UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Klamath River Renewal Corporation **Project Nos. 14803-001;**
PacifiCorp **2082-063**

AMENDED APPLICATION FOR SURRENDER OF LICENSE FOR MAJOR PROJECT AND REMOVAL OF PROJECT WORKS

Attachment A-5

Lower Klamath Project Biological Assessment

Appendix D
(Aquatic Resources Management Plan)

Biological Assessment

Appendix D – Aquatic Resources Management Plan

KLAMATH
RIVER RENEWAL
CORPORATION

March 2021

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Aquatic Resources Management Plan

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March 2021

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Table of Contents

List of Tables

List of Figures

Appendices

1.0 Introduction

The Lower Klamath Project (Project) (FERC No. 14803) consists of four hydroelectric developments on the Klamath River: J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate (Figure 1-1). Specifically, the reach between J.C. Boyle dam and Iron Gate dam is known as the Hydroelectric Reach. In September of 2016, the Renewal Corporation filed an *Application for Surrender of License for Major Project and Removal of Project Works,* FERC Project Nos. 2082-063 & 14803-001 (License Surrender). The Renewal Corporation filed the License Surrender application as the dam removal entity for the purpose of implementing the Klamath River Hydroelectric Settlement (KHSA). In November of 2020, the Renewal Corporation filed its Definite Decommissioning Plan (DDP) as Exhibits A-1 and A-2 to its amended License Surrender application. The DDP is the Renewal Corporation's comprehensive plan to physically remove the Lower Klamath Project and achieve a free-flowing condition and volitional fish passage, site remediation and restoration, and avoidance of adverse downstream impacts (Proposed Action). The Limits of Work is a geographic area that encompasses dam removal related activities in the Proposed Action and may or may not expand beyond the FERC boundary associated with the Lower Klamath Project.

The Proposed Action includes the deconstruction of the J.C. Boyle Dam and Powerhouse (Figure 1-2), Copco No. 1 Dam and Powerhouse (Figure 1-3), Copco No. 2 Dam and Powerhouse (Figure 1-4), and Iron Gate Dam and Powerhouse (Figure 1-5), as well as associated features. Associated features vary by development, but generally include powerhouse intake structures, embankments, and sidewalls, penstocks and supports, decks, piers, gatehouses, fish ladders and holding facilities, pipes and pipe cradles, spillway gates and structures, diversion control structures, aprons, sills, tailrace channels, footbridges, powerhouse equipment, distribution lines, transmission lines, switchyards, original cofferdam, portions of the Iron Gate Fish Hatchery, residential facilities, and warehouses. Facility removal will be completed within an approximately 20-month period.

This Aquatic Resources Management Plan describes the measures the Renewal Corporation will implement to manage aquatic resources as part of the Proposed Action. The Renewal Corporation has prepared 16 Management Plans for FERC's review and approval as conditions of a license surrender order. These Management Plans were developed in consultation with federal, state and county governments and tribes.

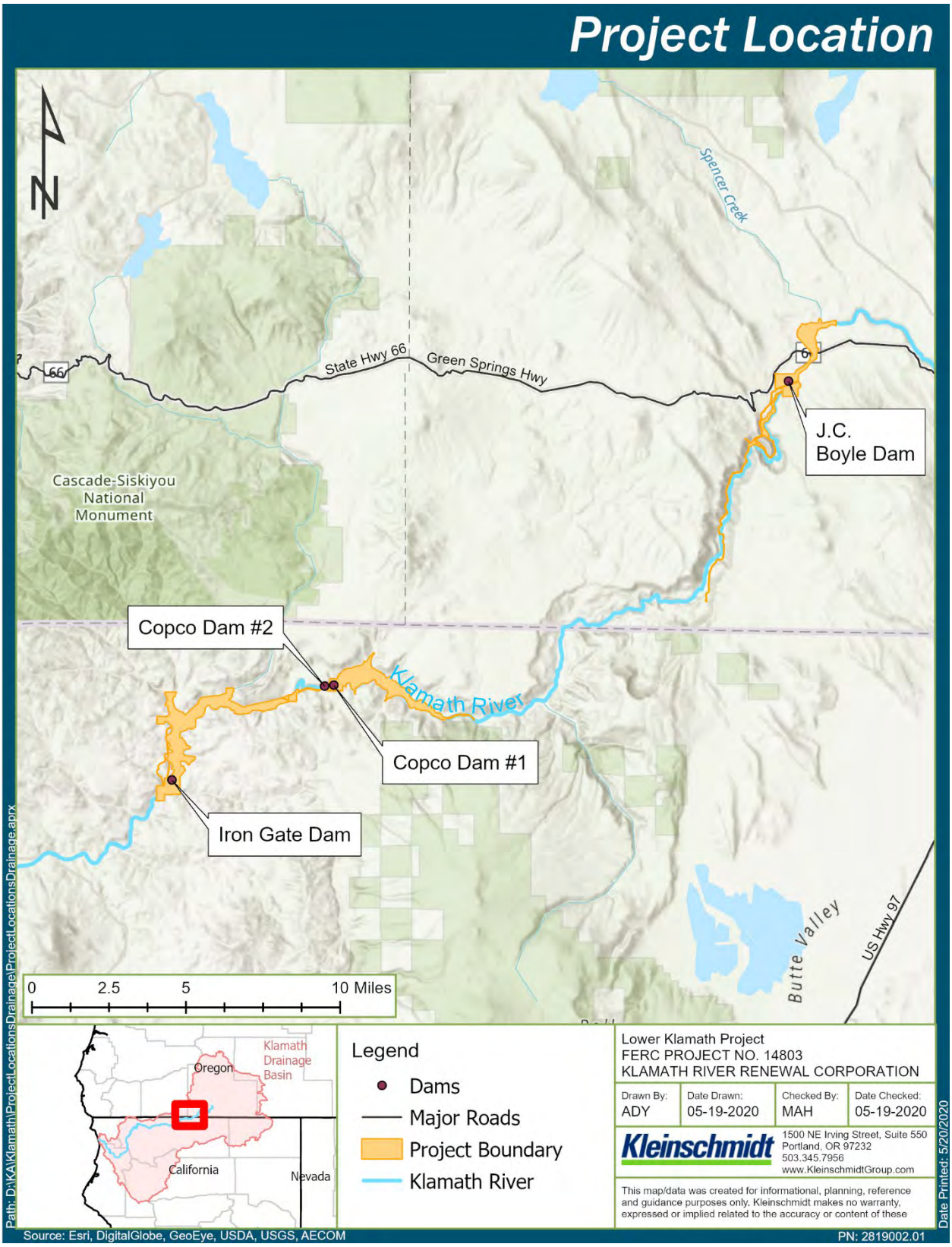

Figure 1-1. Lower Klamath Project Location

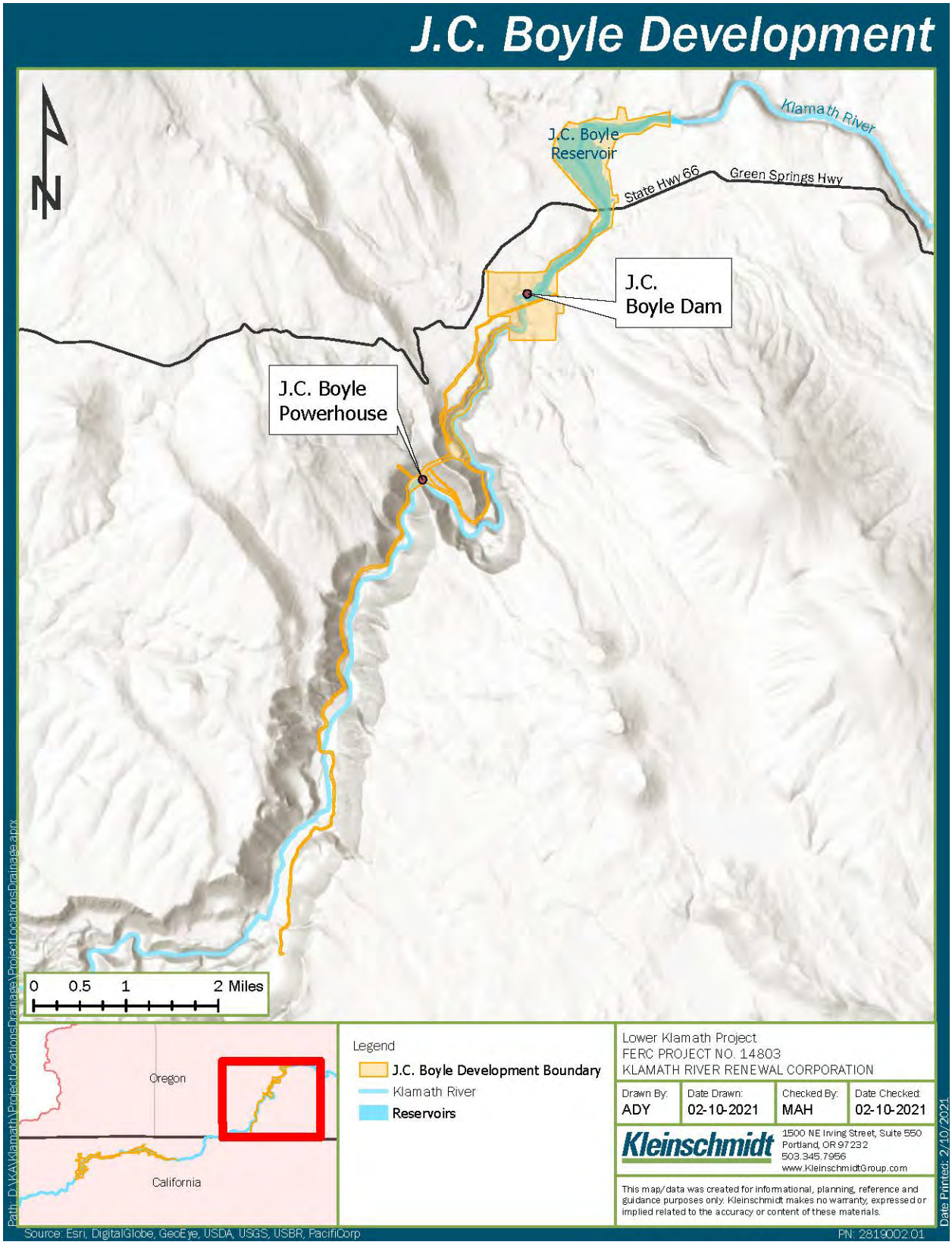

Figure 1-2. J.C. Boyle Development Facility Details

Figure 1-3. Copco No.1 Development Facility Details

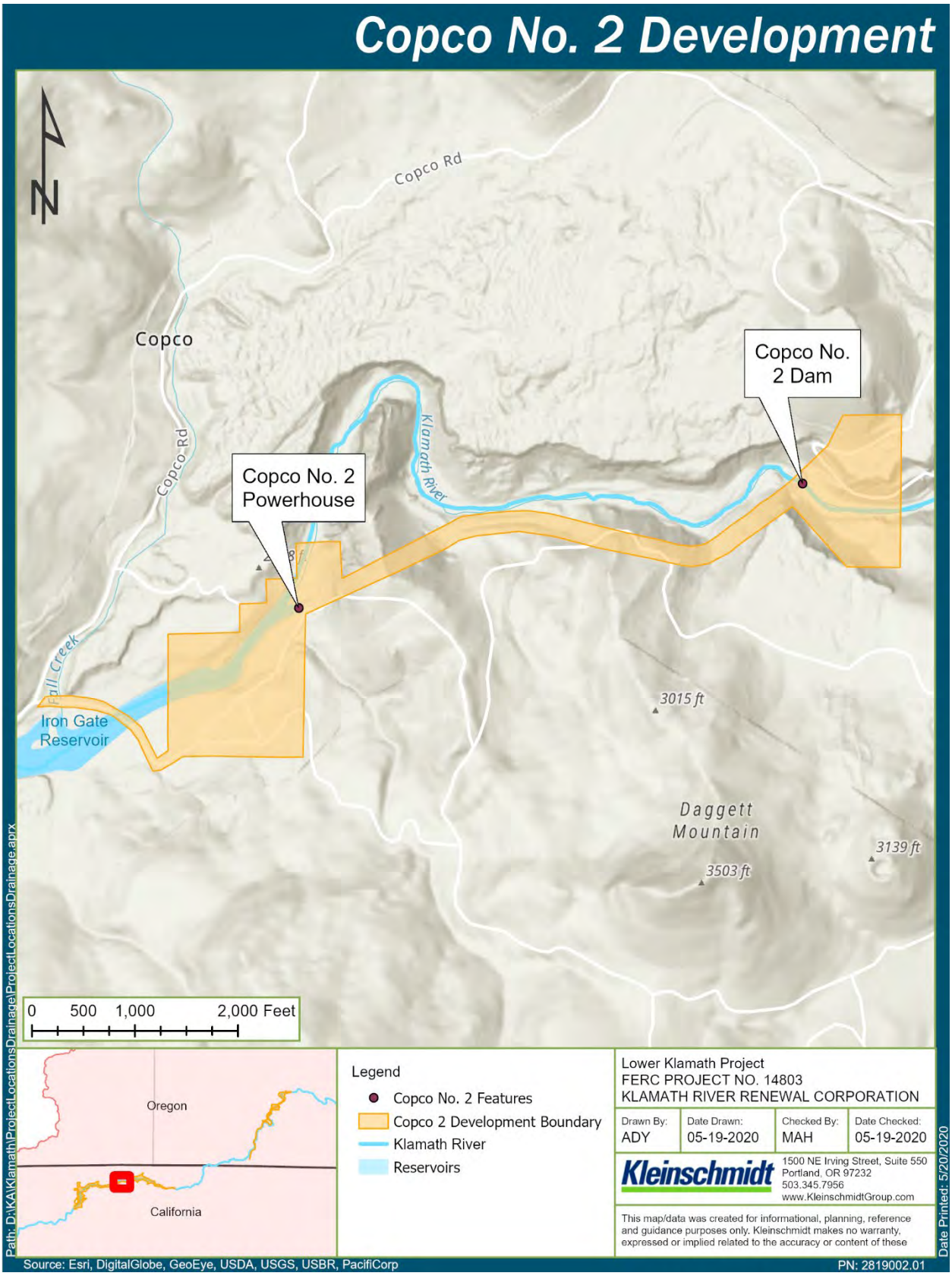

Figure 1-4. Copco No.2 Development Facility Details

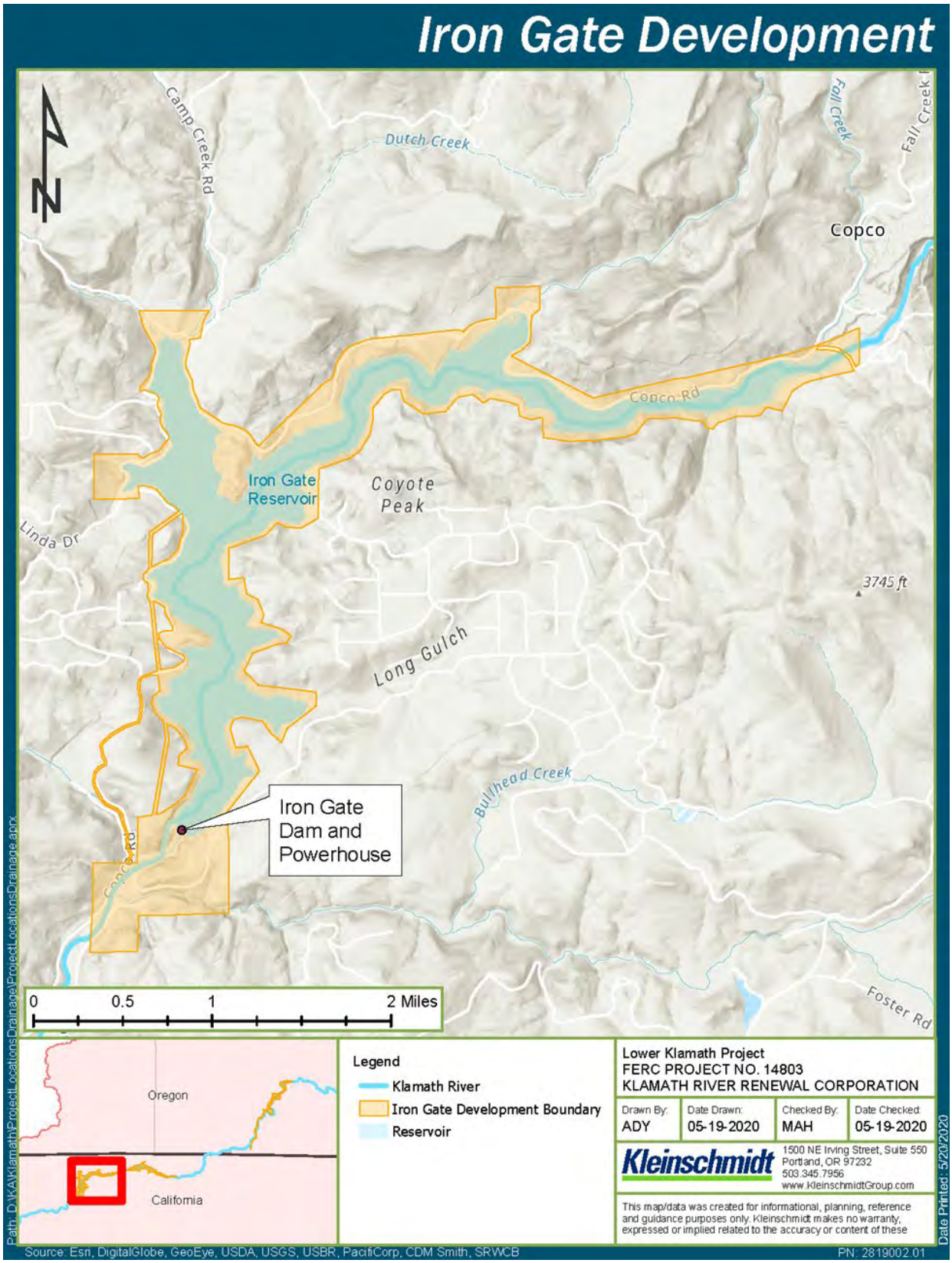

Figure 1-5. Iron Gate Development Facility Details

2.0 Regulatory Context

The Aquatic Resources Management Plan is one of 16 Management Plans implementing the DPP.

Table 2-1. Lower Klamath River Management Plans

1. Aquatic Resources Management Plan	9. Remaining Facilities Plan
2. Construction Management Plan	10. Reservoir Area Management Plan
3. Erosion and Sediment Control Plan	11. Reservoir Drawdown and Diversion Plan
4. Hatcheries Management and Operations Plan	12. Sediment Deposit Remediation Plan
5. Health and Safety Plan	13. Terrestrial and Wildlife Management Plan
6. Historic Properties Management Plan	14. Waste Disposal and Hazardous Materials Plan
7. Interim Hydropower Operations Plan	15. Water Quality Monitoring Management Plan
8. Recreation Facilities Plan	16. Water Supply Management Plan

2.1 Organizational Structure

The Aquatic Resources Management Plan identifies measures that the Renewal Corporation will implement to manage aquatic resources in a manner that is consistent with the overall goals and objectives of the Proposed Action. The Aquatic Resources Management Plan includes the following sub-plans.

- Appendix A: Spawning Habitat Availability Report and Plan
- Appendix B: California AR-6 Adaptive Management Plan-Suckers
- Appendix C: Fish Presence Monitoring Plan
- Appendix D: Tributary-Mainstem Connectivity Plan
- Appendix E: Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan
- Appendix F: Oregon AR-6 Adaptive Management Plan-Suckers

2.2 Specific Regulatory Interests

The Renewal Corporation considered the following regulatory interests in the development of the Aquatic Resources Management Plan:

- California Section 401 Water Quality Certification
- Oregon Section 401 Water Quality Certification

- California Department of Fish and Wildlife MOU
- Oregon MOU
- California Environmental Quality Act, Final Environmental Impact Report
- Draft Biological Assessment (National Marine Fisheries Service NMFS)
- Draft Biological Assessment (U.S. Fish and Wildlife Service USFWS)

2.3 Regulatory Review Process

The Renewal Corporation will implement the Aquatic Resources Management Plan upon FERC approval, including any changes required in the FERC License Surrender Order. A consultation record for the Aquatic Resources Management Plan is included as Appendix G.

3.0 Aquatic Technical Work Group

In addition to consultations with state and federal agencies, the Renewal Corporation has assembled an Aquatic Technical Work Group (ATWG) to provide technical, regulatory, and implementation guidance to the Renewal Corporation. The Aquatic Resources Management Plan, and the metrics and objectives contained in the Aquatic Resources Management Plan, were developed based on input from the ATWG on best practices with respect to the management of aquatic resources. The ATWG is comprised of fisheries scientists from several different resource agencies and tribal entities. During the implementation of the Aquatic Resources Management Plan, the ATWG will be comprised of one member from each of California Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, National Marine Fisheries Service, and United States Fish and Wildlife Service, the California State Water Resources Control Board, and the Yurok Tribe and the Karuk Tribe.

During the implementation of the Aquatic Resources Management Plan, the Renewal Corporation will facilitate regular meetings of the ATWG. The frequency of those meetings will depend on the stage of the Aquatic Resources Management Plan implementation. For example, while ATWG meetings may occur every week during reservoir drawdown, they may be reduced to once per quarter (or a different frequency) after drawdown. Prior to the start of Aquatic Resources Management Plan implementation, the Renewal Corporation will establish protocols that govern ATWG meetings, including where meetings will be held, agenda development and the process for memorializing ATWG recommendations.

At ATWG meetings, the Renewal Corporation will consult with the ATWG on the implementation of the Aquatic Resources Management Plan, including upon the occurrence of certain events described in the Aquatic Resources Management Plan. As appropriate, a facilitator designated by the Renewal Corporation will prepare a description of the views of the ATWG members on the issue. The Renewal Corporation will determine a course of action consistent with this plan and other applicable requirements of the License Surrender Order, taking such consultation into account.

4.0 Force Majeure

The Aquatic Resources Management Plan includes metrics, objectives and obligations that are dependent upon natural systems, which are inherently variable. Acts of god, natural disasters, flooding, fire, drought, severe and unusual weather patterns and other events beyond the control of the Renewal Corporation (Force Majeure Event) may make it impossible or materially more difficult for the Renewal Corporation to perform some obligation under the Aquatic Resources Management Plan. If there is a Force Majeure Event, the Renewal Corporation will propose a variance or other appropriate adjustment to the Aquatic Resources Management Plan.

5.0 Reporting

The Renewal Corporation will prepare and submit an Annual Report by February 15th of each year which will include information pertaining to implementation of the Aquatic Resources Management Plan.

6.0 References

Klamath River Renewal Corporation (KRRC). 2018. Definite Plan for the Lower Klamath Project. June 2018. Available online at: http://www.klamathrenewal.org/definite-plan/

Appendix A

Spawning Habitat Availability Report and Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Spawning Habitat Availability Report and Plan

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February 2021

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

The Spawning Habitat Availability Report and Plan described herein is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project). As described in Section 4.0 below, the Renewal Corporation will update the Spawning Habitat Availability Report and Plan following the completion of the survey activities described in Activity 2.

1.1 Purpose of Spawning Habitat Availability Report and Plan

The purpose of the Spawning Habitat Availability Report and Plan is to describe (1) the target metrics the Renewal Corporation will use to determine and offset the short-term effects of the Proposed Action on the spawning habitat for Chinook salmon and steelhead, (2) the surveys that the Renewal Corporation will conduct to determine whether the target metrics have been met, (3) the updates that the Renewal Corporation will make to the Spawning Habitat Availability Report and Plan following the completion of the surveys, and (4) the timing of spawning habitat enhancement activities (if necessary).

1.2 Relationship to Other Management Plans

The Spawning Habitat Availability Report and Plan is supported by elements of the following management plans for effective implementation: Reservoir Drawdown and Diversion Plan, the Reservoir Area Management Plan, Aquatic Resources Management Plan (sub-plans), and the Erosion and Sediment Control Plan. So as not to duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referenced in this Spawning Habitat Availability Report and Plan.

1.3 Spawning Habitat Availability Report and Plan Activities

The remainder of the Spawning Habitat Availability Report and Plan describes the actions that the Renewal Corporation will take and is divided into the following sections:

- Section 2.0 Activity 1: Develop Spawning Habitat Target Metrics: Describes the potential impacts of the Proposed Action and two target metrics (Target Metrics) that are anticipated to offset those impacts, specifically (1) access to spawning habitat in the portion of the mainstem Klamath River from Iron Gate Dam (river mile (RM) 193.1) to Keno Dam (RM 239.2) and (2) access to spawning habitat in the following tributaries from their confluence with the Klamath River upstream to the first natural fish passage barrier: Fall Creek, Jenny Creek, Shovel Creek, Spencer Creek, Camp Creek, Scotch Creek, Dutch Creek, Deer Creek, and Beaver Creek.
- Section 3.0 Activity 2: Spawning Habitat Availability Surveys: Provides a summary of the surveys that the Renewal Corporation will conduct to determine whether the Proposed Action has resulted in the achievement of the Target Metrics, including information about survey methods and survey timing.

- Section 4.0 Activity 3: Updated Spawning Habitat Availability Report and Plan: Provides an overview of the updates that the Renewal Corporation will make to the Spawning Habitat Availability Report and Plan following the completion of the surveys described in Section 3.0.
- Section 5.0 Activity 4: Spawning Habitat Enhancement Implementation: Provides a summary of the timing of the implementation of spawning habitat enhancement activities (if necessary).

2.0 Activity 1: Develop Spawning Habitat Target Metrics

The Proposed Action may have short-term effects on Chinook and coho salmon redds, as well as migrating steelhead and Pacific lamprey. Based on sediment modeling (USBR 2011) and salmonid mortality studies (Newcombe and Jensen 1996), suspended sediment and bedload movement may result in mortality of fall Chinook salmon and Southern Oregon/Northern California Coast (SONCC) coho salmon embryos and pre-emergent alevin within redds in the mainstem Klamath River downstream from Iron Gate Dam (RM 193.1) from reservoir drawdown (USBR and CDFG 2012). The Renewal Corporation's analysis (2018) predicts short term impacts to approximately 2,100 fall Chinook salmon redds and approximately 13 SONCC coho salmon redds during reservoir drawdown. Additionally, the Renewal Corporation (2018) anticipates direct suspended sediment effects to steelhead and Pacific lamprey migrating within the mainstem Klamath River after December 31 during the reservoir drawdown year. Table 2-1 includes the likely and worst-case effects to adult anadromous fish species downstream from Iron Gate Dam potentially attributable to the Proposed Action.

Table 2-1. 2012 EIS/R anticipated effects summary for migratory adult salmonids and Pacific lamprey

SPECIES	LIFE STAGE	LIKELY EFFECTS	WORST EFFECTS
SONCC Coho salmon	Adult spawning	Loss of 13 redds (0.7-26%)[1]	Loss of 13 redds (0.7-26%)[1]
Chinook salmon - fall	Adult spawning	Loss of 2,100 redds (8%)[1]	Loss of 2,100 redds (8%)[1]
Steelhead - summer	Migrating adults	No anticipated mortality	Loss of 0-130 adults
Steelhead - winter	Migrating adults	Loss of up to 1,008 adults (14%)[1]	Loss of up to 1,988 adults (28%)[1]
Pacific lamprey	Adult migration and spawning	36%[2] mortality	71%[2] mortality

Source: USBR and CDFG 2012

[1] : Range of potential year class loss based on the average number of redds associated with the evaluated population(s).

[2] : The 2012 EIS/R predicted Pacific lamprey mortality based on mortality models developed for suspended sediment impacts to salmonids. Model output did not include the number of predicted Pacific lamprey mortalities.

In response to the potential impacts to Chinook salmon and steelhead, the Renewal Corporation (2018) developed targets for increased access to spawning habitat for Chinook salmon and steelhead based on typical spawning redd dimensions for the two species due to the Proposed Action. These targets are anticipated to offset the anticipated short-term loss of Chinook salmon redds and adult steelhead due to reservoir drawdown. Fortune et al. (1966) used 21 square yards (yd^2) and 26 yd^2 of suitable gravel per Chinook salmon redd and steelhead redd, respectively, to calculate spawning potential in areas of the Klamath River and selected tributaries upstream of Iron Gate Dam (Table 2-2). These areas are approximately four times the approximate redd size for each species to allow for interred space when estimating the capacity of spawning gravel areas (Burner 1951).

Based on a potential loss of 2,100 Chinook salmon redds downstream from Iron Gate Dam and a 21 yd^2 area per redd, the Renewal Corporation determined that access to 44,100 yd^2 of additional spawning habitat in the mainstem of the Klamath would offset the potential loss of 2,100 Chinook salmon redds (Mainstem Target).

Based on recent winter steelhead counts, the Renewal Corporation predicts that reservoir drawdown and sediment release could affect an estimated 358 adult steelhead representing 179 spawning redds. Applying Fortune et al. (1966) steelhead redd dimensions, the Renewal Corporation determined that access to approximately 4,700 yd^2 of additional spawning habitat in key tributaries would offset the potential loss of 358 winter steelhead (Tributary Target).

Meeting the Target Metrics will also offset the potential impact to Pacific lamprey and the small numbers of coho salmon that use the mainstem Klamath River for spawning.

Table 2-2. Fall Chinook Salmon and Winter Steelhead Redd Losses and Offsets

METRIC	FALL CHINOOK SALMON	WINTER STEELHEAD
Potential redd loss due to reservoir drawdown and sediment release	2,100	179
Surface area per spawning redd (yd^2)	21	26
Spawning habitat area necessary to offset redd loss (yd^2)	44,100	4,700

Updated anticipated winter steelhead loss based on peak steelhead return of (631 in 2001) to Iron Gate Hatchery between 2000-2016 (California Department of Fish and Wildlife (CDFW) 2016). Expected mortality calculated using the methodology contained in the 2012 EIS/R (631*0.80*0.71=358). The Renewal Corporation converted the 358 adult steelhead to 179 redds that would be lost due to adult steelhead mortality.

3.0 Activity 2: Spawning Habitat Availability Surveys

As Activity 2, the Renewal Corporation will conduct field surveys and remote sensing efforts prior to and following reservoir drawdown to evaluate and quantify the existing spawning habitat which will become available to anadromous salmonids following dam removal. The hydroelectric reach includes the Klamath River and its tributaries, from the upstream end of the J.C. Boyle Reservoir downstream to the base of Iron Gate Dam (Hydroelectric Reach). As described in more detail below, the Renewal Corporation will conduct initial wading surveys on Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek. The Renewal Corporation will also conduct unmanned aerial vehicle (UAV) surveys (and if necessary, boat and/or GPS surveys) on the mainstem Klamath River between Iron Gate Dam (RM 193.1) and Keno Dam (RM 239.2).

3.1 Tributaries Survey

3.1.1 Overview

The Renewal Corporation will complete an inventory type survey to quantify the amount of spawning habitat available to adult anadromous salmonids following reservoir drawdown and dam removal in the following four tributaries: Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek (Table 3-1). During the initial tributary survey, the Renewal Corporation will walk and survey Shovel Creek and Spencer Creek from their mouths upstream for two miles, and Jenny Creek and Fall Creek from their mouths upstream to the first natural fish passage barrier. If the target tributary spawning habitat quantity of 4,700 yd^2 is documented at any time during the initial tributary survey, the tributary survey will cease and be considered completed. If the initial survey does not result in the identification of 4,700 yd^2 of spawning habitat, the Renewal Corporation will conduct a follow-up survey of the remainder of Shovel Creek and Spencer Creek upstream to the first natural barrier. If the Tributary target is still not met after the follow-up survey, the Renewal Corporation will survey additional tributaries within the Hydroelectric Reach that are anticipated to support steelhead following dam removal. These tributaries include Camp Creek, Scotch Creek, Dutch Creek, Deer Creek, and Beaver Creek.

The Renewal Corporation will document any man-made fish passage barriers observed during the tributary surveys.

Table 3-1. Initial existing spawning habitat survey tributaries in the Hydroelectric Reach

TRIBUTARY	TRIBUTARY CONFLUENCE LOCATION AT THE KLAMATH RIVER (RM)	TRIBUTARY LENGTH TO FIRST BARRIER (MI)	INITIAL SURVEY LENGTH (MI)
Jenny Creek	197.4	1.0	1.0
Fall Creek	199.8	1.2	1.2
Shovel Creek	212.0	2.7	2.0
Spencer Creek	233.4	9.0	2.0

3.1.2 Survey Timing

The Renewal Corporation will conduct the spawning habitat surveys on tributaries in the winter or spring in the year prior to reservoir drawdown during flows that are similar to spawning period flows for fall Chinook salmon and steelhead (Table 3-2).

Table 3-2. Expected spawning periods for fall Chinook salmon and steelhead within the Klamath Hydroelectric Reach and tributaries

SPECIES	KLAMATH RIVER AND TRIBUTARY SPAWNING PERIOD
Fall Chinook Salmon	September 1 – December 31
Steelhead	December 15 – May 31

Although tributaries in the Hydroelectric Reach are currently outside the extent of anadromy, resident adult redband trout and suckers may currently use these streams for spawning. If the Renewal Corporation observes redds or adult spawners during the tributary wading surveys, qualifying spawning patches (described in detail below) will be flagged and GPS locations will be marked with detailed habitat measurements taken at a later date to avoid disturbing spawning fish.

The Renewal Corporation will schedule surveys to target the receding limb of the hydrograph following a flow event, when flows are elevated but stable, and when water clarity is acceptable for identifying substrate size and composition. If a follow-up survey is necessary, to the extent feasible, the Renewal Corporation will target tributary discharge comparable to the measured discharge of the initial survey.

3.1.3 Stream Discharge

The Renewal Corporation will measure tributary discharge once at the start of each survey day. The Renewal Corporation will measure stream discharge in the first run or glide encountered upstream from the backwater effect of reservoir or mainstem of the Klamath River. The Renewal Corporation will use a portable flow meter and reel tape to measure the discharge. The flow meter will be calibrated each day prior to discharge measurement. The Renewal Corporation will use the Sum of Partial Discharges Method (West Virginia Department of Environmental Protection (WVDEP), 2018) to measure and then calculate the discharge.

The Sum of Partial Discharges Method consists of: 1) measuring the average velocity of water in each of several subsections (called a vertical) of a cross-sectional transect; 2) computing the partial discharge of each subsection as the product of the velocity and area of the subsection; and 3) summing the partial discharges to obtain the total discharge (Figure 3-1).

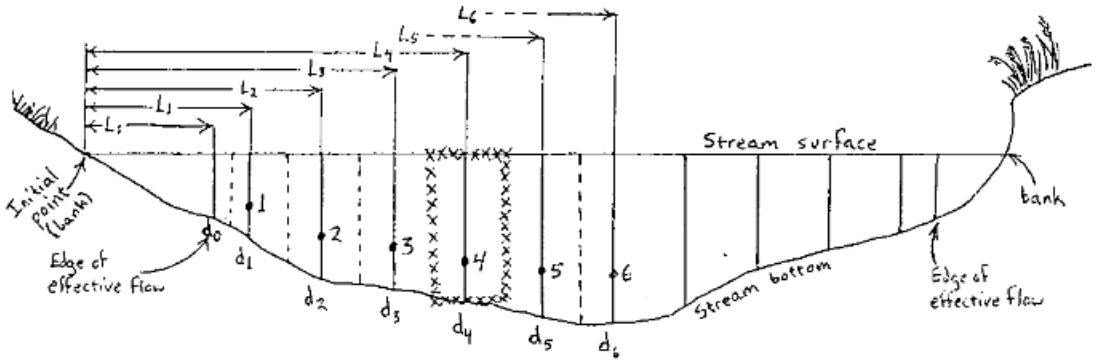

Figure 3-1. Example schematic of sum of partial discharge method

3.1.4 Spawning Habitat Patch Size

The Renewal Corporation will quantify patches of spawning habitat it encounters using a modified version of the Timber-Fish-Wildlife Cooperative Monitoring, Evaluation, and Research Committee's Salmonid Spawning Habitat Availability Survey, refereed to hereafter as the TFW SHA patch survey method (Schuett-Hames et al. 1999). The Renewal Corporation will quantify a patch of spawning habitat if it meets all minimum criteria contained in Table 3-2 The Renewal Corporation selected most of the minimum criteria for identifying a spawning habitat patch as recommended by Schuett-Hames and Pleus (1996). These minimum criteria are general due to the extensive variation in spawning habitat values both within fish stocks and between stocks and species (Burner, 1951; Smith, 1973; Bjornn and Reiser, 1991; Kondolf and Wolman, 1993). The minimum patch size criterion was adapted to meet the minimum redd sizes specified for the target species as described in Fortune et al. (1966).

