when sucker populations in UKL reach a level of 25 percent of their estimated abundance in 2001-2002. This trigger has been met based on population data collected by USGS (Hewitt et al. 2018). Assisted rearing is an important part of listed fish recovery efforts nationwide, including several sucker species (e.g., the June sucker [*Chasmistes liorus*], razorback sucker [*Xyrauchen texanus*], and the robust redhorse sucker [*Moxostoma robustum*]).

The premise is that assisted rearing will enable fish to survive past the most vulnerable early life stages with minimal risk of loss of genetic diversity. Assisted rearing is not based on hatchery production from fertilized eggs obtained from broodstock, but instead makes use of wild-collected young suckers that are raised in ponds, *in situ* in pens, or other enclosures. Rearing young suckers *in situ* or in ponds enables them to feed on natural prey and thus minimizes the risks of malnutrition and domestication resulting from dependence on artificial food.

Additionally, a broodstock program was established in 2017 and currently consists of approximately 329 LRS and 769 SNS from capture years 2017, 2018, 2019, 2020, and 2021. The broodstock program was initiated to continue rearing operations should wild-collected young become unavailable due to extirpation of the species. In conjunction with the brood-stock program, experimental gamete collection, fertilization, and rearing of fertilized eggs has been ongoing since 2020 to develop methodology of traditional hatchery production should the need arise. There are no planned releases of fish reared through brood-stock gamete collection until the need arises and a genetic management plan is developed that addresses pedigrees for future breeding.

In 2015, the Service established the Klamath Basin Sucker Rearing Program as part of the 2013 Opinion and has raised wild-caught larvae in cooperation with a private aquaculture venture, Gone Fishing LLC, since 2016. Larval collections have been successful, and survival at the rearing facility has been high. Initially, the program relied exclusively on natural production in the rearing ponds to provide food for the captive suckers; however, it became clear in 2017 that growth rates were lower than anticipated and supplemental feed would be required to meet the target release size of 8 inches. The first two cohorts of approximately 2,500 2-year-old reared suckers each were released in spring 2018 and 2019. Since then, the Service has expanded this effort and since 2018 approximately 74,018 suckers were released into UKL. Prior to release, all the fish were implanted with Passive Integrated Transponder (PIT) tags that allow for remote detection of any reared fish that join the major spawning populations in UKL, which are both outfitted with PIT detection arrays. While data is currently being reviewed, preliminary information indicates detections of hatchery released suckers arriving on the spawning PIT tag arrays in small numbers from release years 2018 and 2019, multiple years in a row (M. Yost, pers. comms., October 24, 2024).

To allow for monitoring of survival and movement during their first summer after release, a subset of roughly 200 individuals were implanted with radio transmitters prior to release in 2018 and 2019. Additional pre-release tagging events took place in spring and fall of 2022 and spring of 2023. A total of 404 radio-tagged individuals were released in 2022, 138 in the spring and 266 in the fall. The spring 2023 release included 264 radio-tagged individuals. Initial data indicate that the radio-tagged fish had high mortality, but rigorous analyses are not currently available. As noted above, fish did not initially receive supplemental feed and were undersized at an average of 6 inches at release in 2018, and the radio tags were larger relative to their body size than is recommended to avoid tag-related mortality. The 2017 cohort that was released in 2019 averaged around 8 in. after 2 years, which is expected to reduce tag effects on survival and increase overall survival. The 2020 cohort that was released in spring of 2022 averaged approximately 7.7 inches (in.). Radio-tagged fish released in fall of 2022 consisted of capture year 2019 and 2021 which averaged 12 in. and 7.8 in., respectively. Average total length of radio-tagged fish released in spring of 2023 was 8.4 in. These demographics are compliant with the standard operating procedures for surgical tag implantation of radio transmitters in LRS and SNS (USFWS unpublished field operating procedures). A demonstration of larger size leading to increased survival can be observed in captive-reared June suckers in Utah Lake and the minimum size at which some recruitment was observed was around 8 in. (Rasmussen et al. 2009, Billman et al. 2011).

Assisted rearing projects for other sucker species (e.g., the June sucker, razorback sucker, and the robust redhorse sucker) have produced large numbers of suckers to supplement wild populations, and reared suckers have successfully recruited into the adult spawning populations (Marsh et al. 2005, Modde et al. 2005, Grabowski and Jennings 2009, Rasmussen et al. 2009, Billman et al. 2011). However, recruitment rates of repatriated suckers vary among rearing and acclimation strategies and depends on release size (Marsh et al. 2005, Rasmussen et al. 2009, Billman et al. 2011).

Based on the observed variability among rearing programs, the Klamath Basin Sucker Rearing Program is exploring a number of alternative rearing methods to determine which maximizes post- release survival and ultimately recruitment. For example, some of the 2017 cohort was held in captivity for 3 years before reintroduction, the program experimented with *in situ* rearing in net- pens in UKL from 2019-2023, off-channel rearing is taking place to extend grow out and alternative release timing and sites are being evaluated. High mortality occurred during the first several years of net-pen aquaculture, but improvements to the structures were made to further restrict bird predation. Further methodologies for net-pen aquaculture were applied in 2021 including varying sizes and net pen density, and an alternative location at the mouth of 4-Mile Canal in Agency Lake was evaluated in 2022 and the net pen was subsequently moved there for the 2023 season as well. Additional net pens deployed in Gerber Reservoir in 2021 were expected to have greater survival than UKL net pens due to more amenable water quality; however, those pens were harvested prematurely due to low water levels in the reservoir and the suckers held there were repatriated to UKL. The net pen in Gerber Reservoir was deployed 2023, and information on survival and growth will be available in the future.

The Klamath Falls National Fish Hatchery was established in 2021 to allow for further development of the sucker assisted rearing program. Funds have been appropriated for construction of the KFNFH and construction is ongoing, with completion slated for 2027. Planned design elements of the facility include construction of a larger cooling pond for the geothermal water source, construction of traditional rearing ponds with harvesting kettles amounting to approximately seven surface acres of total rearing space, construction of indoor and temperature controlled rearing tanks, research facilities, wastewater settling ponds, upgrades to electrical and source-well infrastructure, and enhanced sucker rearing for suckers salvaged from the A Canal forebay and Klamath Project Canals. It is anticipated that comparisons among 2-year-old releases, 3-year-old releases, *in situ* reared fish, and further research capabilities will clarify the methods that will maximize survival, and the program will be adjusted to focus on those methods.

At this time, it is difficult to fully assess the effects of assisted rearing on suckers because survival after reintroduction is poorly understood. However, based on the high captive survival and growth rates after adjustments to husbandry practices and based on the success with other sucker species, captive larval and juvenile survival rates clearly far exceed wild survival rates in UKL, which means that there is a beneficial effect on the individuals collected. Based on the results from other sucker propagation efforts discussed above, it is reasonable to assume that the increases in release size will result in survival to recruitment for some individuals released during the term of this Opinion. Preliminary data from USGS, presented during FASTA meetings in 2024, suggest that hundreds of the captively reared suckers released from KFNFH in the last 6 years have been persistently redetected on PIT arrays in UKL, suggesting at least some recruitment at higher levels than background (M. Yost, USFWS, Personal Communication October 24, 2024, Krause et al. 2024).

Based on ongoing rearing efforts and planned expansion of the facility, the Service expects the funding provided by Reclamation as part of the conservation measures will be part of a larger program that supports an average release of around 60,000 individuals per year by 2029. Assuming a post- release survival to recruitment of 10 percent for individuals between 200 and 300 mm (Billman et al. 2011), this would result in recruitment of around 3,000 individuals released over a course of 5 years once the facility is operating at full capacity. Given that the Environmental Baseline includes complete lack of LRS and SNS recruitment in UKL for the past two decades, these individuals are expected to substantially reduce the probability of extirpation of both species compared to the status quo (Rasmussen and Childress 2018).

7.1.5.3 Effects of Sucker Monitoring and Recovery Participation

The Revised Recovery Plan for the LRS and the SNS (USFWS 2013a) called for the establishment of a Recovery Implementation Team to coordinate implementation of the recovery plan. In 2013, Reclamation began work with the Service toward achieving the goals and objectives of the revised recovery plan, which included dedication of resources for that purpose (USFWS 2013b).

Reclamation proposes to continue adult sucker monitoring efforts in UKL, Clear Lake Reservoir, and Gerber Reservoir; juvenile sucker monitoring in UKL and Clear Lake Reservoir; and fund sucker research, restoration, and recovery actions in the Upper Klamath Basin. Reclamation's involvement and support of the Recovery Program has greatly contributed to sucker recovery efforts by providing new information regarding threats to the species. The new information has been incorporated into recovery action planning and made recovery implementation timelier and more effective than it would have been without the information. Based on shifts in personnel, the initial Recovery Implementation Team has not met recently, but the Service has hired additional staff who are restructuring the sucker recovery effort to improve its focus on key priorities. Reclamation is participating and contributing funding to this effort that will advance the needs of sucker recovery. Reclamation anticipates annual funds of a $700,000 in 2025 and 2026 from monitoring, research, and recovery projects; additional funding will be provided in later years as funds are available.

Reclamation's proposed commitments to recovery program actions such as monitoring are anticipated to contribute to improving sucker the amount and quality of sucker habitats, sucker passage, and sucker survival in the Upper Basin to offset Project impacts. The overall effect of these actions is difficult to measure but is viewed as an essential component leading towards the survival and recovery of suckers.

7.1.5.4 Summary of Effects to LRS and SNS from Proposed Conservation Measures

The proposed conservation measures are anticipated to have beneficial effects that will minimize overall effects of the PA to suckers and aid in their conservation. Proposed canal salvage is anticipated to benefit up to 1,500 age-0 juveniles by relocating them to permanent habitat. The Service anticipates the proposed support of assisted rearing over the duration of this Opinion will result in increased larval and juvenile survival for collected individuals and result in thousands of individuals recruiting into the adult population in UKL. Additional benefits will also be realized from the recovery and monitoring commitments and involvement from Reclamation, although the extent of those benefits is difficult to fully anticipate. All of these measures also serve to help offset the negative effects from other aspects of the PA.

7.1.6 Effects of the Proposed Action on Lost River and Shortnose Sucker Critical Habitat

This section analyzes the effects of proposed Project operations on the three LRS and SNS critical habitat PBFs: (1) water; (2) spawning and rearing habitat; and (3) food, at the Critical Habitat Unit scale.

7.1.6.1 Effects to LRS and SNS Critical Habitat Unit 1

Critical habitat was designated for the LRS and the SNS in Unit 1 at UKL and along its primary tributaries, including the lower Williamson, the lower Sprague, and lower Wood Rivers (USFWS 2012). This unit also includes critical habitat designated downstream of Link River Dam at the outlet of UKL to Keno Dam (USFWS 2012).

Effects to LRS and SNS Critical Habitat in UKL and its Tributaries

Effects to PBF 1: Water
Both water quality and water quantity are important to the water PBF. As described above in Section 7.1.3.1.6, the PA is not anticipated to measurably influence water quality in UKL because water quality conditions in UKL are primarily influenced by climate, external and internal nutrient loading, and algae bloom and crashes cycles. Recent research (Kann and Walker 2020, entire) indicates that water level fluctuations may negatively influence certain aspects of water quality (i.e., dissolved oxygen, pH, un-ionized ammonia, and chlorophyll-a) individually and in combinations. However, physical drivers such as wind and temperature can interact to stochastically alter these aspects making it difficult to directly predict effects from water levels (see Table 1 in Kann and Walker 2020 p. 1865). A number of possible mechanisms relating lake depth to water quality have been proposed, including hypotheses that suggest that either high or low elevations could increase the probability of poor water quality. Most empirical analyses of water quality data from UKL indicate no clear and statistically significant connection between UKL levels and water quality over the range at which the lake is usually managed (4,138.00 to 4,143.30 ft.; Wood et al. 1996, Morace 2007). The storage and delivery of water in UKL under the PA could potentially affect nutrient cycling in UKL, but additional study is required before the operation parameters of the PA are changed. Further, there is not an established causal link between water quality parameters and sucker mortality at any life stage and managing for water quality improvement may not avoid a fish kill (Burdick et al. 2020 pp. 260-263, Kann and Walker 2020 pp. 1868-1869, Krause et al. 2022 p. 1429).Therefore, based on best available information for LRS and SNS, as discussed in Section 7.1.1.3.6, the Service finds there may be a potential link between Project operations and water quality in UKL, but more research is needed to propose management guidelines.

The PA will have no effect on water quality in the tributaries to UKL within LRS and SNS critical habitat because these areas are upstream of the Project, except near the confluence of the tributaries with UKL which is subject to the influence of lake management. Therefore, water management by the Project will only affect the lower-most reaches of the Williamson and Wood Rivers that are influenced by UKL elevations, and these effects are expected to be insignificant.

In contrast to water quality, water quantity is directly affected by the PA, with UKL elevations expected to be generally higher in the winter and spring and lower in the late summer and fall than historical conditions prior to the construction of Link River Dam. The effects of water depth manipulation under the PA on LRS and SNS habitat are described in Sections 7.1.3.1.1 – 7.1.3.1.5. Effects to spawning and rearing habitat due to water depth are discussed in the following section. Overall, the PA is expected to provide adequate water depths to provide preferred habitat and access to water quality refugia in almost all years. However, in water years similar to the driest years in the POR, shallow water is expected to reduce the amount of habitat available in the preferred depth range (e.g., LRS lakeshore spawners) of sucker adults. Such conditions are anticipated to occur during dry years of the PA but are not expected to result in long-term changes to the habitat. Based on antecedent conditions and the 2020 to 2022 drought, it is reasonable to expect there may be some negative effects on suckers due to limited water quantity. However, the proposed Project operations for the period of this consultation should provide sufficient water quantity to satisfy the needs of suckers for PBF 1. Therefore, the effects to PBF 1 water quantity and water quality are expected to be insignificant.

Effects to PBF 2: Spawning and Rearing Habitat

The PA will have no effect on sucker critical habitat in the tributaries to UKL with respect to its capability to adequately support sucker migration to spawning habitats that are essential to the recovery of these species. All known tributary spawning sites are in upstream reaches of these rivers affected by UKL elevations (i.e., PBF 1, water quantity). In all but the driest of years, implementation of Project operations over the term of this Opinion is likely to create higher than natural surface water elevations in UKL in the spring as a result of water storage. These water levels are likely to support necessary amounts of sucker spawning, rearing, and foraging habitat that will facilitate the annual production of millions of sucker eggs, embryos, larvae, and age-0 juveniles. This aspect of proposed Project operations is likely to provide beneficial effects to the recovery-support function of critical habitat for the LRS and the SNS in UKL. However, in drier years, the PA could have negative effects on spawning habitat at groundwater seeps along the eastern shoreline of UKL because habitat availability is reduced at lake elevations outside of the 4,41.4 ft.to 4,142 ft. range (Burdick et al. 2015b p. 488).

Modeling of the PA shows that there could be years when water levels are so low that it could negatively affect the ability of spawning habitats to support the recovery function of critical habitat for the LRS and the SNS in UKL. As was discussed in section 7.1.3.1.1, LRS shoreline spring spawning and larval rearing habitat is likely to be greatly reduced at lake elevations below the range of 4,141.4 ft. to 4,142.0 ft. (Burdick et al 2015 p. 488). UKL elevation was above 4141.4 ft. by March 1 in 65 percent of years and by March 15 in 73 percent of years. UKL elevation increased above 4,142.0 ft. by April 15 in 67 percent of years. UKL elevation remained above 4,142.0 ft. at the end of April in 67 percent of years and at the end of May in 61 percent of years, including one year that had an elevation of 4,141.96 ft. at the end of May. These elevations should provide adequate spawning habitat across the shoreline spawning period in approximately two-thirds of years and will have no impact on spawning in tributaries, where the majority of LRS and all SNS in UKL spawn. The probability of reduced spawning habitat at shoreline springs due to low lake levels suggests impacts to spawning habitat may occur and would result in adverse effects to LRS and SNS PBF 2.

The critical habitat designation specifically refers to “areas containing emergent vegetation adjacent to open water” (USFWS 2012) to provide rearing habitat for larval LRS and SNS. As larvae transition to juveniles, which occurs by late July, they utilize a variety of habitats but appear to choose shallow water (Buettner and Scoppettone 1990, Burdick et al. 2008). Therefore, availability of emergent vegetation is most important up to around July 15. Based on model output and prior to the wetland restoration and reconnection of Agency-Barnes, the PA provides at least 70 percent (surface elevations of 4,140.80 ft.) of possible wetland edge habitat in 81 percent of years. When lake levels drop below 4,139.60 ft., approximately 80 percent of emergent wetland habitat becomes dewatered, which occurred in 2021. The 3,584 acres of reconnected wetlands of Agency-Barnes will support areas of inundation between 0.5 ft. and 2.5 feet of water depth up to the minimum modeled lake elevation of 4,137.10 ft. The restoration of over 13,887 acres of open and shallow water habitats along the lake fringe of UKL will greatly increase the rearing habitat available to juvenile LRS and SNS in UKL. Of this, 1,282 acres of wocus and emergent wetland is expected to be available as nursery habitat between the elevation of 4,139.0 ft. and 4,140.0 ft. Between the elevations of 4,140.0 ft. and 4,141.0 ft. another 674 acres of emergent wetland is expected to develop as part of the restoration (Dunsmoor 2022 p. 6). The reconnection will be excavated to a depth of 4,134.5 ft. to ensure positive drainage from the site to UKL along the historic tidal slough. Therefore, as the lake elevation in UKL decreases so will the amount of wetland habitat in the lowest water years (as seen in 2021), the PA is expected to have an adverse impact on the availability of shoreline spawning and larval rearing habitats.

Effects to PBF 3—Food

UKL is a highly productive lake and has high densities of invertebrates on which LRS and SNS feed (Stauffer-Olsen et al. 2017), and the PA is not expected to alter food availability.

Growth data from juvenile suckers in UKL suggest that food availability is not a limiting factor (Burdick et al. 2015a). Thus, the PA does not affect the recovery-support function of critical habitat to provide food for the LRS and the SNS in UKL. The PA does not affect food availability in the tributaries to UKL. Therefore, the Service does not expect effects to PBF 3 in UKL as a result of implementation of the PA.

Effects to LRS and SNS Critical Habitat at Keno Reservoir

Effects to PBF 1—Water

In general, the quality of water entering, within, and leaving the Keno Reservoir is largely due to water entering from UKL containing large amounts of organic matter with an associated high oxygen demand (Doyle and Lynch 2003, Deas and Vaughn 2006, Kirk et al. 2010). Drain water coming from the Project contains high concentrations of nutrients and degrades water quality in the vicinity of the Straits Drain at the south end of the reservoir (Kirk et al. 2010). Additionally, winter storm-driven run-off containing nutrients and sediments from the Lost River empties into the Lost River Diversion Channel and that is likely to contribute to stressful water quality conditions in the Keno Reservoir. There are multiple factors affecting water quality in the Keno Reservoir and it is difficult to quantify how much of the degradation to water quality is caused by past Project operations compared to the proposed Project operations. However, diversion appears to result in a net reduction in nutrient loading to Keno Reservoir by rerouting nutrient rich water from UKL (Kirk et al. 2010). To the degree that the Project contributes to poor water quality in Keno Reservoir, the effects likely diminish the overall condition of habitats in the Reservoir. Thus, the PA is likely to have unquantifiable negative effects to PBF 1 water quality in Keno Reservoir.

Water-surface elevations and depths likely to occur under the PA at Keno Reservoir are expected to be compatible with the life-history requirements of the suckers. The relatively constant surface elevations mean that existing habitat is always available, including large areas of emergent vegetation. Therefore, insignificant effects to PBF 1 water quantity are anticipated as a result of implementation of the PA.

Effects to PBF 2—Spawning and Rearing Habitat

An anecdotal report from May of 2007 indicates 10 suckers exhibited spawning behaviors in the lower Link River (Smith and Tinniswood 2007). It is not clear whether this is a regular occurrence due to the low numbers and single observation, but this area is not believed to support successful spawning (Simon et al. 2014). There is no other known spawning habitat between the Link River and Keno Dam. Based on these considerations the proposed operation of the Link River Dam for downstream water needs is not anticipated to affect spawning habitat (PBF 2) downstream of Link River Dam.