Table 3-2. Minimum criteria for determining qualifying patches

PATCH METRIC	MINIMUM CRITERIA (METRIC)	MINIMUM CRITERIA (IMPERIAL)
Dominant Substrate Size	8 – 128 mm	0.3 – 5 in
Substrate Depth	≥ 23 cm	9 in
Water Depth	≥ 10 cm	4 in
Water Velocity	> Slack	> Slack
Patch Size	≥ 5 m^2	≥ 6 yds^2

To qualify as spawning habitat, more than half of the surface area of a patch must be comprised of substrate sizes ranging from small spawning gravel (8 - 64 mm) to large spawning gravel (64

- 128 mm). The Renewal Corporation will determine this by visually estimating the substrate composition of the total patch surface. Minimum depth is determined using a measuring stick or a staff with a fixed mark. Minimum velocity requirement can be determined by floating a leaf or twig to confirm the presence of water velocity. Once a qualifying patch is identified by the Renewal Corporation, the Renewal Corporation will record GPS coordinates using a handheld GPS unit positioned near the center of the patch. If GPS coverage is adequate, the Renewal Corporation will use survey grade GPS to survey the perimeter of each qualifying patch. If GPS coverage is inadequate, the Renewal Corporation will take a specific set of measurements for each qualifying patch using a reel tape. The Renewal Corporation will measure the total length of the patch along the longest axis and record to the nearest tenth of a foot. To determine the average width of the patch, the Renewal Corporation will take five width measurements perpendicular to the length measurement at approximately 10%, 30%, 50%, 70%, and 90% distance along the length axis. The Renewal Corporation will record the five width measurements to the nearest tenth of a foot for each qualifying patch. Figure 3-2 includes a schematic of the measurement locations along a qualifying spawning habitat patch.

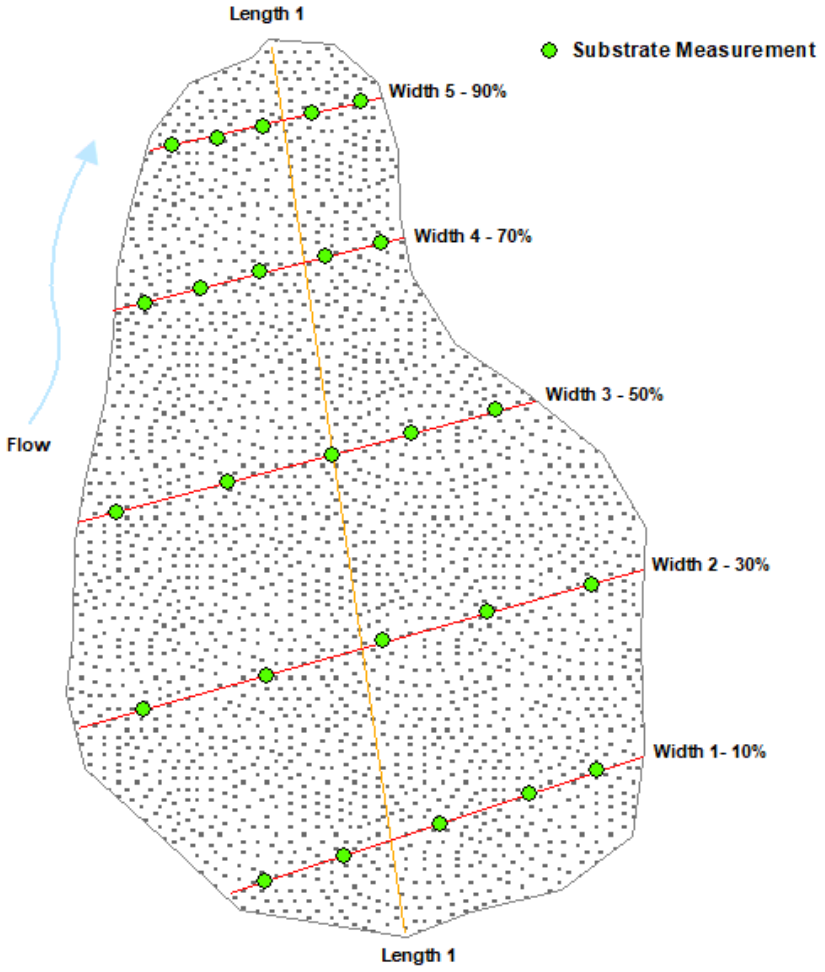

Figure 3-2. Example schematic of length, width, and substrate measurements taken on a qualifying gravel patch

In addition to the spawning habitat patch measurements, the Renewal Corporation will record the sequential patch number, habitat unit type, GPS coordinates, and any photo numbers. If a patch extends into multiple habitat units (e.g., pool and riffle), the Renewal Corporation will split the patch into multiple patches with separate measurements taken for each patch.

3.1.5 Substrate

The Renewal Corporation will estimate substrate visually to determine if a patch meets the qualifying criteria. The Renewal Corporation will estimate the total percentage of the patch that is comprised of either small spawning gravel (8 - 64 mm) or large spawning gravel (64 - 128 mm) and record each spawning patch. The Renewal Corporation will take photographs of the substrate containing a scale object at each qualifying patch.

Additionally, the Renewal Corporation will quantify and classify substrate size using a gravelometer for a subset of qualifying patches in each reach. At the first four qualifying patches encountered in each tributary surveyed, the Renewal Corporation will take a total of 25 substrate measurements by measuring five particles along each of the five width-measurement transects (see Figure 3-2). The Renewal Corporation will take particle measurements at 10%, 30%, 50%, 70%, and 90% of the distance across the width measurement transect. The Renewal Corporation will measure the substrate size along the intermediate axis of each particle, or by using a gravelometer. The Renewal Corporation will then record the particle size class using the classification codes contained in Table 3-4. Additionally, at each transect, the Renewal Corporation will record a visual estimate of the percent fines (sand and silt combined) located along the transect.

Table 3-3. Substrate type, size classes, and classification codes

SUBSTRATE TYPE	SIZE (MM)	CODE
Silt, Clay, Organics, Vegetation	--	1
Sand (coarse)	--	2
Small gravel	2-16	3
Medium gravel	16-32	4
Large gravel	32-64	5
Small cobble	64-128	6
Large cobble	128 - 256	7
Boulder	>256	8
Bedrock	--	9

3.2 Mainstem Klamath River Survey

The Renewal Corporation will conduct spawning habitat surveys using remote sensing techniques on the mainstem Klamath River between Iron Gate Dam (RM 193.1) and Keno Dam (RM 239.2) during the summer or fall in the year of reservoir drawdown to determine the amount of mainstem spawning habitat in the former Hydroelectric Reach suitable for immediate spawning. The Renewal Corporation will use an unmanned aerial vehicle (UAV) to acquire air photos of the free-flowing reach following reservoir drawdown and dam removal. The Renewal Corporation will take air photos at low flows with sufficient water clarity to view the substrate. The Renewal Corporation will capture air photos at a resolution that is adequate for interpreting breaks between substrate sizes of 5 inches (128 mm) or less. If determined necessary by the Renewal Corporation, GPS and/or UAV surveys will be used to identify patch delineation and substrate composition and/or to aid in air photo interpretation and measurements. The Renewal Corporation will then use Geographic Information Systems to delineate and quantify spawning patches based on the information collected using remote sensing techniques in order to determine if the Mainstem Target has been met.

4.0 Activity 3: Updated Spawning Habitat Availability Report and Plan

As Activity 3, the Renewal Corporation will update the Spawning Habitat Availability Report and Plan following the completion of the tributaries and mainstem Klamath River surveys described for Activity 2 above. For the Klamath River or each tributary stream reach surveyed, the Renewal Corporation will update the Spawning Habitat Availability Report and Plan to include a summary description of survey conditions, typical reach characteristics, total spawning habitat available, and a description of any man-made fish barriers encountered during the survey. The Spawning Habitat Availability Report and Plan will be updated to include an appendix that summarizes data collected on each individual spawning habitat patch documented during the surveys, including patch dimensions, area, and spatial location information.

If, based on the surveys, one or more of the Target Metrics have not been met, the Renewal Corporation will, in consultation with the Aquatics Technical Working Group, determine if gravel augmentation or other actions to improve spawning and rearing habitat are appropriate. In addition, the Renewal Corporation may also take certain actions in connection with the implementation of the Reservoir Area Management Plan, including fish passage barrier removal, installation of large woody material, riparian planting for shade coverage, gravel augmentation, wetland construction or enhancement, and cattle exclusion fencing.

The Spawning Habitat Availability Report and Plan will be updated to include the following with respect to any actions taken to improve spawning and rearing habitat: 1) a detailed description of each proposed action; 2) the location(s) of each proposed action; 3) the duration and timing (e.g., season) for implementation of the proposed actions; and 4) an assessment of estimated spawning habitat benefits resulting from the proposed action in compensating for the difference between the Target Metrics and the amount of spawning habitat documented during the surveys.

5.0 Activity 4: Spawning Habitat Enhancement Implementation

As Activity 4, if the Target Metrics have not been met, the Renewal Corporation will implement the proposed actions developed by the Renewal Corporation in accordance with Section 4.0 above. The Renewal Corporation will (if necessary) implement the proposed actions during the reservoir drawdown year (Year 1) and the following year (Year 2) in conjunction with the Klamath River and select tributary stream restoration activities described in the Reservoir Area Management Plan.

The Renewal Corporation proposes to apply the in-water work best management practices (BMPs) as specified in the Erosion and Sediment Control Plan. In-water work BMPs related to seasonal timing of instream work, work area isolation and/or dewatering, and fish rescue and relocation will likely minimize any effects to coho salmon and other aquatic species present.

6.0 Reporting

An annual compliance report will be submitted each year to the California State Water Resources Control Board and the FERC. The report will include, at a minimum:

1. Monitoring data, including graphical representations, as appropriate;
2. Consultation records
3. Narrative interpretation of results
4. Compliance evaluations

7.0 References

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Appendix B

California AR-6 Adaptive Management Plan (Suckers)

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Draft California AR-6 Adaptive Management Plan-Suckers

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March 2021

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

This California Aquatic Resources Measure 6 (AR-6) - Adaptive Management Plan-Suckers (CA Suckers Adaptive Management Plan or Plan) is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose

The purpose of this Plan is to describe the measures the Renewal Corporation has completed to better understand Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) populations in Copco No. 1 Reservoir and Iron Gate Reservoir, and to plan the salvage and translocation of the listed suckers from the two reservoirs prior to reservoir drawdown and dam removal. The sampling plan described herein involves the Renewal Corporation's efforts to understand sucker demographics and genetics, population sizes, habitat use, and successful gear types and fishing methods. Informed by sampling plan results, the Renewal Corporation will conduct sucker salvage and translocation efforts to remove Lost River and shortnose suckers from the Lower Klamath Project reservoirs prior to reservoir drawdown and dam removal.

2.0 Overview

The CA Sucker Adaptive Management Plan entails two actions as part of the Proposed Action: Action 1: Reservoir and River Sampling, and Action 2: Sucker Salvage and Translocation which are summarized below. The Renewal Corporation has completed Action 1 activities as detailed in *Section 3.0 Action 1: Sampling Plan Methods and Results*. The Action 2 activities outlined in *Section 4.0 Action 2: Salvage and Translocation Plan* will be completed prior to reservoir drawdown. A similar plan for J.C. Boyle Reservoir is included in the OR Suckers Adaptive Management Plan.

2.1 Action 1: Reservoir and River Sampling

The Renewal Corporation coordinated a sucker sampling program with U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and the U.S. Geological Survey (USGS) from 2018 through 2020. The Renewal Corporation completed sampling in Copco No. 1 Reservoir and Iron Gate Reservoir and in Klamath River reaches upstream from the respective reservoirs between fall 2018 and spring 2020. Sampling included placing trammel nets in the reservoirs and electrofishing was used in the Klamath River reaches entering the reservoirs and to augment trammel net sampling. Captured Lost River and shortnose suckers were identified by species and sex, marked with a PIT tag (Burdick 2013), fin clipped for genetic material, measured, and released. Klamath smallscale suckers (*Catostomus rimiculus*) were also processed in 2020 to collect genetic material for USFWS' work developing genetic assays. Recaptured fish were used to estimate sucker abundance, and fin clips will be used by USFWS to determine the genetics of the sampled fish. Sampling was typically completed over two nights on Copco No. 1 Reservoir and two nights on Iron Gate Reservoir

during each sampling period. The Renewal Corporation completed annual summary reports following each sampling effort and reports were submitted to CDFW and USFWS. The Renewal Corporation also presented sampling results to the Aquatic Technical Work Group (ATWG), a working group comprised of agency and tribal biologists and fisheries managers.

2.2 Action 2: Sucker Salvage and Translocation

The Renewal Corporation will capture adult listed suckers in Copco No. 1 Reservoir and Iron Gate Reservoir using similar methods as those employed for the sampling effort. The Renewal Corporation will translocate captured suckers to the Klamath National Fish Hatchery, Tule Lake Sump 1A, and possibly other translocation sites that may be identified based on further planning and agreement with USFWS, ODFW, CDFW, and the Renewal Corporation. The Renewal Corporation anticipates salvaging up to a combined total of 300 listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir over 7 days based on sampling catch efficiencies. The 300 listed suckers equate to between 8 percent and 22 percent of the mean population estimates calculated for Copco No. 1 Reservoir and Iron Gate Reservoir. A similar effort will be completed on J.C. Boyle Reservoir in Oregon (see OR Suckers Adaptive Management Plan). During the salvage action, the Renewal Corporation does not anticipate salvaging and translocating the entire populations of Lost River and shortnose suckers residing in the two reservoirs.

3.0 Action 1: Sampling Plan Methods and Results

3.1 Purpose

The Renewal Corporation coordinated a sucker sampling program with USFWS, CDFW, and the USGS from 2018 through 2020. Renewal Corporation field crews completed sampling in fall 2018, spring and fall 2019, and spring 2020. Collected data were used to develop a better understanding of sucker demographics and genetics, population sizes, habitat use, and successful gear types and fishing methods for catching Lost River and shortnose suckers. The sampling results directly informed the salvage and translocation efforts described in *Section 4.0 Action 2: Salvage and Translocation Plan*.

3.2 Previous Efforts

The Renewal Corporation reviewed previous sampling studies completed on Upper Klamath Lake and J.C. Boyle (Oregon), Copco No. 1, and Iron Gate reservoirs as part of pre-sampling planning. The literature review focused on studies that evaluated Lost River and shortnose sucker habitat use and demographics in Copco No. 1 Reservoir and Iron Gate Reservoir. Studies of interest included Coots (1965), California Department of Fish and Game (CDFG) (1980), Beak Consultants (1987), Buettner and Scoppettone (1991), and Desjardins and Markle (2000). These studies documented shortnose suckers in Copco No. 1 Reservoir and Iron Gate Reservoir. Beak Consultants (1987) and Desjardins and Markle (2000) each captured one Lost River sucker in Copco No. 1 Reservoir. Buettner and Scoppettone (1991) referenced the decline of Lost River suckers from Copco No. 1 Reservoir since the 1950s as documented by previous CDFW studies (Coots 1965; CDFG 1980). Buettner and Scoppettone (1991) also noted there was no prior evidence of Lost River or shortnose suckers inhabiting Iron Gate Reservoir,

although Desjardins and Markle (2000) subsequently captured shortnose suckers in Iron Gate Reservoir. Sucker spawning habitat upstream from Copco No. 1 Reservoir and Iron Gate Reservoir is limited due to short riverine reaches, coarse bed material, and fluctuating river levels (Buettner and Scoppettone 1991; Desjardins and Markle 2000). Limited juvenile rearing habitat and predation by non-native fish species also likely limit the reproductive potential of Lost River and shortnose suckers in the reservoirs (Desjardins and Markle 2000). Beak Consultants documented shortnose sucker spawning in the Klamath River in the 1-mile reach of the Klamath River upstream from Copco No. 1 Reservoir (1987), but they found few larval shortnose suckers in Copco No. 1 Reservoir (1988). Identified sucker larvae were believed to be Klamath smallscale suckers or shortnose sucker-Klamath smallscale sucker hybrids (Beak Consultants 1988).

J.C. Boyle Dam and Keno Dam have fish ladders that do not meet current sucker passage criteria (ODFW OAR 412; FishPro 2000) and potentially impede the upstream migration of Lost River and shortnose suckers from the Lower Klamath Project reach to Upper Klamath Lake (PacifiCorp 2013). Desjardins and Markle (2000) suggested the presence of non-native predatory fish, and the lack of rearing habitat in Copco No. 1 Reservoir and Iron Gate Reservoir reduce recruitment to the reservoir populations. Reservoir fluctuations related to water management may also impact juvenile suckers due to juvenile suckers poor swimming ability (PacifiCorp 2013). Desjardins and Markle (2000) also captured adult and larval suckers in Copco Reservoir No. 1 and Iron Gate Reservoir, but few juvenile suckers in Copco Reservoir No. 1 and no juvenile suckers in Iron Gate Reservoir. Sucker populations in Copco Reservoir No. 1 and Iron Gate Reservoir function as sink populations whereby adults persist but there is no evidence of significant reproduction (Rasmussen 2012; USFWS 2012; PacifiCorp 2013).

3.3 Sampling Periods and Locations

The Renewal Corporation field crews completed sampling in Copco No. 1 Reservoir and Iron Gate Reservoir over four sampling periods (Renewal Corporation 2020). Spring sampling was completed in late March and mid-May, and fall sampling was completed in early November. Sampling typically began before dusk and ended after midnight. Sampling effort focused on habitats less than 20 ft deep as adult Lost River and shortnose suckers in Upper Klamath Lake preferentially selected habitats up to 15 ft deep (Reiser et al. 2001; Banish et al. 2009). In addition to target depth, field crews also prioritized habitats with similar depths over distances of at least 300 ft to accommodate the dimension of the deployed trammel nets. Nets were often placed to fish transitional features such as from the shallow shoreline into a submerged historical mainstem channel of a tributary or the Klamath River. Sampling locations were generally in coves and tributary confluence areas that met the sampling habitat criteria defined by water depths less than 20 ft deep and habitats with consistent elevations over a 300 ft distance. Habitats that were successfully sampled during previous efforts, and over the course of the Renewal Corporation's work, were repeatedly sampled.

3.4 Sampling Methods

The Renewal Corporation field crews deployed sampling boats[1] with a captain and two crew members on each boat. The captain was responsible for driving the boat and assisting with data recording during fish processing. Crew members were responsible for deploying and retrieving fishing gear and processing captured fish. Crew members used trammel nets and boat electrofishing to sample suckers. Trammel nets were most frequently used and accounted for nearly all the sampled suckers. A boat electrofisher was used in flowing portions of the Klamath River upstream from Copco No. 1 Reservoir and Iron Gate Reservoir and in select shallow coves. Table 3-1 summarizes the sampling gear employed.

Table 3-1. Gear for sampling listed suckers in Copco No. 1 Reservoir and Iron Gate Reservoir.

SAMPLING EQUIPMENT ITEM	NUMBER	SPECIFICATIONS
Sampling Boat	1 or 2	18 ft and 19 ft sampling boats with necessary safety and anti-pollution equipment
Trammel Net	6	USGS specifications - 300 feet long, 6 feet high; two 12-inch mesh outer panels; one 1.5-inch mesh (3-inch stretch) inner panel; foam-core float line; lead-core bottom line
Electrofishing Equipment	1	3250 watt generator operated boat-mounted Smith-Root Model 1.5 KVA Electrofisher

3.4.1 Trammel Nets

Netting of suckers was predominantly completed at night by one or two boats. Each boat set between two and six nets during each net set. Each trammel net included two 12-inch mesh outer panels and one 1.5-inch mesh inner panel sandwiched between the outer 12-inch mesh panels. A foam-core float line and lead-core bottom line maintained net position. Nets were clipped to an end poly rope with a mushroom or pyramid anchor secured at the bottom of the poly rope and a buoy secured to the top of the poly rope. The distance between the top of the clipped net and the buoy was based on water depth such that nets were fished on the bottom. Nets were paid out from either the bow or the side of the boat depending on the boat. A second anchor and buoy were attached to the poly rope at the end of the trammel net. Each net set location was documented with either a handheld or on-board GPS. During spring 2020, one sampling boat was used to deploy six trammel nets.

Nets were generally set perpendicular to the shoreline in water depths ranging from 3 ft to 50 ft, but nets were most commonly set in 20 ft or less of water. Nets were typically fished for approximately 2 hours, but up to 6 hours during the spring 2020 sampling. At the end of each

[1] Two crews conducted sampling in fall 2018, and spring and fall 2019. One crew conducted sampling in spring 2020. Sampling level of effort was comparable across the four sampling efforts.

net soak, the nets were retrieved, and captured fish were removed from the nets and placed in live wells for processing. Non-target species were identified, enumerated, and released. One Lost River sucker was caught in Copco No. 1 Reservoir in fall 2019, no Lost River suckers were caught in Iron Gate Reservoir.

3.4.2 Boat Electrofishing

Boat electrofishing was an added gear type for fall 2019 and spring 2020 sampling. The electrofishing equipment included dual bow-mounted anode/cathode arrays (each with a terminal 4 wire umbrella). Dual cathode arrays were hung from each side of the boat, each with 14 terminal wires. The electrofisher components were mounted on a 17-foot jet boat. The anode/cathode arrays were operated by a Smith-Root electrofisher control module (Model 1.5 KVA) with electricity provided by a gas-powered generator (Generac GP 3250) with a maximum output of 3250 running watts. The Smith-Root 1.5 KVA electrofisher has a maximum output power of 1,700 watts and can be set to pulsed AC or DC current that draws between 0 and 10 amps. The AC mode produces 60 Hz alternating current between the anode and cathode wires. The DC position produces direct current, pulsing at 120 pulses per second. There is no wattage adjustment on the Smith-Root 1.5 KVA electrofisher.

Per the USFWS Incidental Take Permit for listed suckers, only the DC setting was used. Following the user manual, the Smith-Root 1.5 KVA electrofisher controller was set to DC current and the voltage was set to the lowest setting. The electrofisher was then activated to determine the amount of current (amperage) drawn at the lowest voltage setting. Test electrofishing was conducted and the voltage was increased in a stepwise manner until the desired level of electrotaxis to facilitate capture was exhibited by the target species, while also minimizing injury and mortality of target and non-target species. The effective DC voltage for the Klamath Reservoir surveys was approximately 150 volts, which drew about 5 amps. During electrofishing, two fish netters stationed in the bow controlled the electrofisher via a foot switch.

Sampling focused on shallow water areas less than 6 ft deep in coves and tributary confluences to ensure electrofisher effectiveness and to minimize injury to suckers. Sampling areas mirrored net set locations from previous sampling, as well as flowing reaches of the Klamath River upstream of Copco No. 1 Reservoir and Iron Gate Reservoir in spring 2020. Field crews recorded boat electrofishing level of effort by recording the time the electrofishing unit was engaged by the field crew.

3.4.3 Sucker Processing Procedures

Crew members processed captured shortnose suckers on the boat of capture. Fish processing involved the following observations and other measurements of each captured shortnose sucker.

- Identified the fish species and sex, noting the presence of tubercles and anal fin shape as sex characteristics.
- Identified any external abnormalities including tumors, parasites, lamprey marks, and fin and scale anomalies.

- Measured fork length to the nearest millimeter using a wetted PVC measuring board.
- Collected a fin clip to serve as a genetic material sample.
- Confirmed absence of existing PIT tag, then inserted a PIT tag into the ventral musculature anterior to the pelvic girdle using pre-loaded single use 12-gauge hypodermic needles (HPT12 PLT) fitted onto an implant device (MK-25). Existing or inserted PIT tag numbers were recorded.
- Collected photographs of each sucker's mouth, lateral body view, and features of concern such as lesions or parasites.

Measurement data were recorded on field sheets and photographs and GPS data were transferred from field equipment to laptop computers following sampling. Processed fish were returned to the reservoir away from the immediate sampling area to minimize repeat capture. All efforts were made to minimally handle suckers and release fish in good condition. One shortnose sucker mortality occurred in Copco No. 1 Reservoir due to net entanglement and suffocation.

3.4.4 Sucker Genetics

In 2020, the USFWS-Abernathy Lab compiled genetic libraries for the four Klamath sucker species including Lost River suckers, shortnose suckers, Klamath largescale suckers (*Catostomus snyderi*), and Klamath smallscale suckers (Smith et al. 2020). Genetic results suggested genetic variation within each of the four sucker species was primarily partitioned among subbasins (Smith et al. 2020). Smith et al. (2020) also determined there are potentially thousands of genetic markers for species and population differentiation that will be useful in the recovery of Lost River and shortnose suckers. USFWS will use the genetic results to develop assays that will likely allow managers to distinguish among the four Klamath Basin sucker species, providing an important tool for species conservation (Smith et al. 2020). USFWS is currently developing the assays and will apply the assays to fin clips collected by the Renewal Corporation in the Lower Klamath Project reservoirs to determine sucker genetics.

3.5 Sampling Results

The four sampling efforts results completed between 2018 and 2020 on Copco No. 1 Reservoir and Iron Gate Reservoir are presented below. Results for J.C. Boyle Reservoir are provided in the Oregon Adaptive Management Plan-Suckers.

3.5.1 Level of Effort

Table 3-2 and Table 3-3 include the effort for the trammel net sets and boat electrofishing, respectively.

Table 3-2. Level of effort for trammel net sets.

METRIC	SAMPLING EVENT	RESERVOIRS		NET SET COMBINED VALUES
		COPCO NO. 1	IRON GATE	
Total Net Sets (#)	Spring 2020	36	12	48
	Fall 2019	30	36	66
	Spring 2019	31	25	56
	Fall 2018	22	24	46
	Total	**119**	**97**	**216**
Total Net Soak Time (hrs)	Spring 2020	137.5	45.7	183.3
	Fall 2019	50.3	61.0	111.3
	Spring 2019	42.4	42.6	85.0
	Fall 2018	33.6	37.3	70.9
	Total	**263.8**	**186.6**	**450.5**
Average Net Soak Time (hrs)	Spring 2020	3.8	3.8	3.8
	Fall 2019	1.7	1.7	1.7
	Spring 2019	1.4	1.7	1.5
	Fall 2018	1.5	1.6	1.5
	Average	**2.1**	**2.2**	**2.1**

Table 3-3. Boat electrofishing level of effort for Copco No. 1 Reservoir and Iron Gate Reservoir from fall 2019 and spring 2020 sampling.

SAMPLING EVENT	BOAT ELECTROFISHING EFFORT (SECONDS)	
	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR
Spring 2020	1097	1764
Fall 2019	1271	1000
Total	**2368**	**2764**

3.5.2 Catch Composition

3.5.2.1 Trammel Nets

The Renewal Corporation field crews caught 2,101 fish during the four sampling periods. Fish counts and native and non-native species composition are included in Table 3-4 and Table 3-5, respectively.

Table 3-4. Total trammel net catch for Copco No. 1 Reservoir and Iron Gate Reservoir.

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Spring 2020	309	139	448
Fall 2019	124	146	270
Spring 2019	176	933	1109
Fall 2018	125	149	274
Total	**734**	**1367**	**2101**

Table 3-5. The most common native and non-native fish species caught using trammel nets in Copco No. 1 Reservoir and Iron Gate Reservoir.

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Rainbow Trout (*Oncorhynchus mykiss*)	255
	Smallscale Sucker (*Catostomus rimiculus*)	142
	Tui Chub (*Siphatales bicolor bicolor)*	136
	Shortnose Sucker (*Chasmistes brevirostris*)	120
	Lamprey (potentially multiple species)	5
Non-native Species	Yellow Perch (*Perca flavescens*)	782
	Crappie spp. (*Pomoxis* spp.)	290
	Brown Bullhead (*Ameiurus nebulosus*)	223
	Bluegill (*Lepomis macrochirus*)	68
	Redear Sunfish (*Lepomis microlophus*)	42

3.5.2.2 Boat Electrofishing

The Renewal Corporation field crews caught 2,347 fish during fall 2019 and spring 2020 boat electrofishing. Fish counts and native and non-native species composition are included in Table 3-6 and Table 3-7, respectively.

Table 3-6. Total boat electrofishing catch for Copco No. 1 Reservoir and Iron Gate Reservoir.

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Spring 2020	1006	1241	2247
Fall 2019	50	50	100
Total	**1056**	**1291**	**2347**

Table 3-7. The most common native and non-native fish species caught using boat electrofishing in Copco No. 1 Reservoir and Iron Gate Reservoir in 2019 and 2020 sampling.

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Tui Chub (*Siphatales bicolor bicolor)*	46
	Rainbow Trout (*Oncorhynchus mykiss*)	20
	Smallscale Sucker (*Catostomus rimiculus*)	5
	Shortnose Sucker (*Chasmistes brevirostris*)	1
Non-native Species	Yellow Perch (*Perca flavescens*)	2037
	Other Sunfish (*Lepomis* sp.)	110
	Crappie (*Pomoxis* sp.)	100
	Golden Shiner (*Notemigonus crysoleucas*)	100
	Largemouth Bass (*Micropterus* sp.)	11

3.5.3 Trammel Net and Boat Electrofishing Summary

Table 3-8 includes the total catch for the four sampling periods in Copco No. 1 Reservoir and Iron Gate Reservoir. Table 3-9 includes the most common native and non-native fish species caught in Copco Reservoir 1 and Iron Gate Reservoir using trammel nets and boat electrofishing.

Table 3-8. Total trammel net catch and boat electrofishing catch for Copco No. 1 Reservoir and Iron Gate Reservoir.

SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	TOTAL FISH CAUGHT
Spring 2020	1415	1380	2795
Fall 2019	174	196	370
Spring 2019	176	933	1109
Fall 2018	125	149	274
Total	**1890**	**2658**	**4548**

Table 3-9. The most common native and non-native fish species caught using trammel nets and boat electrofishing in Copco No. 1 Reservoir and Iron Gate Reservoir.

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Rainbow Trout (*Oncorhynchus mykiss*)	255
	Smallscale Sucker (*Catostomus rimiculus*)	142
	Tui Chub (*Siphatales bicolor bicolor)*	136
	Shortnose Sucker (*Chasmistes brevirostris*)	120
	Lamprey (potentially multiple species)	5
Non-native Species	Yellow Perch (*Perca flavescens*)	2819
	Crappie (*Pomoxis* sp.)	390
	Brown Bullhead (*Ameiurus nebulosus*)	233
	Other Sunfish (*Lepomis* sp.)	220
	Golden Shiner (*Notemigonus crysoleucas*)	100

3.5.4 Sucker Catch, Size, and Condition

The Renewal Corporation caught shortnose suckers and potential shortnose sucker hybrids in Copco No. 1 Reservoir and Iron Gate Reservoir (Table 3-10). Potential hybrid suckers were individuals that had intermediate characteristics suggesting hybridization with other sucker species. One Lost River sucker was caught in Copco No. 1 Reservoir. Genetic samples taken during the sampling will be used to confirm sucker genetics once genetic assays are available. The Renewal Corporation did not catch Lost River suckers in Iron Gate Reservoir.

Table 3-10. Shortnose suckers and potential hybrid suckers caught in Copco No. 1 Reservoir and Iron Gate Reservoir using trammel nets and boat electrofishing.

SPECIES[1]	SAMPLING EVENT	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR[2]	TOTAL SUCKERS CAUGHT
Shortnose Suckers	Spring 2020	48	2	50
	Fall 2019	21	10	31
	Spring 2019	16	1	17
	Fall 2018	11	12	23
	Total	**96**	**25**	**121**
Lost River Suckers	Spring 2020	0	0	0
	Fall 2019	1	0	1
	Spring 2019	0	0	0
	Fall 2018	0	0	0
	Total	**1**	**0**	**1**
Potential Hybrid Suckers	Spring 2020	0	0	0
	Fall 2019	0	0	0
	Spring 2019	0	0	0
	Fall 2018	2	5	7
	Total	**2**	**5**	**7**
Total Suckers	Spring 2020	48	2	50
	Fall 2019	22	10	32
	Spring 2019	16	1	17
	Fall 2018	13	17	30
	Total	**99**	**30**	**129**

[1]: Only includes maiden captures (i.e., first capture), does not include recaptured fish.
[2]: One shortnose sucker were caught using boat electrofishing in spring 2020 in Iron Gate Reservoir.

Table 3-11 includes summary length statistics for shortnose sucker caught in Copco No. 1 Reservoir and Iron Gate Reservoir over the sampling effort. The one Lost River sucker captured in fall 2019 in Copco No. 1 Reservoir measured 538 mm fork length.

Table 3-11. Shortnose sucker length statistics for Copco No. 1 Reservoir and Iron Gate Reservoir.

SPECIES	STATISTIC	COPCO NO. 1 RESERVOIR	IRON GATE RESERVOIR	RESERVOIRS COMBINED
Shortnose Suckers	Count	96	25	121
	Maximum (mm)	555.0	549.0	555.0
	Median (mm)	437.5	480.0	453.0
	Mean (mm)	439.5	483.5	448.6
	Minimum (mm)	317.0	390.0	317.0
	1 SD (mm)	52.0	31.2	51.5

Based on length-age relationships for shortnose suckers in Upper Klamath Lake, shortnose suckers sampled in the reservoirs are likely older fish. However, fifteen shortnose suckers caught in Copco No. 1 Reservoir in spring 2020 were less than 389 mm, suggesting a cohort of younger fish that was not sampled during previous Renewal Corporation sampling efforts. These smaller fish reduced the median length of shortnose sucker caught in Copco No. 1 Reservoir from 448 mm to 435 mm.

Prior to the Renewal Corporation's sampling, sucker populations downstream of Keno Reservoir had not been sampled since the late 1990s (Desjardins and Markle 2000) and early 2000s (Desjardins and Markle, unpublished data. In four sampling years, Desjardins and Markle (2000; unpublished data) caught few Lost River suckers (5 adults: 4 in J.C. Boyle Reservoir and 1 in Copco No. 1 Reservoir), but a greater number of adult shortnose suckers in Copco No. 1 Reservoir (n = 165) and Iron Gate Reservoir (n = 22) (Desjardins and Markle 2000). In 2000-2001, Desjardins and Markle caught 40 shortnose suckers and 5 shortnose suckers in Copco No. 1 Reservoir and Iron Gate Reservoir, respectively. A comparison of shortnose sucker lengths from sampling in 1998-1999 (Desjardins and Markle 2000) and 2000-2001 (Desjardins and Markle, unpublished data), and the Renewal Corporation's sampling (2018-2020) is shown in Figure 3-1. The size distribution for shortnose suckers captured in Copco No. 1 Reservoir tended to be smaller in the 2018-2020 period compared to shortnose suckers caught during the earlier efforts, and the size distribution was similar for shortnose suckers caught in Iron Gate Reservoir over the three periods.

The Renewal Corporation captured 120 shortnose suckers and potential hybridized shortnose suckers in Copco No.1 Reservoir and Iron Gate Reservoir over four sampling periods using trammel nets, and one additional shortnose sucker was caught using boat electrofishing, for a total of 121 shortnose and potential hybridized shortnose suckers.

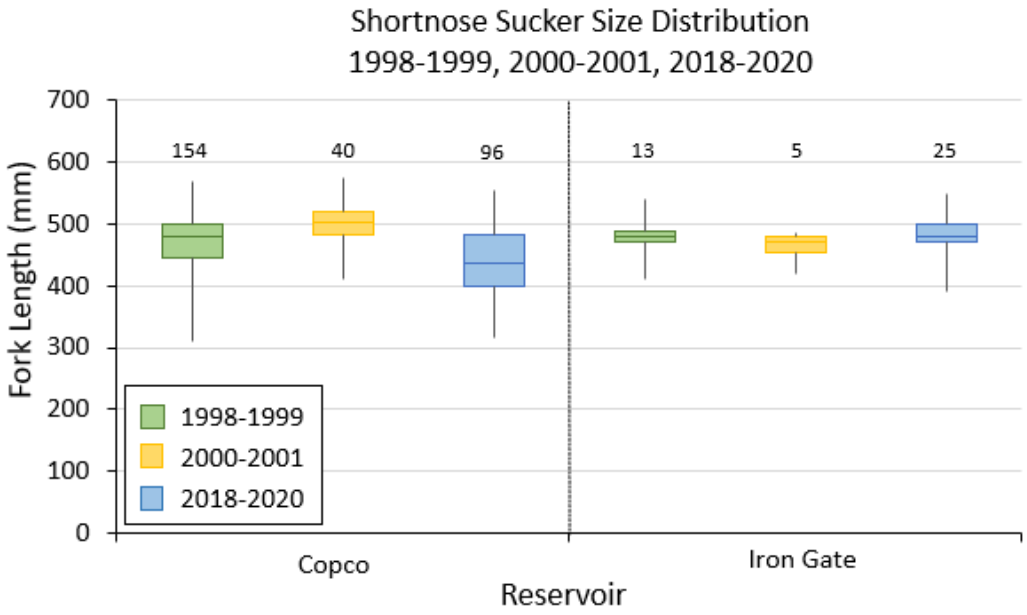

Figure 3-1. Comparison of shortnose sucker fork lengths for fish sampled by Desjardins and Markle (1998-1999 and 2000-2001) and the Renewal Corporation (2018-2020) in Copco No. 1 Reservoir and Iron Gate Reservoir. Sample sizes are posted above each box plot.

Renewal Corporation field crews noted the occurrence of wounds, deformities, and growths/tumors on listed suckers in the reservoirs. Common afflictions included worn fins, caudal fin deformities, parasites, wounds from lamprey attachment, and growths/tumors (Figure 3-2). Between 11% and 33% of suckers had afflictions across the four sampling periods. Due to small sample sizes, affliction patterns across the sampling periods and reservoirs were not apparent although the most afflictions were noted for shortnose suckers (16/48 shortnose suckers with afflictions) sampled in Copco No. 1 Reservoir in spring 2020.

Figure 3-2. Example tumors and growths (left) and deformities (right) afflicting suckers in the Lower Klamath Project reservoirs.

3.5.5 Sucker Catch Per Unit Effort

Table 3-12 compares trammel net catch per unit effort (CPUE) for maiden (i.e., first capture) shortnose suckers over the four sampling events, and the previous sampling completed by Desjardin and Markle in 1998 and 1999 (Desjardins and Markle 2000) for comparison. The

CPUE for shortnose suckers caught in Copco No. 1 Reservoir over the four sampling periods was 0.36 fish/net-hour.

Table 3-12. Shortnose sucker trammel net catch per unit effort for the Renewal Corporation sampling and the Desjardins and Markle sampling (2000). The Renewal Corporation had the highest CPUE in Copco No. 1 Reservoir and the lowest in Iron Gate Reservoir.

SAMPLING EFFORT[1]	CPUE (FISH/NET-HOUR)		
	RESERVOIRS		
	COPCO NO. 1	IRON GATE	RESERVOIRS COMBINED
Desjardins and Markle – 1998 and 1999[2]	0.49	0.04	0.20
Renewal Corporation – Spring 2020	0.35	0.02	0.27
Renewal Corporation – Fall 2019	0.42	0.16	0.28
Renewal Corporation – Spring 2019	0.38	0.02	0.20
Renewal Corporation – Fall 2018	0.33	0.32	0.32
Renewal Corporation - All Events Combined	0.36	0.13	0.27

[1]: Catch per unit effort does not include recaptured fish.
[2]: Desjardins and Markle 2000

3.5.6 Sucker Population Estimates

The Renewal Corporation used recaptured suckers (trammel net data only) to develop population estimates for the three reservoirs, as well as a total population estimate across the three reservoirs. Three different methods were used to develop population estimates, all yielding comparable results.

3.5.6.1 Methods

The Renewal Corporation used the PIT tag mark-recapture data to produce abundance estimates for listed suckers inhabiting each reservoir, and for the three reservoirs combined. Due to the relatively low recapture rates, mark-recapture data for shortnose, Lost River, and potential hybrid suckers were combined. All listed sucker mark-recapture data were aggregated to determine total population estimates. Any listed sucker recaptured at least one day (or longer) after initial capture, tagging, and release was considered a recapture for the determination of the population estimates. Population estimates were then calculated using the following methods.

The Chapman method (Chapman 1951; Johnson et al. 2007) reduces small sample size bias and estimates the total population as:

$$\hat{N} = \frac{(M)(n+1)}{(m+1)}$$

Where:

$\hat{N}$ = Estimated size of the population

n = Number of fish initially marked and released

M = Number of unmarked fish captured during subsequent survey

m = Number of recaptured fish that were marked

Meridian Environmental, Inc. (Renewal Corporation subcontractor) also used a nonparametric bootstrap method (Efron and Tibshirani 1986; Manly 2007) to calculate mean population estimates and estimate variance to produce 95 percent confidence intervals. The bootstrap was run 10 times for each estimate, with 1,000 iterations per run. Population and variance estimates represent the mean of each 10-run set. The Renewal Corporation calculated the 95 percent confidence interval as the square root of the mean bootstrap variance multiplied by 1.96.

Total population estimates were also calculated using the super-population parameterization (Schwarz and Arnason 1996) of the Jolly-Seber model to estimate listed sucker abundance while accounting for subsampling for marking. Abundance is quantified by Schwarz and Arnason (1996) as the total number of gross “births” in the area of interest, which includes listed suckers present at the beginning of the study, those that move into the study area during the monitoring period, and those that do not survive to the end of the monitoring period. The super-population parameterization (Schwarz and Arnason 1996) of the Jolly-Seber model (POPAN model) was applied with the RMark package (Laake 2013) to the capture histories of each individual PIT-tagged sucker with at least one resighting (recapture) opportunity. Intercept-only models were used for capture and survival probabilities due to the low number of recaptured individuals. Because survey occasions were distributed across a period of 18 months, the estimated abundance represents a mean for that time period. Bootstrapping was initially applied to obtain reasonable (i.e., non-negative and finite) confidence interval limits. However, bootstrapped confidence intervals resulted in unrealistically-large upper bounds, so confidence intervals based on asymptotic normality were constructed.

The mark-recapture estimates include the following assumptions: 100 percent PIT tag retention (i.e., no tag loss); mortality of tagged target suckers is the same as untagged target suckers; no emigration of tagged target suckers occurs from the reservoirs between the first and last survey; and trammel net set locations are representative of habitats used by suckers in the three reservoirs. Combining shortnose sucker, Lost River sucker, and potential hybrid sucker mark-recapture data also assumes that the trammel net catchability of these three categories of fish is the same.

An additional assumption is that each sucker species identification is correct. The field teams have collected genetic samples from all shortnose sucker, Lost River sucker, and potential hybrid suckers captured during the three survey efforts, and all target suckers were PIT-tagged. Once these samples are processed, reservoir mark-recapture population estimates can be further refined based on species genetic assignment of each fish in the dataset.

3.5.6.2 Results

The Renewal Corporation's population estimates suggest that the total number of adult listed suckers is highest in Copco No. 1 Reservoir, slightly less in J.C. Boyle Reservoir, and lowest in Iron Gate Reservoir (Table 3-13). The 95 percent confidence intervals suggest that there are several thousand adult suckers in Copco No. 1 Reservoir and J.C. Boyle Reservoir, and several hundred adult suckers in Iron Gate Reservoir. Based on sampling results, shortnose suckers are more abundant than Lost River suckers in J.C. Boyle Reservoir, and Lost River suckers are at low population levels in Copco No. 1 Reservoir and potentially absent from Iron Gate Reservoir. Due to the low number of recaptured suckers over the sampling effort, the 95 percent confidence intervals for the population estimates are large compared to the magnitude of the population estimate (i.e., confidence interval widths greater than ±100 percent of the population estimate for Copco No. 1 Reservoir and J.C. Boyle Reservoir).

Using the Chapman Method, the Renewal Corporation estimates 4,509 listed suckers in all three reservoirs. The bootstrap method yielded a mean estimate of 5,540 listed suckers and a 95% confidence maximum estimate of 11,531 listed suckers across the three reservoirs. The Jolly-Seber model estimated 2,201 listed suckers and a 95% confidence maximum estimate of 4,615 listed suckers across the three reservoirs.

Table 3-13. Population Estimate attributes and estimates for listed and potential hybrid suckers in the Lower Klamath Project reservoirs.

POPULATION ESTIMATE ATTRIBUTES	RESERVOIRS			
	J.C. BOYLE	COPCO NO. 1	IRON GATE	RESERVOIRS COMBINED
Total Maiden Suckers Captured (Fall 2018 through Spring 2020)	95	98	29	222
Total Target Suckers PIT-tagged and Available for Recapture (Fall 2018, Spring 2019, Fall 2019, Spring 2020)[1]	71	83	27	181
Total Tagged Suckers Recaptured (Fall 2018 through Spring 2020)	3	3	2	8
Recapture Efficiency (# Recaptured / # Tagged)	4.2%	3.6%	7.4%	4.4%
Chapman Method - Population Estimate	1,727	2,078	279	4,509
Bootstrap Method - Mean Population Estimate	2,766	3,371	399	5,540
Bootstrap Method - 95% Confidence Interval	±3,730	±4,508	±544	±5,991
Jolly-Seber Model - Mean Population Estimate	864	1,235	102	2,201
Jolly-Seber Model - 95% Confidence Interval	±951	±1,374	±89	±2,414

[1]: Although all target suckers captured on the final night of sampling at each reservoir were PIT-tagged, they were not available for subsequent recapture, and therefore, they were excluded from the total number of target suckers PIT-tagged and released for the mark-recapture estimate.

4.0 Action 2: Salvage and Translocation Plan

4.1 Purpose

The purpose of the Renewal Corporation's salvage and translocation effort will be to remove adult listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir prior to reservoir drawdown and dam removal to reduce project effects on listed suckers residing in the reservoir.

During the development of the sampling and salvage plan, the Renewal Corporation coordinated with the ATWG to develop aquatic resource plan components. The Renewal Corporation originally proposed salvaging 100 Lost River and 100 shortnose suckers from each of the three reservoirs for a total of 600 suckers (Klamath River Renewal Corporation 2017). With the sampling information presented in *Section 3 Action 1: Sampling Plan Methods and Results,* the Renewal Corporation now believes the original proposal is not feasible especially for Lost River suckers which are at low numbers in Copco No. 1 Reservoir and potentially absent from Iron Gate Reservoir.

This revised plan consists of salvaging suckers over a 14-day period including a total 5 days on Copco No. 1 Reservoir and 2 days on Iron Gate Reservoir, and 7 days on J.C. Boyle Reservoir. Based on catch efficiencies from the sampling effort, the Renewal Corporation anticipates catching up to a combined total of 300 listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir, and 300 listed suckers from J.C. Boyle Reservoir. The 300-sucker salvage target equates to between 8 percent and 23 percent of the sucker mean population estimates calculated for Copco No. 1 Reservoir and Iron Gate Reservoir (see *Section 3.5.7 Sucker Population Estimate*). Salvage will continue for 7 days even if the 300-sucker target is exceeded. Salvaged suckers will be translocated to the Klamath National Fish Hatchery and Tule Lake Sump 1A, and possibly other translocation sites that may be identified based on further planning and agreement between USFWS, ODFW, CDFW, and the Renewal Corporation.

4.2 Regulatory Compliance

This CA Suckers Adaptive Management Plan is designed to satisfy provisions of the Endangered Species Act and the State Water Resources Control Board 401 Water Quality Certification pertaining to the Lost River and shortnose suckers. In addition, this plan is consistent with Assembly Bill No 2640, Chapter 586 (2018), which revised Section 2081.11 of the state Fish and Game Code to read: “The take authorization requires department approval of a sampling, salvage, and relocation plan to be implemented and that describes the measures necessary to minimize the take of adult Lost River sucker and shortnose sucker associated with the department’s authorization. The plan shall provide for a sampling effort, the results of which will provide information used to make decisions and to implement the plan while utilizing the principles of adaptive management.”

4.3 Salvage Period

The Renewal Corporation will perform sucker salvage and translocation in either spring or fall prior to reservoir drawdown. The Renewal Corporation proposes to focus the salvage efforts during the spring when shortnose suckers congregate in shallower habitats in advance and during the spring spawning period. Initiation of shortnose sucker spawning runs in Upper Klamath Lake coincides with water temperatures approaching or exceeding 12 °C in the Williamson River (Hewitt et al. 2017). A similar temperature-related spawning migration pattern was documented by Beak Consultants (1987) for shortnose suckers in Copco No. 1 Reservoir. In the Beak Consultants study, shortnose suckers began spawning when average water temperatures exceeded 12 °C on April 15, 1987. Spawning peaked between April 22 and April 30 and spawning ended approximately May 15, 1987 (Beak Consultants 1987). Therefore, a spring salvage period would be completed between mid-April and early May. The Renewal Corporation previously sampled Copco No. 1 Reservoir and Iron Gate Reservoir in late March 2019, and mid-May 2020 and captured shortnose suckers. These previous efforts likely bracketed the listed suckers spawning period.

The fall salvage period is less dependent on water temperature-related sucker behavior and habitat use, although suckers inhabited deeper habitats in a study conducted on Upper Klamath Lake (Reiser et al. 2001). The fall salvage period would take place after water temperatures

decrease to less than 16 °C and Copco No. 1 Reservoir's microsystin levels decline to concentrations below human health advisory levels. A fall salvage period would occur between late October and early November. The Renewal Corporation previously sampled Copco No. 1 Reservoir and Iron Gate Reservoir in early November 2018 and 2019 and captured shortnose suckers, and one Lost River sucker in Copco No. 1 Reservoir.

4.4 Salvage Locations

Copco No. 1 Reservoir and Iron Gate Reservoir salvage locations will correspond to the previous sampling locations and include shallower habitats associated with coves and tributary confluences. During a spring salvage, the Klamath River in the 1.0 mile upstream of Copco Road Bridge in the reach Beak Consultants previously documented shortnose sucker spawning (Beak Consultants 1987), would be prioritized for salvage. Similar reservoir locations would be targeted in a fall salvage period.

4.5 Salvage Methods

The Renewal Corporation will employ similar methods for processing salvaged suckers as were used during the sucker sampling effort. The Renewal Corporation will use trammel nets and boat electrofishing and will fish largely at night, although daytime boat electrofishing may also be used. Two boats will each deploy eight trammel nets in Copco No. 1 Reservoir and Iron Gate Reservoir.

The Renewal Corporation will set trammel nets sequentially and fish the nets for 3-6 hours in previously sampled reservoir habitats. Two or three net sets will be completed per night depending on catch efficiency and bycatch. Electrofishing will focus on shallow areas in coves and the Klamath River upstream from Copco No. 1 Reservoir. Tangle nets may also be used in riverine reaches if congregations of shortnose suckers are encountered during electrofishing. Captured shortnose suckers, and while less likely to be encountered, Lost River suckers will be identified to species and sex, measured, fin clipped, photographed, and PIT tagged. Each sucker will also be scanned to detect existing PIT tags. Salvaged suckers will be held in aerated live wells and periodically transferred to net pens near boat access sites where suckers will be held until transport.

The Renewal Corporation may also use tangle nets or a resistance board weir to salvage suckers from the upstream extent of Copco No. 1 Reservoir, or in flowing portions of the Klamath River upstream from Copco No. 1 Reservoir and Iron Gate Reservoir.

The Renewal Corporation will acquire current information on water quality to better anticipate water quality conditions in the salvage reservoirs, the Klamath National Fish Hatchery and Tule Lake Sump 1A. The information will be used to understand water quality conditions in the salvage and translocation sites. Water quality constituents of interest include water temperature, dissolved oxygen, salinity concentrations, and pH levels. Acquiring this information in advance of the salvage will be necessary to condition the water in the transport live well and to plan the acclimation period at the release locations.

4.6 Transport and Translocation Methods

The Renewal Corporation will remove suckers following the two-day Iron Gate Reservoir salvage, and then after the second day and fifth day of the Copco No. 1 Reservoir salvage and transport them to the translocation sites. At the time of transport, the Renewal Corporation field crews will remove suckers from net pens and scan suckers for PIT tag identification prior to loading fish into aerated live wells (approximately 200-300 gallons) for transport. The Renewal Corporation will coordinate with USFWS, CDFW, ODFW, U.S. Bureau of Reclamation, The Klamath Tribes, and the Yurok Tribe to access transport vehicles. Large live wells will be fiberglass, steel, or polyethylene and will be sized to fit in the open bed of a standard pickup truck or on a trailer. Live wells will be baffled to limit sloshing during transport. The live well will be filled to 75% capacity (about 150 gallons) with salvage reservoir water in the vicinity of the net pens. Transported fish will be large (>300 mm) and care will be required to minimize overstocking the live well. Densities should be the equivalent of approximately 1 lb of fish per gallon of water. Based on an average 3.0 lb weight, no more than 50 shortnose suckers would be transported at one time. The transport density will be adjusted as conditions and sucker response dictate. The following methods will be used to prepare the transport tanks (BOR, 2008; USFWS, unpublished report).

- Live wells are to be disinfected using a Virkon (1.3 oz/gallon) solution or other approved disinfectant. Live wells are to be disinfected daily and thoroughly rinsed following disinfection.
- Water will be pumped from the salvage reservoir into the live well using a portable pump. A handheld YSI meter will be used to measure water quality constituents including water temperature, dissolved oxygen, salinity, and pH prior to adding suckers to the live well. The live well will be refilled at the salvage reservoir prior to each transport.
- Water temperature will be monitored in the live well during transport at least during initial transport runs. Water temperature in the live well should remain within 4 °C of the initial ambient water temperature during the transport. Water temperature will be modified by chillers or heaters.
- Dissolved oxygen concentrations will be monitored in the live well during transport at least during initial transport runs. Dissolved oxygen levels should be maintained at approximately 100 percent saturation. If needed, a portable aeration system will be installed to maintain dissolved oxygen levels at approximately 100 percent saturation.
- Salinity levels should be approximately 0.5%. Coarse ground sodium chloride will be added in small increments to the live well until a 0.5% salinity level is achieved. Since Tule Lake Sump 1A is more saline than the Klamath River, additional ground sodium chloride may need to be added to the live well. Additional coordination with USFWS will be completed prior to the salvage.
- To acclimate suckers at the receiving waterbody, salvage reservoir water in the live well will be replaced with recipient waterbody water over the course of at least an hour. Approximately a quarter to a half of the salvage reservoir water will be drained from the live well and replaced with recipient waterbody water that will be pumped into the live well. Tempering the live well will be important for acclimating the suckers to the recipient

waterbody's water quality constituents. Live well water will be drained away from Tule Lake Sump 1A to avoid discharging salvage reservoir water directly to Tule Lake Sump 1A. Other live well discharge strategies will be coordinated with USFWS. Water quality constituents should be consistently measured during the tempering process. USFWS suggests the target suckers can tolerate a 1 °C temperature change every 15 minutes and temperature changes should not exceed 4 °C per 15 minutes. Releasing fish into the recipient waterbody after dusk is recommended to maximize survival (M. Yost, USFWS, personal communication), although this may require additional personnel to achieve.

4.6.1 Translocation Sites

The Klamath National Fish Hatchery and Tule Lake Sump 1A will be the primary translocation sites for suckers salvaged from Copco No. 1 Reservoir and Iron Gate Reservoir. Other translocation sites may also be identified based on further planning and agreement between USFWS, ODFW, CDFW, and the Renewal Corporation. Salvaged suckers will first be taken to the Klamath National Fish Hatchery where they will be isolated and receive an external parasite treatment before they are integrated into hatchery groups. The Klamath National Fish Hatchery has capacity for approximately 100 salvaged adult suckers. USFWS has requested a ratio between 60:40 and 70:30 shortnose suckers to Lost River suckers be provided to the hatchery, of which, half of the salvaged shortnose suckers (approximately 30 to 35 individuals) originate in Copco No. 1 Reservoir and half originate in J.C. Boyle Reservoir. Because Lost River suckers appear to be at low population levels in Copco No. 1 and Iron Gate reservoirs, Lost River suckers from J.C. Boyle Reservoir will be provided to the Klamath National Fish Hatchery.

Salvaged suckers exceeding the 30 to 35 shortnose sucker capacity of the Klamath Nation Fish Hatchery will be released into Tule Lake Sump 1A. Historically, Tule Lake was the terminal lake for the Lost River. Agricultural development in the basin has altered the Lost River, and Lost River and shortnose suckers in Tule Lake Sump 1A are now isolated to the Tule Lake sump complex and a 5-mile reach of the Lost River between Tule Lake Sump 1A and Anderson-Rose Dam. Tule Lake Sump 1A functions as an agricultural sump that is maintained by agricultural return flow. Until 2018, USFWS used Tule Lake Sump 1A as a translocation site for Lost River suckers and shortnose suckers salvaged from other areas in the basin. However, since 2018, USFWS has translocated salvaged suckers from other areas of the basin to the Klamath National Fish Hatchery rather than to Tule Lake Sump 1A. Adult Lost River and shortnose suckers are known to occupy Tule Lake Sump 1A and listed suckers have been relocated from the sump to Upper Klamath Lake in the past (Courter et al. 2010). Tule Lake Sump 1A is known to currently has the capacity for an additional 3,000 relocated suckers (J. Rasmussen, USFWS, personal communication, 2017). Management of Tule Lake Sump 1A is complicated by multiple user groups and the periodic need to draw down the reservoir for sediment maintenance. USFWS will continue to manage Tule Lake Sump 1A for multiple uses.

Other translocation sites may be identified based on further planning and agreement between USFWS, ODFW, CDFW, and the Renewal Corporation.

4.6.2 Transport Route

The preferred transport route between Copco No. 1 Reservoir and the Klamath National Fish Hatchery is approximately 100 miles and includes two lane county road and state highway. The travel time is estimated at 2 hours. The preferred route includes the following roadways.

- Ager Beswick Road from Copco No. 1 Reservoir to Ager, CA (14 miles)
- Montague Grenada Road from Ager to Grenada, CA (17 miles)
- 99-97 Cutoff Road from Grenada, CA to Highway 97 to Township Road (79 miles)
- Township Road to Lower Klamath Lake Road (8 miles)
- 1 mile on Lower Klamath Lake Road to the Klamath National Fish Hatchery

The preferred transport route between Copco No. 1 Reservoir and the Tule Lake Sump 1A is approximately 115 miles from Copco No. 1 Reservoir to Tule Lake Sump 1A. The entire route is improved roads including two lane county road and state highway. The travel time is estimated at 2 hours. The preferred route includes the following roadways.

- Ager Beswick Road from Copco No. 1 Reservoir to Ager, CA (14 miles)
- Montague Grenada Road from Ager to Grenada, CA (17 miles)
- 99-97 Cutoff Road from Grenada, CA to Highway 97 (18 miles)
- Highway 97 to Tule Lake Sump 1A (66 miles)

4.7 Reporting

The Renewal Corporation will process sucker salvage data including information on the salvaged and transported suckers and water quality constituents. Sucker genetic material will be linked to the individual unique PIT tag identification numbers. The Renewal Corporation will provide USFWS, CDFW, and USGS with an electronic copy of the Microsoft Excel data workbook and photographs. The genetic material will be provided to USFWS for sucker genetics processing. Summary reports will be submitted within three months of completing the salvage. The Renewal Corporation's sucker salvage responsibilities end once listed suckers are released at the intended facility or waterbody. USFWS and CDFW will maintain management responsibilities for Lost River and shortnose suckers through and after the salvage effort.

4.8 Salvage Plan Summary

The Renewal Corporation completed four sampling efforts to gain a better understanding of current sucker demographics and population sizes in the Lower Klamath Project reservoirs. The Renewal Corporation will conduct a combined 7 days of salvage and translocation of listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir. Based on catch efficiencies from the sampling effort, the Renewal Corporation anticipates relocating up to a total of 300 listed suckers from the two reservoirs. The Renewal Corporation will continue to coordinate sucker salvage planning with USFWS, CDFW, and the Klamath Tribes.

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Appendix C

Fish Presence Monitoring Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Fish Presence Monitoring Plan

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February 2021

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Table of Contents

Appendices

1.0 Introduction

The Fish Presence Monitoring Plan described herein is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose of the Fish Presence Monitoring Plan

The Fish Presence Monitoring Plan specifically describes monitoring efforts the Renewal Corporation will undertake to document anadromous fish presence within the hydroelectric reach of the Project following dam removal. The hydroelectric reach includes the Klamath River and its tributaries, from the upstream end of the J.C. Boyle Reservoir downstream to the base of Iron Gate Dam (Hydroelectric Reach). Because the Fish Presence Monitoring Plan addresses the full Hydroelectric Reach, the California and Oregon portions of the mainstem Klamath River and its tributaries are both included within the Fish Presence Monitoring Plan ’s scope.

1.2 Relationship to Other Management Plans

The Fish Presence Monitoring Plan is supported by elements of the following management plans for effective implementation: Reservoir Area Management Plan and the Hatchery Management and Operations Plan. So as not to duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referenced in this Fish Presence Monitoring Plan. Specifically, the Renewal Corporation will implement reporting associated with passage impediments to anadromous fish consistent with the Reservoir Area Management Plan.

2.0 Anadromous Fish Presence Monitoring

2.1 Monitoring Overview

2.1.1 Renewal Corporation Obligations

The Fish Presence Monitoring Plan describes the geographic area that the Renewal Corporation will monitor, the period during which monitoring will occur, and the methods that will be used by the Renewal Corporation during monitoring. In addition, certain geographic areas will be monitored by various agencies, as described in more detail in Section 2.2 and Section 2.3.

2.1.2 Target Species

Under the Fish Presence Monitoring Plan, monitoring efforts by the Renewal Corporation will target the following anadromous fish species: coho salmon (*Oncorhynchus kisutch*), spring-run and fall-run Chinook salmon (*O. tshawytscha*), steelhead (anadromous form of rainbow trout; *O. mykiss*), and Pacific lamprey (*Entosphenus tridentatus*) (collectively, the Target Species). These anadromous fish species were historically found above Iron Gate Dam but varied in their distribution throughout the tributaries in the Upper Klamath Basin (Hamilton *et al.*, 2005).

2.1.3 Monitoring Area

Several tributaries in the Hydroelectric Reach are considered to currently have viable anadromous fish habitat, including Jenny Creek, Fall Creek, Shovel Creek, and Spencer Creek (Huntington, 2006). Other tributaries that historically provided anadromous fish habitat include Beaver Creek (DOI, 2007), Camp Creek and Scotch Creek (i.e., the Camp-Scotch Creek complex; Hamilton *et al.*, 2005). In addition, more than 40 miles of potential salmonid spawning habitat will become available on the mainstem Klamath River following dam removal (Huntington, 2006).

Fish presence monitoring by the Renewal Corporation will be conducted at (1) the Camp-Scotch Creek complex, Jenny Creek, and Beaver Creek channel lengths within the former reservoir footprints and (2) a reach of the mainstem Klamath River from RM 291.6 to the confluence with Shovel Creek (collectively, the Project Monitoring Area). Figures depicting each portion of the Project Monitoring Area and an overview map (Figure 1) are provided in the detailed map book in Appendix A.

2.1.4 Monitoring Duration

The Renewal Corporation will begin monitoring for the Target Species in October of the first year after the year in which drawdown of the reservoirs commenced. Monitoring will continue for a total of four consecutive years. However, monitoring in a given tributary will cease if monitoring surveys document the presence of anadromous fish in that tributary during a given year. Documented anadromous fish presence in a tributary will indicate that anadromous fish have access to the mainstem Klamath River below that tributary, and that portion of the mainstem will no longer be monitored. Finally, the Renewal Corporation may cease monitoring, following consultation with the Aquatics Technical Working Group, if other factors indicate that monitoring is no longer required (e.g., a lack of fish passage barriers may support the conclusion that anadromous fish are present).

Surveys in the Project Monitoring Area will be conducted every other week beginning in the first two weeks of November and continuing through the first two weeks of January, other than for the mainstem monitoring which will occur from the second week of October until the last week of November.

2.2 Monitoring Actions in the Hydroelectric Reach

2.2.1 Tributary Fish Presence Monitoring Methods

The primary monitoring method used by the Renewal Corporation in these tributaries will target adults during their spawning period and will include redd and carcass surveys. The Renewal Corporation will follow methodology similar to that used by the Mid Klamath Watershed Council to survey tributaries in the mid-Klamath watershed (MKWC, 2017). Surveys will be conducted by a crew of two persons, with at least one person who is trained in the survey method being used.

Surveys will be conducted primarily by walking along the tributary, though snorkeling may be used to survey select holding pools if the Renewal Corporation determines that adequate data cannot be collected by a walking survey. Data will be collected on electronic tablets or paper data sheets (an example is provided in Appendix B). The Renewal Corporation will record the tributary name, crew members, date, start and end times, weather, and a description of water visibility. Global positioning system (GPS) points will be collected for observations of live anadromous fish, carcasses, or redds. Redd measurements (length and width) and photographs will be taken when practical.

The sections below detail additional monitoring approaches specific to each tributary, including the survey reaches, as well as which Target Species are expected to be encountered in a given tributary.

2.2.1.1 Camp-Scotch Creek Complex

Camp Creek is the first major tributary upstream of Iron Gate Dam. Following reservoir drawdown, approximately 1.35 miles of historical channel will be restored upstream of the Camp Creek confluence with the Klamath River. Based on this historical channel alignment, Scotch Creek will flow into Camp Creek at approximately river mile (RM) 1.20. Together, these tributaries form the Camp-Scotch Creek complex, which was historically important for Chinook salmon and steelhead trout (Hamilton *et al.*, 2005). Both Camp Creek and Scotch Creek currently support resident *O. mykiss* (BLM, 2000).

The Renewal Corporation will survey Camp Creek from the confluence with the Klamath River to the Copco Road crossing as shown in Appendix A, Figure 2. This reach is approximately 1.40 miles long. The Renewal Corporation will survey Scotch Creek from the confluence with Camp Creek to the Copco Road crossing as shown in Appendix A, Figure 2. This reach is approximately 0.25 miles long. In total the Renewal Corporation will thus survey 1.65 miles of the Camp-Scotch Creek complex for Target Species.

2.2.1.2 Jenny Creek

Jenny Creek is a major, perennial tributary within the Iron Gate Reservoir footprint. Following reservoir drawdown, approximately 0.50 mile of historical channel will be restored upstream of the Jenny Creek confluence with the Klamath River. Historically, Jenny Creek was an important tributary for Chinook salmon and coho salmon (Hamilton *et al.*, 2005). In addition, Jenny Creek is currently occupied by resident *O. mykiss* (BLM, 2000). Based on the historical and current occurrence records, Chinook salmon, coho salmon, and steelhead are expected to occur in Jenny Creek following dam removal.

The Renewal Corporation will monitor Jenny Creek from the confluence with the Klamath River to just upstream of the Copco Road crossing as shown on Appendix A, Figure 3. This reach is approximately 0.65 miles long.

2.2.1.3 Beaver Creek

Beaver Creek is the only anticipated anadromous fish-bearing tributary in Copco Reservoir. This tributary contains habitat for steelhead, Chinook salmon, coho salmon, and Pacific lamprey (DOI, 2007). Following reservoir drawdown, approximately 1.10 miles of historical channel on Beaver Creek will be restored. The Renewal Corporation will monitor for Target Species from the Klamath River confluence to the Copco Road crossing as described in Appendix A, Figure 4. This monitoring reach is approximately 1.30 miles long.

2.2.2 Mainstem Klamath River Fish Presence Monitoring

2.2.2.1 California Reach: Shovel Creek to State Line

The Renewal Corporation will monitor the mainstem Klamath River in the California portion of the Hydroelectric Reach by monitoring an approximately 1.60 mile long reach from RM 291.6 (PacifiCorp Fishing Access Site 6) to the confluence with Shovel Creek as shown in Appendix A, Figure 5.

The primary survey method employed by the Renewal Corporation will be redd and carcass surveys from inflatable catarafts. This technique is currently used by the U.S. Fish and Wildlife Service (USFWS) and the Karuk Tribe to conduct redd and carcass surveys of the Klamath River below Iron Gate Dam (USFWS, 2020).

Cataraft surveys in the reach upstream of Shovel Creek are anticipated to be conducted by a crew of two persons, with one person rowing and one person observing and recording data. Data will be collected on electronic tablets or paper sheets and will include the survey reach name, crew members, date, start and end times, weather condition, and water visibility description. GPS points will be collected for observations of live anadromous fish, carcasses, or redds. Redd measurements (length and width) and photographs will be taken when practical. If conditions allow and raft based observation is insufficient to collect data, the Renewal Corporation may use masks and snorkels to verify redd presence. If determined to be warranted by the observation crew, the observers may stop at holding pools to conduct a snorkel survey for fish presence and stop at fish carcasses for identification.

2.3 Coordination of Planned Monitoring for Agencies and Tribes

2.3.1 Agency Monitoring

Following dam removal, several different state and federal Agencies, as well as Tribal fisheries programs, will be engaged in efforts to monitor and study the response of anadromous fish to the restored access of hundreds of miles of habitat. These monitoring programs will vary in terms of their management objectives and research questions, and, by extension, the methodologies they employ. A commonality will be their focus on documenting anadromous fish presence.

Following dam removal, the California Department of Fish and Wildlife (CDFW) plans to monitor anadromous fish presence in several tributaries in the Upper Klamath Basin in California,

including Jenny Creek (K. Bainbridge, pers. comm., 2020). This CDFW monitoring is expected to follow similar protocols to the monitoring currently conducted under CDFW's Klamath River Project. CDFW works in cooperation with federal, Tribal, local government, and NGO partners to conduct anadromous salmonid surveys in the Lower Klamath Basin. These monitoring efforts include underwater video surveillance of returning adult salmonids, spawning ground and carcass surveys, and juvenile outmigration monitoring on Bogus Creek, Scott River, and Shasta River (CDFW, 2018, 2019a, 2019b). The Renewal Corporation will coordinate with CDFW on the locations and species of anadromous fish observed during the fish presence monitoring period.

A minimum of four weeks prior to conducting monitoring, the Renewal Corporation will notify staff from the California State Water Resources Control Board (SWRCB), the Natural Resources Conservation Board (NCRB), CDFW, and the National Marine Fisheries Services (NMFS) so that each such agencies' staff may participate in the monitoring, if desired.

Coordination with the Oregon Department of Fish and Wildlife (ODFW), CDFW, and NMFS will occur on a quarterly basis (approximately every three months) to maintain an understanding of the scope of fish presence monitoring to be conducted. In addition, coordination and communication is anticipated with academic institutions to better understand the scope of their anadromous fish presence monitoring activities and data to be collected.

2.3.1.1 Fall Creek

Under the Hatcheries Management and Operations Plan, the Fall Creek Hatchery will be modified prior to reservoir drawdown to support salmonid production goals in the Upper Klamath Basin. Priority species of production include fall-run Chinook salmon and coho salmon. Production will continue for eight years following dam removal. CDFW is expected to monitor anadromous fish returns at the Fall Creek Hatchery following dam removal. Coordination with CDFW will determine the species of anadromous fish that return to Fall Creek during the Fish Presence Monitoring Plan 's monitoring period.

2.3.1.2 Shovel Creek

Historically, Shovel Creek was an important tributary for Chinook salmon and steelhead (Hamilton *et al.*, 2005). Positioned upstream of Copco Reservoir and downstream of the California-Oregon border, it lays outside of reservoir influence and therefore outside of the Proposed Action's tributary restoration area.

Following dam removal, CDFW plans to monitor several tributaries in the Upper Klamath Basin in California for anadromous fish presence, including Shovel Creek (K. Bainbridge, pers. comm., 2020). Monitoring in these tributaries is expected to follow monitoring protocols currently conducted under CDFW's Klamath River Project. Such monitoring will likely include underwater video surveillance of returning adult salmonids, spawning ground and carcass surveys, and juvenile outmigration monitoring.

Additionally, CDFW's Heritage and Wild Trout Program currently includes backpack electrofishing, habitat typing, and spawning surveys for trout on Shovel Creek, at five-year intervals (CDFW, 2016). Monitoring efforts from these two CDFW programs will document anadromous fish presence in Shovel Creek.