The PA is not changing water level management at Keno Reservoir, meaning that baseline conditions associated with wetland habitat (important for rearing) will not be changed. Stable water levels can reduce wetland establishment and regeneration because flooding redistributes seeds, and many wetland plants require a period of drying to germinate (Middleton 1999). Thus, management for stable surface elevations in the Keno Reservoir is likely to continue to retard development of additional wetland habitats and could degrade the quality of existing wetlands. Although this is a negative effect to PBF 2, there is abundant marsh vegetation available relative to the number of larval and juvenile suckers present in Keno Reservoir, and stable surface elevations do inundate the established wetland habitats for rearing during sucker early life history stages. While the PA is likely to preclude the development of additional wetlands habitats and will not improve the condition of existing wetland habitats, the rearing habitat that is present provides the recovery-support function of rearing habitat for young suckers. Therefore, implementation of the PA will have an insignificant effect to rearing habitat PBF 2 in Keno Reservoir.

Effects to PBF 3—Food

While there are no known studies on invertebrates in the Keno Reservoir, the Service assumes invertebrate diversity and abundance at Keno Reservoir are high and are similar to those in UKL. Additionally, flows from UKL likely bring prey species such as amphipods, cladocerans, copepods, and midges into the reservoir and the large amounts of organics that enter the reservoir from UKL could provide a substantial food base for invertebrates. For those reasons, the PA is not expected to affect the recovery-support function of critical habitat to provide food for the LRS and the SNS in the Keno Reservoir.

Summary of Effects to LRS and SNS Critical Habitat Unit 1

Overall, implementation of the PA in Critical Habitat Unit 1 is expected to result in insignificant effects to PBF 1, adverse effects to PBF 2, and no effect to PBF 3. There is a potential link to negative effects to water quality (PBF 1) from project operations in UKL, but more research is needed. There is evidence that water diversions through the Project cause a net reduction in nutrients downstream of UKL, which is beneficial. In Keno Reservoir, there are return flows into the reservoir from agricultural diversions that are part of the PA, resulting in some negative effects to water quality. However, given the large inputs of nutrients and organic matter from UKL, it is unlikely that these effects would result in a measurable difference in the parameters most important to suckers, such as dissolved oxygen, and are therefore considered insignificant.

Spawning and rearing habitat (PBF 2) in UKL are expected to be adequate in almost all years under the PA. However, years with the lowest lake elevations in the model POR resulted in significant reductions in available spawning habitat at the lakeshore springs and in emergent wetland habitat available for larval rearing. The proposed Project does not affect food availability (PBF 3) in Unit 1.

7.1.6.2 Effects to LRS and SNS Critical Habitat Unit 2

Critical habitat designated for the LRS and the SNS in Unit 2 includes Clear Lake and its main tributary, Willow Creek; critical habitat designated only for the SNS includes Gerber Reservoir and its main tributaries. Additionally, there are differences in the amount of upstream critical habitat in Willow Creek for the two species. For the LRS, critical habitat includes Willow Creek and its tributary, Boles Creek, upstream to Avanzino Reservoir in California. For the SNS, critical habitat extends up Willow Creek to Boles Creek and upstream past Fletcher Creek, and includes Willow, Fourmile, and Wildhorse Creeks in California, and Willow Creek to its East Fork in Oregon (USFWS 2012).

Effects to LRS and SNS Critical Habitat at Clear Lake

Effects to PBF 1—Water

At Clear Lake, the PA is not likely to result in water quality conditions that are outside the suitable ranges for suckers (discussed in Section 7.1.3.2.1.4 in more detail). Overall, water quality monitoring over a wide range of lake levels and years documented water quality conditions that were adequate for sucker survival during most years (USBR. 1994, USBR 2001a, 2007). As historic operations are not changing, the Service finds that proposed Project operations at Clear Lake are not expected to negatively affect water quality PBF 1 and will continue to provide the recovery-support function of critical habitat. Therefore, implementation of the PA will have an insignificant effect to water quality conditions in Clear Lake.

The PA does affect water quantity through the management of Clear Lake for irrigation deliveries. In general, water levels in Clear Lake are likely higher than before the construction of the dam in 1910. However, due to high evaporative losses from the shallow lake and highly variable hydrology, there is substantial interannual variation in lake elevations. As discussed in Section 7.1.3.2.1.1, low lake elevations can make the habitat less suitable by reducing connectivity between Clear Lake and the spawning habitat in Willow Creek via the east lobe. Low lake elevations have been somewhat more common in recent decades than in the POR, which dates back to 1911. Due to the bathymetry, when lake elevations in the west lobe are below 4,524 ft., access to spawning habitat in Willow Creek is reduced. This occurs in 52 percent of years at the end of January and 36 percent of years at the end of February between 1999 and 2023, which is much higher than the rest of the POR (22 percent and 17 percent respectively). It is unknown if low lake elevations during these time periods preclude access to Willow Creek in years with sufficient stream flow to support spawning. In summary, the PA is likely to adversely affect water quantity PBF 1 in Clear Lake, particularly when the east lobe becomes unsuitable below 4,523 ft.

Effects to PBF 2—Spawning and Rearing Habitat

Although access to spawning areas in Willow Creek and its tributaries can be reduced at low lake elevations (PBF 1), the PA has no effect on the actual spawning habitat, which is outside the action area.

The PA is likely to provide adequate rearing habitat for all sucker life stages in Clear Lake except during multi-year droughts when both water depth and surface area contracts, affecting components of PBF 2. The amount of rearing habitat in Clear Lake is highly variable because inflows to Clear Lake are characterized by multiple low-inflow years punctuated by less frequent high inflow years, and evaporation and leakage are high because of the shallow depths and large surface area of the lake. At the lowest lake elevations, habitat in the east lobe is not accessible and the overall area of habitat is reduced. The minimum proposed Clear Lake elevations will likely provide adequate protection from drought in most years, but extended drought will result in a significant reduction in lake area and depth. Thus, the PA is likely adversely affecting rearing habitat during droughts that are likely to occur once during the term of this Opinion.

The minimum lake elevation being proposed for Clear Lake (i.e., 4,520.6 ft.) has been used to guide operations for decades. Recent monitoring data shows evidence of frequent recruitment, which suggest that available spawning and rearing habitat is sufficient to meet the needs of the species when that habitat is accessible (Hewitt, 2021 pp. 11-18, Hewitt and Hayes 2013), suggesting that the operations have supported the recovery function of the rearing habitat. Therefore, it appears although droughts and resulting low lake levels are likely to have adverse effects at the time they occur, these are not likely to be persistent effects that impact the overall recovery function of PBF 2.

Effects to PBF 3—Food

No specific data concerning the availability of food in Clear Lake exists. The reservoir contains a very large amount of lake habitat and is productive enough to maintain dense populations of zooplankton. There will be no significant change from historic operations; therefore, food availability is not expected to be altered by the PA. For those reasons, the PA is not expected to affect the recovery-support function of critical habitat to provide food for the LRS and the SNS in Clear Lake.

Effects to SNS Critical Habitat in Gerber Reservoir and its Tributaries

Effects to PBF 1—Water

Water quality monitoring in Gerber Reservoir over a wide range of lake levels and years has documented conditions that are periodically stressful, but typically adequate, for sucker survival. Stressful water quality conditions were limited to hot weather conditions that created high water temperatures (USBR 2001a, 2007, 2009, Piaskowski and Buettner 2003). Periodic stratification during summer and fall in the deepest portion of Gerber Reservoir can result in DO concentrations that are stressful to suckers (Piaskowski and Buettner 2003). However, stratification in Gerber Reservoir has been observed persisting for less than a month and is confined to the deepest water in a small portion of the reservoir nearest the dam (Piaskowski and Buettner 2003). This low DO condition is likely more the result of climatological conditions, such as high air temperatures and low wind speeds, than low lake surface elevations because shallower depths would likely increase mixing of bottom waters and thus increase DO concentrations.

Blooms of blue-green algae can also reach densities in the fall and winter high enough to prompt advisories by the State of Oregon, but there is no clear link between Project operations and algal blooms. Therefore, any effects to water quality from project operations are likely to be insignificant.

The minimum proposed elevation for the end of September is 4,798.1 ft. in Gerber Reservoir. Maintenance of this elevation in the past appears to have to provided adequate water depths for protection against winter kill of SNS during cold weather events and is expected to do so in the future.

The PA does not extend into the tributaries of Gerber Reservoir. However, access to Ben Hall and Barnes Valley Creeks, which are the two main Gerber Reservoir tributaries where SNS spawning occurs, could potentially be limited by low reservoir elevation during the February through May spawning season. During very dry years, both Barnes Valley and Ben Hall Creeks typically have low spring flows that are unlikely to provide adequate upstream passage for spawning adults, regardless of lake elevations (USBR 2001a). During these conditions, spawning cues are also unlikely to be present. Although the Gerber Reservoir surface elevations at the end of September have been observed below the proposed minimum elevation of 4,798.1 ft. in 5 years during the POR (1931, 1960, 1961, 1991, and 1992), surface elevations of at least 4,805.0 ft. were reached in these years the following spring by the end of March (USBR 2018a). The consistent presence of a broad size distribution of adult SNS containing individuals from multiple year classes indicates that successful spawning is occurring regularly and resulting in recruitment (Barry et al. 2007, Leeseberg et al. 2007), suggesting that the access to spawning habitat has been maintained under recent management. Continuing to manage the reservoir as it has been managed in the past is expected to provide similarly suitable habitat conditions.

Based on the presence of a broad size distribution representing multiple year classes in Gerber Reservoir and the fact that proposed Project operations will be unchanged from past operations, PBF 1 is expected to continue to function as intended, and the effects of Project operations on PBF 1 are expected to be insignificant.

Effects to PBF 2—Spawning and Rearing Habitat

The PA will not affect spawning habitat in tributaries to Gerber Reservoir because they are outside the action area.

The effects of low water levels in Gerber Reservoir on SNS rearing habitat are not fully understood. In 2015 and 2022, drought conditions reduced water levels within the reservoir to approximately one percent of the maximum storage. This undoubtably reduced the available habitat in the reservoir but specific data is not available to accurately estimate the extent of this reduction. Still, the presence of broad size distributions with multiple year classes indicates that rearing habitat conditions support frequent successful spawning and eventual recruitment (Barry et al. 2007, Leeseberg et al. 2007). Thus, maintaining the current management strategy is not expected to result in adverse effects.

Effects to PBF 3—Food

No specific data concerning the availability of food in Gerber Reservoir exists. The reservoir contains a very large amount of lake habitat and is productive enough to maintain dense populations of zooplankton. Food availability is not expected to be affected by the PA; therefore, PBF 3 will continue to support the recovery-support function of critical habitat for the SNS in Gerber Reservoir under the PA.

Summary of Effects to LRS and SNS Critical Habitat Unit 2

In Clear Lake, the PA will likely adversely affect rearing habitat (PBF 2), access to spawning habitat (PBF 2), and water quantity in the reservoirs or adult habitat (PBF 1) during droughts that may occur during the term of this Opinion. Though Project operations are unlikely to limit spawning access (PBF 1) in wet and dry years, impacts in moderately wet years remain uncertain. No effects are expected to food availability (PBF 3). However, these effects are unlikely to impede the recovery-support function of critical habitat for the LRS and SNS in Clear Lake.

In Gerber Reservoir, effects to PBFs of critical habitat as a result of the implementation of the PA are expected to be insignificant, and the Service expects Gerber Reservoir to continue serving its recovery-support function as critical habitat.

Overall, the Service concludes that Unit 2 of critical habitat will continue to support the recovery role for the LRS and SNS.

7.1.6.3 Effects of the Proposed Action Relative to Special Management Considerations or Protections for Critical Habitat

Section 5.6.5 describes the special management considerations or protections for LRS and SNS critical habitat. Because these are the same for both species and for both critical habitat units, the effects of the PA relative to these considerations or protections together.

Effects to PBF 1 - Water

Water Quality

In general, the PA is anticipated to impact water quality mainly through agricultural diversion return flows; however, these impacts are hard to measure because water quality conditions are primarily influenced by climate, external and internal nutrient loading, and algae crashes. However, there may be a potential link between Project operations and water quality in UKL, but more research is needed.

Preventing algal blooms is outside the scope of the PA. However, lower surface elevations may result in warmer water temperatures during the summer and fall months, although lacking specific observations, the extent that water temperatures would increase under the PA is unknown.. The PA does not contribute to increased sedimentation.

Water Quantity

Overall, the PA is expected to provide adequate water quantity to provide preferred habitat and access to water quality refugia in almost all years. Drought is a complicating factor in management of water quantity, and while drought is not caused by the PA, it can exacerbate its effects. However, while droughts and resulting low lake levels are likely to have impacts at the time they occur, these conditions are not likely to be permanent effects to water quantity.

In all but the driest of years, implementation of proposed Project operations over the term of this Opinion is likely to create higher than natural surface water elevations in UKL in the spring as a result of water storage. These water levels are likely to support extensive amounts of moderate to high- quality sucker spawning, rearing, and foraging habitat that will facilitate the annual production of millions of sucker eggs, embryos, larvae, and age-0 juveniles. However, in drier years like those seen in 2020 to 2022, the PA could have negative effects on spawning habitat at groundwater seeps along the eastern shoreline of UKL because habitat availability is reduced at lake elevations less than 4,142 ft. during the spring spawning months (Burdick et al. 2015b). Similarly, in water years similar to the driest years in the POR and as observed during the 2020 to 2022 drought years, low surface elevations are expected to reduce the amount of larval sucker wetland habitat.

Wetland restoration work and reconnection of Agency-Barnes is expected to increase the availability of diverse juvenile habitats. The Agency-Barnes restoration of over 13,887 acres of open and shallow water habitats along the lake fringe of UKL will greatly increase the rearing habitat available to juvenile and adult LRS and SNS in UKL. Of the 13,887 acres, 1,282 acres of wocus and emergent wetland is expected to be available as nursery habitat between the elevation of 4,139.0 ft. and 4,140.0 ft. Between the elevations of 4,140.0 ft. and 4,141.0 ft. another 674 acres of emergent wetland is expected to develop as part of the restoration (Dunsmoor 2022 p. 6).

Management of water surface elevations and depths at Keno and Gerber Reservoirs are unchanged under the PA and are expected to be compatible with the life-history requirements of the suckers. The relatively constant surface elevations at Keno Reservoir mean that existing habitat is always available, including large areas of emergent vegetation.

The minimum proposed Clear Lake elevations will likely provide adequate protection from drought in most years, but extended drought will result in a significant reduction in lake area and depth.

Effects to PBF 2—Spawning and Rearing Habitat

Gravel and Cobble

The PA will not alter the gravel and cobble substrata; therefore, this special management considerations or protections are not applicable.

Management of Nonnative Fish

The PA will not result in changes to the abundance or distribution of non-native fish; therefore, this special management considerations or protections are not applicable.

7.1.6.4 Summary of Effects to Lost River and Shortnose Sucker Critical Habitat

Overall, implementation of the PA in Critical Habitat Unit 1 is expected to result in insignificant effects to PBF 1, adverse effects to PBF 2, and no effect to PBF 3. There is a potential link to negative effects to water quality (PBF 1) from project operations in UKL, but more research is needed. There is evidence that water diversions through the Project cause a net reduction in nutrients downstream of UKL, which is beneficial. In Keno Reservoir, there are return flows into the reservoir from agricultural diversions that are part of the PA, resulting in some negative effects to water quality. However, given the large inputs of nutrients and organic matter from UKL, it is unlikely that these effects would result in a measurable difference in the parameters most important to suckers, such as dissolved oxygen, and are therefore considered insignificant.

Spawning and rearing habitat (PBF 2) in UKL are expected to be adequate in almost all years under the PA. However, years with the lowest lake elevations in the model POR resulted in significant reductions in available spawning habitat at the lakeshore springs and in emergent wetland habitat available for larval rearing. The proposed Project does not affect food availability (PBF 3) in Unit 1.

Overall, the Service concludes that Unit 2 of critical habitat will continue to support the recovery role for the LRS and SNS.

In Clear Lake, the PA will likely adversely affect rearing habitat (PBF 2), access to spawning habitat (PBF 2), and water quantity in the reservoirs or adult habitat (PBF 1) during droughts that may occur during the term of this Opinion. Though Project operations are unlikely to limit spawning access (PBF 1) in wet and dry years, impacts in moderately wet years remain uncertain. No effects are expected to food availability (PBF 3). However, these effects are unlikely to impede the recovery-support function of critical habitat for the LRS and SNS in Clear Lake.

In Gerber Reservoir, effects to PBFs of critical habitat as a result of the implementation of the PA are expected to be insignificant, and the Service expects Gerber Reservoir to continue serving its recovery-support function as critical habitat.

7.2 Northwestern Pond Turtle

7.2.1 Analytical Approach and Assumptions

While NWPT abundance and distribution within the project area is unknown, the species' presence is assumed in locations where functional nesting and overwintering habitat is present, unless other information is available demonstrating the likely absence of NWPT (e.g., personal communications from parties with historical knowledge of the site). It is also assumed that project activities that occur in aquatic habitats or in uplands within 500 meters of aquatic habitats have the potential to directly impact individuals occupying those habitats and/or important habitat components such as basking, nesting, and overwintering sites. The effects to NWPT are analyzed below by project activities affecting aquatic and upland habitat.

While the Service (2024) (Figure 26) provides general guidance on potential impacts to NWPT by habitat type, please note that this information does not evaluate long term impacts to NWPT habitat.

HABITAT		NWPT		PROJECT ACTIVITY AND NWPT WORK RESTRICTIONS SCHEDULE											
Type	Project Activity	Potential Life Stages Present	Potential Project Impacts	WINTER		SPRING			SUMMER			AUTUMN			WINTER
				JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Aquatic	In-water O&M Activities	Adult, juvenile, and hatchling.	Susceptible to injury, mortality, disturbance	Live flows									Live flows		
						Water deliveries									
						Dam gates							Dam gates		
							Stilling wells								
				Canals, laterals, & drains						Canals, laterals, & drains					
					Screens/ladders									Screens/ladders	
Upland	Upland O&M A	Adult, juvenile, hatchlings, eggs, nests.	Susceptible to injury or mortality.				Boat ramp, access area, road and dike upkeep								
Seasonal Timing Restrictions				OVERWINTERING/NESTING RESTRICTION			EARTHWORK OPEN WORK PERIOD		NESTING RESTRICTION-includes females traveling to and from nesting habitat				OVERWINTERING/NESTING RESTRICTION		
Potential Life Stages Present				Adult, juvenile, hatchling in nest			Uplands-none		Eggs, hatchlings in nest, gravid females				Adult, juvenile, hatchling in nest		
Potential Impacts				Susceptible to injury or mortality			Uplands- none to NWPT		Susceptible to injury or mortality				Susceptible to injury or mortality		

Figure 26. NWPT and project activity seasonal timing and restrictions and potential project related impacts to NWPT by life stage, seasonal activity, and habitat usage (Based on FWS 2024, ODFW 2015).

7.2.2 Effects to NWPT from the Proposed Action

Injury or Mortality

The Service anticipates NWPT are likely to be injured or killed during implementation of the proposed action. Potential project related impacts include 1) injury or mortality to NWPT eggs, hatchlings, juveniles, or adults; 2) habitat loss or degradation, and 3) auditory, visual, and disturbance. Within aquatic habitats, direct injury or mortality may occur during water storage and deliveries, the exercising and dewatering processes, and installation of cofferdams. Activities within upland habitats that may cause direct injury or mortality include gravel application and grading, mowing, and employee and heavy equipment travel.

As NWPT presence is assumed in areas with appropriate aquatic (foraging, basking, and overwintering in muddy substrate) and upland (nesting, overwintering, and aestivation habitat), project impacts will be analyzed by the habitat in which they will occur.