2.3.1.3 Spencer Creek

Historically, Spencer Creek was an important tributary for Chinook salmon, coho salmon, steelhead trout, and Pacific lamprey (Hamilton *et al.*, 2005). The Oregon Department of Fish and Wildlife (ODFW) plans to implement an anadromous salmonid monitoring program for the Upper Klamath River following dam removal (ODFW, 2020). This program will include salmonid life cycle monitoring on Spencer Creek. This program will likely involve a combination of electrofishing surveys, and spawning ground and carcass surveys. On the lower reach of Spencer Creek, these ODFW monitoring plans include an outmigrating juvenile fish trap, a video weir, and passive integrated transponder (PIT) tag arrays. Continued coordination with ODFW leading up to and following dam removal will document the location and species of anadromous fish that are observed during the Fish Presence Monitoring Plan 's monitoring period.

2.3.1.4 Oregon Reach: State Line to Spencer Creek

ODFW plans to implement an anadromous salmonid monitoring program in the Upper Klamath Basin following dam removal (ODFW, 2020). Under this program, ODFW will monitor in the Oregon portion of the Hydroelectric Reach. Approximately 13 miles of the mainstem Klamath River from Keno Dam to the state line will be monitored for anadromous salmonid spawning and carcasses. The survey reaches include the Keno Reach, which extends 6.8 miles from Keno Dam to just downstream of Spencer Creek, and the Frain Ranch Reach, which extends 6 miles from the Spring Island Boat Ramp to Caldera Rapid. In addition, ODFW monitoring includes the operation of a rotary screw trap on the Klamath River downstream of the Spencer Creek confluence and/or on the lower end of the Frain Ranch Reach. Continued coordination with ODFW on the implementation of their monitoring program will aid in the documentation of the location and species of anadromous fish that are observed in Oregon's portion of the Klamath River during the Fish Presence Monitoring Plan 's monitoring period. Such findings would confirm fish presence throughout the mainstem Klamath River in California's portion of the Hydroelectric Reach.

3.0 Reporting

An annual report will be submitted to the SWRCB and the FERC that includes a summary of the following information, at a minimum:

1. A summary of the fish presence results;
2. An overall assessment of fish presence in the mainstem Klamath and tributaries, and consider fish return projections and observations in the summary;
3. The fourth annual report will also, at a minimum, include:

a. An analysis of whether any encountered fish passage impediment is Project-related; and
b. Proposed actions to remedy any Project-related impediments to anadromous fish[1].

4.0 References

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[1] Prior to implementing any proposed actions, the Renewal Corporation shall seek regulatory authorization.

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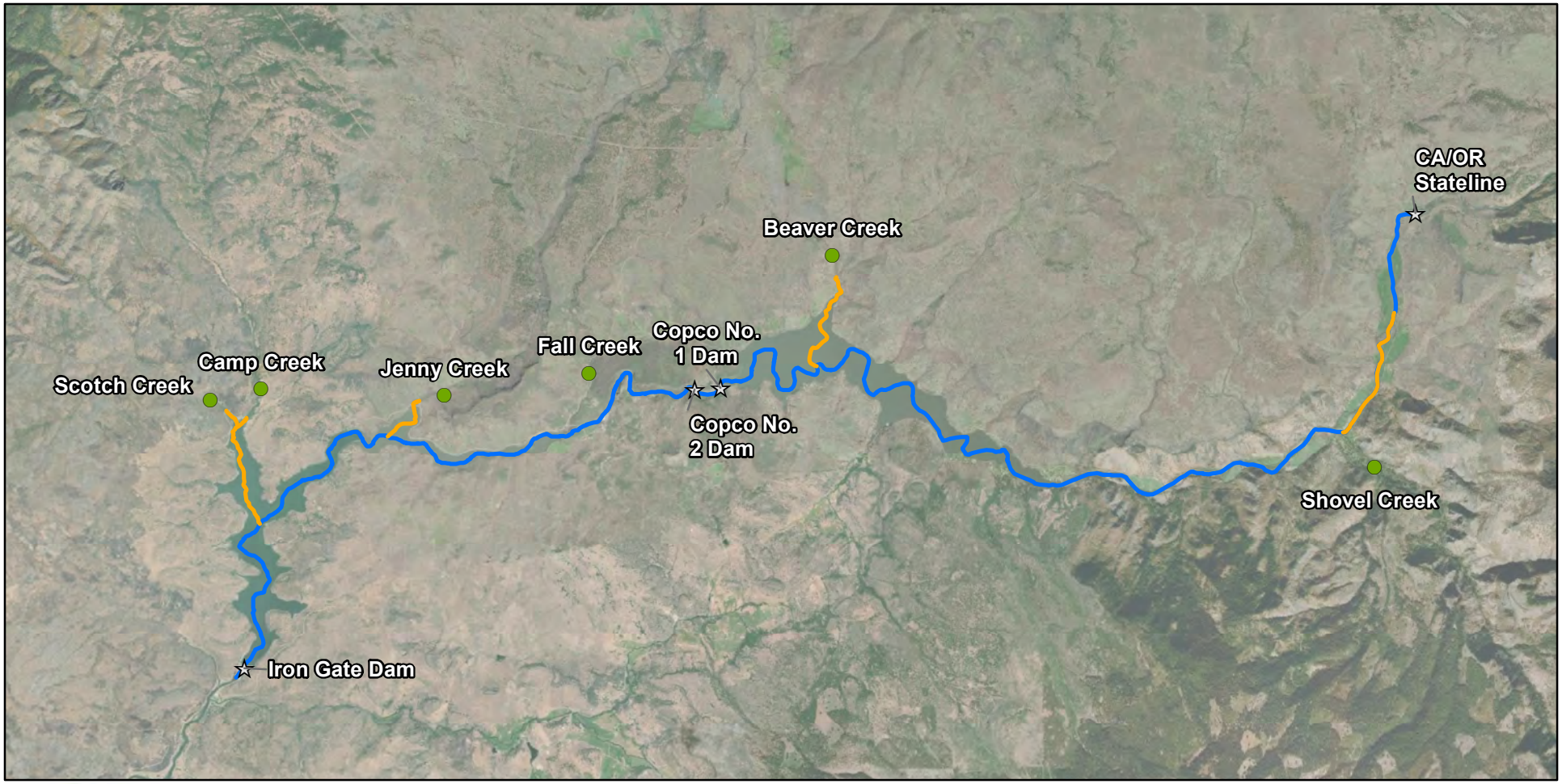
Appendix A

Detailed Map Books



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Plan

Figure 1. Project Monitoring Area

December 2, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

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Legend

- ☆ Reference Sites
- ● Tributaries
- Monitoring Reaches
- Historic Klamath River Aligment

N

0 1.5 3 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Plan

Figure 2. Camp-Scotch Creek Complex Monitoring Reaches

December 3, 2020

Legend

- ☆ Reference Sites
- ● Tributaries
- Monitoring Reaches
- Historic Klamath River Aligment

N

0 0.3 0.6 Miles

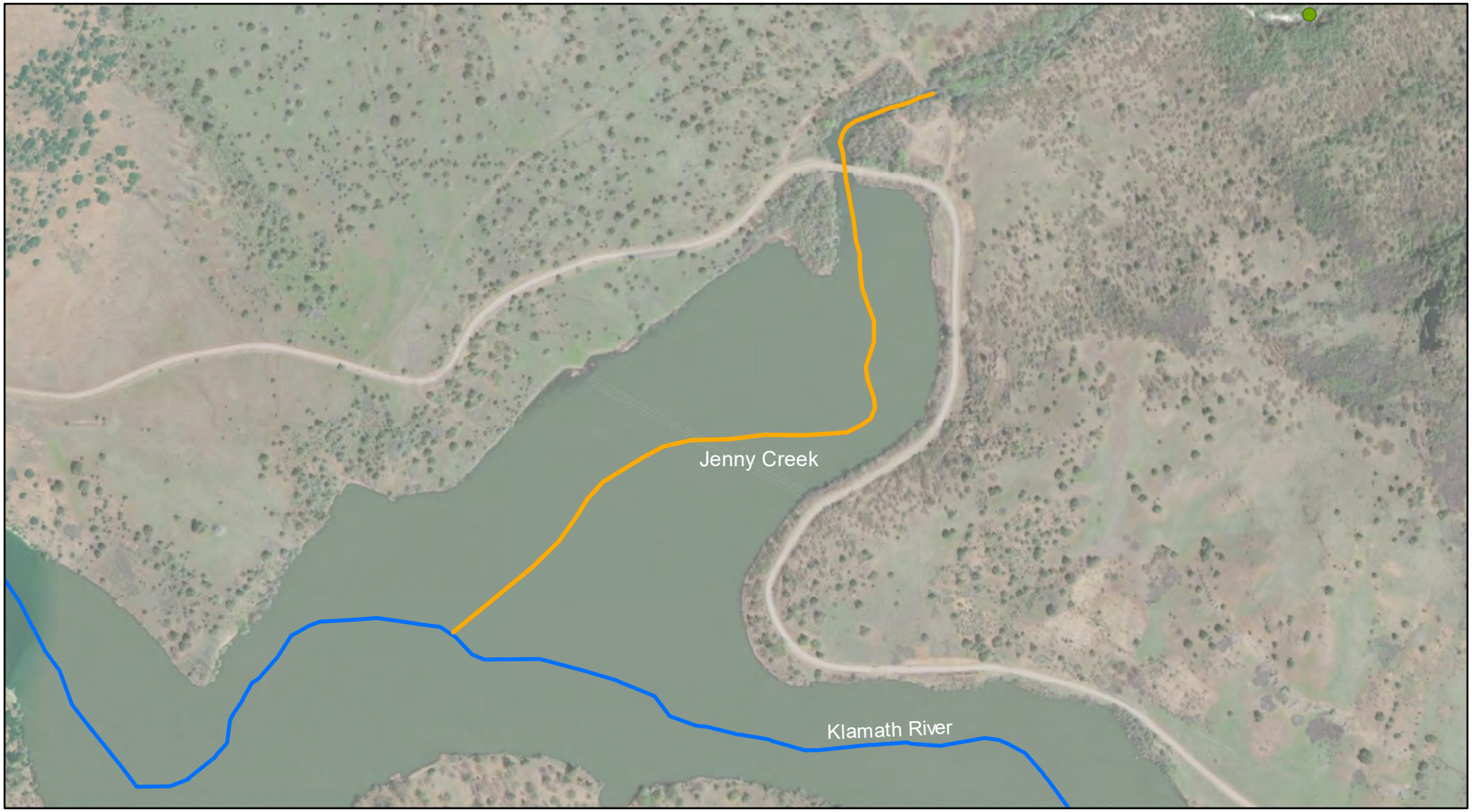
Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Plan

Figure 3. Jenny Creek Monitoring Reach

December 3, 2020

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Legend

- ☆ Reference Sites
- ● Tributaries
- Monitoring Reach
- Historic Klamath River Aligment

N

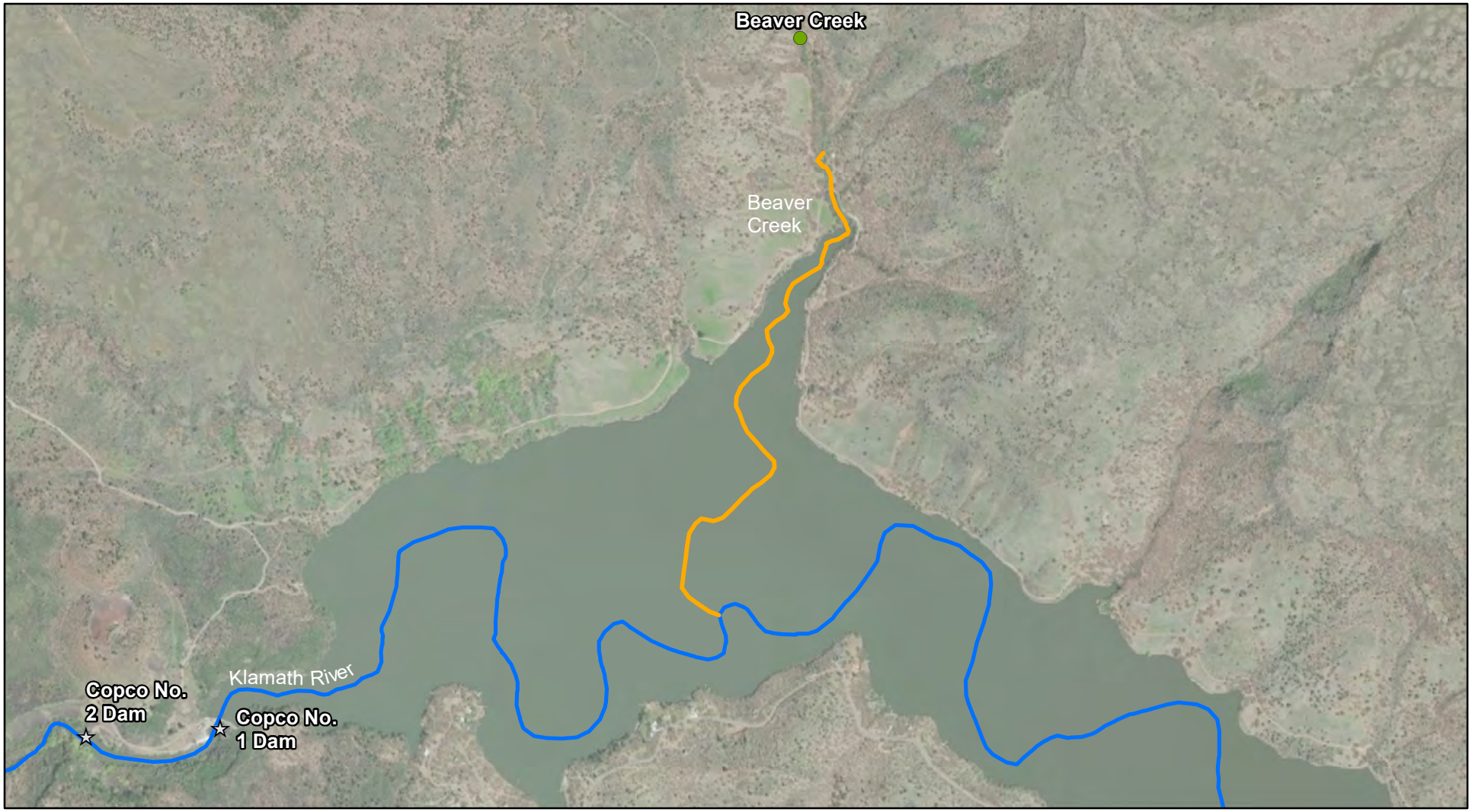
0 0.1 0.2 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Plan

Figure 4. Beaver Creek Monitoring Reach

December 3, 2020

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Legend

- ☆ Reference Sites
- ● Tributaries
- Monitoring Reach
- Historic Klamath River Aligment

N

0 0.3 0.6 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Fish Presence Plan

Figure 5. Mainstem Klamath Monitoring Reach

December 3, 2020

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Legend

- ☆ Reference Sites
- Tributaries
- Monitoring Reach
- Historic Klamath River Aligment

N

0 0.65 1.3 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

Appendix B

Monitoring Data Sheets

Lower Klamath Project

Fish Presence Plan – Survey Data Sheet

Monitoring Reach:	_____	Start Time:	_____
Survey Date:	_____	End Time:	_____
Crew:	_____	Weather:	_____
	_____	Water Visibility:	_____

Redd Observations					
GPS Point Name	**Photographed (Y/N)**	**Previously marked (Y/N)**	**Species**	**Fish on red (Y/N)**	**L (in.) x W (in.)**

Notes and field observations:

Fish Presence Plan – Survey Data Sheet Continued

Monitoring Reach: _____ Survey Date: _____

Fish Observations				
Live fish / carcass	**Species**	**Carcass length**	**Photo taken (Y/N)**	**Tissue/otolith taken**

Notes and field observations:

Appendix D

Tributary-Mainstem Connectivity Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Tributary-Mainstem Connectivity Plan

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February 2021

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Table of Contents

List of Tables

List of Figures

Appendices

1.0 Introduction

The Tributary Mainstem Connectivity Plan described herein is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose of Tributary-Mainstem Connectivity Plan

The purpose of the Tributary Mainstem Connectivity Plan is to describe the fish passage monitoring efforts the Renewal Corporation will undertake to identify potential fish barrier formation along the mainstem Klamath River and at identified fish-bearing tributary confluences within the Tributary Mainstem Connectivity fish passage monitoring area (as described in Section 2.2.2) during the two-year period following the reservoir drawdown. In particular, the Tributary Mainstem Connectivity describes the geographic area that will be monitored by the Renewal Corporation, the period during which monitoring will occur, and the methods that will be used by the Renewal Corporation during monitoring. In addition, the Tributary Mainstem Connectivity summarizes the adaptive management framework that the Renewal Corporation will use to interpret monitoring data and take adaptive management actions.

1.2 Relationship to Other Management Plans

The Tributary Mainstem Connectivity Plan supported by elements of the following management plans for effective implementation: Reservoir Area Management Plan, the Aquatic Resources Management Plan (sub-plans), the Water Quality Management Plan, the Hatcheries Management and Operations Plan, and the Erosion and Sediment Control Plan. So as not to duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referenced in this Plan. More specifically, the Renewal Corporation will implement reporting associated with passage impediments to anadromous fish consistent with the Reservoir Area Management Plan. In addition, the Tributary Mainstem Connectivity Plan is a subpart to the Renewal Corporation's larger fish passage monitoring effort for the Proposed Action, parts of which are also included in the Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan, the Fish Presence Monitoring Plan and the Reservoir Area Management Plan. When combined, the fish passage monitoring procedures described in the Tributary Mainstem Connectivity, the Reservoir Area Management Plan, and the other Aquatic Resources Management Plan sub-plans provide a comprehensive framework for fish passage monitoring in connection with the Proposed Action (Figure 1-1).

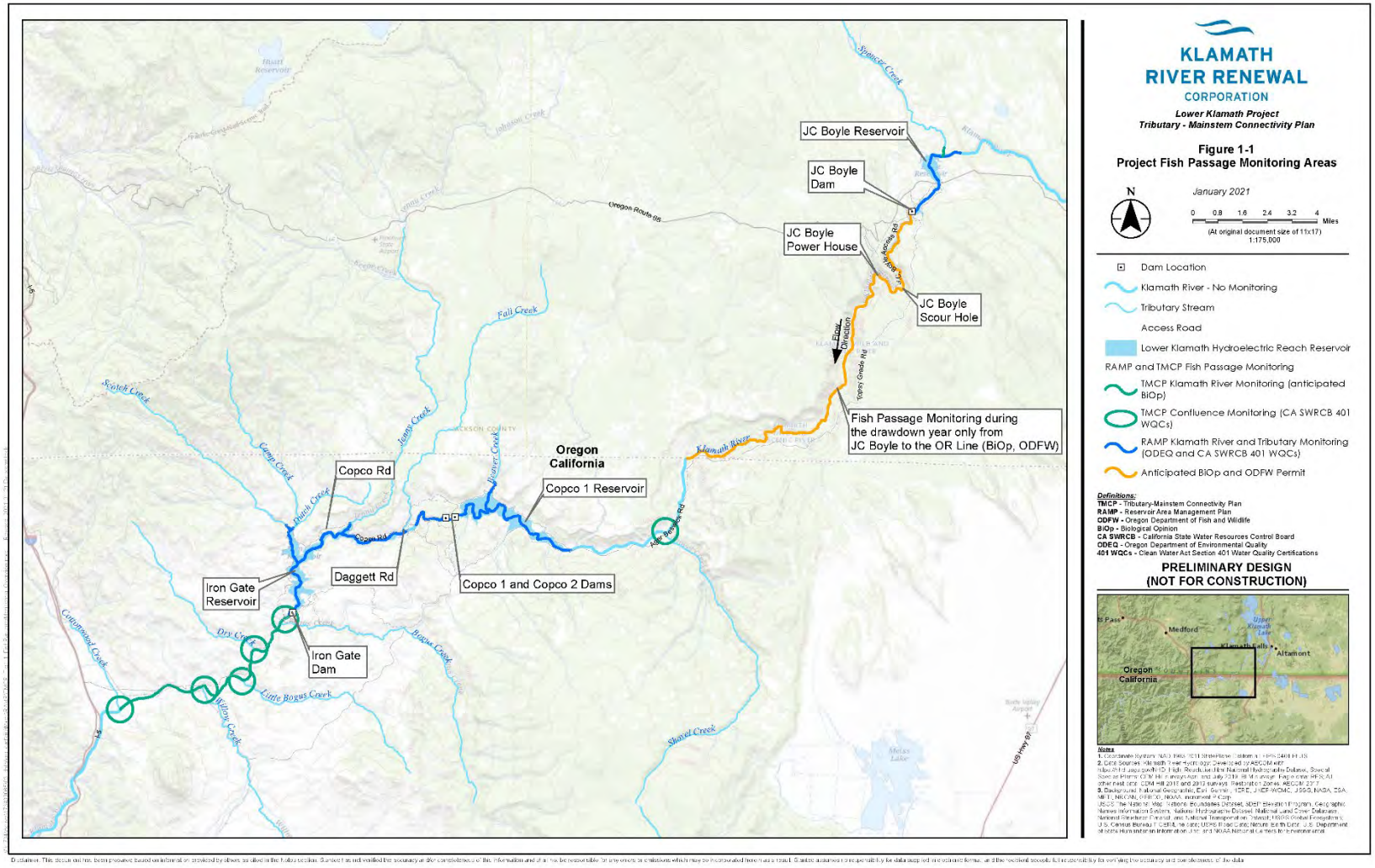

Figure 1-1. Project Fish Passage Monitoring Areas

2.0 Management Plan Measures

2.1 Fish Passage Monitoring

The Renewal Corporation will conduct fish passage monitoring along the 8-mile reach (Reach) of the mainstem Klamath River from the downstream side of the Iron Gate Dam footprint (river mile (RM) 193.1) to Cottonwood Creek (RM 185.1), at the confluence locations of the five fish-bearing streams within the Reach (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek), and at the Shovel Creek confluence with the Klamath River above the Copco No. 1 Reservoir. The Tributary Mainstem Connectivity Plan fish passage monitoring area is depicted in Figure 2-1 and presented in the Map Book in Appendix A.

The Renewal Corporation will monitor the Reach for sediment deposition and potential fish barrier formation resulting from the Proposed Action. The Renewal Corporation's fish passage monitoring and associated adaptive management activities in the Tributary Mainstem Connectivity focus on fish passage impediments caused by anthropogenic features including residual reservoir sediments and anthropogenic debris. Fish passage barriers may occur within the Reach because of sediment evacuation during reservoir drawdown and dam removal, or after dam removal when the Klamath River flows freely allowing for active sediment transport of residual reservoir sediments. Fish passage barriers in the Tributary Mainstem Connectivity fish passage monitoring area could potentially impact the following species: coho salmon (*Oncorhynchus kisutch*), spring-run and fall-run Chinook salmon (*O. tshawytscha*), steelhead (anadromous form of rainbow trout; *O. mykiss*), and Pacific lamprey (*Entosphenus tridentatus*). The Renewal Corporation predicts sediment deposition up to 1.5 feet (ft) from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1) during reservoir drawdown based on hydraulic and sediment transport modeling completed by United States Bureau of Reclamation (BOR) (BOR, 2011). Areas downstream of Cottonwood Creek are expected to have only minor deposition with deposits less than 0.25 ft (BOR, 2011).

The Renewal Corporation will conduct tributary confluence fish passage monitoring at the confluence locations of the five fish-bearing streams within the Reach (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek) to support volitional passage at the confluence site following drawdown and dam removal. For the purpose of this Tributary Mainstem Connectivity Plan, the confluence is defined as the reach of tributary stream that extends 150 feet upstream in the tributary from the point where the left bank of the tributary stream transitions and becomes the left bank of the Klamath River.

The Renewal Corporation will also conduct tributary confluence fish passage monitoring at Shovel Creek (RM 209.0) to support volitional passage at the confluence site following drawdown and dam removal of the J.C. Boyle Dam. The potential for fish passage barrier formation at this site is anticipated to be relatively low because the J.C. Boyle Reservoir has less stored sediment than the Copco 1 and Iron Gate Reservoirs and because the confluence is more than 18 miles from the dam removal site.

2.2 Monitoring Methods

The Renewal Corporation's Tributary Mainstem Connectivity Plan monitoring methods focus on volitional fish passage, consistent with Headcut Migration Monitoring in the Reservoir Area Management Plan and resulting discontinuities in residual reservoir sediments that may be fish passage barriers as defined therein. The following sections describe the Renewal Corporation's specific Tributary Mainstem Connectivity Plan measures.

2.2.1 Initial Establishment

Pre-drawdown topographic data is based on the 2018 baseline bathymetry, which is stored at www.opentopography.org. The open topography website is open to the public and will serve as the baseline data hub for topography and bathymetry. Project baseline data can be downloaded at https://opentopography.org/news/klamath-river-renewal-project-data-access-through-opentopography and https://doi.org/10.5069/G9DN436N. The Renewal Corporation will continue gathering data following drawdown, run-of-the-river operation, and construction operations to inform baseline conditions for monitoring and adaptive management.

2.2.1.1 Tributary Confluence Fixed Photo Points

The Renewal Corporation will establish fixed photo point monitoring locations pre-drawdown at each of the tributary confluences within the Tributary Mainstem Connectivity Plan fish passage monitoring area to establish that confluence sites are not blocked by sediment and that the sediment present does not obscure fish passage.

2.2.2 Tributary Mainstem Connectivity Plan Fish Passage Monitoring Area

The Renewal Corporation will conduct the volitional fish passage monitoring described in the Tributary Mainstem Connectivity Plan in the following 3 locations along the Klamath River:

- The 8-mile Reach
- At the confluence of five tributaries (Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek) in the 8-mile Reach. These tributaries were selected because they are recognized as influential tributaries (e.g., historical fisheries of importance or important freshwater sources) in the mid-Klamath River (Soto et al., 2008).
- At the confluence of Shovel Creek (RM 209.0). While this tributary is outside the reservoir footprints (i.e., upstream of Copco Lake), it was selected for connectivity monitoring due to its historical and/or potential habitat for adult salmonids (Huntington, 2006).

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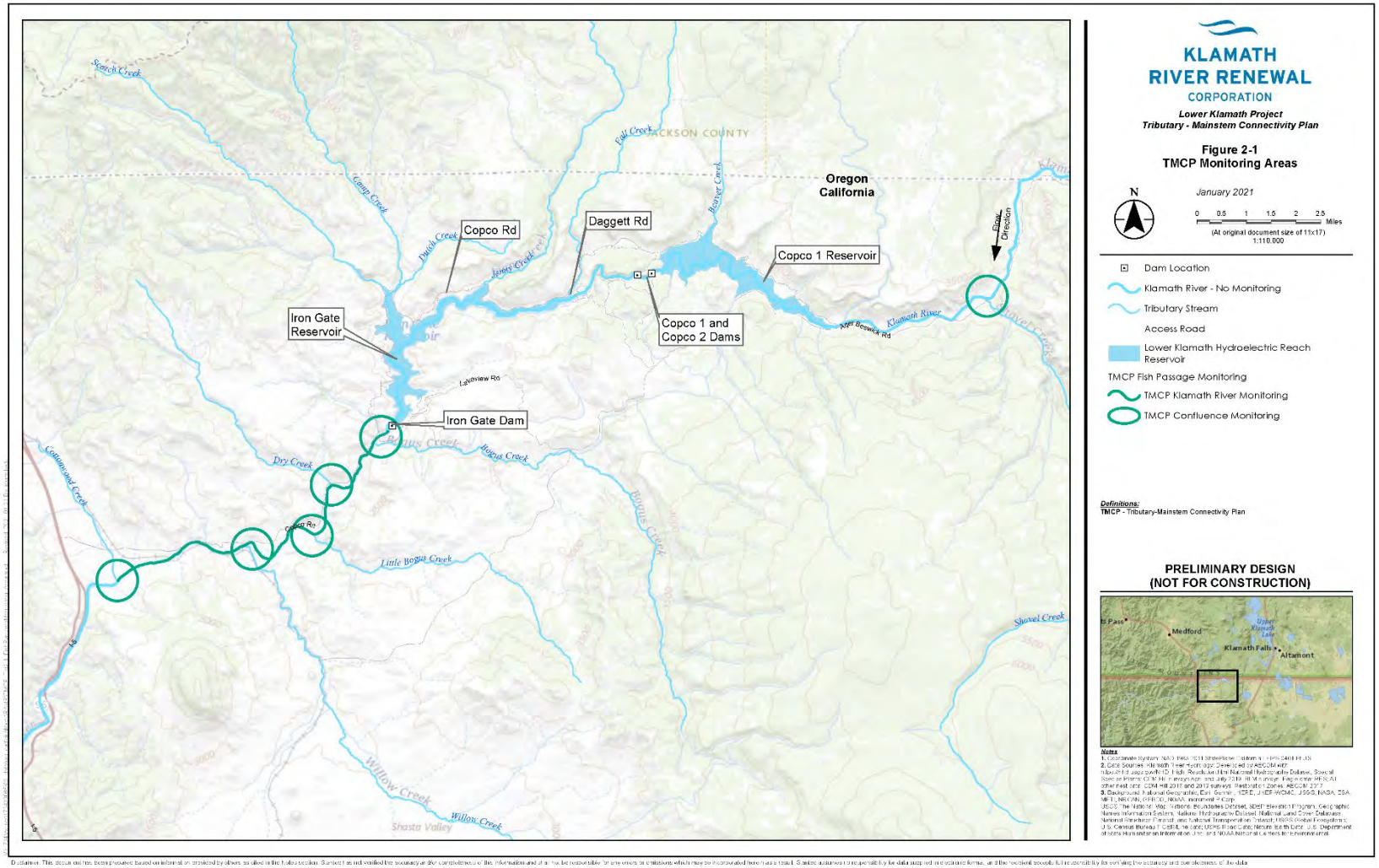

Figure 2-1. TMCP Monitoring Areas

2.2.3 Tributary Mainstem Connectivity Plan Fish Passage Monitoring Schedule

The schedule for the TMCP fish passage monitoring is presented in Table 2-1. During the drawdown year (Year 1), the Renewal Corporation will monitor in the spring, post-final drawdown (which is anticipated to occur in late spring or early summer depending on hydrologic conditions), and in the fall. During the post-drawdown year (Year 2), the Renewal Corporation will monitor after the wet season (which corresponds to a seasonal window and flow period characteristic of native migratory fish movement in the spring) and in early fall. The Renewal Corporation will monitor during the final year of the TMCP (Year 3) after the wet season. The Renewal Corporation's annual fish passage monitoring is addressed in the Reservoir Area Management Plan.

Table 2-1. Schedule for TMCP Fish Passage Monitoring

YEAR	SURVEY PERIOD	LOCATION
Drawdown Year (Year 1)	Spring	TMCP Fish Passage Monitoring Areas
	Post Final Drawdown	TMCP Fish Passage Monitoring Areas
	Fall	TMCP Fish Passage Monitoring Areas
Year 2	After wet season	TMCP Fish Passage Monitoring Areas
	Fall	TMCP Fish Passage Monitoring Areas
Year 3	After wet season	TMCP Fish Passage Monitoring Areas
Drawdown – (Year 3)	*Additional monitoring event will be conducted following a 5-year or greater flow event if it occurs within the two-year TMCP monitoring period.	TMCP Fish Passage Monitoring Areas

* 5-year Flow Event of 10,895 cubic feet per second or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA Gage (#11516530)

2.2.4 Desktop Monitoring, Field Surveys, and Reporting

The Renewal Corporation will undertake fish passage monitoring through a combination of the desktop and field review procedures described in the Reservoir Area Management Plan. The Renewal Corporation will accomplish fish passage monitoring through desktop methods to identify and evaluate potential barriers. The Renewal Corporation will conduct field investigations if the desktop methods are inconclusive or if a potential barrier is identified, warrants adaptive management, and is classified as a significant intervention (Section 2.3.2). If the Renewal Corporation determines that a field-based fish passage barrier evaluation is required, the Renewal Corporation will notify the ATWG and Restoration Technical Work Group

(RTWG) approximately two (2) weeks prior (or 24 hours in the case of an emergency) to the field investigation to allow staff the opportunity to participate in the monitoring effort. TMCP monitoring reports will be prepared annually in coordination with the Reservoir Area Management Plan fish passage monitoring schedule.

2.2.5 Anthropogenic Debris

The Renewal Corporation will remove any human-made structures within the fish passage monitoring area that are visible in channel beds if they both (1) cause greater than a twelve inch discontinuity in water surface elevation and (2) result in a fish passage barrier.

2.2.6 Natural Fish Passage Barriers

The Renewal Corporation will not remove natural barriers consisting of non-residual reservoir sediments, bedrock, and other pre-dam channel elements, such as woody debris and boulders.

2.2.7 Headcut Migration Monitoring

Discontinuities in the channel bed due to uneven evacuation of sediments may lead to temporary headcuts or blockages that could act as barriers to fish migration. Depending on the nature of the residual sediment and subsequent flows experienced, such headcuts may be short-lived and/or not likely to pose a sustained threat to fish passage or long-term habitat function. The Renewal Corporation's methods for evaluating residual reservoir sediment headcuts and the steps to take if they are deemed to be fish passage barriers are set forth in the section of the Reservoir Area Management Plan titled "Headcut Migration Monitoring", which is incorporated into the TMCP by reference.

2.2.7.1 Accreted Sediment Monitoring

The Renewal Corporation will conduct monitoring of potential sediment accretion within the fish passage monitoring area through fixed photo point monitoring at each of the tributary confluences within the TMCP fish passage monitoring area to establish that each confluence site is not blocked by sediment and/or the sediment present does not obscure fish passage. In addition, during headcut migration monitoring (Section 2.2.7), the Renewal Corporation will review digital aerial data capture technologies using low-elevation, geolocated oblique aerial video to assess potential barriers at the tributary confluence sites. While this monitoring protocol is intended for headcut migration monitoring, it also serves to identify potential barriers resulting from accreted residual reservoir sediment to assure connectivity and passability. The presence of accreted sediment alone does not necessitate intervention. Rather, it is the formation of barriers to the fish species listed in Section 2.1 that may trigger adaptive management measures as described in the following sections.

2.3 Adaptive Management

If any of the barriers to fish passage identified in Section 2.2 are described, the following adaptive management framework allows the Renewal Corporation to interpret monitoring data

and take adaptive management actions, including the correction of tributary confluence blockages, when necessary to achieve the Tributary Mainstem Connectivity Plan's purpose.

2.3.1 Triggers

An example of a monitoring result that could trigger adaptive management is presented in Table 2-2.

Table 2-2. Example Monitoring Results that Trigger Adaptive Management Frameworks

MONITORING LOCATION	MONITORING ELEMENT	EXAMPLE MONITORING RESULT	ADAPTIVE MANAGEMENT
Tributary Mainstem Connectivity Plan Fish Passage Monitoring Area	Fish Passage	Water surface elevation drops caused by discontinuity in residual reservoir sediments may preclude fish passage.	May conduct long profile survey, continue to monitor, assess severity, and evaluate need for physical interventions.

2.3.2 Minor and Significant Barrier Intervention

As detailed in Table 2-3, the Renewal Corporation's adaptive management interventions are considered either (1) minor and maintenance-oriented, requiring hand tools, or (2) significant, requiring mobilization of powered equipment and in-water work zone isolation.

Table 2-3. Adaptive Management Interventions

PLAN	MONITORING ELEMENT	MINOR INTERVENTIONS	SIGNIFICANT INTERVENTIONS	REVALUATE OBJECTIVES
Tributary-Mainstem Connectivity	Fish Passage	Maintenance Oriented - Hand Work – No Stream Isolation Required	Mobilization of Excavation Equipment – Stream Isolation May Be Required	Sustained Drought, Extreme Weather, Incorrect Assumptions

The Renewal Corporation will remedy tributary obstructions that limit fish passage through appropriate manual or mechanical means necessary to address obstructions. In particular, the Renewal Corporation will remove obstructions to the extent necessary to provide volitional passage for adult and juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. The Renewal Corporation will redistribute removed gravels and large woody debris within the channel in a manner that will avoid future passage blockage formation. The Renewal Corporation will place removed fine sediments on the adjacent floodplain or uplands and stabilize using appropriate revegetation methods.

Whether an intervention is minor or significant will be determined by the Renewal Corporation based on a number of factors, including without limitation the scale of the issue encountered, inherent risk to aquatic species, the need to mobilize powered excavation equipment to the site, the ability to remedy with less impactful hand approaches, and in-water work zone isolation requirements (Table 2-3).

In the event that data gathering is required to support significant interventions on the mainstem Klamath River, the Renewal Corporation will take guidance from relevant sections of the U.S. Environmental Protection Agency (EPA) Field Operations Manual for Non-Wadeable Streams (EPA, 2013b). In addition, the Renewal Corporation will take guidance from the EPA Field Operations Manual for Wadeable Streams (EPA, 2013a) for data gathering for significant interventions on priority tributaries.

2.3.3 Communication Process for Significant Interventions

The Renewal Corporation will use the Tributary Mainstem Connectivity Plan fish passage monitoring program to determine if adaptive management is required. If the Renewal Corporation believes that a significant adaptive management intervention is required, the Renewal Corporation will notify ATWG and RTWG members to confer on the need for corrective actions and provide them with the location of the issue, photographs, and characteristics, as well as the assessed type and severity of the issue. Notifications will be provided to ATWG and RTWG members approximately (2) weeks prior to field activities or 24 hours in advance of emergency interventions.

2.3.4 In-Water Work Best Management Practices for Significant Interventions

The Renewal Corporation will implement the following best management practices during significant interventions that require in-water work:

1. The National Marine Fisheries Service (NMFS) will be notified a minimum of 24 hours before start of work;
2. Unless under the guidance of NMFS, in-water work activities will occur during the in-water work window, expected to be June 15 to October 31;
3. A biologist will evaluate the in-water habitat to determine if salmonids or protected fish occur in the limits of work;
    a. If salmonid or protected fish are or are assumed to be present in the in-water work area, fish rescue, relocation, and exclusion will occur under the direction of a qualified fisheries biologist.
        i. General conditions for fish capture and relocation activities: Exclusion will include the use of block nets or similar to isolate the work area from fish access. The fisheries biologist will determine the upstream and downstream extent of the fish exclusion and relocation efforts, which will be based on the minimal amount of wetted channel where salmonids may experience potential injury or mortality from the in-water activity. Fish relocation will be performed using seine nets, dip nets, and/or electrofishing as determined appropriate and effective by the fisheries

biologist. The duration and extent of fish relocation actions will be determined by the fisheries biologist. Once the work area is determined to be cleared of salmonids, in-water work activities will be cleared to begin.

1. Electrofishing: All electrofishing will be conducted in accordance with NMFS' Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act (NMFS, 2000).
2. Salmonid handling and relocation: The National Oceanic and Atmospheric Administration Restoration Center's Programmatic Approach to Endangered Species Act/Essential Fish Habitat Consultation Streamlining for Fisheries Habitat Restoration Projects (NMFS, 2017), Section 2.4.1.E – Guidelines for Relocation of Salmonids will guide relocation work.

b. If no salmonids or protected fish occur in the work area, a biologist will monitor the in-water work actions to ensure that there is no change in conditions that would require fish exclusion or relocation. The biologist will document and report the completion of the in-water work activity to NMFS as described in item 10, below.

4. Disturbance to existing riparian vegetation and channel banks will be minimized to the extent feasible to complete the required restoration or maintenance action.
5. In the priority tributary restoration areas, cofferdam and flow diversion around the work area will be used if channel bed adjustments are required.
6. The use or storage of petroleum-powered equipment shall be accomplished in a manner to prevent the potential release of petroleum materials into waters of the state.
7. Areas for fuel storage, refueling, and servicing of construction equipment will be located in an upland location.
8. Oil absorbent and spill containment materials will be on site when mechanical equipment is in operation within 100 ft of the proposed watercourse crossings. If a spill occurs, no additional work shall commence in-channel until the following occurs: (1) the mechanical equipment is inspected by the contractor, and the leak has been repaired; (2) the spill has been contained; and (3) NMFS and California Department of Fish & Wildlife are contacted and have evaluated the impacts of the spill.
9. Project invasive species control measures will be followed to minimize potential transport of aquatic invasive species.
10. Documentation and reporting: Photographs of the in-water work location, summary of actions including any fish relocation, and notification of completion of the in-water work will be provided to NMFS within one (1) week of the completion of in-water work.

3.0 Reporting

An annual report will be submitted that includes a summary of the following information, at a minimum:

1. Summary of monitoring results;
2. An overall assessment of fish passage in the mainstem river and tributaries; and

3. A summary of tributary obstructions observed during monitoring events, if any observed, and proposed remedial actions.

4.0 References

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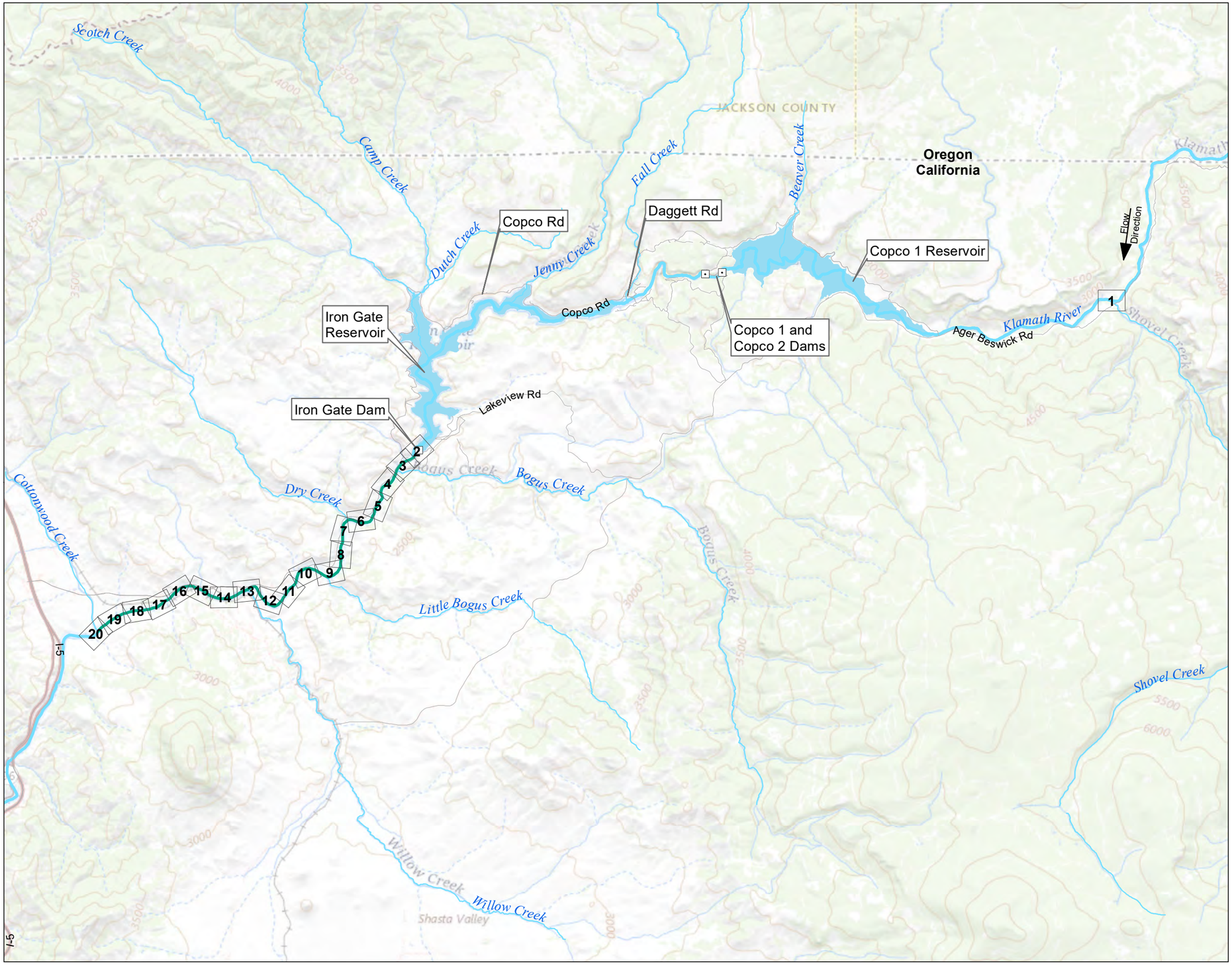
Appendix A

Map Book



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas Monitoring Map Index

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- Dam Location
- Access Road
- TMCP Monitoring Map Index
- Lower Klamath Hydroelectric Reach Reservoir
- Klamath River
- Tributary Stream
- TMCP Klamath River Monitoring and Confluence Monitoring at:
  - Shovel Creek RM 209.0
  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
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Definitions:
TMCP - Tributary-Mainstem Connectivity Plan

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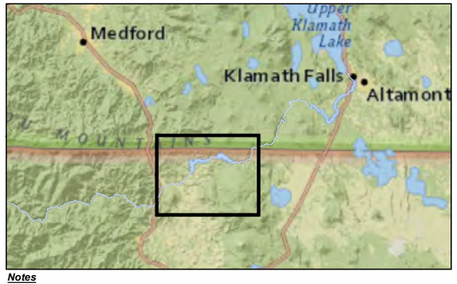

Notes
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3. Background: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
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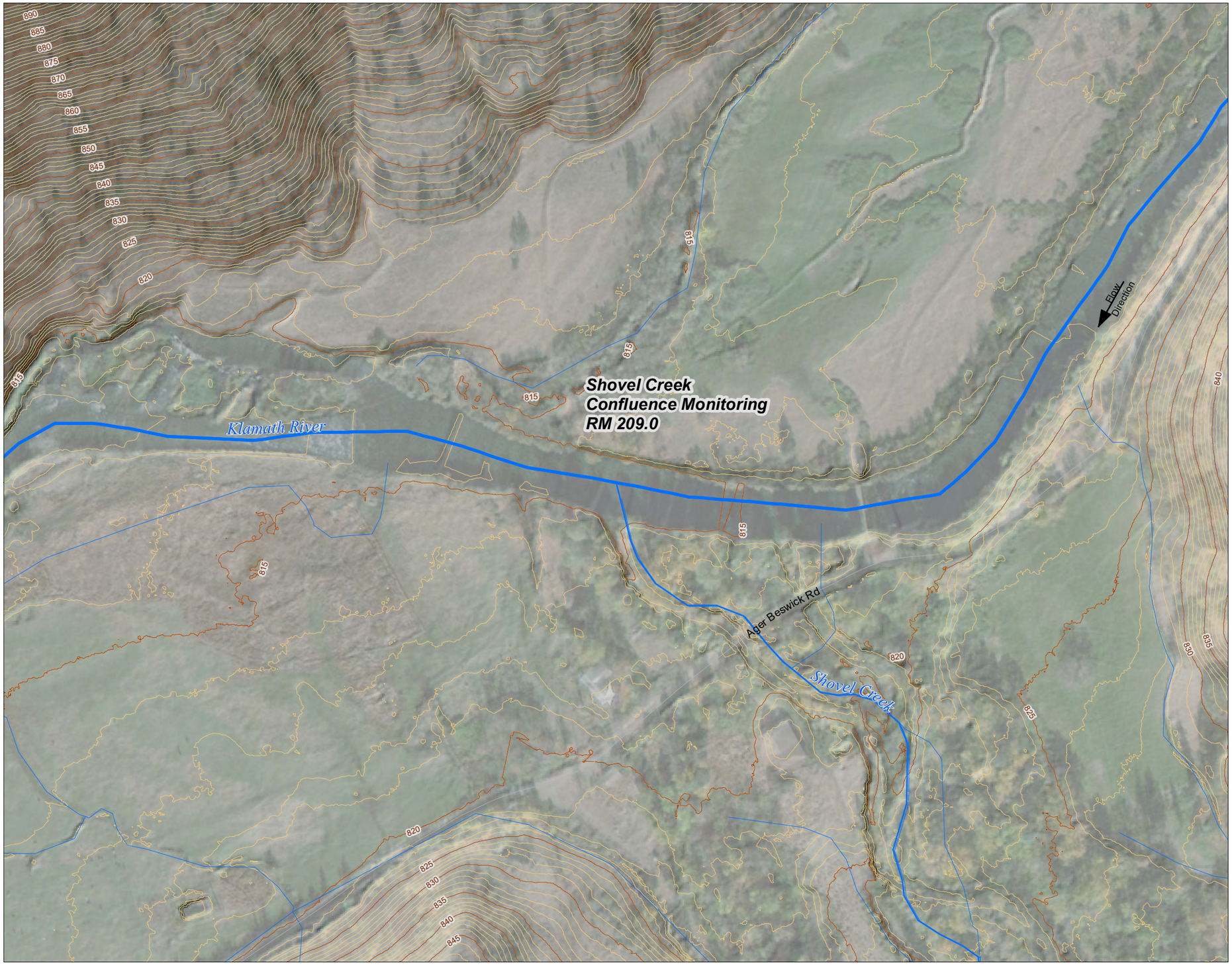

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 1 of 20

January 2021

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- Access Road
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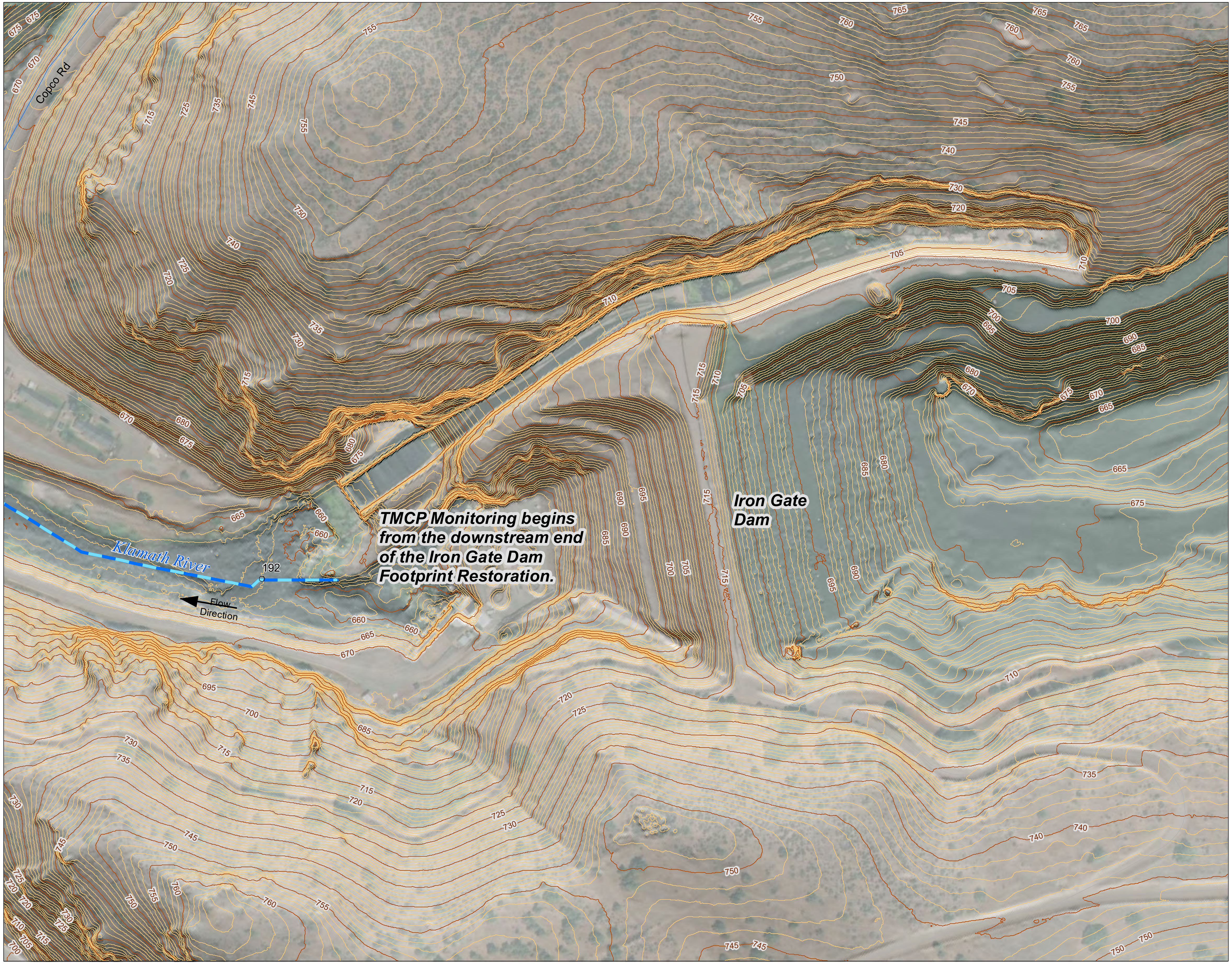

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 3 of 20

January 2021

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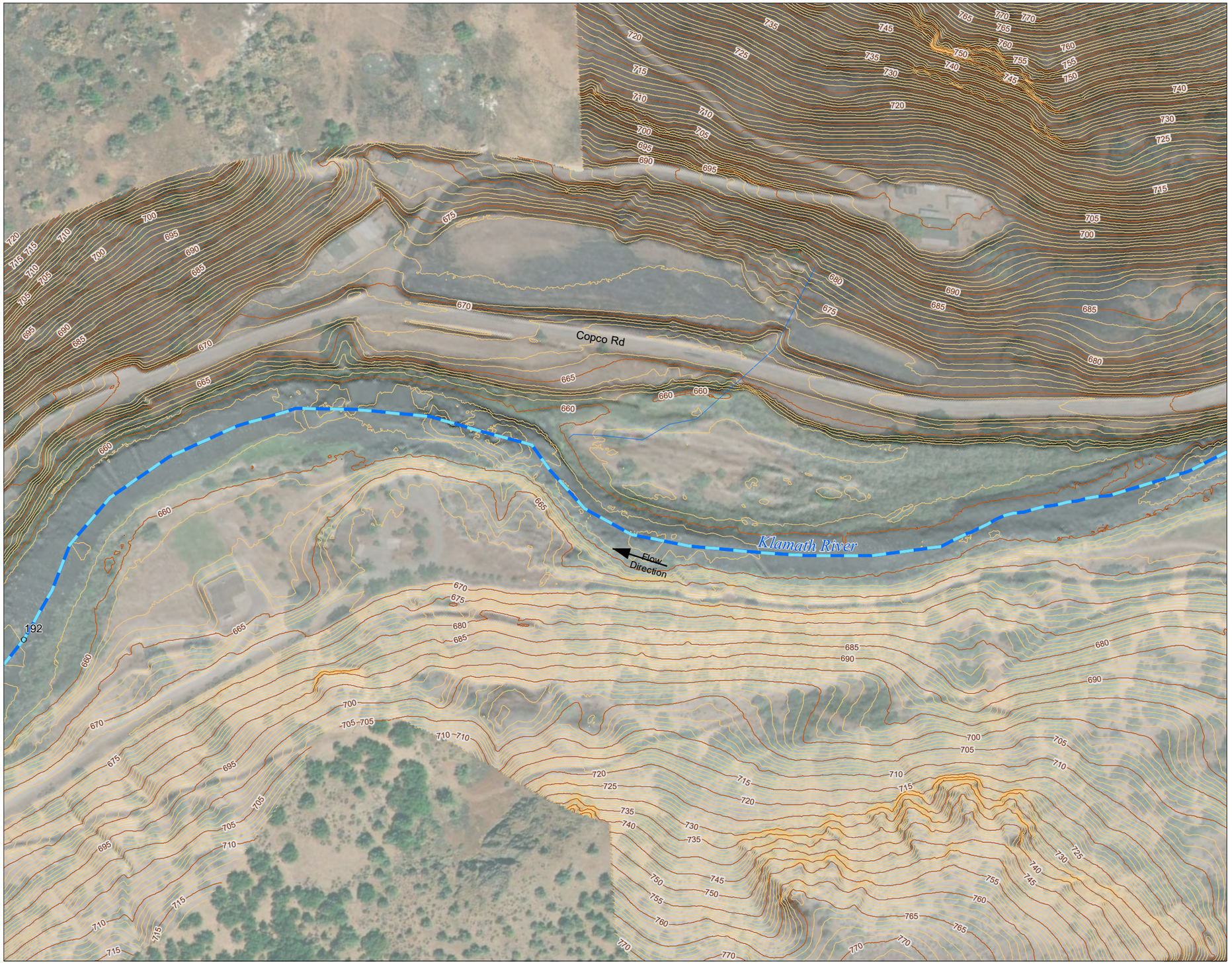

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 4 of 20

January 2021

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 5 of 20

January 2021

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1:2,400

- River Milepost
- Access Road
- 1 ft Contour
- 5 ft Index Contour
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Definitions:
TMCP - Tributary-Mainstem Connectivity Plan

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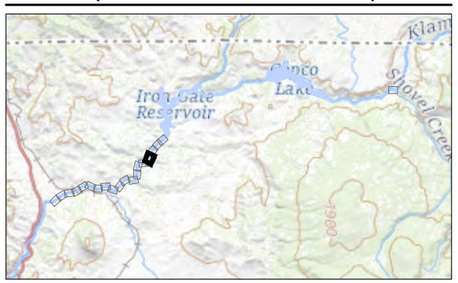

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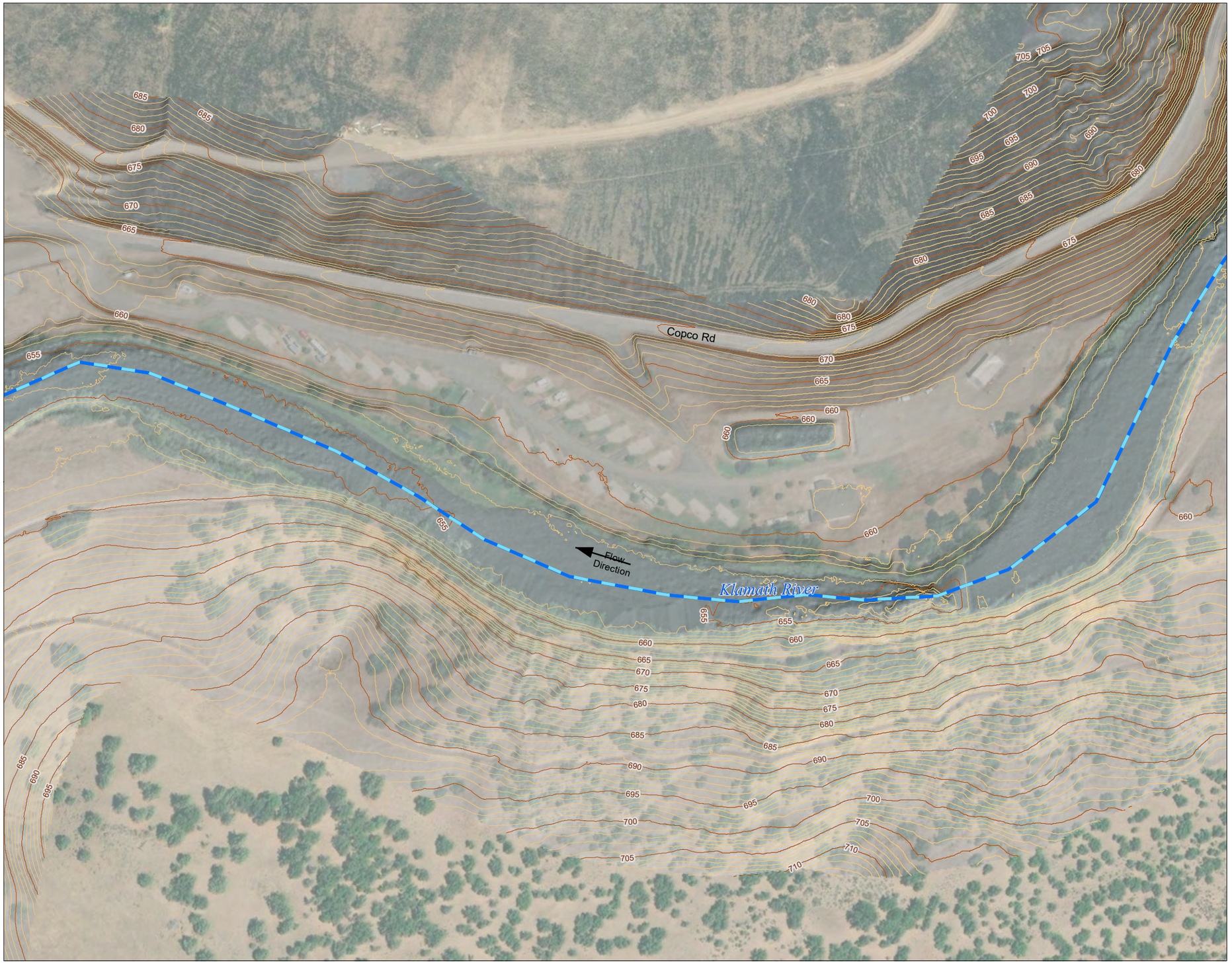

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 6 of 20

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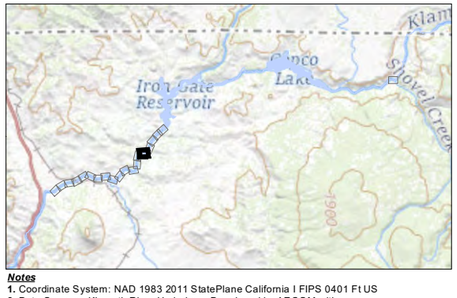

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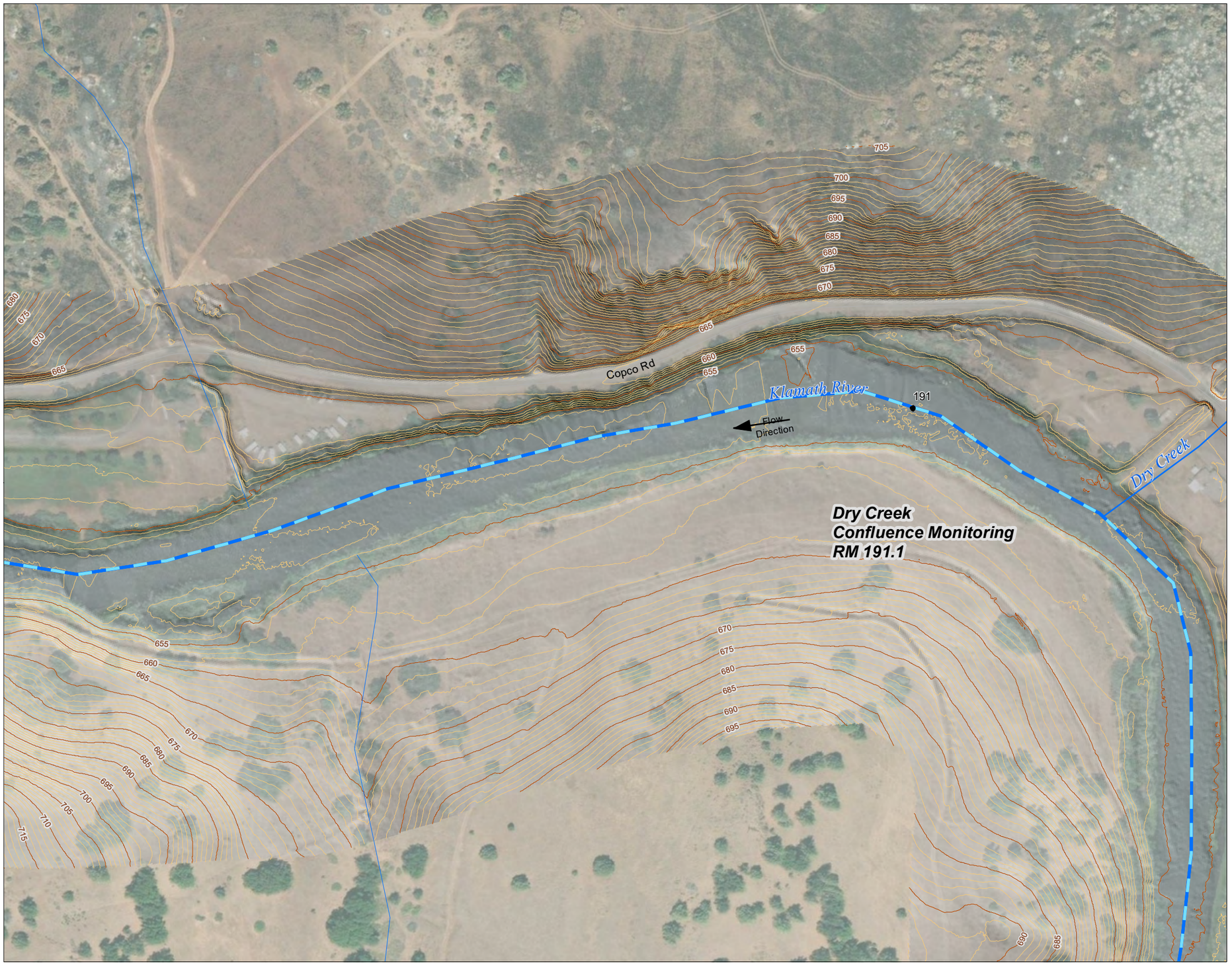

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

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Page 7 of 20

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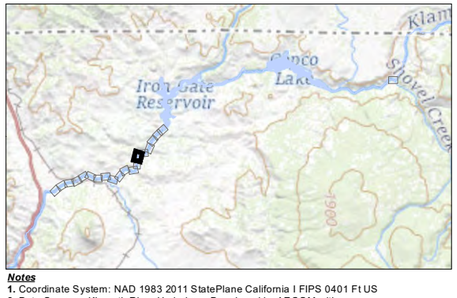

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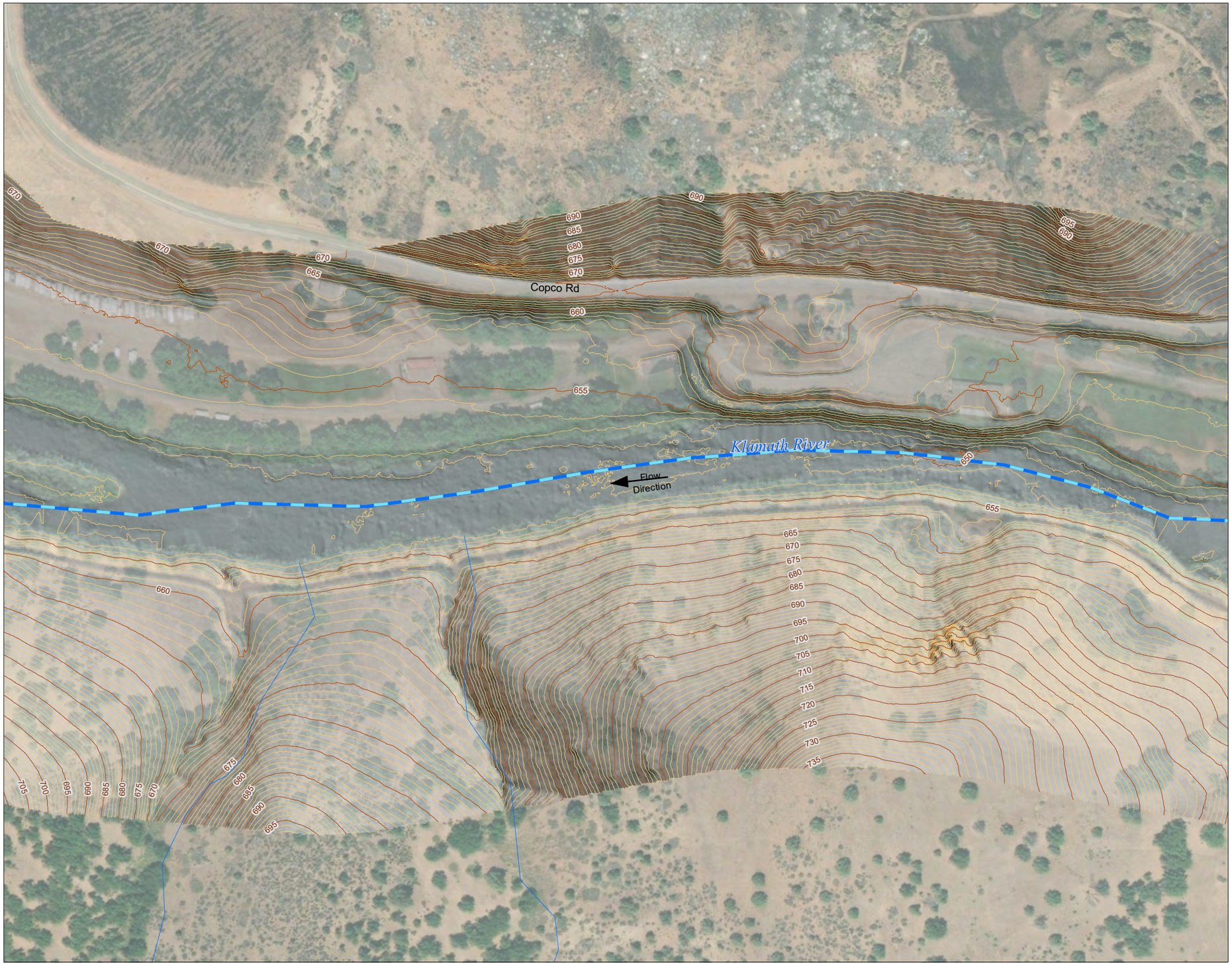

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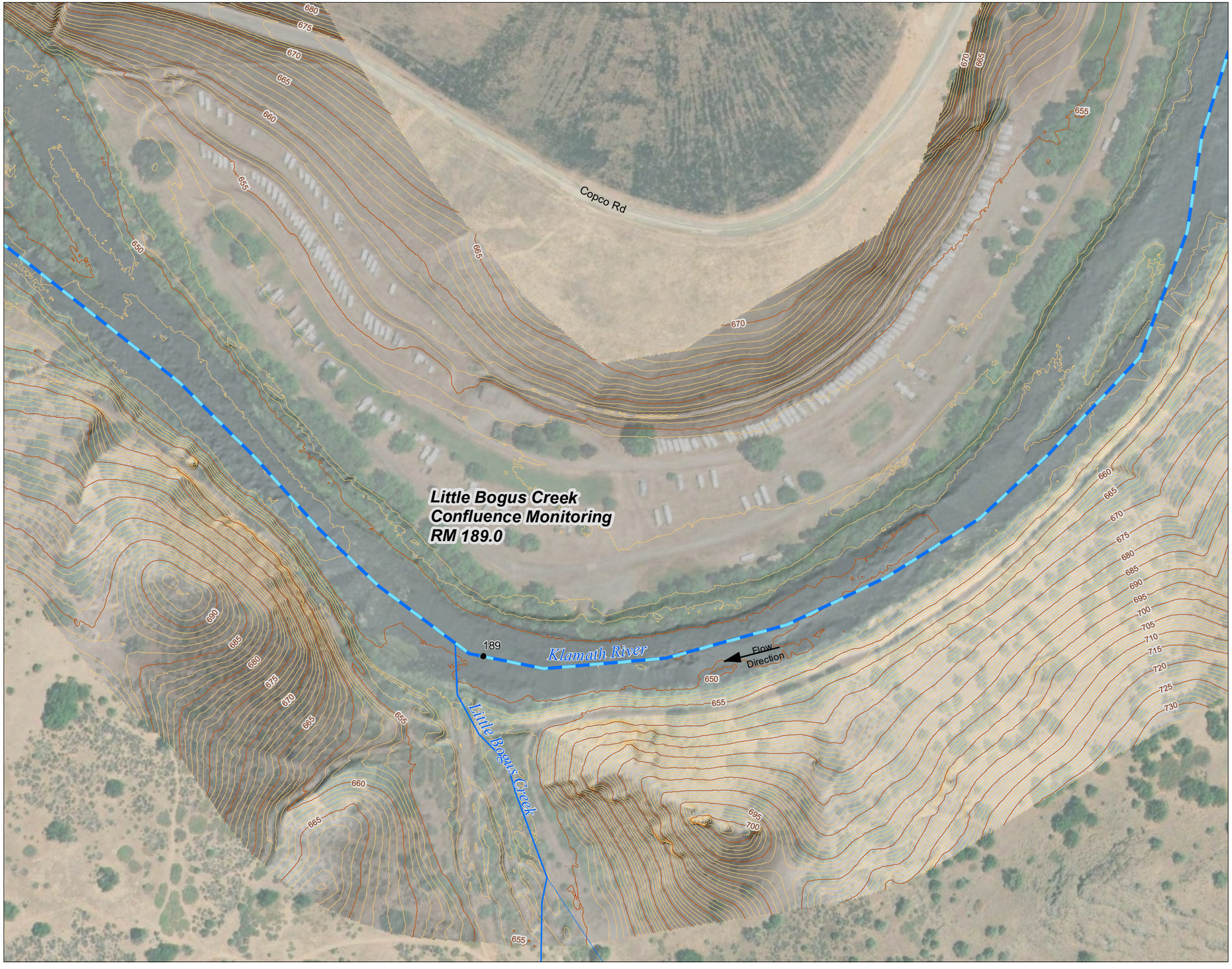