7.2.2.1 Effects to NWPT within Aquatic Habitat

Implementation of the proposed action would occur in aquatic habitats known or assumed to be used by NWPT for foraging, basking, and overwintering in muddy substrate. Activities that occur within or near aquatic habitat include water storage and deliveries; exercising dam gates and dewatering or lowering of water of canals, laterals, and drains; stilling water maintenance; dam component and pumping facility inspection and maintenance; and fish screen and ladder cleaning and maintenance. These activities are conducted at various times throughout the year, potentially affecting hatchling and gravid females during travel between nesting and aquatic habitat, and juveniles and adults during periods of basking, foraging, refugia, and muddy substrate overwintering and/or aestivation (Refer to Figures 19 and 26).

Effects from Water Storage and Delivery

Water storage and delivery include live flow into UKL, Clear Lake Reservoir, and Gerber Reservoir October through April and delivery of stored waters between March and October. However, releases for irrigation or flooding can occur year-round, as needed. In general, lake and reservoir elevations are characterized as high in late winter through early summer (i.e., due to inflow and subsequent storage from precipitation events) and low in late summer through early winter (i.e., due to irrigation deliveries and evaporation). While water levels can change at varying rates depending on the season and hydrological conditions, under the proposed action scenario lake elevations are expected to rarely increase or decrease at a rate equal to or greater than 0.6 ft in three weeks of any date between March and May.

Most in-flows occur while the majority of juvenile and adult NWPT are overwintering in upland hibernacula and nestlings remain in the nest, potentially impacting all life stages in the case of flood events. The timing of water delivery events overlaps with hatchling emergence and travel toward aquatic habitat; gravid females traveling between aquatic and nesting habitat; and juvenile and adult foraging and basking, potentially impacting nestlings, juveniles, and adults by fluctuating water levels, including flooding; increased sediment; and availability of basking structures and food source.

Controlled released of stored waters can be implemented throughout the year as needed to avoid flood events, therefore it is unlikely that storage or in-flow waters will overflow into upland overwintering or nesting habitat, impacting nestlings, juvenile, or adult turtles. Fluctuating water levels are unlikely to impact hatchling, juvenile, or adult NWPT within aquatic habitat as most individuals will move away from any sudden changes in their surrounding environments. Additionally, stored water is released slowly enough that there is no risk of hatchlings, juvenile, or adult turtles being washed or floated into deeper waters or unsuitable habitat or being stranded and exposed to increased predation or travel time back to suitable habitat. Slow releases will also avoid wave action that might potentially remove basking structures or generate large amounts of sediment. Any sediment generated by changing water levels will be small, temporary plumes.

While the amount of wetland edge habitat, and therefore the availability of wetland vegetation, may be impacted by changing water levels, the changes are small, seasonal, and temporary. Additionally, dedicated water deliveries to Tule Lake and Lower Klamath National Wildlife Refuges will improve aquatic habitat, including through the elimination and decomposition of terrestrial vegetation that encroached during drought times which in turn will and by promoting the new growth of aquatic vegetation, which will increase foraging habitat and provide long term beneficial effects to NWPT. Some impacts from project water operations and management activities in aquatic settings, which occur between July and mid-April, could be potentially beneficial for NWPT, as they may increase the availability of ephemeral and permanent aquatic habitats near beneficial terrestrial habitats (e.g., nesting and overwintering areas). Therefore, impacts from water storage and delivery actions are expected to not likely adversely affect NWPT.

Effects from Exercising Gates and Dewatering

The exercising and dewatering process of dam gates and plunge pools, canals, laterals, and drains occur between February and November, when turtles could be overwintering in muddy substrate, hatchlings and gravid females travel between nesting and aquatic habitat, and all life stages are actively foraging and basking in aquatic habitats. Potential impacts are changes in water levels and the generation of small, short-term plumes of sediment. Changes in water levels related to the exercising and dewatering process are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes. Neither are expected to create inhospitable conditions for NWPT, as most individuals will move away from any sudden changes in their surrounding environment and then return, if desired. Therefore, the effects to individual turtles from the exercising and dewatering process are considered to be temporary and insignificant.

Effects from Stilling Well Maintenance

Stilling well maintenance is typically conducted once per year during the irrigation season, when hatchlings and gravid females are traveling between aquatic and nesting habitat, and hatchlings, juveniles, and adults are foraging, basking, and moving from aquatic habitat into overwintering habitat. Maintenance activities generally include stilling well structural upkeep and flushing of accumulated sediment. Sediment volumes are often very small and may temporarily increase sediment a short distance downstream of the gauge. If a large amount of sediment is present, it is removed from the stilling well and deposited at nearby upland locations. Replacement or repositioning of measurement device and associated infrastructure may require the construction of a small coffer dam or be conducted during low flow periods. Measurement device sites are anticipated to need replacement or repair once every 5 to 10 years.

Flushing of stilling wells, replacement of equipment and replacement or readjusting of a site will have temporary impacts to NWPTs present. Short term increase in sediment may impact nestling, juvenile, and adult turtles through decreased water quality and the required building of any coffer dams may increase travel distance between habitats or disrupt turtle activity due to project activity. However, most individuals will likely avoid activity disturbance or move way from sudden changes in their environment. Therefore, any impacts to individual nestlings, juveniles, and adult NWPT and their habitat related to the cleaning and maintenance of stilling water wells will be temporary and insignificant.

Effects from Dam Component and Pumping Facilities Inspection and Maintenance

Dam component and pumping facilities inspection and maintenance includes land-based observations and/or deployment of divers to determine if repair and/or replacement of dam components is necessary (replacements, however, are not included as part of this proposed action, nor is weed control using pesticides) and maintaining boat ramps and associated access areas.

Inspection and maintenance of dam and pumping facilities are conducted at various times throughout the year, with the maintenance procedures, requirements, and schedule outlined in the Standard Operating Procedures. Land based visual inspections are conducted as needed and are implemented without entering aquatic habitat. Dive inspections, which involve dewatering of the facility being inspected, occur between August and December, when hatchlings, juveniles, and adults are foraging, basking, and moving from aquatic habitats into upland overwintering habitat. Changes in water levels related to the dewatering process are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes. Implementation of identified pump repair also requires the dewatering of facilities and the placement of a gate, bulkhead, or coffer dam. Boat ramp and associated access area maintenance activities occur outside of aquatic habitat and will be discussed in the upland habitat section, below.

Depending on the inspection location and proximity to occupied basking sites, visual inspections may temporary disturb basking NWPT. However, this impact is expected to be temporary and short term and any NWPT present is likely to be used to human presence and can also return after the disturbance if they desire. Dive inspections will have temporary impacts to any NWPT present through activity related disturbance and the associated dewatering process, which could increase sedimentation and decrease water quality. The presence of divers within aquatic habitat and the dewatering process could disturb juveniles and adults during foraging and basking activities. Facility dewatering could also impact NWPT through short term and temporary water level changes and the generation of small, short-term sediment plumes. However, any potential impacts to NWPT from dive inspections and facility dewatering are not expected to create inhospitable conditions for NWPT, as most individuals will likely avoid activity disturbance or move away from any sudden changes in their surrounding environment and then return, if desired. Therefore, visual inspections will not impact NWPT and impacts to NWPT from dive inspections and related facility dewatering will be temporary and insignificant.

Effects from Fish Screen and Ladder Maintenance Activities

Fish screen and ladder maintenance activities occur in February, March, November, and December and include the cleaning of screens and exercising of head and attraction flow gates. As part of the screen cleaning process, an extra set of screens is placed behind the set to be removed for cleaning, preventing any unprotected gaps. Changes in water levels related to the exercising and dewatering process are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes.

Maintenance activities occur during the NWPT overwintering season, when there could be juveniles and adults overwintering in muddy substrate in the area. Overwintering turtles are known to sometimes emerge during sunny, warm winter days to bask before returning to their hibernacula. Fish screen and ladder maintenance activities will temporarily impact any overwintering NWPT in the area that come out of hibernation to bask. Potential impacts include a decrease in water quality through the generation of small, short-term plumes of sediment, and temporary changes in water levels. While the presence of basking turtles is unlikely, small, short-term plumes of sediment and temporary water level changes do not create inhospitable conditions to turtles and most will move away from any sudden changes in their surrounding environment. Therefore, impacts to NWPT and its habitat from fish screen and ladder maintenance activities are expected to be temporary and insignificant.

Summary of Effects to NWPT within Aquatic Habitats from the Proposed Action

Project activities implemented within or near aquatic habitats are water storage and deliveries and O&M activities, which includes exercising dam gates and dewatering or lowering of water of canals, laterals, and drains; stilling water maintenance; dam component and pumping facility inspection and maintenance; and fish screen and ladder cleaning and maintenance.

Project activities conducted within aquatic habitats can impact hatchling and gravid females during travel between nesting and aquatic habitat, and juveniles and adults during periods of basking, foraging, refugia, and muddy substrate overwintering and/or aestivation (Refer to Figures 19 and 26).

Positive effects include the potential for increased ephemeral and permanent aquatic habitats. Potential negative effects include disturbance, increased travel time between habitats, increased sedimentation/decreased water quality, and changes in water levels. However, these effects are short term, temporary, and seasonal, and most individuals will likely avoid activity disturbance and move away from any sudden changes in their environment. Impacts to hatchling, gravid females, juvenile, and adult NWPT and NWPT aquatic habitats from project activities conducted within or near aquatic habitats will be temporary and insignificant. Additionally, implementation of the proposed conservation recommendations will minimize project related impacts to NWPT. Therefore, impacts from project related activities with aquatic habitats are expect to not likely adversely affect NWPT.

7.2.2.2 Effects to NWPT within Upland Habitat

Activities that occur in or near uplands includes management of boat ramps, access areas, roads, and dikes, as well as travel by employees and heavy equipment. Management activities include gravel application and grading, concrete repair/replacement, and mowing, and are implemented as needed between April and October, potentially impacting nests, eggs and hatchlings in the nest, emerging hatchlings traveling into aquatic habitat, gravid females traveling to and from nesting sites, and juveniles and adults moving between upland and aquatic habitats.

The number of boat ramps, access areas, roads and dikes within the project area are unknown. However, there are approximately 1,220 miles of canal, lateral, and drains accessible on at least one side by a gravel road, indicating a minimum number of 1,220 miles of access road. All boat ramp, access area, road, and dike infrastructures are previously constructed and consist of compacted dirt, rock, or concrete. Boat ramps and associated access areas at all reservoirs must be maintained to allow all weather boating access. Gravel ramps are maintained on a 5-year cycle and concrete on a 10-year cycle. Maintenance can also include grading, geotextile fabric placement and gravel augmentation/concrete placement, depending on the type of boat launch. Application and grading of gravel and mowing requires the use of heavy equipment.

Implementation of right-of-way and access infrastructure maintenance activities are expected to negatively impact present NWPT. The reduction of vegetation height through mowing could provide beneficial benefits to NWPT, such as increased access to nesting and overwintering habitat and increased solar exposure to nests. However, the majority of anticipated impacts from gravel application and grading, concrete repair/replacement, and mowing will result in negative effects to NWPT, including the direct injury or mortality of all age classes of NWPT. Gravel augmentation and grading, and concrete and geotextile placement will not affect eggs and hatchlings in nests as infrastructure as compacted and do not provide nesting or overwintering habitat. However, eggs and hatchlings in nests may be crushed by mowing and hatchling, juvenile, and adult NWPT traveling between aquatic and upland habitats may be trampled or crushed by heavy equipment or employee travel upon roads, causing adverse effects. Hatchlings, juveniles, and adults traveling in uplands could also be injured or killed by mower blades. As overwintering habitat generally occurs in forested upland locations, mowing is not expected to impact overwintering NWPT. Additional negative impacts to NWPT could result from destruction of suitable nesting or overwintering habitat due to soil compaction or disturbance from noise and movement of equipment or placing of gravel. Implementation of the proposed conservation recommendations will minimize direct injury or mortality of NWPT due to project activities.

Summary:

Implementation of the proposed action will occur in or near upland habitats know or assumed to be used by NWPT. O&M activities that occur in or near uplands include gravel application and grading, concrete repair/replacement, mowing, and on and off-road travel by employees and heavy equipment.

Management activities are implemented as needed between April and October, potentially impacting nests, eggs and hatchlings in the nest, emerging hatchlings traveling into aquatic habitat, gravid females traveling to and from nesting sites, and juveniles and adults moving between upland and aquatic habitats.

Potential impacts include crushing of nests, eggs, and hatchlings in nests by heavy equipment; injury or mortality to traveling hatchlings, juveniles, and adults from being trampled or crushed by heavy equipment or employee travel or from mower blades. Therefore, project related impacts from activities implemented within upland habitat may adversely affect NWPT.

7.2.3 Effects to NWPT Habitat from the Proposed Action

Habitat Loss and Degradation

Implementation of the proposed project will occur in aquatic and upland habitat known or assumed to be used by NWPT for foraging, basking, nesting, overwintering, and aestivation activities. Project activities within or near aquatic habitats include water storage (Element 1) and delivery (Element 2); and O&M (Element 3) including exercising dam gates and dewatering or lowering of water of canals, laterals, and drains; stilling water maintenance; dam component and pumping facility inspection and maintenance; fish screen and ladder cleaning and maintenance; and gravel application and grading. Project O&M activities occurring within upland habitats include gravel application and grading, concrete repair/replacement, and mowing.

7.2.3.1 Effects to Aquatic Habitat

NWPT use aquatic habitats for foraging, basking, and occasionally as muddy substrate overwintering habitat. The project encompasses the Klamath Basin’s hydrologic system that consists of a complex of interconnected rivers, canals, lakes, marshes, dams, diversions, wildlife refuges, wilderness areas, and agricultural lands in Klamath County, Oregon, and Siskiyou and Modoc Counties, California.

<u>Effects from Water Storage and Delivery</u>

Water storage and delivery includes live flow into UKL, Clear Lake Reservoir, and Gerber Reservoir, for a total water storage capacity of 1,066,000-acre feet, October through April and delivery of stored waters between March and October. However, releases for irrigation or flooding can occur year-round, as needed. Water delivery is implemented through approximately 675 miles of canals and laterals and irrigation return flows and local runoff are collected and returned to storage by 545 miles of drains.

In general, lake and reservoir elevations are characterized as high in late winter through early summer (i.e., due to inflow and subsequent storage from precipitation events) and low in late summer through early winter (i.e., due to irrigation deliveries and evaporation). While water levels can change at varying rates depending on the season and hydrological conditions, under the proposed action scenario lake elevations are expected to rarely increase or decrease at a rate equal to or greater than 0.6 ft in three weeks of any date between March and May. Stored water is released slowly, which avoids wave action. Any generation of sediment will be small, temporary plumes.

While the amount of wetland edge habitat, and therefore the availability of wetland vegetation, may be impacted by changing water levels, the changes are small, seasonal, and temporary. Additionally, dedicated water deliveries to Tule Lake and Lower Klamath National Wildlife Refuges will improve aquatic habitat, including through the decomposition of terrestrial vegetation that encroached during drought times and by promoting the new growth of aquatic vegetation, which will increase foraging habitat and provide long term beneficial effects to NWPT. Some impacts from project water operations and management activities in aquatic settings, which occur between July and mid-April, could be potentially beneficial for NWPT, as they may increase the availability of ephemeral and permanent aquatic habitats near beneficial terrestrial habitats (e.g., nesting and overwintering areas). Therefore, impacts from water storage and delivery activities are not likely to adversely affect aquatic habitats.

Effects from Exercising Gates and Dewatering

The exercising and dewatering process of dam gates and plunge pools, canals, laterals, and drains occur between February and November. Potential impacts are the generation of small, short-term plumes of sediment related to changes in water levels. However, changes in water levels related to the exercising and dewatering process are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes. Therefore, any impacts to aquatic habitats from exercising or dewatering processes will be temporary and insignificant.

Effects from Stilling Well Maintenance

Stilling well maintenance is typically conducted once per year during the irrigation season, and s generally include stilling well structural upkeep and flushing of accumulated sediment. Sediment volumes are often very small and may temporarily increase sediment a short distance downstream of the gauge. If a large amount of sediment is present, it is removed from the stilling well and deposited at nearby upland locations. Replacement or repositioning of measurement device and associated infrastructure may require the construction of a small coffer dam or be conducted during low flow periods. Measurement device sites are anticipated to need replacement or repair once every 5 to 10 years. Impacts to aquatic habitats from stilling well maintenance will be temporary and insignificant.

Effects from Dam Component and Pumping Facilities Inspection and Maintenance

Dam component and pumping facilities inspection and maintenance includes land-based observations and/or deployment of divers to determine if repair and/or replacement of dam components is necessary (replacements, however, are not included as part of this proposed action); weed control; and maintaining boat ramps and associated access areas. Dive inspections involve the dewatering of the facility being inspected as does the implementation of any identified repairs. Changes in water levels related to the dewatering process are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes. Boat ramp and associated access area maintenance activities occur outside of aquatic habitat and will be discussed in the upland habitat section, below. There will be no impacts to aquatic habitats from visual or dive inspections and impacts related to the dewatering process will be temporary and insignificant.

Effects from Fish Screen and Ladder Maintenance Activities

Fish screen and ladder maintenance activities occur in February, March, November, and December and include the cleaning of screens and exercising of head and attraction flow gates. Potential impacts to aquatic habitats include changes in water levels and generation of sediment. However, changes in water levels are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes. Therefore, impacts to aquatic habitats from fish screen and ladder maintenance activities will be temporary and insignificant.

Right-of-way and access maintenance occur between April and November and may temporarily cause sedimentation into adjacent waterways, principally canals. Gravel is periodically added to roadbeds or boat ramps and vehicle access points and roadbeds are periodically re-graded. The impact of sedimentation is likely to have a temporary impact to aquatic habitat; however, seasonal consideration and soil retention cloth are used to mitigate sedimentation of waterways when these activities occur. Therefore, impacts to aquatic habitats from right-of-way and access maintenance activities will be temporary and insignificant.

Summary of Effects to NWPT Aquatic Habitats

Project activities implemented within or near aquatic habits are water storage and deliveries and O&M activities, which includes exercising dam gates and dewatering or lowering of water of canals, laterals, and drains; stilling water maintenance; dam component and pumping facility inspection and maintenance; fish screen and ladder cleaning and maintenance, and maintenance of right-of-way and access infrastructures.

Project activities will impact aquatic habitats, with potential impacts related to changes in water levels, including decreased water quality, increased sedimentation, increased erosion, and changes in quality and amount of wetland habitats. However, water deliveries are released slowly preventing additional erosion, changes in water levels related to exercising and dewatering processes are short term and temporary (10 to 30 minutes) as are the generation of small short-term sediment plumes.

Some impacts from project activities occurring in aquatic habitats could be potentially beneficial for the habitats, as they may increase the availability of ephemeral and permanent aquatic habitats. Additionally, dedicated water deliveries to Tule Lake and Lower Klamath National Wildlife Refuges will eliminate encroaching terrestrial vegetation within wetlands, increase organic materials through the decomposition of the terrestrial vegetation, and promoting the new growth of aquatic vegetation. None of the project activities will cause loss or degradation of NWPT foraging, basking, or overwintering aquatic habitat. Therefore, impacts from project Element 1, 2, and 3 activities conducted within or near aquatic habitats may affect but are not likely to adversely affect NWPT aquatic habitats.

7.2.3.2 Effects to Upland Habitats

The amount of upland habitat within the project and action areas is unknown, as is the amount of NWPT overwintering and nesting habitat. However, there are approximately 1,220 miles of access roads within the action area. As NWPT nesting habitat is found within 100 meters of aquatic habitat, it follows that applying a 100-meter buffer to the estimated miles of access roads will provide an estimate of potential nesting habitat, which comes to 48,515 acres. As aestivation and overwinter habitat is found with 500 meters of aquatic habitat, applying the same logic provides an estimate of 242,576 acres of potential aestivation and overwintering habitat, in which the estimated nesting habitat is also included. This estimate of affected acres is likely high because not all acres within all of the adjacent buffered areas are considered suitable nesting habitat. The area buffered to create the acreage total includes areas (e.g., roadbeds, concrete, gravel/rocked surfaces) that are not suitable for turtles due to compacted soils and other substrate that do not provide conditions necessary for turtle nesting or overwintering. Additionally, some areas for mowing likely include thick vegetation compared to nesting habitat that typically has sparse vegetation and short grasses and forbs (See Section 6.2). Information is lacking to precisely tease apart those areas that may be unsuitable for turtles, meaning the area of potential impact is larger than the area likely used by turtles, if present.