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
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Page 9 of 20

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 10 of 20

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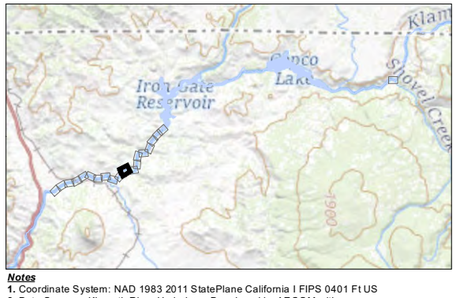

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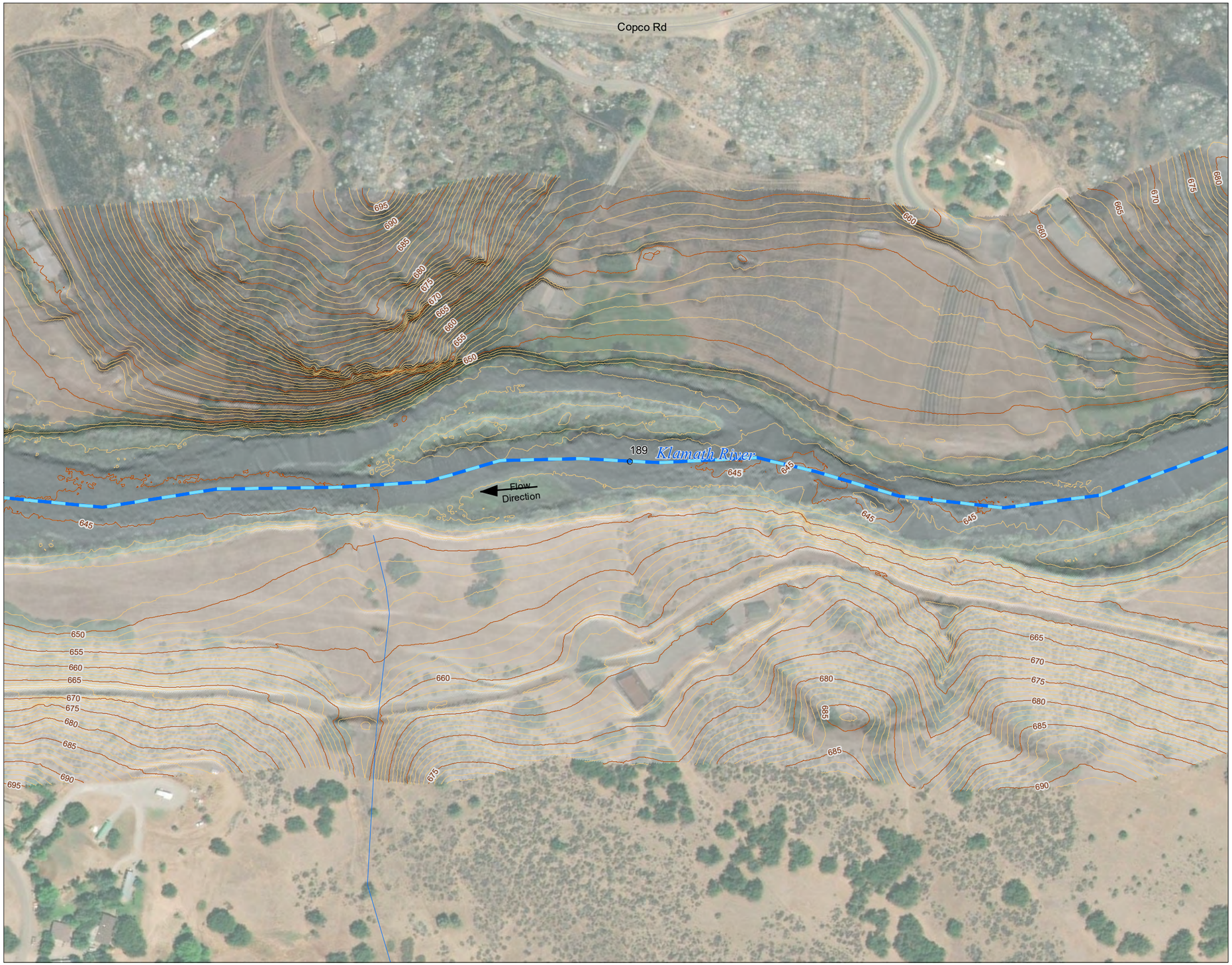

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

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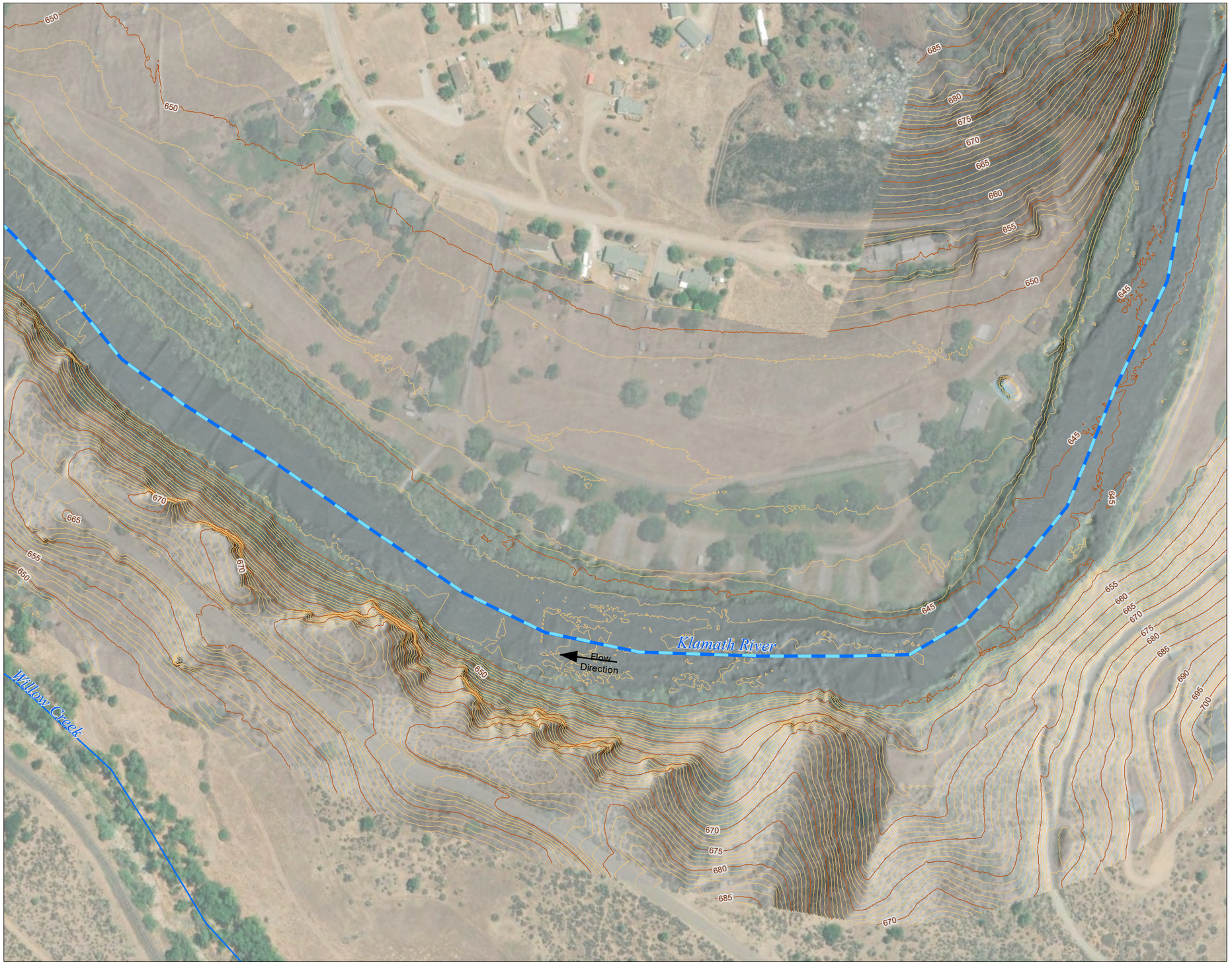

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 12 of 20

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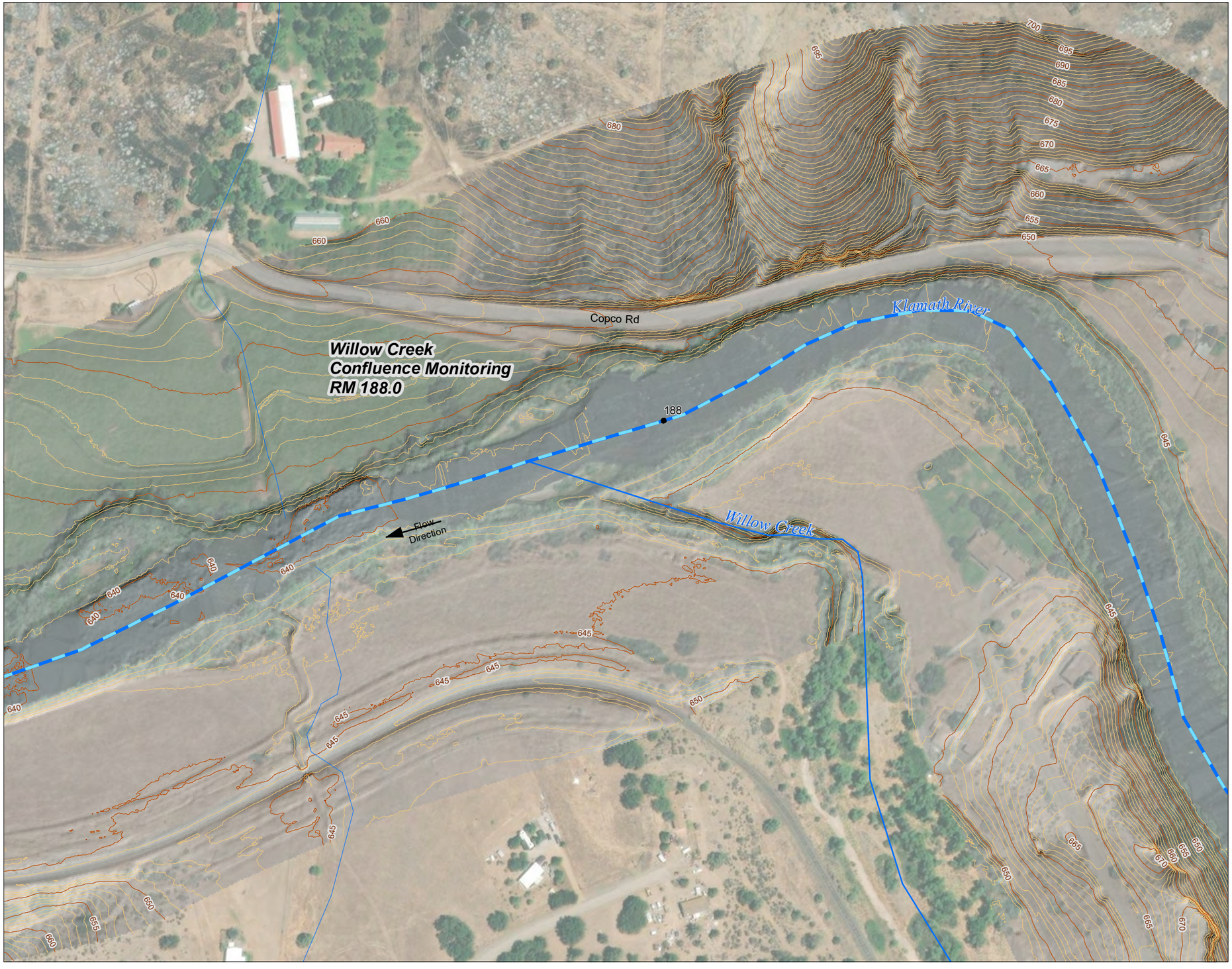

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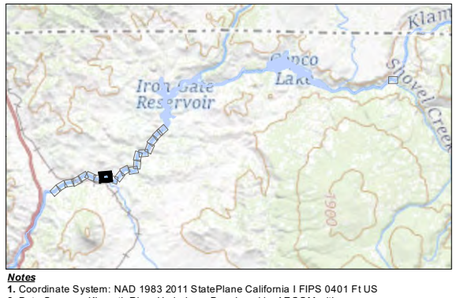

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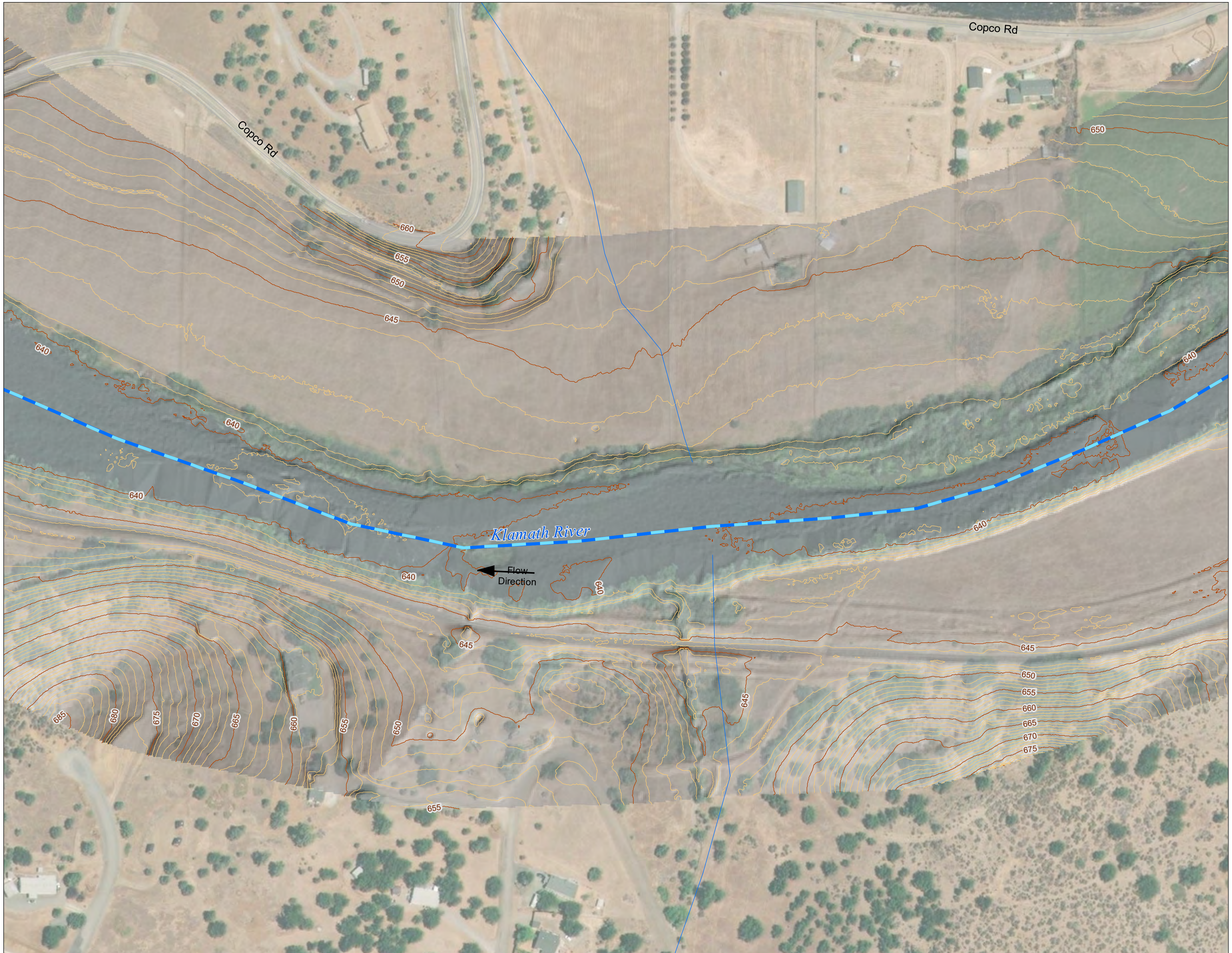

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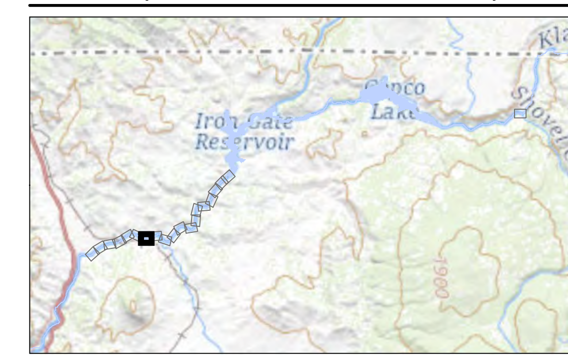

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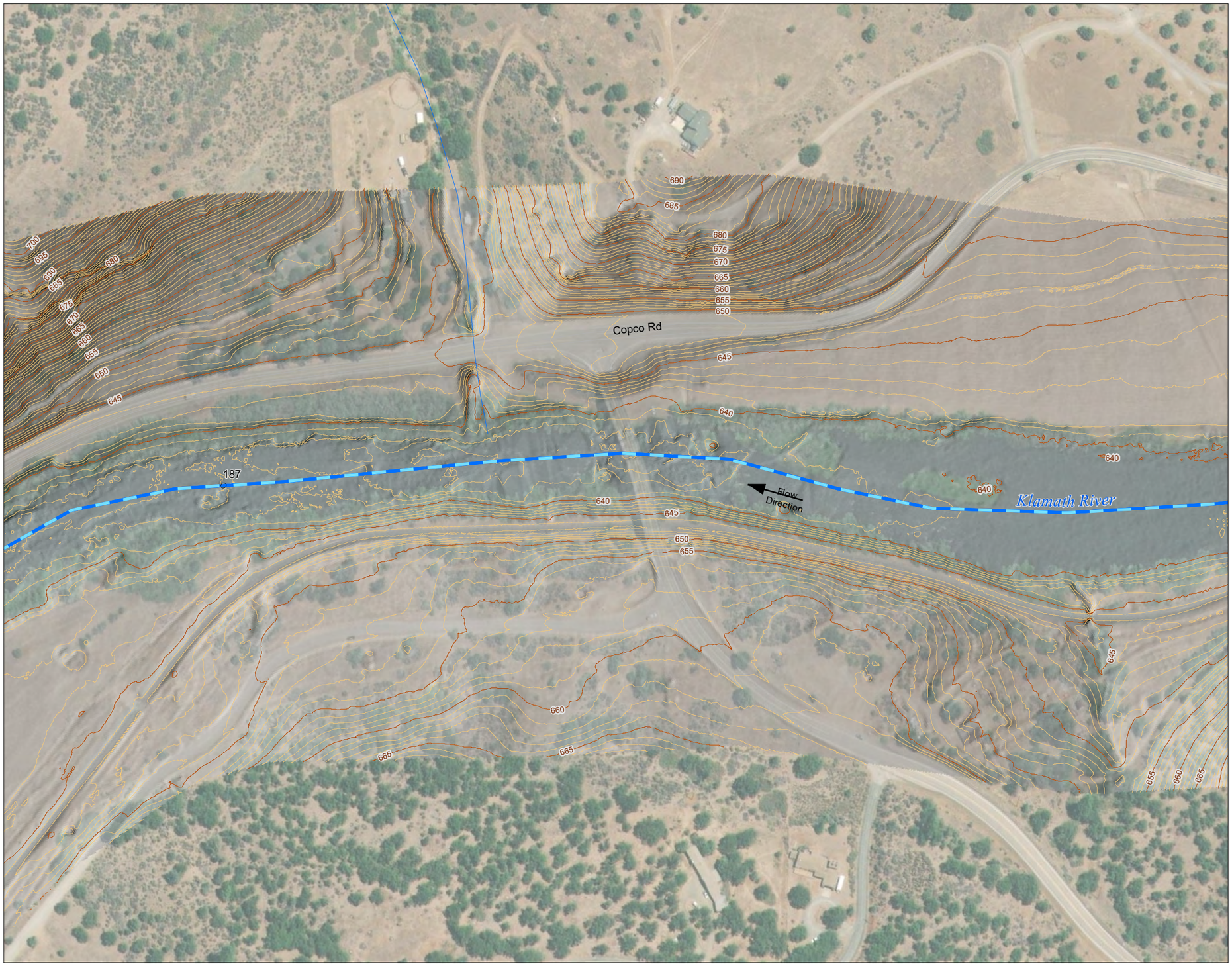

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Page 15 of 20

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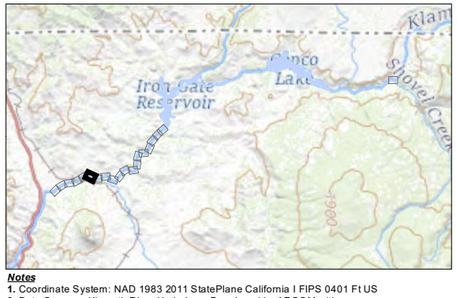

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- TMCP Klamath River Monitoring and Confluence Monitoring at:
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  - Bogus Creek RM 192.6
  - Dry Creek RM 191.9
  - Little Bogus Creek RM 189.0
  - Willow Creek RM 188.0
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Definitions:
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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

January 2021

N

0 0.01 0.02 0.03 0.04 0.05 Miles

(At original document size of 11x17)
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- River Milepost
- Access Road
- 1 ft Contour
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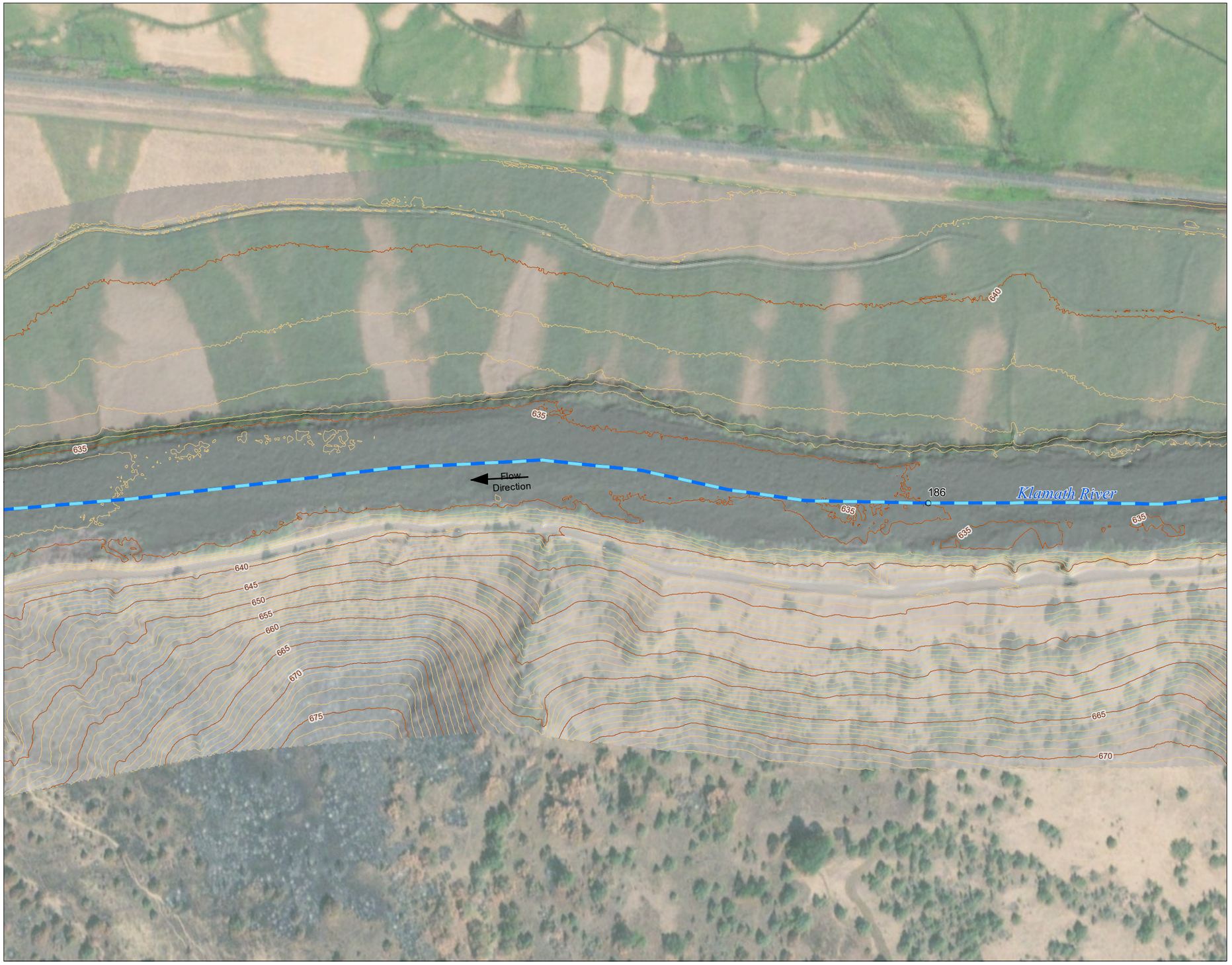

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Lower Klamath Project
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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
Tributary - Mainstem Connectivity Plan

TMCP Monitoring Areas

Page 19 of 20

January 2021

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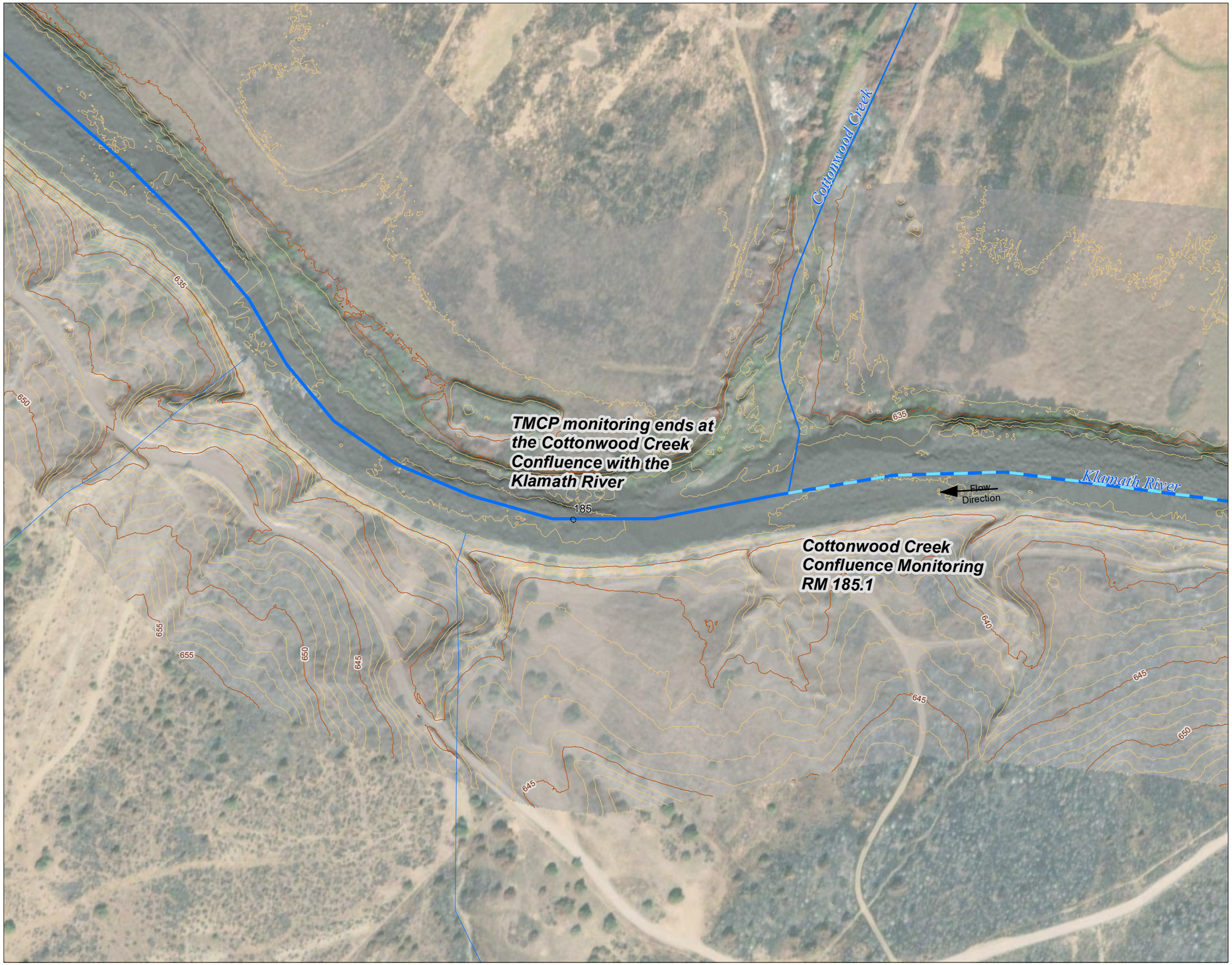

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
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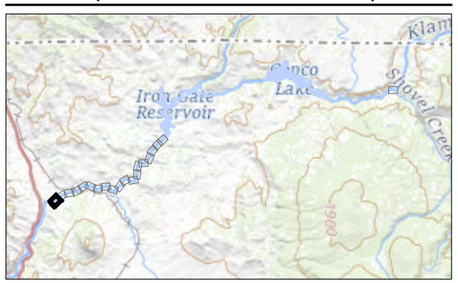

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Appendix E

Juvenile Salmonids and Pacific Lamprey Rescue and Relocation Plan

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan

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Prepared by:
RES
1210 G Street
Sacramento, CA 95814

February 2021

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Table of Contents

List of Tables

List of Figures

Appendices

1.0 Introduction

The Juvenile Salmonid and Pacific Lamprey Rescue and Relocation Plan (Juvenile Salmonid Plan) described herein is a sub-plan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose of Juvenile Salmonid Plan

Juvenile salmonids use the mainstem Klamath River and its tributaries as migration corridors to redistribute in the spring and early summer (USFWS, 2018a; Soto *et al.*, 2016), when Suspended Sediment Concentrations will likely be highest as a result of the Proposed Action (KRRP, 2020). However, it is not expected that juvenile Pacific lamprey will be as adversely affected by elevated Suspended Sediment Concentrations as juvenile salmonids[1]. Therefore, juvenile Pacific lamprey are not addressed in this Juvenile Salmonid Plan. The Renewal Corporation will leave any incidental catch of juvenile Pacific lamprey at the site of capture to continue volitional outmigration.

The purpose of the Juvenile Salmonid Plan is to describe (1) the water quality and temperature monitoring that the Renewal Corporation will undertake, (2) the framework the Renewal Corporation will use to determine when to relocate juvenile salmonids based on the monitoring criteria, (3) the methods the Renewal Corporation will use to relocate juvenile salmonids, and (4) the reporting requirements applicable to the Renewal Corporation under this Juvenile Salmonid Plan. The actions described in this Juvenile Salmonid Plan will occur from January 1 of the year in which the reservoir drawdown commences until to December 31 of that year.

1.2 Relationship to Other Management Plans

The Juvenile Salmonid Plan is supported by elements of the Water Quality Management Plan following management plan for effective implementation: Water Quality Management Plan. So as not to duplicate information, elements from these other management plans are not repeated herein but are, where appropriate, referenced in this Juvenile Salmonid Plan.

1.3 Juvenile Salmonid Plan Activities

The remainder of the Juvenile Salmonid Plan describes the actions that the Renewal Corporation will take and is divided into the following sections:

- Section 2.0 provides an overview of the Renewal Corporation's monitoring efforts, including the time period during which water quality monitoring will occur, the areas that

[1] The effects of turbidity on Pacific lamprey are largely unknown (USFWS, 2012). However, juvenile Pacific lamprey emigration is highly associated with large rainfall events and the high turbidity that typically follows (Goodman *et al.*, 2015). It is thought that outmigration of juvenile Pacific lamprey under the cover of high turbidity increases survival (Stillwater Sciences, 2014).

the Renewal Corporation will monitor, and the criteria that will be used during water quality monitoring.

- Section 3.0 provides an overview of the Renewal Corporation's capture and relocation efforts, including a list of the target species, a description of the equipment and methods that Renewal Corporation will use, detailed information regarding site-specific approaches to capture, and a summary of the different relocation sites and relocation logistics.
- Section 4.0 provides a description of the reporting that will be conducted by KRRC

2.0 Juvenile Salmonid Plan Monitoring

2.1 Monitoring Plan Overview

As a natal tributary begins to warm, juvenile salmonids occupying that tributary typically redistribute, including by entering the mainstem to find cooler water (USFWS, 2018a). If the Klamath River mainstem has elevated levels of Suspended Sediment Concentrations due to the reservoir drawdown, juvenile salmonids in the mainstem have an increased risk of mortality. In addition, high water temperatures increase the risk of juvenile salmonid mortality.

The Renewal Corporation will monitor (1) suspended sediment concentrations of the mainstem Klamath River using two U.S. Geological Survey (USGS) water quality monitoring gages and (2) water temperature at the 13 tributary confluences listed below using underwater temperature data loggers. The tribuatary confliuences are presented in the figures included in Appendix A. Additionally, during site visits when water temperature loggers are being offloaded, the Renewal Corporation will visually record observations of fish in the tributary and the thermal mixing zone, where the mainstem and tributary waters mix (i.e. Thermal Refugia). The observations will include estimated fish densities and fish behavior including lethargy, increased agonistic behavior, excessive gill flaring (Nielsen *et al.*, 1994), unusual swimming patterns (Logue *et al.*, 1995), and visible signs of disease, injury, or mortality. The Renewal Corporation will record water quality data and fish behavior observations on electronic tablets or paper data sheets (Appendix B).

Based on the criteria set forth in Section 2.5, the Renewal Corporation will determine if capture and relocation efforts are required. As part of its determination, the Renewal Corporation will consider the relative water quality conditions of the mainstem and tributaries. For example, when the mainstem has elevated Suspended Sediment Concentration and tributary temperatures remain cool, or tributaries warm but the mainstem levels of Suspended Sediment Concentrations are below target elevated levels, juvenile salmonids will be able to redistribute or out-migrate between the mainstem and tributaries without the need for capture and relocation.

If a decision is made to capture and relocate juvenile salmonids, the Renewal Corporation will relocate collected juvenile salmonids to suitable relocation sites based on the species, life stage, and location of collection. Each monitored tributary has a list of relocation sites (Relocation Sites), which are set forth in Section 3.3.3 and were selected in consultation with the Aquatic

Technical Working Group. If necessary, additional relocation sites will be selected, in consultation with the Aquatic Technical Working Group, based on the criteria used to identify the Relocation Sites. If capture and relocation is warranted, the Renewal Corporation will perform a reconnaissance survey of the identified Relocation Site(s) prior to the relocation to ensure habitat conditions and capacity are suitable for the anticipated number of relocated fish.

2.2 Monitoring Timeline

The Renewal Corporation will conduct monitoring from March 1 to July 1 during the reservoir drawdown year (Drawdown Year). This timeline, developed in consultation with the Aquatic Technical Working Group, is based on the timing of juvenile salmonid outmigration, water temperature suitability, and anticipated Suspended Sediment Concentration modeling for the Klamath River during drawdown (KRRC, 2018; KRRP, 2020).

2.3 Areas to be Monitored

The Renewal Corporation will monitor (1) water temperatures at the confluences of 13 tributaries between Iron Gate Dam and Seiad Creek (Appendix A, Figure 1) (Monitored Tributaries) and (2) Suspended Sediment Concentrations at two locations on the mainstem Klamath river.

The Monitored Tributaries (from downstream to upstream) are:

- Seiad Creek (RM 131.9)
- Grider Creek (RM 132.1)
- Walker Creek (RM 135.2)
- O'Neil Creek (RM 139.1)
- Tom Martin Creek (RM 144.6)
- Scott River (RM 145.1)
- Horse Creek (RM 149.5)
- Beaver Creek (RM 163.3)
- Humbug Creek (RM 173.9)
- Shasta River (RM 179.3)
- Cottonwood Creek (RM 185.1)
- Dry Creek (RM 190.9)
- Bogus Creek (RM 192.6)

The areas to be monitored under this Juvenile Salmonid Plan were selected, in consultation with the Aquatic Technical Working Group, based on their importance as natal streams for salmonid spawning or as key Thermal Refugia for juvenile salmonids.