Project activities occurring within or near upland habitats includes O&M (Element 3) activities for right-of-way and access maintenance for boat ramps, access areas, roads, and dikes. These infrastructures are previously established and consist of compacted dirt, rock, and/or concrete. Management activities are implemented as needed between April and October, and include gravel application and grading, concrete repair/replacement, and mowing. Potential impacts to upland habitats from O&M activities include compaction of soils due to heavy equipment travel and/or mowing and reduction of vegetation height.

It is unknown how many acres of upland is mowed but mowing is primarily conducted along the 1,220 miles of roads and dikes. As overwintering habitat generally occurs in forested upland locations, mowing is not expected to impact overwintering habitats. Therefore, analysis of potential impacts to NWPT habitat are restricted to the estimated 48,515 acres of nesting habitat.

Reduction of vegetation height could provide beneficial impacts to NWPT nesting habitat by increasing access and solar exposure to the habitats. However, soil compaction resulting from mowing or off-road heavy equipment movement could reduce or prevent NWPT nest excavation, thereby reducing availability of suitable nesting habitat or rendering it as unsuitable for nesting. Therefore, the mowing of uplands (Element 3) is expected to adversely affect NWPT nesting habitat.

<u>Summary of Effects to NWPT Upland Habitats</u>
Project activities are expected to impact potential NWPT nesting habitat. Potential impacts include reduction of vegetation height and compaction of soils due to heavy equipment travel and/or mowing. While reduction of vegetation height may provide beneficial impacts to NWPT nesting habitat through improved access and solar exposure, impacts to the habitat from soil compression are likely adverse, reducing or eliminating nesting habitat.

Therefore, impacts from project Element 3 mowing and heavy equipment activities conducted within upland habitats are likely to adversely affect NWPT nesting habitats.

7.2.4 Effects to NWPT from Audio and Visual Disturbance

Whether auditory and visual disturbance represent a potential adverse effect to NWPT is unknown, but presumed by the Service based on anecdotal responses of NWPT to human presence that generally includes a quick retreat from the area, such as leaving basking sites. Potential audio and visual disturbance impacts generated by project activities within or near aquatic and upland habitats include seeing/hearing workers and activity during inspections, repairs, and general maintenance.

Activities conducted during NWPT active season is anticipated to disturb juveniles and adults during foraging, basking, and movement periods within the project footprint but not within the larger action area. However, disturbance impacts are expected to be seasonal, temporary, and short term. Additionally, the observation of NWPT along canal rights-of-way suggest that NWPT have a tolerance to disturbance at these locations and disturbed individuals can easily move to available habitat up or downstream of the activity. Therefore, project related audio and visual disturbance impacts to NWPT are expected to be temporary and insignificant.

7.2.5 Effects to NWPT Recovery

The Service has not developed a recovery plan for NWPT with recovery needs. Therefore, it is difficult to assess effects to NWPT recovery from the PA. In the absence of a recovery plan, the Service defaults to standard conservation practices for NWPT, which include creating and enhancing habitat; providing native vegetation buffers around wetlands and other waterbodies; avoiding direct modifications to waterbodies and waterways, including alterations of hydrology and causing increased sedimentation rates; avoiding or minimizing disturbance from public access or other human activities in and around wetlands; and considering permanent protection of wetlands and other waterbodies supporting breeding turtle populations (ODFW, 2015).

The action area is completely within the range of NWPT. Project related impacts do not represent a major change from the existing conditions for NWPT because the project area has a long history of project related disturbances. NWPT have likely already modified their use of potential impacted habitat. Additionally, project related impacts to NWPT do not occur within the entire action area or all potential NWPT habitat but are limited to the 48,515 acres of potential upland nesting habitat located adjacent to access roads within the Project where mowing and heavy equipment activities are anticipated to occur. This estimate of affected acres is likely high because not all acres within all of the adjacent buffered areas are considered suitable nesting habitat. The area buffered to create the acreage total includes areas (e.g., roadbeds, concrete, gravel/rocked surfaces) that are not suitable for turtles due to compacted soils and other substrate that do not provide conditions necessary for turtle nesting or overwintering. Additionally, some areas for mowing likely include thick vegetation compared to nesting habitat that typically has sparse vegetation and short grasses and forbs (See Section 6.2). This is the best reasonable estimate to determine potentially impacted habitat, since nesting habitat has not been mapped within the Project.

The PA does not include specific Conservation Measures or practices for NWPT, including those that could promote recovery such as implementing restoration activities, applying buffers, avoiding, or minimizing disturbance, or permanently protecting breeding habitat. The Conservation Measures in the PA are specific to LRS and SNS and do not provide secondary benefits for NWPT because the actions are planned to promote recovery through salvage of LRS and SNS in dewatered canals, support captive rearing for LRS and SNS, and support LRS and SNS monitoring efforts.

The PA is not expected to significantly impact NWPT population numbers, reproduction, or distribution at the range wide scale because the potential impacts to NWPT and its habitat will only affect a small spatial area in relation to the range of the species. The scale of the effects from the PA is small when compared to the large range of the NPWT that expands across three states (California, Oregon, and Washington). Therefore, project-related adverse effects to the recovery of NWPT are expected to be minimal.

8 CUMULATIVE EFFECTS

Section 7 regulations define cumulative effects as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. (50 CFR 402.02). Future Federal actions that are unrelated to the PA are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

8.1 Lost River and Shortnose Sucker

8.1.1 Cumulative Effects for Lost River and Shortnose Sucker

The non-Federal actions that are expected in the action area include habitat restoration, water quality improvements, and other actions that are regularly funded by the Oregon Watershed Enhancement Board, National Fish and Wildlife Foundation, as well as through other entities. For example, past work has been done by the Klamath Basin Rangeland Trust, Klamath Watershed Partnership, The Klamath Tribes, The Nature Conservancy, Trout Unlimited, Sustainable Northwest, Klamath Soil and Water Conservation District, and Klamath Water Users Association. Funding has been consistent through these entities for years, but uncertainty always remains. Much of the uncertainty surrounding progress in ecosystem restoration is the willingness of private land-owning entities and persons to participate in voluntary restoration actions. However, given the amount of focused effort and the involvement of several key organizations in the Upper Klamath Basin, progress is expected toward the groups' priorities over the next two years that will be measurable at some scales.

The Service is unaware of other non-Federal activities within the action area that need to be considered in relation to this consultation. Most of the non-Federal actions listed above will improve water quantity, water quality, and habitat in areas that support listed suckers, including UKL and its tributaries and the Keno Reservoir. Screening will reduce entrainment of suckers and improve overall survival. Habitat restoration will increase the amount and quality of areas important to complete sucker life cycles. Water quality improvement projects will work towards addressing a major factor limiting listed sucker recovery in the Upper Klamath Basin. If water quality is improved in Keno Reservoir, this area would likely support a substantial population of adult suckers and/or provide habitat to support larval and juvenile suckers that eventually will return to UKL as adults. Therefore, future State, and private actions, will not cumulatively add to the adverse effects of the PA. However, the beneficial effects cannot be quantified at this time because project details are limited and/or cannot currently be estimated.

8.1.2 Cumulative Effects for Lost River and Shortnose Sucker Critical Habitat

The actions identified in Section 8.1.1 of this document, *Cumulative Effects* to LRS and SNS, are the same actions considered for cumulative effects to designated critical habitat for LRS and SNS. The actions listed in Section 8.1.1 will improve water quantity, water quality, and habitat in areas that support listed suckers, including UKL and its tributaries and the Keno Reservoir. Habitat restoration will increase the amount and quality of areas important to complete sucker life cycles. Water quality improvement projects will work towards addressing a major factor limiting listed sucker recovery in the Upper Klamath Basin, specifically PBF 1 in Critical Habitat Unit 1. These future State and private actions are anticipated to result in beneficial effects to designated critical habitat for LRS and SNS over the term of this Opinion and therefore will not cumulatively add to the adverse effects of the PA. However, the benefits cannot be quantified at this time because specific project details are not available.

8.2 Northwestern Pond Turtle

The non-Federal actions that are expected in the action area include habitat restoration, water quality improvements, and other actions that are regularly funded by the Oregon Watershed Enhancement Board and the National Fish and Wildlife Foundation, as well as through other entities. For example, past work has been done by the Klamath Basin Rangeland Trust, Klamath Watershed Partnership, The Klamath Tribes, The Nature Conservancy, Trout Unlimited, Sustainable Northwest, Klamath Soil and Water Conservation District, and Klamath Water Users Association. Funding has been consistent through these entities for years, but uncertainty always remains. Much of the uncertainty surrounding progress in ecosystem restoration is the willingness of private land-owning entities and persons to participate in voluntary restoration actions. However, given the amount of focused effort and the involvement of several key organizations in the Upper Klamath Basin, progress is expected toward the groups’ priorities over the next two years that will be measurable at some scales.

The Service is unaware of other non-Federal activities within the action area that need to be considered in relation to this consultation. Many of the non-Federal actions listed above will improve aquatic and riparian habitat conditions in areas that could support NWPT, including tributaries of UKL. Many potential habitat restoration projects will have long-term benefits by increasing the amount and quality of habitat important to complete NWPT life cycles. Therefore, future State, and private actions, will not cumulatively add to the adverse effects of the PA. However, the beneficial effects cannot be quantified at this time because project details are limited and/or cannot currently be estimated.

9 CONCLUSION

After reviewing the current status of Lost River and shortnose suckers and their critical habitat, northwestern pond turtle, the environmental baseline, the effects of the PA, and the cumulative effects, it is the Service’s biological opinion that implementation of the Project is not likely to jeopardize the continued existence of Lost River and shortnose suckers and northwestern pond turtles. The Service also concludes the implementation of the Project will not result in the destruction of adverse modification of critical habitat for Lost River and shortnose suckers. The Service reached this conclusion based on the factors analyzed above, which are summarized below.

9.1 Jeopardy Determination

9.1.1 Lost River and Shortnose Sucker

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the current range wide condition of the Lost River sucker and shortnose sucker, the factors responsible for that condition, and its survival and recovery needs; (2) the

Environmental Baseline, which analyzes the condition of the Lost River sucker and shortnose sucker in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the Lost River sucker and shortnose sucker; (3) the Effects of the Action, which determines all consequences to the Lost River sucker and shortnose sucker caused by the PA that are reasonably certain to occur in the action area; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities, that are reasonably certain to occur in the action area, on the Lost River sucker and shortnose sucker.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the Lost River sucker and shortnose sucker, taking into account any cumulative effects, to determine if implementation of the PA is likely to reduce appreciably the likelihood of both the survival and recovery of the Lost River sucker and shortnose sucker in the wild by reducing the reproduction, numbers, and distribution of that species.

Range-wide Status of the LRS and SNS and the Environmental Baseline in the Action Area

Section 5.4 describes the factors that have led to the current status of the LRS and SNS as endangered throughout their range under the ESA, and particularly the threats identified at the time of listing (e.g., habitat loss, non-native species, and water quality) and new threats identified since listing (e.g., introgression, climate change, parasites, and diseases). These factors, along with others, are affecting the current status such that there is a lack of resiliency and redundancy due to reductions of self-sustaining populations range-wide, dramatic population declines in UKL, and loss of important habitats and populations in large parts of their range (USFWS 2013a). Reproducing populations of SNS remain in three locations (UKL, Clear Lake, and Gerber Reservoir), and reproducing LRS populations remain in two (UKL and Clear Lake). The only populations with frequent recruitment are SNS occurring in Gerber Reservoir and Clear Lake. LRS in Clear Lake show some recruitment, but recruitment is highly variable in magnitude. Neither LRS nor SNS have recruited in significant numbers into the adult populations in UKL since the late 1990s. In sum, the only populations with regular recruitment are SNS in Clear Lake and Gerber Reservoir.

Additional details on the UKL populations are included here because the status is more tenuous and dynamic than those in the Lost River recovery unit. Specific factors limiting LRS and SNS resilience in UKL include higher than natural mortality of age-0 juveniles due to degraded water quality, algal toxins, disease, parasites, predation, competition with native and introduced species, and entrainment into water management structures. Adult populations in UKL are limited by negligible recruitment, stress and mortality associated with severely impaired water quality, and the fact that adult suckers are approaching the limits of their life span. Additionally, these species are limited by a lack of connectivity throughout their range by dams, periodic low flows, and degraded habitat.

Because of a multi-decade lack of recruitment of LRS and SNS in UKL and the current old age of existing adults, both species will be at a high risk of extirpation without recruitment. A die-off of adult suckers in UKL, similar to those that occurred in the 1990s, could be catastrophic, especially for SNS because of its low abundance. This lack of resiliency to a stochastic event such as a die off highlights the need for auxiliary and redundant populations in case of a catastrophic event. It is also possible that the low adult survival rates from the most recent year of data available could portend an increase in mortality due to senescence, but additional years of data will be necessary to evaluate this hypothesis. Regardless, their continued survival in UKL depends on significant recruitment in the near future.

The *Status and Environmental Baseline of the Lost River Sucker and the Shortnose Sucker* (Section 5), describes conditions and past actions that currently adversely affect the LRS and SNS within the action area, including: (1) negative effects of water quality (e.g., low DO, high ammonia, high pH, algal toxins, and urban and agricultural run-off) to suckers in UKL, Keno Reservoir, and Lost River; (2) native and introduced pathogens, parasites, and predators; (3) injury and mortality associated with entrainment into irrigation canals, turbines, and spillways at water control structures and dams; (4) migration barriers such as dams that prevent access to spawning and rearing habitats across suckers' historic range and adverse water quality and low flows that could also act as seasonal barriers; and (5) historic ecosystem modification for diversion of water for agriculture and drought that can reduce the access to and availability of spawning and rearing habitats throughout their range, especially during droughts when water use increases.

The *Environmental baseline of LRS and SNS in the Action Areas* (Section 5.5.11), summarizes past and ongoing consulted on actions that occur within the action area which affected or are affecting LRS and SNS. The previous consultations included in the baseline are recovery actions, research, widening of Oregon highway 140, BLM and FS grazing, Agency-Barnes wetland restoration, decommissioning of the Lower Klamath Hydroelectric Project, PacifiCorp HCP, and past Klamath Project consultations. The incidental take for these actions contributes to the current conditions of the species and the action area, including some significant beneficial effects, and are not likely a limiting factor to the persistence and recovery of the LRS and SNS. Therefore, the addition of these actions to the current consultation have not reached the level of jeopardy for LRS and SNS.

Conversely, conservation efforts and restoration activities have been implemented and are ongoing in an effort to improve the environmental baseline for suckers, either directly or indirectly. Enforcement of State water-quality criteria and State water rights upstream of Project reservoirs that contain suckers; implementation of management plans associated with the Total Daily Maximum Loads (TMDL); and on-going restoration/enhancement of sucker habitat (e.g., Agency-Barnes reconnection) should improve the environmental baseline, but when or exactly how they will benefit LRS and SNS populations is difficult to predict at this time. Furthermore, the assisted rearing program will have beneficial effects to the individuals that are collected by increasing survival above observed rates in UKL, which are annually close to zero; this is anticipated to enable recruitment of some individuals into the adult sucker populations in UKL by stocking individuals in size classes that should have higher survival. Overall, the environmental baseline for the species in the action area is highly degraded and is contributing to their current endangered status; conservation efforts and restoration activities are anticipated to provide benefits to suckers and their habitats.

Summary of Effects to LRS and SNS

The effects of the PA on LRS and SNS are summarized below, based on recovery units identified in the revised recovery plan (USFWS 2013). The PA affects LRS and SNS in both recovery units (UKL and Lost River Basin), and each of the eight management units therein, though effects to the management unit downstream of Keno Dam are less substantial than at the other seven units.

UKL Recovery Unit

The UKL Recovery Unit includes LRS and SNS populations in UKL, and Keno Reservoir (USFWS 2013). As described in the *Effects of the Action in the UKL Recovery Unit* (Section 7.1.3.1), the PA is likely to result in a variety of effects to the LRS and SNS. Presented below is a summary of these effects.

Adverse effects of the PA to LRS and SNS in UKL Recovery Unit are expected to include:

- Low lake elevations in some years may limit access to spawning habitat at the UKL shoreline springs.
- In UKL, diversion of water during dry years will decrease habitat availability for larvae in early summer and for juvenile and adult suckers in late summer.
- Substantial entrainment of larvae and age-0 juvenile suckers will occur at the A Canal and Link River Dam.
- Some entrainment of larvae and age-0 suckers will occur at Project diversions in the Keno Reservoir such as the Lost River Diversion Channel, Ady Canal, North Canal, and private diversions that use Project water.
- Dewatering of canals as part of seasonal O&M operations at Project facilities is expected to strand LRS and SNS, including any age-0 juveniles present and make them vulnerable to bird predation.

Beneficial effects of the PA to LRS and SNS in the UKL Recovery Unit are likely to include:

- Water storage in UKL during the winter will increase the amount of shoreline spawning, embryo, pre-swim-up larval, and larval habitat during the spring (March-June) in most years.
- Variable water levels in UKL will likely help maintain emergent marsh vegetation that requires air exposure for successful germination and growth of plant seedlings and support a variety of sucker nursery and rearing habitat.
- Water diversions during the irrigation season results in a net reduction of nutrients entering Keno Reservoir and downstream.
- Consistent annual delivery of at least 21,000 AF of water to Lower Klamath National Wildlife Refuge Unit 2 will maintain habitats for the establishment of an auxiliary sucker population.

Aspects of the PA, including Conservation Measures, that will likely minimize impacts of the Project to LRS and SNS in UKL Recovery Unit include:

- The A Canal fish screen minimizes entrainment of all life stages into the canal.

- The Link River Dam fish ladder allows adult suckers in the Keno Reservoir to move upstream past the dam to UKL.
- Canal salvage identified in the Conservation Measures will reduce the numbers of suckers that die in canals at the end of the irrigation season, thereby minimizing entrainment effects.
- Financial and technical support for the assisted rearing program identified in the Conservation Measures will enable continued rearing of suckers and will result in the production of substantial numbers of juveniles larger than 8 inches that are likely to have substantially higher survival rates than larvae and age-0 suckers. The benefit of increased larval and juvenile survival for the reared individuals serves to indirectly offset the loss or injury of larval and age-0 suckers that may be adversely affected by the PA. The program is also likely to increase recruitment of suckers into the adult populations in UKL, though the magnitude of this change is uncertain.
- Participation and support by Reclamation for sucker monitoring and Recovery Program participation identified in the BA and addendum is expected to help offset adverse effects of the PA by advancing the planning and implementation of sucker recovery efforts other than assisted rearing.
- Water will be managed according to the decision rules outlined in the PA to provide variable UKL elevations dependent upon actual and forecasted inflows and water use conditions.

<u>UKL Recovery Unit - Conclusion</u>

The Service concludes, based on the analysis of the effects of the PA presented in the *Effects of the Action in the UKL Recovery Unit* (Section 7.1.3.1) and summarized above, the most substantial effects to LRS and SNS in the UKL Recovery Unit likely include: (1) decreases in larval and age-0 juvenile habitat between July and October; (2) decreased availability of habitat with adult suckers' preferred depths at the lowest water levels; (3) decreased access to shoreline spawning habitat in years with the lowest water levels; and (4) entrainment of age-0 juveniles at the Link River Dam. This adverse effect is significant because of the large numbers of juveniles entrained annually and the important function these fish should serve by recruiting into the adult populations. Recruitment in UKL is limited by unknown factors, but any reduction in juveniles that could subsequently recruit is a concern.

Lost River Basin Recovery Unit

The Lost River Recovery Unit includes LRS and SNS populations in Clear Lake, Gerber Reservoir, Tule Lake, and the Lost River (USFWS 2013). SNS are found throughout the Lost River subbasin with the largest populations occurring in Clear Lake and Gerber Reservoir. LRS are represented by a small population in Clear Lake. LRS are rare in the Lost River and LRS do not occur in Gerber Reservoir. Small populations of LRS and SNS occur in Tule Lake Sump A. As described in the *Effects of the Action in the Lost River Recovery Unit* (Section 7.1.3.2), the PA could have a variety of effects to the LRS and SNS. These effects are summarized below.

Adverse effects of the PA on LRS and SNS in the Lost River Basin Recovery Unit are expected to include:

- Diversion of water from Clear Lake for agriculture decreases habitat availability for all life-history stages and may strand small numbers of individuals at the lowest expected elevations.
- A portion of suckers entrained into Project facilities at Clear Lake, Gerber Reservoir, Tule Lake, and in the Lost River are likely to be injured or killed.
- Agricultural discharges from private lands that use Project water are likely to contribute to adverse water quality in sucker habitats in the Lost River through the release of nutrients, organics, and pesticides.
- Dewatering of canals as part of seasonal O&M operations at Project facilities is likely to strand LRS and SNS and make them more vulnerable to bird predation.

Beneficial effects of the PA to listed sucker populations in the Lost River Basin Recovery Unit are likely to include:

- Water storage in Clear Lake will increase habitat for suckers during some years (i.e., during average and above-average inflow conditions).
- Water storage in Gerber Reservoir will increase habitat for suckers in the spring.
- Water releases from Clear Lake and Gerber Reservoir during the irrigation season increase habitat in the Lost River.
- Consistent annual delivery of at least 22,000 AF of water to Tule Lake Sump 1A will maintain habitats for sucker population and maintain areas with sufficient water depths to reduce predation risk.

Aspects of the PA, including Conservation Measures, that minimize impacts to LRS and SNS in the Lost River Basin Recovery Unit, include:

- The Clear Lake fish screen reduces entrainment of juvenile suckers and prevents adult entrainment.
- Maintenance of seasonal water levels in Tule Lake provides habitat for LRS and SNS within operational constraints.
- Proposed salvage of suckers in canals around Tule Lake will minimize adverse effects of entrainment and seasonal dewatering.
- Management of irrigation deliveries from Clear Lake and Gerber Reservoir to avoid lake elevations below the proposed minima will limit adverse effects of reductions to available habitat or restricted access to spawning tributaries.
- Maintaining flow in Miller Creek through the frost valve at Gerber Reservoir will minimize stranding of suckers.

Lost River Basin Recovery Unit - Conclusion

The most substantial effects of the PA to LRS and SNS in the Lost River Basin Recovery Unit are likely to be the seasonal loss of habitat resulting from water diversions from Clear Lake during infrequent prolonged droughts and entrainment at Clear Lake Dam and Gerber Reservoir Dam. The best available information indicates that Project operations will not be a limiting factor for spawning in dry years, when streamflow will likely preclude spawning regardless of Project operations, or in wet years, when rapid increases in lake elevations should provide access even following relatively low lake elevations in the fall. However, uncertainty remains about Project effects in moderately wet years.

Effects to LRS and SNS Population Viability

ESA Section 7(a)(2) requires the Service to determine if the PA would likely result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution. As was discussed in the *Status of the Species* (Section 5), to both survive and to recover (i.e., to be viable), the LRS and SNS needs to have resiliency and redundancy, and that requires frequent recruitment and multiple populations, which can only occur when there is adequate survival of all life stages from embryos to adults.

Currently in UKL, the primary limiting factor for LRS and SNS is low age-0 juvenile survival, as described in the *Status of the Species* (Section 5). Based on the knowledge that juvenile survival is the primary factor putting LRS and SNS populations at risk of extirpation in UKL, there are two aspects of the effects analysis that deserve particular attention: 1) Does the PA contribute additively to the annual juvenile disappearance?, and 2) Are effects to the remaining adults small enough to allow for the continued production of larvae to support assisted rearing and natural survival rates?

Estimated entrainment losses of age-0 juveniles measured at the UKL outlet make it clear that thousands of larvae and age-0 juveniles are likely to be entrained from UKL every year as a result of Project operations. Furthermore, entrainment rates of age-0 juveniles are likely elevated by the PA because Link River flows during August and September, when age-0 juveniles are present, are artificially increased by Reclamation in order to provide water for irrigation. Loss of age-0 juveniles is more of a concern than loss of larvae because juveniles should have a greater likelihood of recruiting into the adult population than larvae. Based on this, entrainment of young suckers is likely to affect population viability. Assisted rearing reduces the overall effect of the PA on population viability.

Reclamation has committed to provide funding for a multi-faceted assisted rearing program. The Reclamation-funded portion of this program, as implemented by the Service, is intended to reduce the effects of the PA on LRS and SNS populations – not to produce sufficient suckers to achieve recovery. Though mortality is expected during collection and rearing of suckers, overall survival during collection and in captivity is expected to be an order of magnitude higher than in the wild, and survival of reared fish after release back into UKL is also expected to be much higher than current survival of age-0 juveniles, as discussed in detail in Section 7.1.5.2. Therefore, assisted rearing is anticipated to have beneficial effects to larval and juvenile survival while fish are in captivity and ultimately result in recruitment to the adult populations, which will promote population viability.

Based on observed adequate adult survival across a wide range of lake elevations, Project operations are not expected to appreciably reduce adult sucker survival in UKL. There is a chance of adverse effects to reproductive output at the shoreline springs; however, the probability of such conditions occurring in the term of the Opinion is low and should these conditions occur, it will only impact a small portion of the LRS spawning population. Additionally, it is expected that overall larval production would still be large under such conditions given that the maximum impact to reproduction at the shoreline springs is expected to be around 35 percent, and there would be no impacts to spawning in the Williamson River where a large majority of LRS and all SNS spawn. Therefore, the effects of the PA on adult survival and spawning are not expected to reduce population viability.

The Service is also actively engaged in sucker recovery actions in and around Klamath Project reservoirs, with financial and logistical support from Reclamation. These recovery actions are intended to both reduce the impact of the PA on all life stages of suckers and actively work toward recovery of the species. The PA primarily impacts lake elevations, and while management of water in the lake has clear direct and indirect impacts to suckers, it is not the only factor, nor likely even the most crucial factor, limiting recovery. Service efforts focused on water quality improvement, habitat restoration, and algal bloom reduction, bolstered by the release of captively-reared suckers, address and work toward recovery, and therefore population viability, of suckers.

The PA also provides for consistent water deliveries to historic sucker habitat at Lower Klamath and Tule Lakes. While establishment of these populations does not directly impact the loss of juveniles in UKL nor mitigate for the impacts to remaining adults, it does provide important resiliency should there be a catastrophic loss of one of the other populations. This risk is particularly high for the UKL populations of LRS and SNS, given the complete lack of recruitment in the lake and the continued decline of the existing adult population due to this lack of recruitment. This part of the PA, while having some potential to reduce habitat in UKL in a subset of dry years, will increase the likelihood of recovery of the species by offering habitat in which larval and juvenile suckers can survive and increase the distribution of the species across its historical range.

At Clear Lake and Gerber Reservoir, SNS appear to be experiencing frequent recruitment. Although sufficient data is not available to evaluate whether recruitment rates are sufficient to offset adult mortality, the PA is consistent with operations that have sustained these populations over the recent past decades, so it is not likely to significantly affect viability. The population of LRS in Clear Lake appears to be in a more tenuous state, with variable recruitment and the apparent loss of some cohorts as older juveniles or young adults. Adverse effects of lake-level management on LRS in Clear Lake cannot be ruled out because LRS and SNS habitat needs and the hydrologic conditions that allow for access to Willow Creek are not fully understood. Resolving this uncertainty is critically important to ensure the conservation of endangered suckers in Clear Lake; the Service is actively involved in working to address this lack of knowledge through various monitoring and research efforts. However, based on the best available information, the PA does not appear likely to reduce the viability of the sucker populations in Clear Lake and Gerber Reservoir.

Summary of Cumulative Effects

Future non-Federal actions within the action area are expected to result in beneficial effects. Specifically, increased screening should reduce entrainment into irrigation diversions, habitat restoration is expected to improve habitat availability and water quality, and the Klamath Tribes' sucker rearing efforts are anticipated to increase recruitment to the UKL sucker populations.

Synopsis of Non-Jeopardy Determination

The Service's non-jeopardy determination for the effects of the PA on the LRS and SNS is based on the following. The small number of remaining LRS and SNS populations, the status of the LRS and SNS populations in UKL, and the status of the Clear Lake LRS population suggest that further reductions in the resilience of populations in UKL, Clear Lake, or Gerber Reservoir raise concerns for the ability of the species to recover. Survival is expected to continue to be influenced by Project activities such as entrainment; however, larval and juvenile survival are expected to increase due to assisted rearing, canal salvage relocating up to 1,500 juvenile sucker that were entrained, and the implementation of recovery and monitoring commitments that will assist in species recovery actions as part of the PA. The highly degraded state of the environmental baseline and status of LRS and SNS were apparent throughout this consultation. To address these factors, Reclamation coordinated extensively with the Service during development of the PA (See Consultation History). That effort resulted in a PA that includes dedicated water deliveries to National Wildlife Refuges for the establishment of auxiliary populations and higher seasonal UKL elevations than the species experienced historically. For example, before the construction of Link River Dam (1905-1921), UKL surface elevations in mid-July ranged from 4,139.96 ft. to 4,141.66 ft., narrower than the range of conditions expected under the PA and with both higher low elevations and lower high elevations. Higher average seasonal UKL elevations are important to provide habitat for larval, juvenile, and adult LRS and SNS, due to the widespread loss of other habitat in the past. However, substantial adverse effects remain that could not be further minimized by modifying water management, such as entrainment at the Link River Dam. Consequently, the Service worked closely with Reclamation to propose specific conservation measures that would likely be most successful in further minimizing adverse effects and maintain or improve resilience and redundancy. The goal of the conservation measures was to minimize the remaining adverse effects of the PA on population viability, thus making the action compatible with the survival and recovery needs of the species. In particular, assisted rearing is expected to increase the survival of larvae and juveniles that are brought into captivity; and based on preliminary results and results from other sucker propagation efforts, the Service expects that some of the large juvenile suckers released from the program are likely to survive and recruit into the adult populations, increasing the resilience of the UKL populations. Additionally, the PA provides at least 43,000 AF of dedicated Project supply annually, to Tule Lake and Lower Klamath National Wildlife Refuges to maintain habitat for endangered suckers at these locations.

Based on the analysis above, the Service concludes that the PA is not likely to result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution.

9.1.2 Northwestern Pond Turtle

Synopsis of Non-Jeopardy Determination

Section 6.3 describes the factors that have led to the current status of the NWPT as proposed threatened throughout its range under the ESA, and particularly the threats identified at the time of proposed listing (e.g., habitat loss, disturbance, alteration of natural hydrology, and predation).

In determining the current status of the species, the Service separated the NWPT range into fourteen analysis units based upon genetic, management, and ecological data. Across its range, the NWPT is distributed across four states, and maintains redundancy, particularly in the central portion of the range in which the action area lies. While the species exhibits representation due to ecological flexibility, there is evidence of low genetic diversity in a large portion of the range. Overall, the NWPT has an 85 to 95 percent likelihood of persistence within the next approximately 25 years, indicating that the species currently maintains resiliency, or the ability to withstand stochastic events. Taken together, this indicates that NWPT currently maintains some ability to adapt to changing environmental conditions in the near term (Service, 2023).

In the future, the northwestern pond turtle has an increasing risk of extinction over time from stochasticity, catastrophic events, and inability to adapt to changing conditions. In 2075, abundances will decrease over time, but persistence of analysis units is more likely than not. By 2100, abundances decrease further and 5 to 7 of the 14 analysis units are more likely to become functionally extinct than to persist, indicating increasing species-level extinction risk in the next approximately 75 years (Service, 2023).

The action area is completely within the range of the NWPT, and the area has a long history of project related disturbances. NWPT are known to occur within the action area, although their distribution, abundance, and condition are not known. Similarly, little is known about the extent of nesting and overwintering habitat, although it is assumed to exist, based upon the known existence of NWPT within the action area. It is also assumed that habitats are scattered and that the quality of the habitat varies across the action area, depending upon local conditions including soil and vegetation composition, permanent versus ephemeral water, and anthropogenic factors such as recreation, irrigation, grazing, etc. However, the action area represents an area of likely diverse habitat conditions which can be important for NWPT resilience and representation and therefore also important to the NWPT survival and recovery.

It is assumed that turtles will be exposed to project activities during project implementation where turtles or their habitats are present. Implementation of proposed project activities may result in adverse effects to NWPT including (1) injury or mortality of NWPT eggs, hatchlings, juveniles, or adults, (2) habitat loss or degradation, and (3) auditory, visual, and disturbance.

Adverse effects to NWPT resulting from project activities may include direct injury or mortality to hatchling, juvenile, and adult NWPT may occur from trampling, crushing, or burying of nests, eggs in nests, or individuals during road, dike, boat ramp, and access area maintenance. Adverse effects may also occur through direct contact with foot traffic or mowing and heavy equipment within upland nesting habitat. Adverse effects are expected to upland nesting habitat through soil compaction resulting from mowing and heavy equipment activity. All other project related impacts to NWPT and its habitat, including auditory and visual disturbance impacts, are expected to be temporary and insignificant.

While the Service expects adverse impacts to potentially affect local NWPT numbers, the overall impact to NWPT analysis units or populations at the range wide scale is expected to be minimal. Due to the project area's long history of being subject to PA disturbance, project related impacts do not represent a major change from the status quo and NWPT have likely already modified their use of potential habitat. Additionally, project related NWPT impacts do not occur within the entire action area or even within all potential NWPT habitat within the action area. Impacts are instead limited to the 48,515 acres of potential upland nesting habitat located within the project footprint along access roads, where mowing and heavy equipment activities are anticipated to occur. This estimate of affected acres is likely high because not all acres within all of the adjacent buffered areas are considered suitable nesting habitat. The area buffered to create the acreage total includes areas (e.g., roadbeds, concrete, gravel/rocked surfaces) that are not suitable for turtles due to compacted soils and other substrate that do not provide conditions necessary for turtle nesting or overwintering. Additionally, some areas for mowing likely include thick vegetation compared to nesting habitat that typically has sparse vegetation and short grasses and forbs (See Section 6.2). This buffering method provides the best reasonable estimate to determine potentially impacted habitat, since nesting habitat has not been mapped within the Project. The amount of potentially affected nesting habitat represents a small spatial area in relation to the large range of the species, which expands across three states (California, Oregon, and Washington). Therefore, range wide impacts to NWPT reproduction, numbers, and distribution at the range wide scale are expected to be minimal.

Based on the analysis above, the Service concludes that implementation of the PA is not likely to result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution.

9.2 Destruction or Adverse Modification of Critical Habitat Determination

The destruction or adverse modification analysis determines if the PBFs of critical habitat would remain functional to serve the intended recovery role for the species as a result of implementation of a proposed Federal action (USFWS 2012). The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that alter the physical or biological features to an extent that appreciably reduces the conservation value of critical habitat for the LRS and the SNS (USWF 2012). The role of critical habitat is to support life-history needs of the species and provide for the conservation of the species.

The destruction or adverse modification analysis in this opinion relies on four components: (1) the Status of Critical Habitat, which describes the range wide condition of the critical habitat for the Lost River sucker and shortnose sucker; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which are all consequences to critical habitat caused by the PA that are reasonably certain to occur in the action area; and (4) Cumulative Effects, which evaluate the effects of future non-Federal activities in the action area that are reasonably certain to occur.

For the section 7(a)(2) determination regarding destruction or adverse modification, the Service begins by evaluating the effects of the proposed Federal action and the cumulative effects. The Service then examines those effects against the condition of all critical habitat described in the listing designation to determine if the PA's effects are likely to appreciably diminish the value of critical habitat as a whole for the conservation of the species.

9.2.1 Summary of the Status of LRS and SNS Critical Habitat

PBF 1 is water quantity and quality. The two critical habitat units have a similar status with respect to water quantity. Namely, water quantity across days, seasons, and years, and low lake elevations or streamflow can reduce the recovery support function of the critical habitat by reducing availability of and access to suitable habitat. The water quality component of PBF 1 appears to be functioning in Critical Habitat Unit 2; however, water quality is highly degraded in Critical Habitat Unit 1.

PBF 2 is spawning and rearing habitat. Spawning habitat is largely functioning as intended in both critical habitat units. However, low streamflow conditions in the tributaries to Gerber Reservoir and Clear Lake in Unit 2 can reduce the ability of the habitat to support successful reproduction. Similarly, some of the habitat at the UKL shoreline springs in Unit 1 becomes unusable in low water years due to low lake elevations. Rearing habitat has been greatly reduced from historical levels in Unit 1 through the draining of wetlands. The wetland restoration and reconnection of Agency-Barnes to UKL, adds over 13,800 acres of wetland habitat available to LRS and SNS. Currently, it is unclear how long it will take for existing plant communities to transition to more diverse wetland plant communities and how and when LRS and SNS will use this wetland area. However, the restoration of over 13,800 acres of open and shallow water habitats along the lake fringe of UKL will greatly increase the rearing habitat available to LRS and SNS, a limiting factor to species recovery. Thousands of acres of emergent wetlands still exist, but these can become largely unavailable at very low lake elevations. Although Clear Lake and Gerber Reservoir are largely devoid of emergent vegetation, both reservoirs exhibit regular recruitment, suggesting that the habitat is serving its recovery support function.

PBF 3 is food. Although food availability has not been specifically evaluated across all of the critical habitat, the upper Klamath basin is highly productive, and all of the critical habitat appears to contain an abundant forage base.

9.2.2 Summary of the Environmental Baseline of LRS and SNS Critical Habitat

Overall, the habitat of the species has been lost or degraded in numerous ways that are likely to reduce the capacity of the habitat to support the life history and provide for the conservation of LRS and SNS. In Critical Habitat Unit 1, the environmental baseline of poor water quality is of particular note because it creates stressful conditions for juvenile and adult suckers annually in late summer. In Critical Habitat Unit 2, water quantity as it relates to spawning access is especially important, particularly in Clear Lake. Low streamflow and/or lake elevations during the spawning season can limit access to spawning habitat such that the habitat does not provide its function of supporting reproduction.

9.2.3 Summary of the Effects to LRS and SNS Critical Habitat

The *Effects of the Action on LRS and SNS Critical Habitat* (7.1.6) in this Opinion describes how the PA was likely to affect the PBFs essential to the conservation of LRS and SNS in the two critical habitat units (UKL and Lost River Basin).

The primary effects of the PA on critical habitat are to PBFs 1 (water) and 2 (spawning and rearing habitat) through the seasonal and longer-term changes that occur owing to water storage and delivery. This results in increases of habitat in some seasons and years and decreases in others, resulting in beneficial, adverse, and insignificant effects. For UKL, the PA was designed to provide lake levels that provide availability of important habitats, which is often a result of managing water.

In Unit 1, there is no causal link to adverse effects to water quality (PBF 1) in UKL from implementation of the PA; however, there is evidence that water diversions through the Project cause a net reduction in nutrients downstream of UKL, which is beneficial. In Keno Reservoir, there are return flows into the reservoir from agricultural diversions that are part of the PA, resulting in some negative effects to water quality. Under the PA there are expected to be occasional adverse effects to spawning and rearing habitat (PBF 2) and availability of preferred depths for adults (PBF 1), but they are expected to still provide for the long-term recovery function of UKL. The proposed Project does not affect food availability (PBF 3) in Unit 1.

In Unit 2, there is no effect to water quality (PBF 1) or food availability (PBF 3) from proposed Project operation in Clear Lake, but the effects of the PA on access to spawning habitat (PBF 2) are unclear. As described in the *Effects Analysis* (Section 7.1.6.2), there are no anticipated effects in wet or dry years, but there is uncertainty about whether adverse effects will occur under intermediate hydrologic conditions Still, these effects are unlikely to impede the conservation role of critical habitat for the LRS and SNS in Clear Lake based on the recurring recruitment that has occurred in the recent past, which suggests that the habitat is available and does function when PBF 1 is present. The PA is likely to adversely affect rearing habitat (PBF 2) and adult habitat (PBF 1) during droughts that could potentially occur during the term of this Opinion. In Gerber Reservoir, there are no adverse effects to PBFs of critical habitat as a result of the implementation of the PA. Project effects to PBF 1 and 2 in Gerber Reservoir are expected to be insignificant.