2.4 Water Quality Monitoring Criteria

2.4.1 Water Quality Triggers

Water quality triggers for mainstem Suspended Sediment Concentration and tributary confluence temperatures were established in consultation with the Aquatic Technical Working Group (KRRC, 2018). The Suspended Sediment Concentration trigger (Suspended Sediment Concentration Trigger) is a Suspended Sediment Concentration greater than 1,000 mg/L. Because measuring Suspended Sediment Concentration requires lengthy laboratory procedures that do not permit real-time decision making, the Renewal Corporation has determined that water turbidity will be used as a proxy for Suspended Sediment Concentration. As set forth below, water turbidity will primarily be measured continuously in 30-minute intervals at USGS gages.

The Renewal Corporation will conduct baseline water quality monitoring on the mainstem Klamath River as part of the Water Quality Management Plan, including monitoring Suspended Sediment Concentration levels through bimonthly collections of grab samples and continuous monitoring of turbidity starting January 1 of the pre-drawdown year and extending into the post-drawdown period. Data collected by the Renewal Corporation during Suspended Sediment Concentration and turbidity monitoring will be fit to a regression developed by the USGS to better define the local relationship between these two variables. This will guide the Renewal Corporation's efforts to monitor this plan's mainstem water quality trigger, and the regression will set the continuously-monitored turbidity level that will be the surrogate for the Suspended Sediment Concentration Trigger.

The Renewal Corporation will monitor water temperatures at the Monitored Tributaries and has, in consultation with the Aquatic Technical Working Group, established both early-warning and trigger temperatures based on a 7-day average of the daily maximum values (7DADM). A 17°C 7DADM will be used as an early indication of warming temperatures. A 19°C 7DADM will be used as the water temperature trigger (Water Temperature Trigger).

2.4.2 Mainstem Klamath Suspended Sediment Monitoring

The Renewal Corporation will use the following two USGS monitoring gages downstream of Iron Gate Dam to monitor Suspended Sediment Concentration in the mainstem Klamath River (Appendix A, Figure 1): USGS Klamath River Below Iron Gate Dam CA gage (No. 11516530) and USGS Klamath River Near Seiad Valley CA gage (No. 11520500).

The USGS stations provide continuous turbidity monitoring data and serve as proxies for evaluating if the mainstem Suspended Sediment Concentration Trigger is exceeded, as described in more detail above. The Renewal Corporation will take supplemental Suspended Sediment Concentration grab samples and turbidity readings using a handheld water quality meter during periods when the water temperature at a monitored tributary either exceeds or is anticipated to exceed the Water Temperature Trigger.

2.4.3 Tributary Confluence Water Temperature Monitoring

Given differences between the Monitored Tributaries, the spatial extent of monitoring at each confluence will vary. Generally, the confluence is the point where the tributary meets the mainstem Klamath River. The areas monitored by the Renewal Corporation (Tributary Confluence Monitoring Areas) are described in more detail below and may be modified by the Renewal Corporation due to landowner and/or access issues. The Renewal Corporation's primary goal at each Monitored Tributary is to identify a location to monitor water temperatures that is representative of where juvenile salmonids may congregate. Given that the spatial extent of the thermal mixing zones shift daily and throughout the season (Brewitt and Danner, 2014), the Renewal Corporation will install a water temperature logger within each Tributary Confluence Monitoring Area in an accessible location that is representative of the Thermal Refugia for that tributary confluence. Loggers will collect water temperature at 30-minute intervals. During the Drawdown Year, the Renewal Corporation will offload water temperature loggers every other week between March 1 – April 30 and on a weekly basis from May 1 – July 1.

2.4.4 Behavioral and Observation Monitoring

During site visits when water temperature loggers are being offloaded, the Renewal Corporation will record visual estimates of juvenile fish density and observations of fish behavior. With respect to fish behavior, the Renewal Corporation will note lethargy, increased agonistic behavior, excessive gill flaring (Nielsen *et al.*, 1994), unusual swimming patterns (Logue *et al.*, 1995), and visible signs of disease, injury, or mortality. The Renewal Corporation will photograph noteworthy habitat changes that may adversely impair habitat quality. While visual observations will be made primarily from shore, the Renewal Corporation may undertake in-water fish observations (i.e., snorkel surveys) as temperatures approach the Water Temperature Trigger depending on the Renewal Corporation's ability to obtain visual observations of the fish.

2.5 Aquatic Technical Working Group Coordination; Capture and Relocation Criteria

The Renewal Corporation will schedule standing calls with the Aquatic Technical Working Group to review water quality data and fish observations. In addition to the water quality data and monitoring observations, the Renewal Corporation will provide the Aquatic Technical Working Group with hydrologic and meteorological forecasts for the upcoming monitoring period.

Before each call, the Renewal Corporation will prepare a weekly/bi-weekly monitoring report for rapid tracking of tributary conditions relative to water quality triggers. Each tributary will have a three-color code to represent whether no water quality trigger has been exceeded (Green), one water quality trigger has been exceeded (Yellow), or both water quality triggers have been exceeded (Red). An example of a monitoring report is presented in Figure 2-1.

Figure 2-1. Example monitoring report.

Monitoring Period	Tributary Confluence Monitoring Area												
	Seiad Creek	Grider Creek	Walker Creek	O'Neil Creek	Tom Martin Creek	Scott River	Horse Creek	Beaver Creek	Humbug Creek	Shasta River	Cotton-wood Creek	Dry Creek	Bogus Creek
May 24 - May 30													
May 31 - June 6													
June 7 – June 13													

When reviewing water quality data, the Renewal Corporation will determine which, if any, mainstem Klamath River monitoring sites have exceeded the Suspended Sediment Concentration Trigger. If the Suspended Sediment Concentration Trigger has not been exceeded, no capture and relocation efforts will be implemented unless (1) unusual fish behavior has been observed and (2) the Renewal Corporation determines capture and relocation is warranted.

If the Suspended Sediment Concentration Trigger has been exceeded, the Renewal Corporation and Aquatic Technical Working Group will assess whether any Tributary Confluence Monitoring Areas have exceeded the early warning temperature of 17°C 7DADM. If both the Suspended Sediment Concentration Trigger and early warning temperature have been exceeded, the Renewal Corporation will determine, based on observations of fish behavior and upcoming hydrologic and meteorological data, whether capture and relocation is warranted.

If both the Suspended Sediment Concentration Trigger has been exceeded and the Water Temperature Trigger of a Tributary Confluence Monitoring Area has been exceeded, the Renewal Corporation will proceed with capture and relocation efforts in the manner described in Section 3.0 below.

3.0 Juvenile Fish Capture Methods and Relocation Sites

3.1 Capture and Relocation Overview

If the Renewal Corporation determines that fish relocation is necessary at a Monitored Tributary, the Renewal Corporation will promptly commence capture and relocation, typically within 48

hours. The number of crew members required will depend on the level of effort needed at that tributary and on the capture equipment that will be used.

3.1.1 Target Species

Target species for capture and relocation include coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*O. tshawytscha*), and steelhead trout (anadromous form of rainbow trout; *O. mykiss*). The target life stage for these salmonids during capture and relocation is the juvenile life stage, which includes fry and parr (collectively young-of-the-year or YOY) and smolts.

3.1.2 Equipment and Methods

The Renewal Corporation will use seines, backpack electrofishing equipment, and fyke nets as its primary fish capture equipment. The equipment used to capture fish at a given tributary confluence will depend on several factors, including habitat type (e.g., shallow eddy vs. deep pool), habitat complexity (e.g., sandy vs. rocky bottom), the total number of fish expected, and whether fish will be actively out-migrating during the capture period. For example, in a shallow, sandy eddy, a seine may be the best option. Alternatively, trapping with fyke nets may be the best capture option from a deep pool with a rocky bottom in a tributary that juveniles are actively out-migrating. Therefore, the Renewal Corporation's selection of equipment will be site-specific and made close in time to capture and relocation efforts. When required, the Renewal Corporation will use a small boat or cataraft to safely relocate captured fish to transport vehicles.

Electrofishing, if used, will be performed by a qualified individual and conducted according to the National Marine Fisheries Service (NMFS) *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act* (NMFS, 2000). The Renewal Corporation will submit staff qualifications to NMFS for approval prior to conducting electrofishing. Due to both the variation in water quality that may occur as a result of reservoir drawdown conditions and the variation in species composition and size encountered during capture activities, electrofishing will only be conducted by the Renewal Corporation in the event that seining is considered an ineffective measure for safely collecting and relocating fish from the Tributary Confluence Monitoring Area. While the following sections describe the anticipated methods to be used at each Monitored Tributary, the final determination of what methods to use will be made by the Renewal Corporation based on the specific characteristics of the Tributary Confluence Monitoring Area at the time of capture and relocation.

The Renewal Corporation may, in coordination with the California Department of Fish and Wildlife (CDFW), also use rotary screw traps and existing outmigration monitoring locations in implementing this Juvenile Salmonid Plan.

3.2 Site-Specific Approaches to Juvenile Salmonid Capture

This section of the Juvenile Salmonid Plan addresses the following with respect to the Monitored Tributaries:

- The species that are expected to be most abundant in the Tributary Confluence Monitoring Area during the monitoring period.
- With respect to certain Monitored Tributaries, if volitional fish passage is expected to be available from the Tributary Confluence Monitoring Area to cooler reaches upstream.
- With respect to certain Monitored Tributaries, if and when the Renewal Corporation expects the Water Temperature Trigger to be exceeded.
- The equipment and methods that the Renewal Corporation anticipates using for fish capture and relocation.

Figures referenced in the sections below delineate the Tributary Confluence Monitoring Area where the Renewal Corporation will install water temperature logger(s) and, if needed, where fish collection activities will take place (Appendix A).

3.2.1 Seiad Creek

The Renewal Corporation will monitor the lower approximately 1,500 Ft (0.29 miles) of Seiad Creek (Appendix A, Figure 2). This tributary is anticipated to be heavily used by juvenile coho salmon, especially non-natal individuals (Witmore, 2014). The lower reach and confluence of Seiad Creek may exceed the Water Temperature Trigger around late July to mid-August, which is outside of the monitoring period. Additionally, there is a cold-water refuge near the Highway 96 bridge, about 0.5 miles upstream of the confluence. Since there are no known fish passage barriers between the tributary confluence and the upstream cold-water refuge, fish are expected to be capable of volitionally moving to cooler habitat as needed. Therefore, the Renewal Corporation does not expect that capture and relocation of out-migrating juvenile Seiad Creek salmonids will be needed.

While the Water Temperature Trigger is not anticipated to be exceeded during the monitoring period, Seiad Creek may experience an increase in use by non-natal salmon, potentially resulting in overcrowding in the thermal refuge. If the Renewal Corporation observes overcrowding and negative fish behavior, the Renewal Corporation may engage in capture if the Suspended Sediment Concentration Trigger is exceeded. If the Renewal Corporation engages in capture, a seine is likely to be used, with capture and relocation likely requiring a crew of three persons working over a one or two-day period.

3.2.2 Grider Creek

The Renewal Corporation will monitor approximately 500 Ft (0.10 miles) of Grider Creek (Appendix A, Figure 3). The Renewal Corporation does not expect that Grider Creek will exceed the Water Temperature Trigger. Sediment deposition at the confluence is relatively dynamic and typically does not result in deep pools that are utilized by juvenile coho salmon (T. Soto, pers. comm., 2020). In addition, there has not been a significant amount of juvenile habitat identified in the Tributary Confluence Monitoring Area. The Renewal Corporation anticipates using a seine or backpack electrofishing if the Renewal Corporation determines that juvenile fish do need to be relocated from this Tributary Confluence Monitoring Area. This capture effort will likely be done by a crew of three persons working over a one to two-day period.

3.2.3 Walker Creek

The Renewal Corporation will monitor the lower approximately 700 Ft (0.14 miles) of Walker Creek (Appendix A, Figure 4). The Renewal Corporation does not expect that Walker Creek will exceed the Water Temperature Trigger. Walker Creek does not support a large population of spawning salmonids, though non-natal salmonids are occasionally observed in the Tributary Confluence Monitoring Area (T. Soto, pers. comm., 2020). The confluence of Walker Creek is dynamic, and its structure can shift annually based on flows and sediment deposition. The Renewal Corporation anticipates using a seine or backpack electrofishing if the Renewal Corporation determines that juvenile fish do need to be relocated from this Tributary Confluence Monitoring Area. This capture effort will likely be done by a crew of three persons working over a one to two-day period.

3.2.4 O'Neil Creek

The Renewal Corporation will monitor the lower approximately 800 Ft (0.15 miles) of O'Neil Creek (Appendix A, Figure 5). The Renewal Corporation has not identified any significant Thermal Refugia in O'Neil Creek upstream of the tributary confluence, though there is a thermal refuge for juvenile salmonids at the tributary confluence, which is included in the Tributary Confluence Monitoring Area. This thermal refuge typically provides habitat for a large amount of non-natal fish, especially Scott River juveniles (Gorman, 2016). The Renewal Corporation anticipates using a seine, backpack electrofishing, or fyke net traps if the Renewal Corporation determines that juvenile fish need to be relocated from this Tributary Confluence Monitoring Area. Due to the relatively high habitat complexity, the Renewal Corporation will determine the specific equipment type based on site conditions and the anticipated number of fish to be encountered. This capture effort will likely be done by a crew of up to five persons working over a one to four-day period.

3.2.5 Tom Martin Creek

The Renewal Corporation will monitor the lower approximately 350 Ft (0.07 miles) of Tom Martin Creek and approximately 580 Ft (0.11 miles) of Klamath River side channel habitat (Appendix A, Figure 6). Due to a fish passage barrier just upstream of the mouth, Tom Martin Creek does not have an adult spawning population of salmon. However, it is a significant thermal refuge for non-natal salmon (Soto *et al.*, 2016; Witmore, 2014). Importantly, Tom Martin Creek is the first cold water tributary downstream of the Scott River, offering Thermal Refugia for redistributing YOY salmon (Gorman, 2016).

The Renewal Corporation anticipates that Tom Martin Creek will remain a source of cold-water refuge. Due to its location, the Tributary Confluence Monitoring Area will likely be impacted by increased Suspended Sediment Concentrations in the mainstem Klamath. Therefore, salmonids in this Tributary Confluence Monitoring Area may require capture and relocation if behavioral and habitat observations indicate actions should be taken. The Renewal Corporation anticipates using a seine if the Renewal Corporation determines that juvenile fish need to be relocated from this Tributary Confluence Monitoring Area. If seining is an issue due to substrate and habitat complexity, the Renewal Corporation may use backpack electrofishing instead. If required, the Renewal Corporation may use a small boat or cataraft to capture and relocate fish to transport

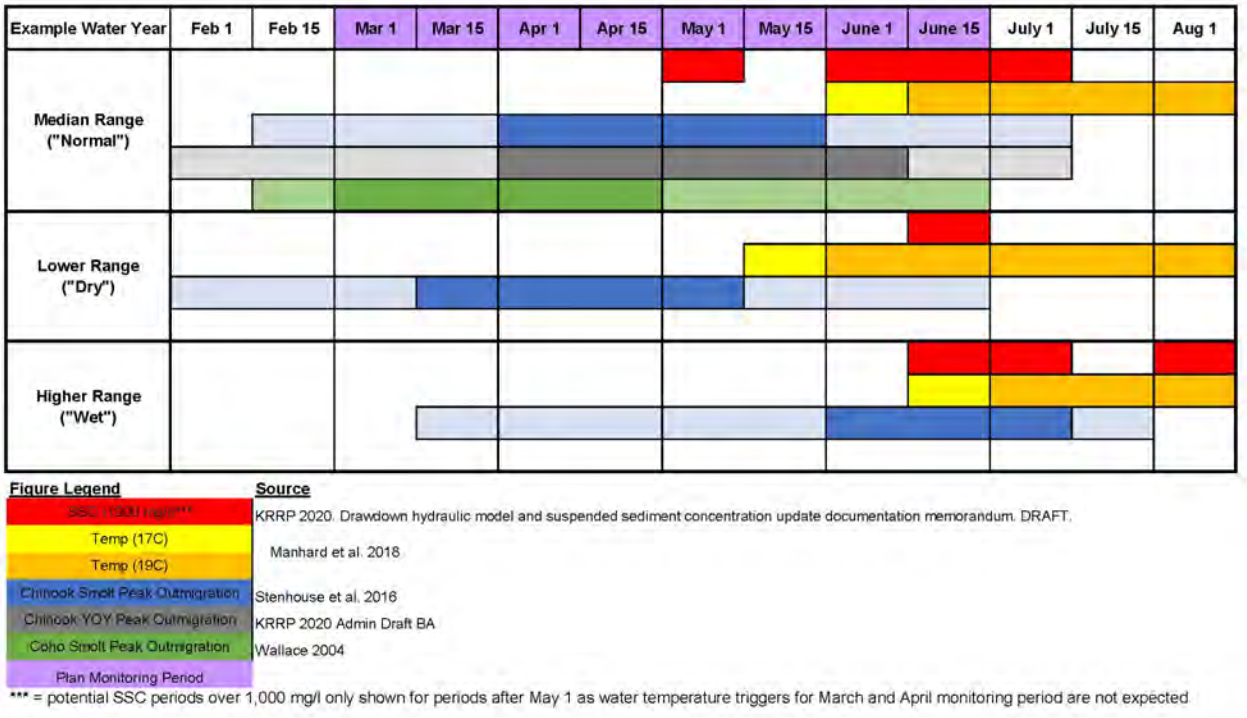
vehicles. This capture effort will likely be done by a crew of up to five persons working over a one to four-day period.

3.2.6 Scott River

The Renewal Corporation will monitor the lower approximately 1,200 Ft (0.23 miles) of Scott River (Appendix A, Figure 7). In typical years, the Scott River begins to warm in late spring, potentially exceeding the Water Temperature Trigger by late May to mid-June (Figure 3-1). This period is anticipated to overlap with elevated Suspended Sediment Concentration levels in the mainstem Klamath River. Therefore, the Renewal Corporation anticipates that both water quality triggers may be exceeded during a 2-4 week period in June of a typical water year.

The Scott River is a significant salmon producing tributary, with large populations of coho salmon, Chinook salmon, and steelhead trout. The timing of peak juvenile salmonid outmigration is variable based on water year type. Dry water years typically see peak salmon outmigration in late March to early April, with 90 percent of the juveniles having out-migrated by the end of May (CDFW, 2016a). Other water year types have more variable outmigration timing, sometimes extending into June.

Figure 3-1. Scott River Potential Overlap of Water Quality Triggers and Juvenile Salmonid Outmigration.



With the potential overlap of outmigration periods with exceeded water quality triggers, juvenile salmonid outmigrant trapping may be required (Figure 3-1). If required in this Tributary Confluence Monitoring Area, the Renewal Corporation anticipates deploying two to three fyke net traps to span the majority of the river channel. The Renewal Corporation will check fyke net traps daily, when operating, to process collected fish and clear debris. This capture effort will

likely be done by a crew of two to three persons working for the duration of time that the fyke nets are operating. The Renewal Corporation anticipates the fyke nets operating for two to four-weeks, depending on water quality conditions. To the extent necessary, the Renewal Corporation anticipates using seining to capture fish in areas downstream of the deployed fyke nets. If seining is an issue due to substrate and habitat complexity, the Renewal Corporation may instead use backpack electrofishing in the areas that will not have an electric field containing the fyke net live cars (i.e., where captured fish consolidate in the trap).

Of the Monitored Tributaries, the greatest number of out-migrating juvenile salmonids are likely to be encountered during fish collection activities at Scott River. Therefore, the Renewal Corporation will coordinate any outmigrant trapping in this Tributary Confluence Monitoring Area with CDFW. This may include support and/or coordination on capture activities at existing out-migrating trap monitoring locations in the Scott River. The Renewal Corporation will use fish capture in association with these outmigrant trap locations to support capture efforts during the monitoring period if water quality triggers are exceeded and fish relocation is needed.

3.2.7 Horse Creek

The Renewal Corporation will monitor approximately 650 Ft (0.12 miles) of Horse Creek (Appendix A, Figure 8). Horse Creek is a significant producer of coho salmon within the Upper Klamath diversity strata[2]. Previous habitat restoration in the Horse Creek watershed by the Karuk Tribal Fisheries Program and the Mid Klamath Watershed Council has included placement of large woody elements and the construction of several off-channel ponds, providing juvenile salmon in the watershed access to Thermal Refugia. This creek is not expected to warm in the upper reaches; however, the lower reaches may warm due to agricultural diversions. The Renewal Corporation anticipates that volitional passage upstream to cooler water will be available. However, if the Renewal Corporation determines that it is necessary to capture and relocate fish from the lower reaches, the Renewal Corporation anticipates using a fyke net trap for out-migrating juvenile salmonids. If necessary, the Renewal Corporation anticipates deploying a single fyke net trap in a location to span the majority of the creek channel. The Renewal Corporation will check the fyke net trap daily, when operating, to process collected fish and clear debris. This capture effort will likely be done by a crew of two to three persons working for the duration of time that the fyke net is operating.

If the Renewal Corporation determines that an alternative method of fish capture should be used, the Renewal Corporation anticipates using a seine net to capture fish within the Tributary Confluence Monitoring Area. This capture effort will likely be done by a crew of three persons working over a one to two-day period.

[2] Horse Creek is part of the Upper Klamath population unit of the Southern Oregon/Northern California Coast coho salmon Evolutionary Significant Unity. The Upper Klamath population unit boundaries are Portuguese Creek (non-inclusive) upstream to Spencer Creek (inclusive) (NMFS, 2006).

3.2.8 Beaver Creek

The Renewal Corporation will monitor the lower approximately 500 Ft (0.10 miles) of Beaver Creek and approximately 630 Ft (0.12 miles) of Klamath River (Appendix A, Figure 9). Beaver Creek is a significant coho salmon producing tributary and a critical site for non-natal rearing. Immediately downstream of the confluence in the mainstem of the Klamath River is a spring-fed thermal refuge, which is considered part of the Tributary Confluence Monitoring Area. This pool is heavily utilized by non-natal juvenile salmonids, as it stays cool throughout the summer months.

The Renewal Corporation does not anticipate any fish passage issues in lower Beaver Creek that would impede access of juvenile salmonids to suitable habitat upstream of the Tributary Confluence Monitoring Area. The mainstem Beaver Creek typically does not exceed the Water Temperature Trigger during the monitoring period. Therefore, the Renewal Corporation does not expect that capture and relocation will be needed.

The portion of the Tributary Confluence Monitoring Area that is in the mainstem Klamath River will likely see increased Suspended Sediment Concentration during the reservoir drawdown. While the Renewal Corporation does not expect the Water Temperature Trigger to be exceeded, salmonids in this refuge may still require capture and relocation if behavioral and habitat observations indicate that actions should be taken. The Renewal Corporation anticipates using a seine if the Renewal Corporation determines that fish need to be relocated from this Tributary Confluence Monitoring Area. If seining is an issue due to substrate and habitat complexity, the Renewal Corporation may use backpack electrofishing instead. If required, the Renewal Corporation may use a small boat or cataraft to capture and relocate fish to transport vehicles. This capture effort will likely be done by a crew of up to five persons working over a one to four-day period.

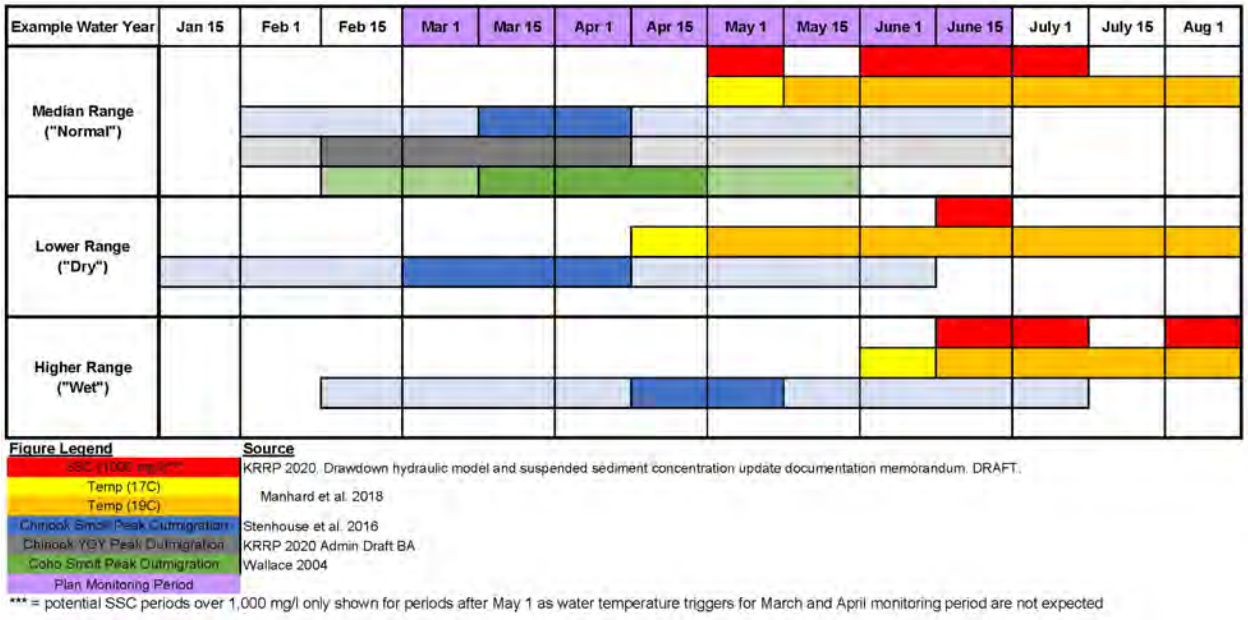
3.2.9 Humbug Creek

The Renewal Corporation will monitor the lower approximately 950 Ft (0.18 miles) of Humbug Creek (Appendix A, Figure 10). There are no known documented Thermal Refugia found near the confluence of Humbug Creek or within the Tributary Confluence Monitoring Area. The lower reaches of Humbug Creek typically begin to dewater in early summer and completely disconnect from the Klamath by July or August. The upper reaches of Humbug Creek experience relatively stable flows and temperatures through the summer months (T. Soto, pers. comm., 2020). Since there are no known fish passage issues, fish can volitionally move throughout Humbug Creek and gain access to the cooler upper reaches. In addition, Humbug Creek is not a significant producer of coho salmon. Therefore, the Renewal Corporation anticipates a small or even non-existent capture and relocation effort in the Tributary Confluence Monitoring Area. If the Renewal Corporation determines that juvenile fish need to be relocated from stranded pools, the Renewal Corporation anticipates using a seine. This capture effort will likely be done by a crew of three persons working over a one to two-day period.

3.2.10 Shasta River

The Renewal Corporation will monitor the lower approximately 700 Ft (0.13 miles) of the Shasta River (Appendix A, Figure 11), which covers an area from the confluence upstream to the CDFW rotary screw trap. The Shasta River is among the most significant salmon-producing tributaries of the Klamath River, containing its own distinct population (NMFS, 2006). In addition, it warms relatively early, forcing rearing juveniles into the mainstem Klamath. Irrigation diversions typically begin on April 1, sometimes reducing Shasta River average monthly flows by half or more (CDFW, 2016b). In a dry water year, these diversions may result in the Water Temperature Trigger being exceeded as early as mid-April or early May. Juvenile salmonid outmigration begins relatively early on the Shasta River. Peak outmigration is expected to occur throughout March, with 90 percent of the juveniles having out-migrated by mid-April (CDFW, 2016b).

Figure 3-2. Shasta River Potential Overlap of Water Quality Triggers and Juvenile Salmonid Outmigration.



With the potential overlap of outmigration periods with exceeded water quality triggers, the Renewal Corporation anticipates the need for juvenile salmonid outmigrant trapping in the Tributary Confluence Monitoring Area (Figure 3-2). Depending on the type of water year, the Renewal Corporation may initiate outmigrant trapping as early as May though it is most likely to be needed in June. Similar to the Scott River, the Renewal Corporation will coordinate this effort with CDFW due to the potential for a number of fish to be encountered. CDFW operates a rotary screw trap (RST) about 0.15 miles upstream of the confluence. In the event that fish capture actions are necessary, the Renewal Corporation anticipates using this RST since it will provide an efficient and effective capture method. Even if the RST is used, the Renewal Corporation expects that some number of juvenile salmon will be found in the reach downstream of the RST. If both water quality triggers are exceeded and the Renewal Corporation determines that remaining juvenile salmonids in this lower reach need to be relocated, the Renewal Corporation anticipates using a seine.

In the event RST collection is not possible, or capture actions are needed to supplement the RST, the Renewal Corporation anticipates using two to three fyke net traps deployed in locations that span the majority of the river channel. The Renewal Corporation will check the fyke net traps daily, when operating, to process collected fish and clear debris. This capture effort will likely be done by a crew of two to three persons working for the duration of time that the fyke nets are operating. The Renewal Corporation anticipates the fyke nets operating for two to four-weeks, depending on water quality conditions. To the extent necessary, the Renewal Corporation anticipates using seining to capture fish in areas downstream of the deployed fyke nets. If seining is an issue due to substrate and habitat complexity, the Renewal Corporation may instead use backpack electrofishing in the areas that will not have an electric field containing the fyke net live cars (i.e., where captured fish consolidate in the trap).

3.2.11 Cottonwood Creek

The Renewal Corporation will monitor the lower approximately 950 Ft (0.18 miles) of Cottonwood Creek (Appendix A, Figure 12). There are no known documented Thermal Refugia found near the confluence of Cottonwood Creek or within the Tributary Confluence Monitoring Area. In the event that the Tributary Confluence Monitoring Area is not directly accessible, the Renewal Corporation will install a temperature logger at the Copco Road crossing.

Cottonwood Creek contains several agricultural diversions, which typically results in the dewatering and pooling of the lower reach during the irrigation season. Juvenile salmonids will not typically be congregating near the tributary confluence. However, if the lower reach does dewater during a period when the mainstem Suspended Sediment Concentration Trigger is exceeded, the Renewal Corporation anticipates using a seine to capture and relocate juvenile salmonids that may become stranded in pools in the lower reach. If required, the Renewal Corporation may use a small boat or cataraft to capture and relocate fish to transport vehicles. This capture effort will likely be done by a crew of two to four persons working over a one to two-day period.

3.2.12 Dry Creek

The Renewal Corporation will monitor the lower approximately 250 Ft (0.05 miles) of Dry Creek (Appendix A, Figure 13). Dry Creek is a relatively small tributary that tends to dewater by summer. This creek is not thought to provide important rearing habitat for juvenile salmonids and does not have great access for juvenile fish to the upper reaches due to its relatively high gradient. It is not expected that juvenile salmonids will be using habitat in the Tributary Confluence Monitoring Area throughout the summer.

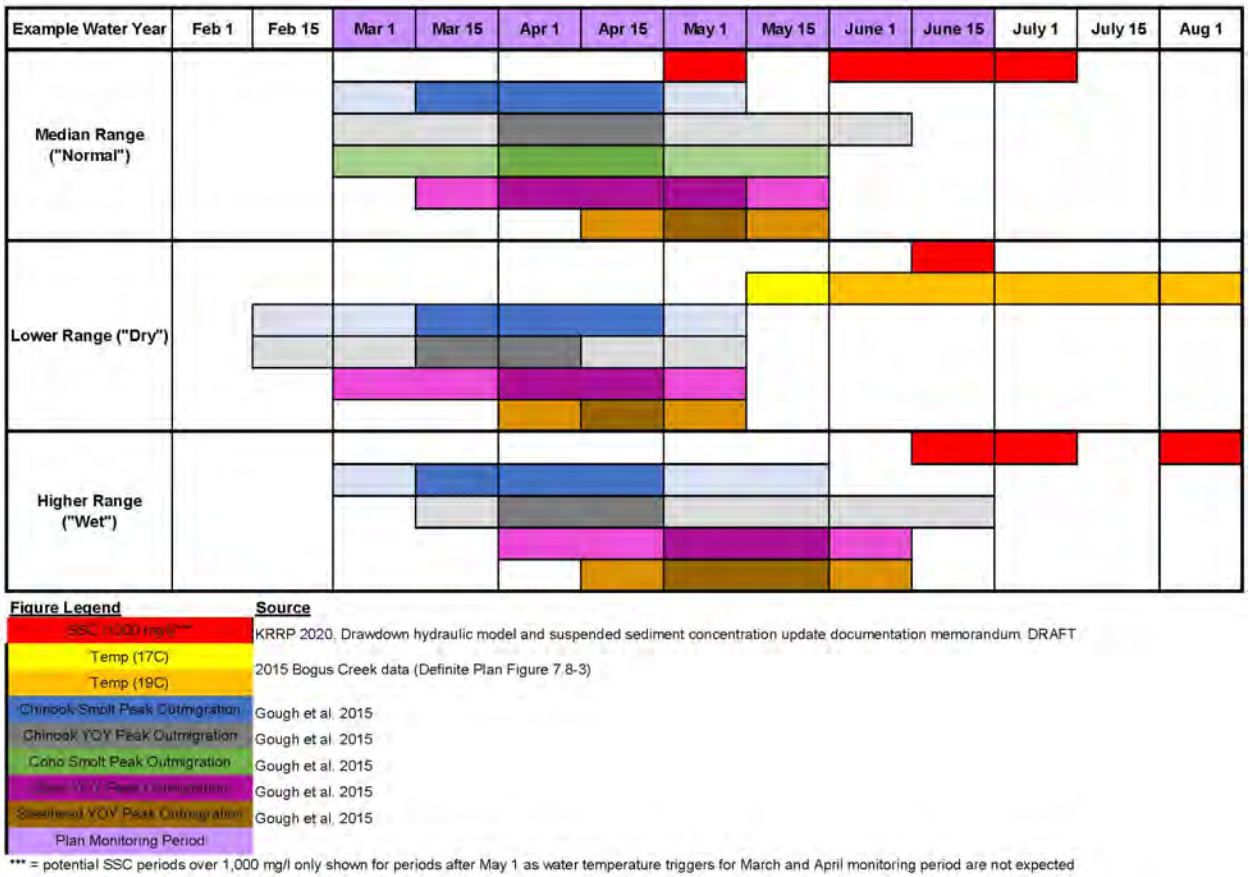
Capture and relocation efforts are therefore not expected to be needed in Dry Creek. However, if the Renewal Corporation determines that it is necessary to capture and relocate fish from the Tributary Confluence Monitoring Area, the Renewal Corporation anticipates using a seine. This capture effort will likely be done by a crew of three persons working over a one-day period.

3.2.13 Bogus Creek

The Renewal Corporation will monitor the lower approximately 500 Ft (0.1 miles) of Bogus Creek (Appendix A, Figure 14). Bogus Creek is a relatively cool, spring-fed creek. It is anticipated that during normal or wet water year types that Bogus Creek will not exceed the Water Temperature Trigger within the monitoring period. However, in a dry year, Bogus Creek may exceed the Water Temperature Trigger by mid-May or early June.

Bogus Creek is a significant salmonid-producing tributary, especially for Chinook salmon. The USFWS operates an RST in the mainstem Klamath River, about one mile downstream of Bogus Creek (USFWS, 2015). Based on data from this station, peak outmigration is expected to occur from mid-March to late April, with 90 percent of the juveniles having out-migrated by the end of April. Therefore, the Renewal Corporation anticipates that a significant portion of juvenile outmigrants will have already passed through the Tributary Confluence Monitoring Area prior to the period during which the Water Temperature Trigger may be exceeded (Figure 3-3).

Figure 3-3. Bogus Creek Potential Overlap of Water Quality Triggers and Juvenile Salmonid Outmigration.



If dry conditions occur during the monitoring period and water quality triggers are exceeded, then outmigrant trapping may be necessary for a portion of June. If this occurs, the Renewal Corporation anticipates using one to two fyke net traps deployed in locations that span the majority of the creek channel. The Renewal Corporation will check Fyke net traps daily, when

operating, to process collected fish and clear debris. This capture effort will likely be done by a crew of two to three persons working for the duration of time that the fyke nets are operating. The Renewal Corporation anticipates the fyke nets operating for two to four-weeks, depending on water quality conditions. To the extent necessary, the Renewal Corporation anticipates using seining to capture fish in areas downstream of the deployed fyke nets. If seining is an issue due to substrate and habitat complexity, the Renewal Corporation may instead use backpack electrofishing in the areas that will not have an electric field containing the fyke net live cars (i.e., where captured fish consolidate in the trap).