9.2.4 Summary of the Cumulative Effects

In general, the cumulative effects on critical habitat described above are expected to improve the status in UKL through reductions in nutrient inputs and eventually in water quality (PBF 1), but the timeline for such improvements is uncertain.

9.2.5 Synopsis for Non-Adverse Modification Determination

Based on the analysis in this Opinion, designated critical habitat is expected to continue to provide the conservation role of critical habitat for LRS and SNS at the scale of designated critical habitat. Critical habitat range-wide remains functional in all but the driest years with the lowest lake elevations which, result in reductions in available spawning and rearing habitat. To support LRS and SNS, which are long-lived, highly fecund species, critical habitat needs to support the survival of adults and recurrent, but not necessarily uninterrupted, reproduction because infrequent, strong cohorts can support populations. The adverse effects to the PBFs described above are temporary, limited to days or weeks, and do not preclude the critical habitat's support of adult survival and frequent successful reproduction and rearing. Therefore, the Service does not anticipate that effects of the PA will result in the destruction or adverse modification of LRS and SNS critical habitat because the PA will not alter the essential physical or biological features to an extent that appreciably reduces the conservation value of critical habitat range wide for LRS and SNS.

10 INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant section 4(d) of the Act prohibit the take of endangered and threatened species, respectively without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm in the definition of "take" in the Act means an act which actually kills or injures wildlife. Such [an] act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Under the terms of Sections 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the Incidental Take Statement.

This incidental take statement is based upon the PA occurring as described in the accompanying biological opinion. Take of listed species in accordance with this incidental take statement is exempt under section 7(o)(2) of the Act. For the exemption in Section 7(o)(2) of the Act to apply, Reclamation must implement the PA as described in this biological opinion and undertake the non-discretionary measures described below, so that they become binding conditions of any grant or permit issued to the permittee(s), as appropriate. Reclamation has a continuing duty to regulate the activity covered by this Incidental Take Statement. If Reclamation fails to assume and implement the terms and conditions or fails to retain oversight to ensure compliance with these terms and conditions, the exemption provided in section 7(o)(2) may lapse. To monitor the impact of incidental take, Reclamation must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR 402.14(i)(3)].

10.1 Lost River and Shortnose Suckers

10.1.1 Assumptions

Sections 7.1.1 and 7.1.2 of this Opinion, provides several assumptions and sideboards regarding the Service's understanding of how the PA would be implemented. The analysis of effects to LRS and SNS is based on these assumptions and sideboards; therefore, both are integral to the determination of the amount of take that will likely result from implementing the PA. These assumptions and sideboards should be monitored throughout the term of this Opinion to determine if they are valid; otherwise, ongoing Project operations could be outside the scope of this Opinion and reinitiation of consultation could be triggered. Please refer to *Analytical Approac*h (Section 7.1.1) and *Key Assumptions for the Effects Analysis* (Section 7.1.2) within this Opinion for a description of the assumptions and sideboards upon which the analysis is based.

10.1.2 Amount or Extent of Take

Over the five-year term of the PA, take of adults, juveniles, and larval LRS and/or SNS is anticipated to occur in the form of collect, capture, kill, and harm. The Service anticipates the PA could result in the annual incidental take of up to 168,658 listed suckers of all life stages by killing, 7,039,533 by injury, 36,000 by capture, and 121,500 by collection; approximately 99 percent of the anticipated annual incidental take would be of sucker larvae and eggs. Overall, the incidental take is expected to be both lethal and nonlethal and result from entrainment into Project facilities, seasonal habitat reductions in Project reservoirs due to water diversions, sucker monitoring and required studies, assisted rearing, and O&M activities associated with the Project, including sucker salvage (Tables 9 and 10).

Table 9. Summary of Maximum Annual Levels of Incidental Take of LRS and SNS Anticipated to Occur as a Result of the PA.

Cause of Take	Locations of Take	Type of Take	Life Stage Affected	Combined Maximum Annual Amount of LRS and SNS Taken
Entrainment into Project Diversions	A Canal Link River Dam Clear Lake Dam Gerber Reservoir Dam, Other Project Diversions	Kill and Injure	Larvae Juveniles Adults	6,926,680 larvae injured 135,438 larvae killed 112,653 juveniles injured 2,263 juveniles killed 2 adults killed
Stranding of Juveniles at Lake Elevations Lower than 4522 ft.	Clear Lake	Kill	Juveniles	50 juveniles 5 adults
Dewatering of Spawning Habitat	Upper Klamath Lake	Kill	Eggs	14% reduction in the number of spawning females, 36% reduction in duration of spawning
Dewatering of Habitat	Tule Lake NWR Sump 1A and Lower Klamath NWR Unit 2	Kill and Injure	Larvae Juveniles Adults	LKNWR: 100 juveniles killed or injured TLNWR: 50 juveniles and 50 adults killed or injured

Cause of Take	Locations of Take	Type of Take	Life Stage Affected	Combined Maximum Annual Amount of LRS and SNS Taken
Implementation of Conservation Measures	UKL and Tributaries Project canals	Kill and Collect	Eggs Larvae Juveniles Adults	30,000 eggs or larvae killed, and 120,000 larvae collected; 240 juveniles killed and 1,500 collected; 1,000 adults captured and 100 killed
Monitoring of Adult Sucker Populations and Larval and Juvenile Entrainment[1]	UKL, Clear Lake, Gerber Reservoir, Tule Lake Sump 1A, and Keno Reservoir	Kill and Capture	Larvae Juveniles Adults	200 juveniles killed and 20,000 captured; 150 adults killed and 15,000 captured
Operation and Maintenance Activities	Project Wide	Kill Capture	All life stages	10 total of all life stages killed Capture and salvage of any suckers in the work area

1. Monitoring of adult sucker populations in Project reservoirs is part of the monitoring requirements. As such, they are in addition to take occurring as a result of the PA.

In most cases, the amount of incidental take of the listed suckers is based on limited data and numerous assumptions, and nearly all forms of take will be impracticable to detect and measure for the following reasons: (1) to identify larval and juvenile listed suckers to species requires collecting, transporting to a lab, and x-raying the suckers to count the number of vertebrae; (2) precise quantification of the number of listed suckers entrained into Project facilities would require nearly continuous monitoring, and would itself result in considerable lethal take; (3) their cryptic coloration makes detection difficult during salvage operations; (4) the likelihood of finding injured or dead suckers in a relatively large area, such as a reservoir or canal system, is very low; and (5) a high rate of removal of injured or killed individuals by predators or scavengers is likely to occur, which also makes detection difficult. Furthermore, listed suckers will die from causes unrelated to Project operations and determining the cause of death is unlikely. For example, many moribund adult suckers were collected at the Link River Dam during the die-offs of the 1990s (Gutermuth et al. 2000b, 2000c). These suckers were likely entrained because they were either dead or dying from disease or stressed as a result of the adverse water quality documented at that time. Therefore, the number of listed suckers taken is estimated and cannot be accurately quantified. However, the Service has tried to estimate take as the maximum anticipated take to avoid underestimating the effect of the take. The Service also identified the PA provides lake levels and flows that correlate with the amount of take described; these elements of the action are measurable and provide a suitable surrogate to identify when take may be exceeded.

10.1.3 Incidental Take Caused by Entrainment at Project Facilities

Entrainment of LRS and SNS is anticipated to occur at Reclamation's water management facilities, including: A Canal, Link River Dam, Clear Lake Dam, Gerber Reservoir Dam, Lost River Diversion Channel, and Ady Canal. Entrainment is also anticipated to occur at privately owned pumps and gravity diversions that use Project water and therefore are part of the Project, as described in the *Environmental Baseline* and *Effects of the Action* (Sections 5.5 and 7.1) of this Opinion. The amount of entrainment is expected to vary on a seasonal and yearly basis, depending upon the level of larval production in any given year and other factors. The level of take authorized is based upon what is believed to be high production conditions, and thus should be close to the maximum. Adjustments in estimated entrainment rates were made due to decreases in LRS and SNS population estimates based on the assumption that entrainment is likely to be proportional to the abundance of adult suckers. Additional assumptions for these entrainment estimates, and the details of the calculations are described in Section 7.1.3.1.7.

A Canal Entrainment Estimates

Most of the entrainment take by the Project occurs at A Canal and Link River Dam spillway gates because these facilities are immediately downstream from UKL. Although the A Canal is equipped with a state-of the-art fish screen that meets the Service criteria, up to 69,236 larvae (20 percent of the expected 346,180 that reach the screen) pass through the screen and are entrained into the canal every year based on the maximum volume diverted in the model POR.

Most larvae that pass through the screen will be harmed because they are likely to be injured or die from adverse water quality conditions, passing through pumps and being discharged onto agricultural fields, or remaining in irrigation canals when they are drained at the end of the irrigation season. However, some larvae will survive in the canals and up to 1,500, with an average of around 300, are expected to be salvaged as age-0 juveniles at the end of the irrigation season and will be moved to permanent water bodies, such as UKL, where they are more likely to survive. The number of larvae and age-0 juveniles entrained into the A Canal headworks and that subsequently pass through the screen will be highly variable annually; the amount will likely depend on several factors, including annual production, which can vary annually by several orders of magnitude (Simon et al. 2014). The analysis assumes that all larvae entrained into the A Canal will be killed to ensure take is not underestimated. Thus, the expected annual number of larvae killed by entrainment into the A Canal is 69,236 based on the calculations described in the *Effects Analysis*. Larvae that do not enter the A Canal are screened and diverted through the gravity bypass because the pumped bypass is not operated during the spring and early summer when larvae are present. The Service anticipate that the proportion of suckers injured or killed as a result of physical strikes with objects and pressure changes during gravity bypass would be less than or equal to the amount that passes through a dam, which is expected to be two percent (Whitney et al. 1997 pp. 16–17, Muir et al. 2001 p. 142). Thus, the Service expect an additional 1,385 larvae to be killed during bypass.

Suckers larger than about 30 mm total length are not likely entrained into the A Canal because of the small-sized openings in the screen (Simon et al. 2014 pp. 79 & 101–102). Based on sampling at the FES between 2013 and 2018, the maximum expected number of juveniles bypassed would be 60,000 based on complete season estimates from 2016—the year with the highest catches at FES (USBR 2018c Appendix B). The pumped bypass has a "fish friendly" pump that minimizes injuries and mortality during bypass (Marine and Gorman 2005). Therefore, it is expected that injuries and mortality would be less than that experienced during passage through a dam spillway and a maximum of two percent (1,200) could be killed due to physical strikes with objects or pressure changes (Whitney et al. 1997 pp. 16–17, Muir et al. 2001 p. 142). No adults should be entrained at the A Canal due to exclusion by the trash rack, which has two openings. All of the suckers passing through the pumped or gravity bypass will experience substantial disruption of normal behaviors, such as feeding and predator avoidance. However, as described above it is expected that two percent could be injured or killed. Thus, the Service estimates up to 1,200 juveniles could be killed annually at the A Canal.

Link River Dam Entrainment Estimates

Based on the analysis described in the *Effects Analysis* section 7.1.3.1.7, more than 2.05 million total suckers, the vast majority larvae, could be entrained annually at Link River Dam. Because power generation has ceased at both the West Side and the East Side Power Canal, nearly all of the Link River flow passes through the spillway gates of the dam, and consequently the Service assumed all of the take occurring there will be attributable to the Project. Based on a review of the literature on the effects of dams on fish that have documented injuries resulting from physical strikes with objects and pressure changes associated with passing through spillways, the Service assumed two percent of the fish passing through the spillway of the Link River Dam will be harmed (Whitney et al. 1997 pp. 16–17, Muir et al. 2001 p. 142).

Based on the POR, the maximum annual larval entrainment is expected to be 2,056,256 with harm to 41,125 of those. Up to 2,840 age-0 juveniles are estimated to be entrained at the dam every year based on observed densities of entrained juveniles prior to the installation of the fish screen at the A Canal. The Service estimates an additional 24,992 age-0 juveniles could be entrained at the Link River Dam after passing through the pumped bypass (50 percent of bypassed individuals, see *Effects Analysis*). The Service assumes two percent of the juveniles entrained (27,832) through Link River Dam are likely harmed by passing through the spillway gates as described above, resulting in an estimate of 557 harmed juveniles. Similarly, annual entrainment of adult suckers at the Link River Dam is estimated to be approximately 50 plus an additional 47 bypassed from the A Canal. Assuming that two percent of these 97 adults are killed as a result of physical strikes with objects and pressure changes associated with passing through the spill gates, two adults would be killed.

The Service estimates up to 2.05 million larvae, 27,832 juveniles, and 97 adults could be entrained through the Link River Dam annually. Of the suckers entrained, the maximum annual lethal take at the Link River Dam is estimated to be 41,125 larvae, 557 juveniles, and two adults.

Entrainment at Clear Lake Dam

In contrast to Upper Klamath Lake, there is no upstream passage for fish that are entrained through Clear Lake Dam. There is no accessible spawning habitat in the Lost River system below Clear Lake Dam or Gerber Reservoir Dam, so even if individuals survive the relatively poor habitat conditions in the Lost River, entrained individuals are effectively lost from the reproducing populations. Therefore, all entrainment through Clear Lake Dam is treated as take, which could manifest in the form of harm as individuals pass through the dam or as an inability for individuals to reproduce.

Releases from Clear Lake Dam were sampled for larval and juvenile fish between April 22, 2013, to July 17, 2013, and an estimated 268,335 larval suckers and 3,659 juvenile suckers were entrained over that period. Larval sucker entrainment was concentrated in the spring with the bulk of the catch coming between the last week of April and mid-May, but some larval entrainment was observed into June. The timing of larval drift is likely to vary among years. Based on the timing of adult migration relative to the run in 2013 (Hewitt and Hayes 2013), it is assumed the larval entrainment period most likely falls between April 1 and June 30 in all years. The 2013 data is assumed to be representative of larval densities in Clear Lake because information on the interannual variation in larval abundance is not available. The average larval densities between April 22 and June 30, 2013 (22.3027 larvae/AF) were multiplied by the volume of water released from Clear Lake between in April-June for each water year between 1986 and 2018 to estimate larval entrainment. During times of extremely high inflows, Reclamation makes flood control releases to ensure that sufficient capacity remains in the reservoir. Entrainment under such conditions would not be considered take because it is driven by hydrology rather than water management and such operations are outside of Reclamation's discretion. Excluding years with flood control operations (1998 and 1999) and 2000 due to releases in preparation for dam reconstruction, the maximum estimated entrainment of larvae was 573,654 individuals. The Service anticipates two percent of these (11,473) are likely to be killed as they pass through the dam as described above. The remaining 562,181 individuals would not be able to complete their life cycle as described above and would be considered injury.

Juvenile sucker entrainment was estimated in a similar manner except there was no clear seasonal pattern in juvenile sucker entrainment during the 2013 study, so it was assumed that juvenile entrainment is constant across the year. Thus, the average density of juvenile suckers from the 2013 study (0.1867 juveniles/AF) was multiplied by the total releases for the water year, and the maximum that occurred between 1986 and 2018 was 12,265. As described above, two percent (245) are expected to be killed, and the rest (12,020) are expected to be injured. The Service does not anticipate take of any adults through entrainment at Clear Lake Dam.

Entrainment at Gerber Reservoir Dam

Although data on the densities of entrained suckers at Gerber Reservoir Dam are not available, salvage efforts and sampling in Miller Creek indicate that some suckers are entrained annually (Hamilton et al. 2003b). The Service expects larval entrainment to be less than or equal to the entrainment at Clear Lake Dam for two reasons: 1) the adult SNS population in Gerber Reservoir is thought to be smaller than the combined SNS and LRS populations in Clear Lake, and larval and juvenile production is also expected to be smaller; and 2) larvae in Clear Lake are likely to be more vulnerable to entrainment than those in Gerber Reservoir due to the proximity of the mouth of Willow Creek to Clear Lake Dam. Therefore, the Service anticipates the maximum annual entrainment at Gerber Reservoir would not be greater than the entrainment estimated at Clear Lake.

Entrainment at Other Project Facilities

Entrainment is also likely occurring at other Project facilities, such as Lost River Diversion Channel and diversions along the Lost River, including privately owned diversions that use

Project water, as discussed in the *Effects of the Action* (Section 7.1). However, the location-specific data is unavailable to precisely estimate take at these facilities. Take at most of these locations, particularly the private diversions along the canal system and the Lost River, would comprise individuals that are included in the estimates of take through entrainment at other facilities such as Clear Lake Dam, Gerber Reservoir Dam, and the A Canal. The Service has used the best available information to account for take through these locations regardless of previous entrainment into canals or other structures.

Entrainment at the locations described above is difficult to quantify but is likely to occur at a low level because of the smaller volumes of water moving through these structures and the low density of suckers in these areas. There is extremely limited data available on sucker densities outside of the main reservoirs. The available information includes sampling in the Lost River system, which yielded 6.5 percent of mean catches from sampling in Clear Lake (Shively et al. 2000b p. 82, Hewitt and Hayes 2013 p. 17). Therefore, the Service assumes that collectively, Project facilities that are not discussed in the above sections, including private diversions that use Project water, are likely to have approximately 6.5 percent of entrainment that occurs from Clear Lake (Table 10).

Entrainment Estimates for the Entire Project

Based on the analysis presented above, the total estimated annual entrainment, take of LRS and SNS at all Project diversions, as a result of implementing the PA, could be up to 212,845 killed and 1.19 million injured; most of these will be larvae (Table 10).

Table 10. Estimated Annual Maximum Take Due to Entrainment of LRS and SNS at Project Facilities as a Result of Implementing the PA.

Location	Larvae		Juveniles		Adults	
	Non-Lethal	Lethal	Non-Lethal	Lethal	Non-Lethal	Lethal
A Canal	246,180	70,621	60,000	1,200	0	0
Link River Dam	2,056,256	41,125	27,832	557	0	2
Clear Lake Dam	562,181	11,473	12,020	245	0	0
Gerber Reservoir Dam	562,181	11,473	12,020	245	0	0
Other Project Facilities	36,542	746	781	16	0	0
Total	6,926,680	135,438	112,653	2,263	0	2

10.1.4 Incidental Take from Seasonal Reductions in Habitat due to Water Management and Reduced Instream Flows

A number of large-scale restoration efforts are underway in the Klamath basin creating ecosystem level changes to the environment that will fundamentally change UKL surface area and the amount of wetland habitat. This paradigm shift has removed required elevations in the PA therefore, surface elevations are used as a surrogate to estimate incidental take due to habitat reduction. The PA could result in take of individuals at the springs along the eastern shoreline of UKL under certain conditions. Elevations that fall below 4,142 ft. between the end of March and the end of May would be expected to alter the spawning behavior of LRS at the shoreline springs. At elevations between 4,141.4 ft. and 4,142 ft., reduced spawning durations for female suckers would be expected by approximately 20 percent (Burdick et al. 2015b p. 487). If spawning duration is directly proportional to eggs deposited, these elevations would result in take of approximately 20 percent of the reproductive output of the shoreline springs spawning population. More extreme elevations, similar to those observed in 2010, would be expected to result in 14 percent fewer females spawning and a 36 percent reduction in duration on the spawning grounds (Burdick et al. 2015b pp. 483–484). In the POR, (under the pulse flow simulation) only four years had elevations similar or worse than those observed in 2010, so similar reductions in spawning would be expected to be the maximum observed in a given year. However, the frequency of adverse effects is also a concern. Lake elevations below the range of 4,141.4 ft. to 4,142 ft. between the end of March and the end of May during the five-year term of this Opinion are possible as described in Section 7.1, and therefore the possibility of lake elevations below the range of 4,141.4 ft. to 4,142 ft. every year has been considered in this incidental take statement.

As described in the *Effects Analysis*, the dewatering of wetlands under the PA could displace larvae. Larvae tend to occur in higher densities in emergent wetland habitats. Higher densities of larvae in emergent wetlands could result from active selection of the habitat, reduced movement out of the habitat, or increased survival within the habitat. Habitat selection or decreased movement likely would be driven by access to some resource, such as food or cover. Thus, displacement from the habitat would likely result in decreased access to this resource or in decreased survival. However, the specific effects of decreased wetland inundation on survival are difficult to infer, particularly given that lake elevations would be expected to decrease from spring to fall due to natural hydrology. One way to evaluate the sufficiency of wetland inundation is to compare lake elevations from the POR on July 15, after which emergent wetlands are thought to be less important, with conditions observed before the construction of Link River Dam. Three years in the modeled POR are below the range for observed pre-dam conditions (minimum of 4,140.8 ft.), and 29 of 32 model years are above the mean from the pre-dam period. Based on this comparison, the Service anticipates there could be take of larval suckers by increasing mortality rates when lake elevations fall below 4,140.8 ft., at which 20 percent of wetland edge habitat is inundated to at least 1 ft. The lowest elevation in the POR on July 15 was 4,139.51 ft., at which 10 percent of wetland edge habitat is inundated to at least 1 ft. UKL surface elevations are below 4,140.8 ft. in 12 percent of the years on July 15 based on the modeled POR and are therefore unlikely to be observed during the five-year term of this Opinion. The Service anticipates take of larvae through dewatering of wetlands when elevations are below 4,140.8 ft. on July 15. Lake elevations lower than 4,140.8 ft. on July 15 are possible and, to ensure a conservative approach given that lack of recruitment is the primary hinderance to sucker survival and recovery in UKL, have been considered possible every year in this incidental take statement.

In Clear Lake there is an increased risk of stranding of juvenile suckers during droughts. For example, the pool of water near Clear Lake Dam became disconnected from the east lobe in 2009 when lake elevations were around 4,522 ft. Based on salvage efforts during that event, the Service anticipates that elevations below 4,522 ft. could kill approximately 50 juvenile and five adult suckers due to stranding. In addition, there is uncertainty about the potential for take when access to Willow Creek for spawning is limited at certain lake levels, if and when those conditions are attributable to water management.

This analysis of Project impacts, and of incidental take is premised upon Reclamation following the PA for purposes of lake elevations. Therefore, the analysis in this Opinion is not applicable and triggers reinitiation, if Reclamation does not operate the Project in accordance with the rules and parameter settings from the PA's KRM run titled, "Viewer_v11d for MST11b_Draft PA_Jan26." This includes ensuring that water surface elevations at UKL, Clear Lake, Gerber Reservoir, Tule Lake NWR Sump 1A, and Lower Klamath NWR Unit 2 remain within modeled parameters and commensurate with the observed antecedent and current year hydrology conditions in any given water year (see Section 7.1).

10.1.5 Incidental Take from Water Management at Tule Lake National Wildlife Refuge and Lower Klamath National Wildlife Refuge

The provision of a consistent water supply to Tule Lake National Wildlife Refuge Sump 1A and Lower Klamath National Wildlife Refuge Unit 2 will allow existing populations at those locations to persist and will allow for future establishment of populations of at least 1000 individuals through a combination of volitional fish movement into those locations and releases of captively reared and salvaged fish. Though an annual volume of at least 43,000 acre-feet is made available under the PA to ensure minimum habitat is provided, additional water may be made available in any given year resulting in additional habitat establishment in locations beyond Sump 1A and Unit 2. Further, reduction of habitat throughout the water year to the minimum habitat proposed could result in stranding or desiccation, though these impacts are likely to be infrequent and limited largely to below average and dry water years.

Based on current estimates of population size and composition at Unit 2 and Sump 1A, it is likely that the existing populations are small and limited in age class variability. Unit 2 currently supports a population of hundreds of suckers, all of which are likely juveniles in the first two years of their lives descended from juveniles reared at Klamath Falls National Fish Hatchery and larvae captured in UKL. The number of suckers in Sump 1A is more difficult to estimate, but the composition of that population is likely more diverse, including adults and juveniles from the Lost River system. Though these populations are expected to increase over time, these current estimates suggest annual maximum take from Sump 1A would be 50 juveniles and 50 adults, and annual maximum take from Unit 2 would be 100 juveniles. In most years, take resulting from water management would be expected to be lower than these annual maxima, and ongoing monitoring at Sump 1A and Unit 2 will occur to ensure these estimates are accurate.

This analysis of Project impacts, and of incidental take is premised upon Reclamation following the PA for purposes of lake elevations. Therefore, the analysis in this Opinion is not applicable and triggers reinitiation, if Reclamation does not operate the Project in accordance with the rules and parameter settings from the PA's KRM run titled, "Viewer_v11d for MST11b_Draft PA_Jan26." This includes ensuring that water surface elevations at UKL, Clear Lake, Gerber Reservoir, Tule Lake NWR Sump 1A, and Lower Klamath NWR Unit 2 remain within modeled parameters and commensurate with the observed antecedent and current year hydrology conditions in any given water year (see Section 7.1).

10.1.6 Incidental Take Caused by LRS and SNS Monitoring Activities in Project Reservoirs

Reclamation is required to implement monitoring of adult suckers in Project reservoirs as part of their incidental take monitoring requirements described below. As a result of this monitoring, LRS and SNS will be captured and a small percentage harmed, both of which are considered take under the ESA. Assuming the required adult monitoring would occur at the five large reservoirs used by the Project (UKL, Clear Lake, Gerber Reservoir, Keno Reservoir, and Tule Lake Sump 1A) in any given year, the Service estimates the maximum annual take by capture for adult suckers from monitoring would be approximately 15,000 total, most of which are likely to be SNS because they dominate in all of the reservoirs except UKL. In developing these estimates, it was assumed maximum capture rates based on previous studies done in these reservoirs (Hewitt and Hayes 2013b, Hewitt et al. 2018c). Capture is likely to alter normal behavior substantially, such as feeding and predator avoidance, at least for a short time. Mortality as a result of monitoring activities is estimated to be very low (E. Janney, Personal Communication, February 8, 2019). To ensure that take is not underestimated from the impacts of these activities, it was assumed that one percent (i.e., 150 total LRS and SNS) will be lethally harmed by unavoidable injuries received during capture. Because this take of adults is spread among the major sucker populations, adverse effects are not likely to be concentrated at any one location.

These numbers represent the maximum take that is likely to occur in any year as a result of monitoring. Actual take will likely be less because not all of the monitoring is likely to be done in a given year due to staffing and funding limitations and monitoring is not required to be done every year.

This monitoring was not proposed by Reclamation, but it is a requirement under the Terms and Conditions and thus must be implemented. The effects of the monitoring were not analyzed in the effects analysis because monitoring was not included in the PA. Therefore, take resulting from this monitoring will be in addition to take caused by the PA. It is the Service’s opinion that this take is not likely to cause jeopardy to LRS and SNS because although some individuals are harmed, most of the suckers handled will only have a temporary disruption to their normal behavior. In summary, the Service estimated up to 200 juveniles and 150 adult suckers could be killed annually as a result of monitoring in Project reservoirs.

10.1.7 Incidental Take Caused by Proposed Conservation Measures

Canal Salvage

Reclamation proposes to capture and relocate suckers found in the irrigation canals at the end of the irrigation season. Based on recent capture rates, up to 1,500 age-0 suckers could be relocated annually. All of these individuals will experience substantial disruption of normal behaviors, and based on recent relocation efforts, it is assumed that 5 percent (i.e., 75 total LRS and SNS) will be killed during capture and transport (Zachary Tiemann, USFWS, personal communication December 20, 2018). Although survival is expected to be higher for fish that are salvaged and rehabilitated at the assisted rearing facility, additional mortality is expected during captivity due to preexisting afflictions. Based on recent rehabilitation efforts, the Service anticipates 11 percent (165) could be lethally taken prior to release into UKL and have been considered in the incidental take statement.

Assisted Rearing

Reclamation has continued partial funding for a Service-implemented assisted rearing program for the LRS and SNS. The Service anticipates up to 120,000 larvae will be removed from the wild each year to implement the rearing program, and this take is covered under the Service's 2024 10(a)(1)(A) take permit (FWSKFFWO_003314-13 sub permit, USFWS 2024). If larval collections do not yield the numbers required to meet production targets, artificial propagation may occur until the full capacity of the KFNFH is realized. Fertilized eggs that are a product of artificial propagation gamete collection may come from captive broodstock, or from wild adults. The number of wild adults that may be captured for gamete collection is currently limited to 100 individuals of each sex for shortnose sucker, river-spawning Lost River sucker, and shoreline-spawning Lost River sucker, for a total of 600 fish (USFWS 2024). Although up to 120,000 larvae could be collected, in most years, collections will be much smaller—for example the 2024 wild larval collection total was 30,150 larvae, which was supplemented with 56,458 fry were hatched as a product of artificial propagation. The full number of larvae and eggs would not be collected in the same year and would not total more than 120,000 combined. The rearing capacity is expected to increase over the term of the Opinion to accommodate the production of 60,000 juvenile suckers (both species combined) per year. The source of the wild eggs or larvae will be the Williamson River and the lakeshore springs. Based on recent survival rates at the assisted rearing facility, it is estimated that 30 percent (30,000) of the larvae could die at some point during the 18-24 months that they are in captivity. However, the mortality rate is expected to be much lower than that of larvae that are not brought into captivity.

Sucker Recovery Implementation Team Involvement

Reclamation proposes to participate in the LRS and SNS Recovery Implementation Team. No specific details are available for those activities at this time, so effects to listed species will be covered with an ESA Section 10 recovery permit when sufficient details are available.

Incidental Take Caused by O&M Activities

Reclamation intends to perform various annual maintenance activities that could require sucker salvage. Based on similar efforts in the past, this could result in lethal harm to 11 percent of salvaged sucker up to 10 total suckers of all life stages. Because capture of suckers during salvage efforts is anticipated to be a beneficial action, this ITS authorizes the capture and relocation of all suckers in the immediate project area for the purpose of salvage to minimize harm.

10.1.8 Incidental Take Summary

In summary, the Service anticipates the PA could result in annual take of all types of up to 7,039,333 LRS and SNS of all life stages and lethal take of up to 167,790 individuals (Table 11). The vast majority of the take (99 percent) will be larvae. Entrainment is the largest single action resulting in take.

Table 10. Summary of Anticipated Maximum Annual Amount of Incidental Take Occurring as a Result of the PA.

Form of Take	Eggs or Larvae	Larvae	Juveniles	Adults	Unspecific Life Stage	Totals
Kill	30,000	135,438	2,263	259	10	167,970
Injure	0	6,926,680	112,653	0	0	7,039,333
Capture	0	0	20,000	16,000	0*	35,000
Collection	120,000	0	1,500	0	0	121,500

*Capture and salvage of all suckers in the vicinity of O&M activities is authorized.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of LRS and SNS.

10.2 Northwestern Pond Turtles

10.2.1 Amount or Extent of Take

The Service expects an unknown number of nests, eggs and nestlings in nests, juvenile, and adult NWPT will likely be "taken" in the form of harm due to injury (sublethal) or death (lethal) resulting from direct impacts with right-of-way and access maintenance equipment and activities occurring within the Project. However, it is difficult to estimate the number of NWPT that could be "taken" by the proposed action because current NWPT abundance and distribution within the action area is unknown. Additionally, abundance and potential losses are difficult to determine due to seasonal variation in habitat use, the uncertainty of nesting and overwintering site locations, and environmental disturbances. Therefore, this Opinion uses habitat as a surrogate to determine the extent of take of NWPT as a result of the PA. As described in the Effects Section above, potential loss of nesting habitat could occur from soil compaction caused from mowing and heavy equipment activities. These activities could also result in direct injury or direct injury or mortality of all age classes of NWPT from trampling or crushing. There are approximately 1,220 miles of access roads within the Project where mowing and heavy equipment activities are anticipated to occur, which could result in impacts to 48,515 acres of adjacent potential NWPT upland nesting habitat (within 100-meters of the access roads). This estimate of affected acres is likely high because not all acres within all of the adjacent buffered areas are considered suitable nesting habitat. The area buffered to create the acreage total includes areas (e.g., roadbeds, concrete, gravel/rocked surfaces) that are not suitable for turtles due to compacted soils and other substrate that do not provide conditions necessary for turtle nesting or overwintering. Additionally, some areas for mowing likely include thick vegetation compared to nesting habitat that typically has sparse vegetation and short grasses and forbs (See Section 6.2). This is the best reasonable estimate to determine potentially impacted habitat, since nesting habitat has not been mapped within the Project.

In summary, the Service estimates project related take of NWPT in the form of harm is expected to occur within the estimated 48,515 acres of upland nesting habitat adjacent to project access roads within the Project, due to loss of nesting habitat resulting from soil compaction and potential trampling and crushing of turtles at all life stages within this habitat. Take will be considered exceeded in the event that the project footprint extends beyond the existing 1,220 miles of roads in the Project, which would increase the amount of potential nesting habitat impacted within 100 meters of the access roads.

10.3 Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures designed to minimize impacts on specific individuals or habitats affected by the PA and involve only minor changes to the Project. Pursuant to 50 CFR 402.14 (I) (ii), reasonable and prudent measures are those the Service considers necessary to minimize the effects of the incidental taking. The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize the effect of the take on Lost River and shortnose suckers.

RPM 1. Reclamation shall take all necessary and appropriate actions within its authorities to minimize take of listed suckers and proposed NWPT as a result of implementing the PA.

10.4 Terms and Conditions

To be exempt from the prohibitions of Section 9 of the Act, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline monitoring and reporting requirements. These terms and conditions are non-discretionary.

10.4.1 Lost River and Shortnose Suckers

To ensure documentation of Project take and effects on listed species survival and recovery, and to ensure all necessary and appropriate actions within Reclamation's authorities are taken to minimize take of listed suckers as a result of the PA, Reclamation shall commit to meeting the Terms and Conditions below.

T&C 1a. Monitor and Ensure Klamath Project Operations Do Not Deviate from the Keno Release Model

Reclamation shall monitor and ensure that Klamath Project operations do not deviate from the rules and parameter settings from the PA's KRM run titled, "Viewer_v11d for MST11b_Draft PA_Jan26." This includes, but is not limited to, ensuring operational adherence to the following specific model outputs**:**

1. Daily River Base Flow (RBF) for Keno Dam releases (Keno Dam minimum flows)
2. Daily UKL Status;
3. Daily and Seasonal NWI;
4. Daily Operations Index;
5. Daily Keno Release Target calculations;
6. Project Supply calculations; and
7. Tule Lake and Lower Klamath National Wildlife Refuge water supply.

Reclamation will monitor compliance with these key model outputs, ensuring that operations remain within the modeled parameters and commensurate with observed previous years and current year hydrologic conditions in any given water year consistent with the proposed action.

Reclamation will provide documentation of such compliance to the Service and NMFS as requested, but not less than annually. If Reclamation anticipates that operations will deviate or if operations have deviated from any of these model outputs, Reclamation will notify NMFS and the Service immediately. The incidental take expected and analyzed in this biological opinion reflects the Keno Release Model operations; thus, operations that result in deviations from the model's rules, parameter settings, or outputs could result in changes to flows, lake elevations, or other physical conditions and cause more take than has been analyzed. If the Service and NMFS determine that these deviations change the Project operations analyzed in the effects analysis, Reclamation shall reinitiate consultation. Until consultation is complete, Reclamation will take any necessary interim measures, as recommended by the Service and NMFS, to minimize incidental take.

T&C 1b. Activate the A Canal Pumped-bypass System Annually by August 1 and Ensure that No Unnecessary Actions are Taken that Increase Entrainment at the Link River Dam

Reclamation shall activate the A Canal pumped-bypass system to run continuously beginning no later than August 1 every year and will continue using the pumped-bypass system until the A Canal diversions are terminated at the end of the irrigation season. After the end of the irrigation season, at the time Reclamation ceases using the pumped-bypass system, Reclamation shall initiate use of the A Canal gravity-bypass system.

T&C 1c. Actions to Determine Irrigation Supply and Take Corrective Actions to Avoid Going below Minimum Elevations in Clear Lake Reservoir, Gerber Reservoir

Prior to initiation of deliveries to irrigators or prior to April 15, whichever comes first, each year, Reclamation shall assess projected inflows and water levels in Clear Lake and Gerber Reservoirs to determine an anticipated irrigation supply from each reservoir along with projected end of season lake elevations. Reclamation shall coordinate with the Service to ensure the anticipated irrigation supply and the end of the season elevation of both reservoirs falls within the effects of the PA that were analyzed and the level of incidental take that is exempted in this incidental take statement. This coordination is to ensure that releases, particularly those above and beyond typical historical releases, will not result in increased harm beyond what is already considered in the analysis and incidental take statement to listed suckers in Clear Lake Reservoir due to reduced access to spawning habitat in Willow Creek. Reclamation will control the release of project supply from both reservoirs to ensure the end of September target elevations shall be at or above minimum elevations of 4520.6 ft. at Clear Lake and 4798.1 ft. at Gerber Reservoir.

At least once a week throughout the year, Reclamation shall assess projected water levels to determine if they are likely to fall below proposed minimums listed in the paragraph above for Clear Lake Reservoir and Gerber Reservoir for that relevant time period. If conditions indicate that these reservoirs are likely to experience hydrologic conditions that would likely result in water levels going below the reservoir minimums described above, Reclamation shall notify the Service immediately and take appropriate action to minimize risk to affected listed species and maintain minimum elevations. Reclamation's required water-level monitoring for Clear Lake Reservoir and Gerber Reservoir is described below.

T&C 1d. Annual Identification and Installation of Needed Water-Level and Flow-Measurement Gages in the Project

Reclamation shall continue to consult annually with Service hydrologists, biologists, and other appropriate agencies (e.g., USGS, Oregon Department of Water Resources, and irrigation districts) to assess the need for additional or replacement gages in the Project area to ensure that incidental take associated with water surface elevations in Project lakes and reservoirs is properly documented. If additional or replacement gages are deemed necessary, Reclamation shall take appropriate actions to acquire and install the gages and incorporate them into the QA/QC network as quickly as possible. An annual summary of progress on identification and installation of necessary gages shall be included in the *Annual Monitoring Report* due every March 1.

T&C 1e Operations Updates

Reclamation shall maintain the operations spreadsheets used to implement the PA. The spreadsheet(s) translate the code in the KRM and the detailed written description of the PA provided in Appendix C of Reclamation's biological assessment (USBR 2018b) into an operations spreadsheet(s). The operations spreadsheet(s) bring together the input data (e.g., UKL net inflow, UKL elevations, Ops Indices), equations (e.g., seasonal water supply allocations, Normalized Wetness Index), and forecasts (e.g., UKL lake elevation, expected flow volumes) that Reclamation uses on a daily basis to implement the PA. Reclamation shall provide the Service and NMFS with the PA implementation and operation spreadsheet(s) upon request. Reclamation shall provide updates to the Service and NMFS within 2 weeks of Reclamation's acceptance and use of an updated operations spreadsheet(s). Reclamation shall support the Service's and NMFS's use of the spreadsheet.

T&C 1f. Lower Klamath and Tule Lake Elevations

Reclamation's PA makes available 43,000 AF at a daily rate annually between April 1 and October 30 to maintain sucker habitat at refuges, subject to the accrual and provision of alternate water resources under the Project Credit logic (Appendix C, pp. C-36-38). Reclamation shall utilize an appropriate volume of water from return flows or other authorized sources to maintain LKNWR Unit 2 at or above 4,087.4 ft and to maintain TLNWR Sump 1A at or above 4,034.0 ft., commensurate with hydrology and the needs of listed suckers in these locations. Additionally, Reclamation shall install and maintain telemetered, continuously recording water surface monitoring gages in Unit 2 and Sump 1A to ensure adequate water levels throughout the irrigation season and incorporate these data into key documentation (e.g., operational spreadsheets, Klamath teacup diagram). Reclamation and the Service will coordinate throughout the term of the PA to ensure sucker habitat needs are met and sucker populations at Sump 1A and Unit 2 are supported.

T&C 1g. Monitoring and Adaptive Management Actions to Ensure Take Minimization

To ensure beneficial outcomes for listed species and monitor incidental take associated with the PA, Reclamation shall commit to technical and financial support, subject to the availability of funding, of the following actions, in coordination with the Service:

1. Monitoring of sucker habitat availability and utilization at priority locations. These include, but are not limited to, Upper Klamath Lake, including Agency-Barnes and shoreline spring spawning sites; Clear Lake, including Willow Creek; Gerber Reservoir; Tule Lake National Wildlife Refuge, including Sump 1A, Sump 1B, and the Lost River below Anderson-Rose Dam; and Lower Klamath National Wildlife Refuge, including Unit 2.
2. Adult and juvenile sucker monitoring at priority locations. These include, but are not limited to, Upper Klamath Lake, Tule Lake National Wildlife Refuge Sump 1A, and Lower Klamath National Wildlife Refuge Unit 2.
3. Monitoring and assessment of sucker spawning habitat at priority locations. These include, but are not limited to, shoreline springs in Upper Klamath Lake, Williamson River, Willow Creek, and the Lost River below Anderson-Rose Dam.

These priority actions will also inform Reclamation's Structured Decision Making (SDM) process, as described in the PA, while it is being developed and may be used for adaptive management of the PA in coordination with the Service and other federal, state, and Tribal partners. Priority monitoring and adaptive management actions and locations may be reassessed by Reclamation and the Service at any time based on new information collected from ongoing monitoring efforts.

T&C 1h. Captive Rearing Support

Through the term covered by this Opinion, Reclamation shall continue technical and monetary support of the captive rearing efforts by the Service for LRS and SNS (e.g. Klamath Falls National Fish Hatchery activities, net pen projects) to offset incidental take related to implementation of the PA. Reclamation shall support a UKL population growth program by funding Service led or designed projects to create conditions for production goals of size, numbers, and stocking methods that provide a credible trajectory for future growth. Reclamation will continue to provide technical and monetary support of the Service's monitoring of hatchery released fish and natural juvenile and adult suckers for survival, rearing, spawning, and habitat use in UKL, Clear Lake and Gerber Reservoir, and other waterbodies at the discretion of the Service.

T&C 1i. Project Salvage

Reclamation shall, in coordination with both Services, continue the salvage of suckers both for routine maintenance and repair at Project structures and at conclusion of the irrigation season when project canals, laterals, and drains are dewatered.

10.4.2 Northwestern Pond Turtle

NWPT T&C 1. Road and Dike Heavy Equipment Access

Reclamation shall avoid direct injury or mortality of NWPT if observed on roads, dikes, or other facilities access points while conducting operations and maintenance activities. If NWPT are observed on or in any Reclamation facilities, Reclamation shall notify the Service during annual reporting.

10.5 Monitoring Requirement

In order to monitor the effects of incidental take, Reclamation must report the progress of the action and its effects on the species to the Service. The reporting requirements are established in accordance with 50 CFR 13.45 and 18.27 and specified as follows:

10.5.1 Lost River and Shortnose Suckers

When incidental take is anticipated, the Terms and Conditions must include provisions for monitoring to report the progress of the action and its impact on the listed species as specified in the Incidental Take Statement (50 CFR §402.14(i)(3)). However, monitoring the amount or extent of take of suckers due to entrainment and habitat loss as a result of the PA is impossible, as was described above. Therefore, taking the above findings into consideration, monitoring of the incidental take shall be conducted by Reclamation.
Monitoring shall be as described below.

1. Entrainment Monitoring at Project Facilities

The following are required for entrainment take monitoring at Project facilities.

1a. Flow Monitoring at the A Canal, Link River, Clear Lake Reservoir, and Gerber Dams as a Surrogate for Larval Sucker Entrainment Monitoring

Entrainment monitoring of larval suckers at the A Canal, and dams at Link River, Clear Lake Reservoir, and Gerber Reservoir is impracticable because of difficulty in identifying sucker larvae, expense, limited and sometime difficult or dangerous access at Clear Lake and Gerber reservoirs, and human safety concerns associated with night sampling at Gerber and Clear Lake dams. Therefore, Reclamation shall monitor flows at each dam during the larval period: Link River Dam - April 1 to July 15; Clear Lake Dam - April 1 to June 1, and Gerber Dam - April 1 to June 1. The use of flow as a surrogate for larval entrainment is reasonable and appropriate because entrainment of suckers has been determined to be proportional to flow at two of these facilities (additional information on the flow and entrainment is found in both the *Environmental Baseline* (Section 5.5) and *Effects of the Action* (Section 7.1) of this Opinion (Gutermuth et al. 2000a, 2000d). The studies that Gutermuth et al. (Gutermuth et al. 2000a, 2000d) conducted at the A-Canal and Link River Dam found that the numbers of larval suckers entrained was a function of flow and that entrainment increased with increasing flow, and thus was proportional. Therefore, measurement of flow is a reasonable and appropriate surrogate for monitoring larval entrainment. The flow data, reported as acre-feet per day, shall be included in the March 1 *Annual Monitoring Report* described below, and presented as total flow through the A Canal, and the Link River, Clear Lake, and Gerber Dams. Reclamation shall know if they have likely exceeded authorized take of LRS and SNS larvae at these facilities when the discretionary monthly flow volumes, in acre-feet, exceeds those that occurred during the POR analyzed in this Opinion. The Service recognizes there are likely to be uncontrolled flow releases (“spills”) at these dams, or emergency releases, due to high lake levels and concerns for large inflow events resulting from storms. Because these events are outside of Reclamation’s discretion, any entrainment occurring during those events would not result in unauthorized take.

1b. Canal Salvage Reporting

Reclamation has proposed to salvage suckers entrained into the irrigation canal system during drawdown in the fall. Salvage efforts include take of individuals through capture, and the results of this salvage effort will be included in the *Annual Monitoring Report*.

2. Adult LRS and SNS Monitoring in Project Reservoirs

The Service anticipates that the monitoring efforts in the PA will serve a dual purpose of providing critical data that can be used to assess the status of the LRS and SNS and information that is needed to monitor the effects of the PA on sucker populations. Therefore, Reclamation will provide technical and monetary support of additional adult monitoring of LRS and SNS in UKL and Clear Lake. Since the status of populations and the extent of Project effects in Gerber Reservoir are less certain Reclamation shall undertake annual trammel net sampling in Gerber Reservoir. These sampling efforts will allow for Reclamation and the Service to monitor the population, including gather size-frequency data, implant PIT tags, and scan fish for previously implanted tags. The monitoring and sampling in UKL, Clear Lake and Gerber Reservoir will be included in the *Annual Monitoring Report*. The sampling efforts and monitoring programs will be coordinated with the Service and adjusted as necessary to maximize the value of the monitoring.

3. Klamath Project Implementation and Hydrologic Monitoring

Reclamation shall undertake appropriate hydrologic monitoring in Project reservoirs and canals because accurate monitoring of water levels in Project reservoirs and flows through Project facilities is fundamental to the Service's understanding of the effects of the PA and amount of take of LRS and SNS.

Required hydrologic monitoring includes the following:

3a. Klamath Basin Planning Model

Reclamation shall use the WRIMS 2.0 software platform for the annual updates during the duration of this Biological Opinion. Reclamation may update the software to new versions as they are published and verified, and Reclamation shall inform the Service and NMFS prior to doing so. The potential use of software other than WRIMS will be evaluated in coordination with the Service and NMFS.

3b. Monitor and Maintain Water-Level and Flow-Measurement Gages throughout the Project

Water level and flow measurement gages shall be maintained throughout the Project in accordance with the requirements of T&C 1d. All hydrologic data, including water levels in Project reservoirs shall be monitored at frequent intervals, at least daily, and Reclamation shall make all collected data available to the Service and NMFS via a secure website or other appropriate means. An annual summary of reservoir water level and flow-monitoring compliance shall be included in the *Annual Monitoring Report* due March 1 every year.

Accurate hydrologic data are needed to calculate Project water use and effects on listed suckers and ensure compliance with this Incidental Take Statement. Monitoring shall be conducted at the following locations, and the list shall be evaluated annually and could include additional monitoring if needed.

Flow Measurement:

- A Canal
- Lost River to Lost River Diversion Channel at Lost River Diversion
- Ady Canal (at the point of common diversion for agriculture and the Lower Klamath Lake NWR, and at the point of entry into the Refuge)
- North Canal
- Straits Drain at State Line and at pumps F and FF
- Link River Dam
- Keno Dam
- West Side Power Canal at Link River Dam
- Station 48
- Miller Hill Pumping Plant, including spill from the pumping plant
- Anderson Rose Dam
- J Canal Diversions
- D Plant

Water Level:

- UKL, Clear Lake, Gerber Reservoir
- Tule Lake Sump 1A and 1B
- Lower Klamath Unit 2

11 REPORTING REQUIREMENT

Upon locating a dead, injured, or sick endangered or threatened species specimen, prompt notification must be made to the nearest Service Law Enforcement Office (Wilsonville, Oregon; telephone: 503-682-6131) and the Klamath Falls Fish and Wildlife Office (Klamath Falls, Oregon; telephone: 541-885-8481). Notification must include the date, time, and location (including GPS location information in UTMs, NAD 83) of the incident or discovery of a dead or injured endangered or threatened species, as well as any pertinent information on circumstances surrounding the incident or discovery. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The Annual Incidental Take and Term and Condition Monitoring Report shall be submitted to the Field Supervisor of the Service’s Klamath Falls Fish and Wildlife Office by March 1 every year through October 31, 2029.

12 CONSERVATION RECOMMENDTATIONS

Section 7(a)(1) of the Act requires Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a PA on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service makes the following recommendations:

12.1 Northwestern Pond Turtles

- When practicable, conduct surveys while conducting other work, to document NWPT presence in canals, ditches, or other project facilities.
- When feasible, conduct pre-activity surveys to determine NWPT presence and potential nesting or monitor for turtle presence and activity during project activities.
- To avoid impacts to nesting, aestivating, and overwintering northwestern pond turtle, utilize existing disturbed areas (e.g., roads) or other non-habitat areas to access work sites and stage equipment/supplies. Reduce the number of new routes and survey/flag proposed pathways.
- Avoid temporary changes to the hydrology or sedimentation rates of waterbodies supporting turtles. Dewater after October 1, when turtles are overwintering.
- If feasible, place silt fencing or other barriers around suitable nesting habitat when working in suitable nesting habitat in late April to early May to prevent turtles from nesting in the project area.
- When feasible, delay maintenance activities within suitable nesting habitat, outside of the nesting period (June 1 to September 30).

In order for the Service to be informed of actions minimizing or avoiding adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

13 REINITIATION NOTICE

This concludes formal consultation pursuant to the regulations implementing the Endangered Species Act, 50 C.F.R. §402.16. Reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A – MONARCH BUTTERFLY – STATUS OF THE SPECIES AND EFFECTS

1 STATUS OF THE MONARCH BUTTERFLY

1.1 Legal Status

On December 31, 2014, U.S. Fish and Wildlife Service published a 90-day finding that a petition to list the monarch butterfly (*Danaus plexippus*) presented substantial scientific or commercial information and that listing may be warranted (USDI FWS 2014). On December 17, 2020, the Service published the 12-month finding that listing the monarch butterfly was warranted but precluded by higher priority listing actions (USDI FWS 2020a). The Service will develop a proposed rule to list the monarch butterfly as priorities allow. Monarch became a candidate species and was assigned a listing priority of number eight indicating the magnitude of threats as moderate and imminent (USDI FWS 2022). To date, the monarch is still considered a candidate species warranted for listing (USDI FWS 2023).

1.2 Life History

Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic (USFWS 2020b p. 7).

Life History and Habitat

During the breeding season, monarchs lay their eggs on their larval host plant, milkweed (primarily Asclepias spp.), and larvae emerge after two to five days (Zalucki 1982; CEC 2008). Larvae feed on the milkweed and develop over a period of 9 to 18 days, and then pupate into chrysalis before emerging 6 to 14 days later as an adult butterfly (Parsons, 1965). There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks. Late summer and fall adults migrate and overwinter in dormancy living up to 10 months (Cockrell et al. 1993; Herman and Tatar 2001; James and Kappen 2021).

The monarch life cycle varies by geographic location. In temperate climates, such as eastern and western North America, monarchs undergo long-distance migration, where the migratory generation of adults is in reproductive dormancy and lives for an extended period (Herman and Tatar 2001; James and Kappen 2021). In western North America, monarchs begin migrating to overwintering sites in late summer and fall; individuals generally fly south and west to overwintering groves along the California coast into northern Baja California (Solensky 2004; James and Kappen 2021). In early spring (February-March), surviving monarchs break dormancy and mate at the overwintering sites before dispersing (Leong et al. 1995; van Hook 1996). The same individuals that undertook the initial southward migration begin flying back through the breeding grounds and their offspring start the cycle of generational migration over again (Malcolm et al. 1993). In the spring in western North America, monarchs migrate north and east over multiple generations from coastal California toward the Rockies and to the Pacific Northwest (Urquhart and Urquhart 1977; Nagano et al. 1993; James and Kappen 2021)

During migration to overwintering sites, most monarchs are in reproductive dormancy, but continue to need blooming nectar plants throughout the migratory habitat to provide sugar that is eventually stored as lipid reserves (Brower et al. 2015). On their return, monarchs are laying eggs, and thus need both nectar sources and milkweed. This habitat needs to be distributed throughout the landscape to ensure connectivity throughout their range and maximize lifetime fecundity (Zalucki and Lammers 2010; Miller et al. 2012). In western North America, nectar and milkweed resources are often associated with riparian corridors, and milkweed may function as the principal nectar source for monarchs in more arid regions (Dingle et al. 2005; Pelton et al. 2018; Waterbury and Potter 2018; Dilts et al. 2018). However, the specific optimal amount of habitat and its spatial distribution are unknown; more research is needed on optimal distances between habitat patches, as well as optimal patch sizes and milkweed density and characteristics of patches selected for female oviposition (Kasten et al.2016; Stenoien et al., 2016; Grant et al. 2018; Waterbury and Potter 2018). Many monarchs use a variety of roosting trees along the fall migration route (USDI FWS 2020b, p. 10). Southern Oregon and Northern California (Klamath Project area) are important areas for monarch breeding in spring and summer. It is also an important part of the migration flying north in spring and south in the fall. Thus, nectar sources are very important at both times. A primary nectar source for fall migrants is rabbitbrush.

Distribution, Abundance, Population Trends
The monarch is globally distributed throughout 90 countries, islands, and island groups. These butterflies are well known for their phenomenal long-distance migration in the North American populations. Two North American populations, the migratory populations located east and west of the Rocky Mountains, have been monitored at their respective overwintering sites in Mexico and California since the mid-1990s. While these populations fluctuate year-to-year with environmental conditions, these census data indicate long-term declines in the population abundance at the overwintering sites in both populations (USDI FWS 2020b).

The western North American Monarch population has been censused annually since 1997, providing an estimate of annual population size; in 2022, the population estimate of overwintering monarchs was 335,000 (USDI FWS 2023). This is a decline from the estimated 4.5 million monarchs that overwintered on the California coast in the 1980s (USDI FWS 2023). The population decline is likely due to multiple stressors across the monarch’s range, including the loss and degradation of overwintering habitat; pesticide use, particularly insecticides; loss of breeding and migratory habitat; climate change; parasites and disease (James, 2024). Historically, the majority of western monarchs spent the winter in forested groves near the coast from Mendocino County, California, south into northern Baja California, Mexico. In recent years, monarchs have not clustered in the southern-most or northern-most parts of their overwintering range, and there are year-round residents in some areas of the coast (James et al., 2021). This resident phenomenon is likely due to a combination of climate change and an abundance of residential-planted non-native, tropical milkweed that is available for monarchs year-round.

1.3 Threats

The primary drivers affecting the health of the two North American migratory populations are: loss and degradation of habitat (from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence, and incompatible management of overwintering sites in California, urban development, and drought), continued exposure to insecticides, and effects of climate change. Relative to the recent past, both the eastern and western North American populations have lower abundances and declining population growth rates (USDI FWS 2020b).

1.4 Environmental Baseline

Status of Species in Action Area

The distribution, numbers, terrestrial habitat use, or population dynamics of monarchs is unknown within the Project action area. Data on monarch populations in Klamath County, Oregon, are sparse, and their movement is variable and difficult to predict. The Western Monarch Milkweed Mapper, a project that is part of a collaborative effort between several nonprofits and state and federal agencies, (The Xerces Society for Invertebrate Conservation, Idaho Department of Fish and Game, Washington Department of Fish and Wildlife, NFWF, and USFWS) to map monarch butterflies and their host plants, is one source of data on western monarch and milkweed distribution and phenology.

The Milkweed Mapper includes data from the early 1900s to the present. From 1918 to the present, 20 recorded sightings of monarchs (two of actively breeding monarchs) in Klamath County, Oregon. The data provided by this map indicate there have only been two recorded sightings of monarchs (one of actively breeding monarchs) in Klamath County since 2020. Monarchs and monarch habitat, i.e., milkweeds, have been observed in a few areas throughout the Project. These monarch and milkweed observations on the Project have been made during the summer months at what appear to be riparian areas. Monarchs have also been observed in along roadsides in upland habitat along Hill Road beginning at the Refuge Headquarters. Additionally, I-Naturalist has recorded 64 observations of monarchs since 2020 in Klamath County.

Status of Species Habitat in Analysis Area

During the breeding season in spring and summer, monarch butterflies may exist in areas with a high number of nectar floral resources that are embedded with the larval host plant, milkweed (USDI FWS 2020). The Project is located in an area of moderate milkweed distribution and thus moderate potential for monarch breeding areas, based on a broad monarch and milkweed habitat suitability modeling (USDI FWS 2020b, Fig. 6.4 on p. 64),

The Milkweed Mapper has recorded 12 observations of milkweed in Klamath County from 1918 to the present, and only one sighting of milkweed, in Klamath County since 2020. Additionally, according to OregonFlora (https://oregonflora.org/), of the milkweed host plant species found in Oregon, narrow-leaf milkweed, (*Asclepias fascicularis*) and showy milkweed (*Asclepias speciosa*) have been documented within or adjacent to the Klamath Project action area. Additionally, I-Naturalist has recorded 33 observations of milkweed since 2020 in Klamath County, including milkweed planted on the refuge. Occurrences of milkweed in the Klamath Project action area are not systematically surveyed or documented. However, monarchs and monarch habitat, i.e., milkweeds, have been observed in a few areas throughout the Project. These monarch and milkweed observations have been made during the summer months at what appear to be riparian areas. The most likely habitat would be adjacent to water storage areas or at project facilities.

2 EFFECTS OF THE ACTION TO MONARCH BUTTERFLY

Project water operations on monarchs residing in or traveling through the Project Area are largely unclear. These impacts could be potentially beneficial for monarchs as they may increase the health of riparian habitats and vegetation. However, water operation impacts might also have negative consequences for individuals in areas that are seasonally dewatered in late fall, as this could negatively impact milkweed and blooming nectar plants and lead to increased travel distances between habitats.

Project O&M activities have the potential to affect monarch habitat, due to habitat alteration, damage or removal of floral resources, soil compaction, and damage or loss of floral forage from vegetation removal, seasonal mowing, road management, ditch/canal cleaning, or application of herbicide. These activities may have seasonal effects that could potentially harm an unknown number of monarchs. Specifically, activities conducted during late spring and summer could impact milkweed and may pose a risk to monarch butterflies. The effects from the proposed action are discountable to monarchs because of the low number of monarch and milkweed observations in Klamath County and the Project and compared to the small footprint where activities could occur within the action area.

3 CONSERVATION RECOMMENDATIONS

If milkweed is detected within the Project facility and maintenance, to the extent practicable, avoid the removal of milkweed plant(s) and other adjacent nectaring plants. If removal or damage of milkweed cannot be avoided, consider reseeding the affected area with milkweed and nectaring plants to the extent practicable and commensurate with the area of impact.

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