3.3 Juvenile Fish Relocation Sites

3.3.1 Relocation Site Selection

This Juvenile Salmonid Plan identifies relocation sites (Relocation Sites) for each Tributary Confluence Monitoring Area. The selection of the Relocation Sites was based on information from the Karuk Tribal Fisheries Program and was made in consultation with the Aquatic Technical Working Group (KRRC, 2018; Aquatic Technical Working Group, 2020). The Renewal Corporation's final selection of a Relocation Site will be made once a capture effort is determined to be necessary for a Tributary Confluence Monitoring Area. Final Relocation Site selection will be based on several factors, including the collection location, species, life stage captured, and habitat conditions at the Relocation Site.

The Renewal Corporation will relocate young-of-the-year (YOY; i.e., fry, and parr) coho salmon and *O. mykiss* to tributary channels or off-channel ponds (Table 3-1). Here, fry is defined as the life stage immediately after the yolk sac has been absorbed. This life stage is typically under 55 mm in length (CDFW, 2016b). Parr is the life stage immediately following fry, when parr marks are visible and smoltification has not yet begun. Where possible and appropriate, the Renewal Corporation will prioritize relocation to in-watershed sites. When determined to be inappropriate by the Renewal Corporation, or if dictated by the number of fish captured, the Renewal Corporation will relocate fish to the nearest Relocation Site with suitable water quality conditions and holding capacity. Primary tributary Relocation Sites include Beaver Creek (RM 163.3), Horse Creek (RM 149.5), and Seiad Creek (RM 131.9). These three tributaries each have long upper reaches of cool water with suitable habitat for juvenile salmonids, including several constructed off-channel ponds. For the Scott River and Shasta River, the Renewal Corporation will also consider upstream locations that provide suitable Thermal Refugia for YOY rearing. Details for relocation to these key tributaries are outlined in Section 3.3.3.1.

Table 3-1. Primary and Secondary Relocation Sites for YOY Juvenile Salmonids for the 13 Tributary Confluence Monitoring Areas.

TRIBUTARY CONFLUENCE MONITORING AREA	PRIMARY RELOCATION SITE	SECONDARY RELOCATION SITE
Seiad Creek	Upstream Seiad Creek	Seiad Creek off-channel ponds
Grider Creek	Upstream Grider Creek	Seiad Creek off-channel ponds
Walker Creek	Upstream Walker Creek	Seiad Creek off-channel ponds
O'Neil Creek	Upstream O'Neil Creek	Seiad Creek off-channel ponds
Tom Martin Creek	Seiad Creek off-channel ponds	Horse Creek off-channel ponds
Scott River	Scott River	Seiad Creek off-channel ponds
Horse Creek	Upstream Horse Creek	Horse Creek off-channel ponds
Beaver Creek	Upstream Beaver Creek	Horse Creek off-channel ponds
Humbug Creek	Beaver Creek	Horse Creek off-channel ponds
Shasta River	Shasta River	Beaver Creek
Cottonwood Creek	Beaver Creek	Horse Creek off-channel ponds
Dry Creek	Beaver Creek	Horse Creek off-channel ponds
Bogus Creek	Upstream Bogus Creek	Beaver Creek

The Renewal Corporation anticipates relocating coho salmon smolts, steelhead smolts, and all Chinook juvenile life stages directly into the mainstem Klamath River. Smolts are identified by having lost their parr marks, are silvery in color with scales that are beginning to set and have an expected size range of 80-150 mm (Moyle, 2002). The primary reason for relocating these fish to the mainstem is to allow them to continue volitional downstream outmigration. These relocation areas are divided into two reaches: Happy Camp to the Salmon River and Salmon River to the Trinity River. The Renewal Corporation's release locations for each reach are located within two miles upstream of a perennial cold-water tributary. The Renewal Corporation identified these reaches due to the relatively high number of tributary inputs that are expected to increasingly dilute the elevated Suspended Sediment Concentrations from the reservoir drawdown. In general, the Renewal Corporation anticipates relocating these fish to the nearest Klamath River reach listed above, assuming the existence of suitable Suspended Sediment Concentration conditions. Specific relocation areas for these two groups are discussed below in Section 3.3.3.2.

3.3.2 Fish Occupancy and Water Quality at Relocation Sites

The Renewal Corporation will make its final determination of a Relocation Site on a case-by-case basis. The Renewal Corporation will support its decision with reconnaissance surveys of the Relocation Site. For a tributary Relocation Site to be used for relocation of YOY coho salmon and *O. mykiss,* the Renewal Corporation will conduct a reconnaissance survey in the spring of the Drawdown Year in order to assess habitat conditions and holding capacity, especially with respect to any off-channel pond site. The Renewal Corporation will also use

reconnaissance surveys to confirm the suitability of selected Relocation Sites. The Renewal Corporation will consult with the Aquatic Technical Working Group concerning any restrictions or limitations to be placed on the use of a Relocation Site.

The Renewal Corporation will conduct habitat assessments of selected Relocation Sites to ensure habitat conditions remain supportive of juvenile salmon. The assessment will evaluate (among other things) the suitability of cover, hydrologic connection, depths, and water temperature. As part of the assessment, the Renewal Corporation will use biologists experienced with salmonid habitats and relocation efforts to conduct a visual assessment of habitat conditions at selected Relocation Sites.

In addition to habitat conditions, fish occupancy and holding capacity are critical to understand prior to relocation, as high fish densities may lead to density-dependent food limitation (Brewitt *et al.*, 2017). Holding capacities for several of the constructed off-channel ponds are understood, although capacities may change over time. The Renewal Corporation will qualitatively assess holding capacity and fish occupancy as part of the reconnaissance survey(s) conducted at Relocation Site(s) in the spring of the Drawdown Year. When available, the Renewal Corporation will use information from independent spawning season surveys to assess anticipated holding capacity and fish occupancy for a Relocation Site.

Based on the results of the reconnaissance survey(s), the Renewal Corporation will determine the suitability of each surveyed Relocation Site to support relocated fish. If the Renewal Corporation determines that it is necessary, a follow-up reconnaissance survey of the Relocation Site will be performed up to 48 hours before fish relocation will occur.

3.3.3 Relocation Sites

3.3.3.1 Tributary Relocation Sites

The Renewal Corporation's prioritization of Tributary Confluence Monitoring Area Relocation Sites for YOY coho salmon and *O. mykiss* is set forth below (Table 3-1).

3.3.3.1.1 Seiad Creek Off-Channel Ponds

Seiad Creek contains a complex of six constructed off-channel ponds that are suitable Relocation Sites (Appendix A, Figure 15). These ponds are suitable for winter habitats and are suitable during summer months. Three of these ponds (May Pond, Alexander Pond, and Durazo Pond) have a strong groundwater influence that provides favorable conditions for relocation during summer months. During the summer months, these ponds display relatively low densities compared to similar ponds in the Klamath River Basin (Witmore, 2014).

Seiad Creek's off-channel ponds typically hold 1,000-1,500 juvenile salmon each (Soto *et al.*, 2018). Seiad Creek and its complex of ponds have good vehicle and crew access and are relatively easy to sample if needed. The Karuk Tribal Fisheries Program is anticipated to continue sampling and monitoring work at these locations, including off-channel pond holding

capacity surveys and the planned installation of a passive integrated transponder (PIT) tag array on lower Seiad Creek. Data collected from this work will provide additional information on pond utilization that the Renewal Corporation can factor into its decision to utilize these locations during the monitoring period.

Table 3-1 identifies Tributary Confluence Monitoring Areas being considered by the Renewal Corporation for YOY salmonid relocation to Seiad Creek off-channel ponds. Seiad Creek and its off-channel ponds have been identified as the primary Relocation Site for YOY coho salmon and *O. mykiss* from Tom Martin Creek. Seiad Creek and its off-channel ponds have also been identified as the secondary Relocation Site from the following creeks and rivers, if needed: Grider Creek, Walker Creek, O'Neil Creek and Scott River. If YOY salmonids from Scott River are not relocated within the Scott River Basin, then Seiad Creek off-channel ponds will be a suitable location, as PIT tagged Scott River fish have been documented using Seiad Creek off-channel ponds to rear (Gorman, 2016). YOY coho salmon and *O. mykiss* relocated from the Seiad Creek Tributary Confluence Monitoring Area will remain in the Seiad Creek watershed.

3.3.3.1.2 Beaver Creek

Beaver Creek contains several miles of cold-water habitat suitable for rearing juvenile salmonids (USFWS, 2018b). In addition, future restoration activities on lower Beaver Creek are expected to provide enhanced reaches with large wood placement and the construction of off-channel ponds. The Renewal Corporation anticipates that this work will be completed prior to the commencement of the monitoring period. The prevalence of cold-water rearing habitat allows YOY fish to volitionally distribute throughout the over 5-mile relocation reach identified below the West Fork of Beaver Creek (Appendix A, Figure 15). Since YOY fish relocated by the Renewal Corporation will have the ability to redistribute to suitable habitat within this reach, issues related to overcrowding and capacity limitations will be minimized. The Renewal Corporation has identified a number of potential Relocation Sites along Beaver Creek, from the confluence with West Fork Beaver Creek down to the confluence with the mainstem Klamath River. These Relocation Sites have good vehicle and crew access from Beaver Creek Road (Forest Road 48N01).

Table 3-1 identifies Tributary Confluence Monitoring Areas being considered by the Renewal Corporation for YOY salmonid relocation to Beaver Creek. Beaver Creek has been identified as the primary Relocation Site for YOY coho salmon and *O. mykiss* from Humbug Creek, Cottonwood Creek and Dry Creek. Beaver Creek has also been identified as the secondary Relocation Site from the following creeks and rivers, if needed: Bogus Creek and Beaver Creek. Depending on the water year, Shasta River may require a relatively large relocation effort, and Beaver Creek is the closest downstream tributary with suitable habitat. If the Renewal Corporation is not able to relocate YOY salmonids from the Shasta River within the Shasta River Basin, then Beaver Creek is next closest suitable location.

3.3.3.1.3 Horse Creek

The upper reaches of Horse Creek provide several miles of cold-water habitat that is suitable for rearing juvenile salmonids (T. Soto, pers. comm., 2020). Previous habitat enhancement work in

Horse Creek included large wood placement as well as multiple off-channel ponds to enhance rearing habitat availability. Approximately 2.75 miles of upper Horse Creek, along with a complex of eight off-channel ponds in upper Horse Creek and two off-channel ponds in Middle Creek (tributary to Horse Creek), provide suitable relocation options (Appendix A, Figure 15).

Table 3-1 identifies Tributary Confluence Monitoring Areas being considered by the Renewal Corporation for YOY salmonid relocation to Horse Creek. Horse Creek and its off-channel ponds have been identified as the secondary Relocation Site for YOY coho salmon and *O. mykiss* from the following creeks, if needed: Tom Martin Creek, Beaver Creek, Humbug Creek, Cottonwood Creek and Bogus Creek. YOY coho salmon and *O. mykiss* relocated from the Horse Creek Tributary Confluence Monitoring Area will remain in the Horse Creek watershed.

Depending on the annual adult coho salmon return, Horse Creek typically supports a relatively large population of spawning adult coho salmon. The Renewal Corporation will consider distribution, capacity, and habitat utilization by YOY fish at Horse Creek prior to any decision to relocate captured YOY to the off-channel ponds at Horse Creek. The Renewal's Corporation decision will be informed by the reconnaissance survey(s) conducted at the Relocation Site(s) in the spring of the Drawdown Year.

3.3.3.1.4 Scott River

Coho salmon in the Scott River watershed are a distinct population within the Interior Klamath River Diversity Stratum (NMFS, 2016). Therefore, whenever possible, the Renewal Corporation prefers relocating these fish within the same watershed. The upper reaches of the Scott River and its tributaries are therefore the Renewal Corporation's primary Relocation Sites for YOY coho salmon and *O. mykiss* captured in the lower reaches of the Scott River. Relocation Sites in the Scott River watershed include French Creek and Sugar Creek. Both of these tributaries have off-channel ponds that have previously served as Relocation Sites for Scott River juvenile salmonids (Bull *et al.*, 2015). The Renewal Corporation may consider using other Scott River watershed locations, including Shackleford Creek and the South Fork Scott River. The Renewal Corporation will capture and relocate YOY salmonids within the Scott River watershed in coordination with CDFW.

3.3.3.1.5 Shasta River

Coho salmon in the Shasta River watershed are a distinct population within the Interior Klamath River Diversity Stratum (NMFS, 2016). Therefore, whenever possible, the Renewal Corporation will relocate these fish within the same watershed. The upper reaches of the Shasta River and its tributaries are the Renewal Corporation's primary Relocation Sites for YOY coho salmon and *O. mykiss* captured in the lower reaches of the Shasta River. Relocation Sites in the Shasta River watershed are on CDFW's Shasta Big Springs Ranch, which contains 2.2 miles of Big Springs Creek and all of Little Springs Creek. Recent management practices made in the Big Springs Creek complex have enhanced juvenile coho salmon rearing habitat (Adams, 2013; CDFW, 2012), restoring a critical component of the watershed. The Renewal Corporation will coordinate the capture and relocate YOY salmonids within the Shasta River with CDFW. The

Renewal Corporation's selection of final Relocation Sites will be informed by reconnaissance survey(s) of the potential Relocation Sites.

3.3.3.2 Mainstem Klamath River Relocation Sites

The Renewal Corporation will relocate captured coho salmon smolts, steelhead smolts, and Chinook salmon juveniles to the mainstem Klamath River. As these species/life stages will be out-migrating from their natal tributaries during the monitoring period, the Renewal Corporation will relocate these species/life stages into the mainstem Klamath River at downstream locations that facilitate continued outmigration.

The Happy Camp (RM 108.4) to Salmon River (RM 66.4) and Salmon River to Trinity River (RM 43.4) mainstem release reaches are described below. The Renewal Corporation selected up to four release sites for each reach based on (1) their upstream proximity to a tributary with known suitable water quality conditions and (2) accessibility for transport vehicles. Each subsequent downstream release site in a reach has increasing tributary accretion flows, diluting Suspended Sediment Concentrations in the river and affording relocated fish the option to seek refuge if mainstem conditions worsen.

The Renewal Corporation will give preference to the most upstream release site considered appropriate given the anticipated mainstem Suspended Sediment Concentrations at the time of relocation. For example, if water quality triggers are exceeded and capture activities are required following a short duration sediment spike, the Renewal Corporation will select the most upstream release site. If capture activities are required during the upward peak of a large suspended sediment spike, then release locations further downstream may be used since downstream locations are expected to have lower Suspended Sediment Concentrations due to the dilution effects of incoming tributaries. The Renewal's Corporation final decision regarding the release site will be based on anticipated conditions during release, which will be informed by information from the USGS water quality stations and about drawdown and dam removal activities.

3.3.3.2.1 Happy Camp to Salmon River

If water quality conditions are suitable, the Renewal Corporation will relocate coho salmon smolts, steelhead smolts and Chinook salmon juveniles to the mainstem Klamath River reach between Happy Camp, CA and the Salmon River. The Renewal Corporation has identified river access points in this reach to strategically relocate fish within two miles upstream of a tributary with suitable water quality conditions (Appendix A, Figure 16). The tributaries are Elk Creek, Clear Creek, and Ti Creek. This will allow released fish to volitionally relocate to tributary accretion flows as necessary to refuge from mainstem conditions during their continued outmigration. The Renewal Corporation will determine final Relocation Sites using the metrics and objectives described in this Juvenile Salmonid Plan prior to juvenile salmonid relocation. This reach of the Klamath River is the closest reach to the Tributary Confluence Monitoring Areas. Therefore, if water quality conditions permit, it will serve as the Renewal Corporation's primary Relocation Site for coho salmon smolts, steelhead smolts, and Chinook salmon juveniles.

3.3.3.2.2 Salmon River to Trinity River

The Renewal Corporation has identified four Relocation Sites between Salmon River and Trinity River for the relocation of coho salmon smolts, steelhead smolts, and Chinook salmon juveniles. The Renewal Corporation expects these Relocation Sites to be used only if water quality conditions warrant release below Salmon River. The Renewal Corporation has identified river access points in this reach to strategically relocate fish within two miles upstream of a tributary with suitable water quality conditions (Appendix A, Figure 16). The tributaries are Camp Creek, Bluff Creek, and the Trinity River. This will allow released fish to volitionally relocate to tributary accretion flows as necessary to refuge from mainstem conditions during their continued outmigration. Additional Relocation Sites below this confluence will not be needed because it is anticipated that accretion flows in this reach will reduce the elevated Suspended Sediment Concentration from the reservoir drawdown.

3.3.4 Relocation Effort and Logistics

The Renewal Corporation will adjust equipment, capture method and logistics for a specific Tributary Confluence Monitoring Area (Section 3.2) as needed given the type of water year, site access, expected duration of capture activities and the estimated number and species/life stage of the fish. The Renewal Corporation's methods used for capture and handling fish are adapted from *Standard Methods for Sampling North American Freshwater Fishes* (Bonar *et al.*, 2009) and will be supplemented and/or modified based on regulatory requirements.

Upon capture, the Renewal Corporation will transfer juvenile salmonids to insulated coolers (i.e., holding coolers), filled with water from the tributary and equipped with battery operated aerators. The Renewal Corporation will handle Endangered Species Act-listed fish with extreme care and fish will be kept in water to the maximum extent possible during capture and relocation activities. The Renewal Corporation will keep all captured fish in cool, shaded, aerated water protected from excessive noise, jostling, or overcrowding and will minimize fish handling to the greatest extent possible. Holding coolers will have water temperature and dissolved oxygen levels checked by a handheld YSI meter (or equivalent) to monitor the suitability of water quality. As necessary, the Renewal Corporation will refresh water in the holding coolers to ensure temperature and dissolved oxygen levels remain suitable for juvenile salmonids.

The Renewal Corporation will mark holding coolers to indicate tributary or mainstem Klamath River Relocation Site destination. The Renewal Corporation will then move the coolers to a truck or sport utility vehicle and secure them to prevent sliding or overturning. The Renewal Corporation will transport fish to Relocation Sites on the same day of capture so no overnight holding will occur. One transport vehicle will be used to relocate YOY fish to the tributary Relocation Site and a second vehicle will be used to transport smolts and Chinook juveniles to the mainstem Klamath River Relocation Site. Depending on the number and species/life stage anticipated to be encountered during the fish capture activity, the Renewal Corporation may use multiple transport vehicles for a specific Tributary Confluence Monitoring Area.

The Renewal Corporation will take water temperature in the holding cooler(s) and at the Relocation Site prior to release. If the difference between the two exceeds 1.5°C, then the

Renewal Corporation will make partial water transfers in the holding coolers to adjust and acclimate fish to the temperature of the Relocation Site. The Renewal Corporation will then release the fish directly into the Relocation Site.

Data collected by the Renewal Corporation at each Relocation Site will include the release location, start and end time, counts from each species and life stage, and any mortality during transport. The Renewal Corporation will also record air temperature, water temperature, and dissolved oxygen at the time of release. The Renewal Corporation will record data collected during fish relocation on electronic tablets or paper data sheets (Appendix B). The Renewal Corporation will take photographs of each release site.

4.0 Reporting

A report will be prepared following implementation of this Plan that includes, at a minimum, the following information:

1. A summary of applicable water quality data collected;
2. Rescue and relocation actions implemented, including the number and age class of juvenile salmonids rescued;
3. Release location; and
4. Results of relocation.

At a minimum, reporting shall include: a summary of the water quality data collected; any actions taken by the Licensee to rescue and relocate lamprey and juvenile salmonids, including number of lamprey and juvenile salmonids rescued (including age class), release location, and the success of such efforts.

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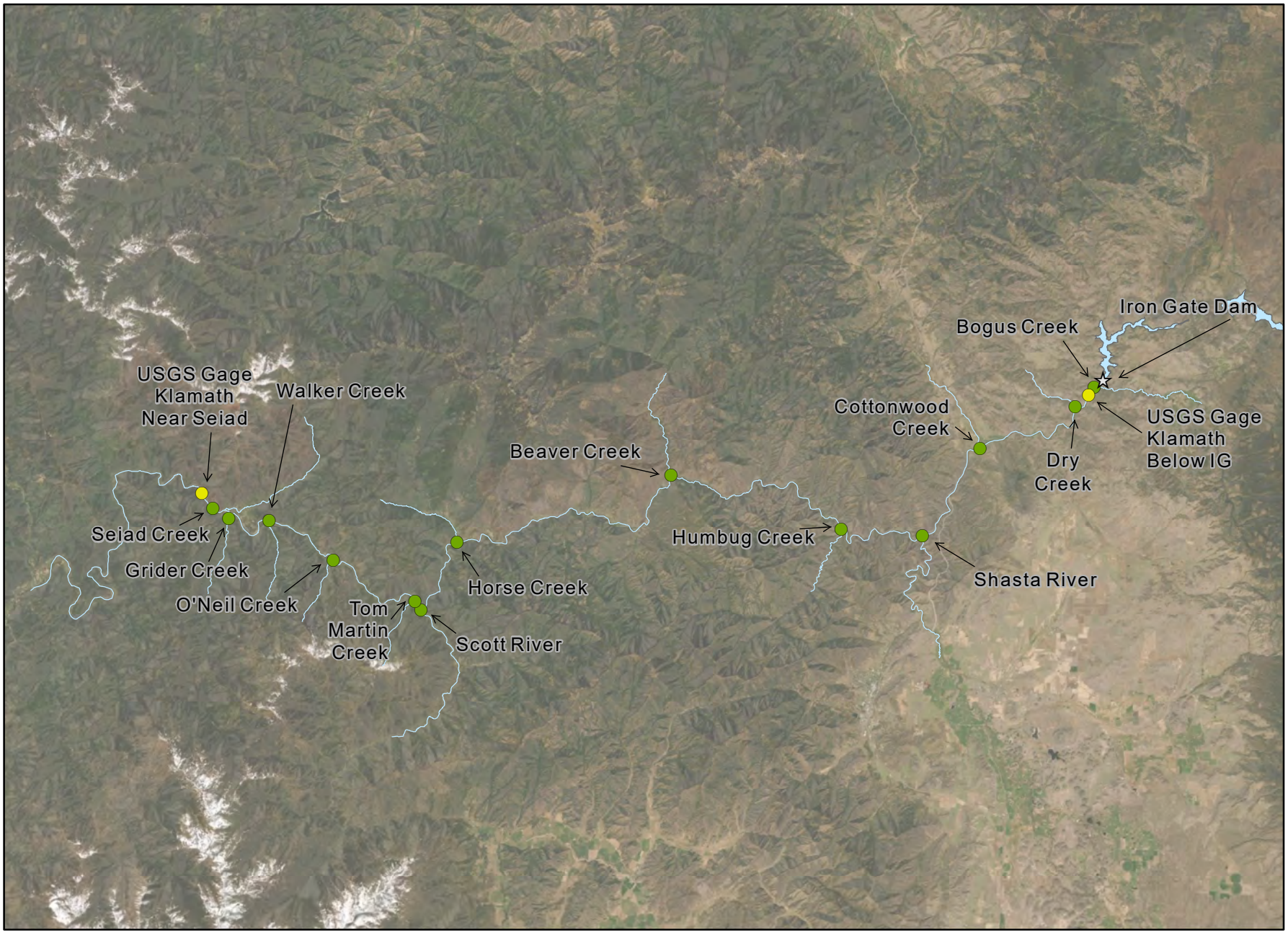
Appendix A

Detailed Map Books



KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 1. Mainstem and Tributary Water Quality Monitoring Sites

November 11, 2020

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Legend

- Tributary Monitoring Sites
- Mainstem Monitoring Sites
- Reference Sites
- Klamath River and Tributaries
- Reservoir Boundaries

N

0 6 12 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Monitoring Sites: RES; Klamath River: RES; Res. Bdry.: National Hydrography Dataset USGS*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 2. Tributary Monitoring Area

Seiad Creek Monitoring Area

November 12, 2020

0 190 380 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 3. Tributary Monitoring Area

Grider Creek Monitoring Area

November 12, 2020

0 340 680 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area
- Secondary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 4. Tributary Monitoring Area

Walker Creek Monitoring Area

November 12, 2020

0 160 320 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 5. Tributary Monitoring Area

O'Neil Creek Monitoring Area

November 12, 2020

0 160 320 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Areas

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 6. Tributary Monitoring Area

Tom Martin Creek Monitoring Area

November 12, 2020

0 110 220 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 7. Tributary Monitoring Area

Scott River Monitoring Area

November 12, 2020

0 160 320 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 8. Tributary Monitoring Area

Horse Creek Monitoring Area

November 12, 2020

0 675 1,350 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area
- Secondary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 9. Tributary Monitoring Area

Beaver Creek Monitoring Area

November 12, 2020

0 160 320 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 10. Tributary Monitoring Area

Humbug Creek Monitoring Area

November 12, 2020

0 160 320 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 11. Tributary Monitoring Area

Shasta River Monitoring Area

November 12, 2020

0 110 220 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 12. Tributary Monitoring Area

Cottonwood Creek Monitoring Area

November 12, 2020

0 160 320 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 13. Tributary Monitoring Area

Dry Creek Monitoring Area

November 12, 2020

0 50 100 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 14. Tributary Monitoring Area

Bogus Creek Monitoring Area

November 12, 2020

0 110 220 Feet

N

Legend

- Monitored Tributary
- Primary Monitoring Area

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmomoid monitoring areas: RES;*

3. *Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS*

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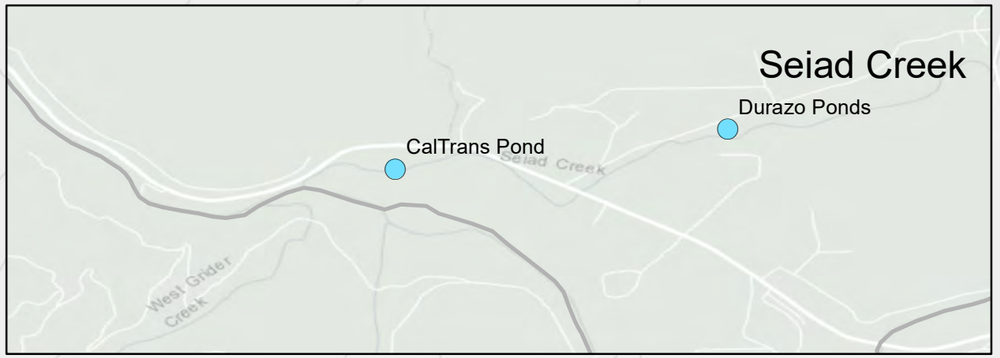
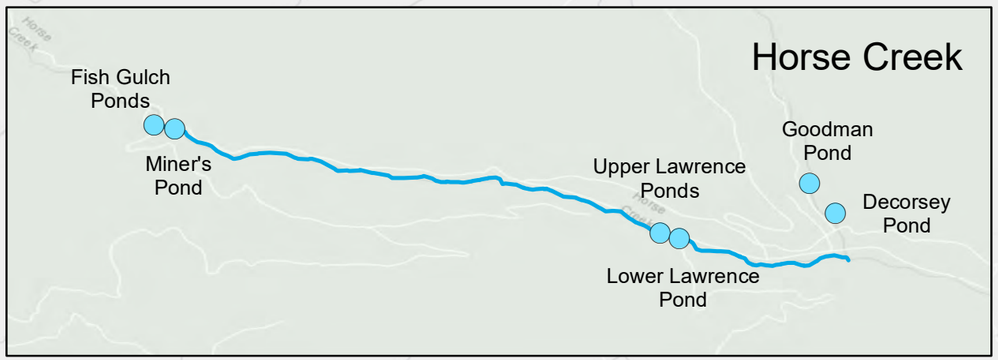
Seiad Creek
West Grider Creek
Horse Creek
Shasta River
Cade Creek
Elk Creek
Tom Martin Creek
Scott River
Sandy Bar Creek
Stanshaw Creek
Camp Creek





KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmonid Plan

Figure 15. Coho and* O. mykiss *Young-of-the-Year Relocation Sites

November 12, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. McMillen Jacobs Associates has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. McMillen Jacobs Associates assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

N

0 4 8 12 Miles

Legend

- Primary Relocation Tributaries
- Alternative Relocation Tributaries
- Tributary Relocation Sites
- Klamath River
- Tributary Relocation Reaches

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmon relocation sites: RES; Klamath River: National Hydrography Dataset USGS*

3. *Background: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community*

Document Path: C:\Users\uhlmann\Box\GIS\Project_Based\Klamath_River_Renewal_MJA\GIS_Request_Tracking\GIS_Requests_Management_Plans\RES_MPs\juvenile_salmonid_MP\coho_and_mykis_trib_relo_sites2.mxd

Happy Camp, CA
Elk Creek
Indian Creek River Access
Wingate Bar River Access
Clear Creek
Ti Bar River Access
Ti Creek
Salmon River Access
Somes Bar, CA
Orleans, CA
Orleans Bar River Access
Camp Creek
Big Bar River Access
Bluff Creek
Trinity River

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project

Juvenile Salmon Plan

Figure 16. Coho Smolt and Chinook Mainstem Relocation Sites

December 8, 2020

PRELIMINARY DESIGN (NOT FOR CONSTRUCTION)

Legend

- ☆ Reference Points

Relocation Sites

- Happy Camp to Salmon River
- Salmon River to Trinity River

Tributaries

- Happy Camp to Salmon River
- Salmon River to Trinity River

Reaches

- Happy Camp to Salmon River
- Salmon River to Trinity River

N

0 3 6 Miles

Notes

1. *Coordinate System: NAD 1983 2011 StatePlane California I FIPS 0401 Ft US*

2. *Data Sources: Salmon relocation areas: RES; Klamath R. Reaches: RES*

3. *Background: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community*

Document Path: C:\Users\uhlmann\Box\GIS\Project_Based\Klamath_River_Renewal_MJA\GIS_Request_Tracking\GIS_Requests_Management_Plans\Stantec_RAMP_Trib_MP\coho_smolt_chinook_mainstem_relocation_v2_zu.mxd

Appendix B

Monitoring Data Sheets

Lower Klamath Project

Juvenile Salmonid Plan – Water Quality Monitoring Data Sheet

Date: ____________________

Tributary Confluence Monitoring Area: ____________________

Weather: ____________________

Air Temp. (°C): ____________________

Logger Offloaded: ☐

Notes and field observations, including juvenile salmonid behavior:

Date: ____________________

Tributary Confluence Monitoring Area: ____________________

Weather: ____________________

Air Temp. (°C): ____________________

Logger Offloaded: ☐

Notes and field observations, including juvenile salmonid behavior:

Date: ____________________

Tributary Confluence Monitoring Area: ____________________

Weather: ____________________

Air Temp. (°C): ____________________

Logger Offloaded: ☐

Notes and field observations, including juvenile salmonid behavior:

Lower Klamath Project

Juvenile Salmonid Plan – Capture Data Sheet

Capture Tributary: _____

Capture Date: _____

Crew: _____

Start Time: _____

End Time: _____

Gear(s) Used: _____

Habitat Type: _____

Weather: _____

Air Temp. (°C): _____

Water Temp. (°C): _____

DO (mg/L): _____

Turbidity (NTU): _____

Captured Fish				
Relocation Sites	**Life Stage**	**Species**	**Number Caught**	**Number of Mortalities**
Tributaries	YOY (fry and parr)	Coho salmon		
		O. mykiss		
Mainstem Klamath	YOY	Chinook salmon		
	Smolt	Coho salmon		
		O. mykiss		
		Chinook salmon		
Released On-Site	Ammocoete	Pacific lamprey		
	Transformer			
	Adult			

Notes and field observations:

Lower Klamath Project

Juvenile Salmonid Plan – Relocation Data Sheet

Capture Tributary: _____

Species & Life Stage: _____

Number of Coolers: _____

Prim. Relocation Site: _____

Sec. Relocation Site: _____

Crew: _____

Release Date: _____

Release Time: _____

Air Temp. (°C): _____

Site Water Temp. (°C): _____

Cooler Water Temp. (°C): _____

DO (mg/L): _____

Turbidity (NTU): _____

Relocated Fish			
Life Stage	**Species**	**Number Released**	**Number of Mortalities**
	Coho salmon		
	O. mykiss		
	Chinook salmon		

Photo captured of relocations site: ☐

Difference between site and cooler temp: _____

Was an acclimation period needed? _____

If so, how long? _____

Temp. difference at time of release: _____

Notes and field observations:

Appendix F

Oregon AR-6 Adaptive Management Plan (Suckers)

KLAMATH RIVER RENEWAL CORPORATION

Lower Klamath Project
FERC Project No. 14803

Draft Oregon AR-6 Adaptive Management Plan - Suckers

Klamath River Renewal Corporation
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March 2021

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

This Oregon Aquatic Resources Measure 6 (AR-6) - Adaptive Management Plan (Suckers) (OR Suckers Adaptive Management Plan or Plan) described herein is a subplan of the Aquatic Resources Management Plan that will be implemented as part of the Proposed Action for the Lower Klamath Project (Project).

1.1 Purpose

The purpose of this Plan is to describe the measures the Renewal Corporation has completed to better understand Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) populations in J.C. Boyle Reservoir, and to plan the salvage and translocation of the listed suckers from the reservoir prior to reservoir drawdown and dam removal. The sampling plan described herein involves the Renewal Corporation's efforts to understand sucker demographics and genetics, population sizes, habitat use, and successful gear types and fishing methods. Informed by sampling plan results, the Renewal Corporation will conduct sucker salvage and translocation efforts to remove Lost River and shortnose suckers from the Lower Klamath Project reservoirs prior to reservoir drawdown and dam removal.

2.0 Overview

The OR Sucker Adaptive Management Plan entails two actions as part of the Proposed Action: Action 1: Reservoir and River Sampling, and Action 2: Sucker Salvage and Translocation which are summarized below. The Renewal Corporation has completed Action 1 activities as detailed in *Section 3.0 Action 1: Sampling Plan Methods and Results*. The Action 2 activities outlined in *Section 4.0 Action 2: Salvage and Translocation Plan* will be completed prior to reservoir drawdown. A similar plan for Copco No. 1 Reservoir and Iron Gate Reservoir is included in the CA Suckers Adaptive Management Plan.

2.1 Action 1: Reservoir and River Sampling

The Renewal Corporation coordinated a sucker sampling program with U.S. Fish and Wildlife Service (USFWS), Oregon Department of Fish and Wildlife (CDFW), and the U.S. Geological Survey (USGS) from 2018 through 2020. The Renewal Corporation completed sampling in J.C. Boyle Reservoir in at the upstream end of the reservoir where the Klamath River enters the reservoir. Sampling took place over four periods between fall 2018 and spring 2020 (Renewal Corporation 2020). Sampling included placing trammel nets in the reservoir and electrofishing was used in the Klamath River reach entering the reservoir and to augment trammel net sampling. Captured Lost River and shortnose suckers were identified by species and sex, marked with a PIT tag (Burdick 2013), fin clipped for genetic material, measured, and released. Klamath smallscale suckers (*Catostomus rimiculus*) were also processed in 2020 to collect genetic material for USFWS' work developing genetic assays. Recaptured fish were used to estimate sucker abundance, and fin clips will be used by USFWS to determine the genetics of the sampled fish. Sampling was typically completed over three nights. The Renewal Corporation completed annual summary reports following each sampling effort and reports were submitted

to USFWS and ODFW. The Renewal Corporation also presented sampling results to the Aquatic Technical Work Group (ATWG), a working group comprised of agency and tribal biologists and fisheries managers.

2.2 Action 2: Sucker Salvage and Translocation

The Renewal Corporation will capture adult listed suckers in J.C. Boyle Reservoir using similar methods as those employed for the sampling effort. The Renewal Corporation will translocate captured suckers to the Klamath National Fish Hatchery, the Klamath Tribes sucker rearing facility, and possibly other translocation sites that may be identified based on further planning and agreement with USFWS, ODFW, CDFW, and the Renewal Corporation. The Renewal Corporation anticipates salvaging up to 300 listed suckers from J.C. Boyle Reservoir over 7 days based on sampling catch efficiencies. The 300 listed suckers equate to between 11 percent and 35 percent of the mean population estimates calculated for J.C. Boyle Reservoir. A similar effort will be completed on Copco No. 1 Reservoir and Iron Gate Reservoir in California (see CA Suckers Adaptive Management Plan). During the salvage action, the Renewal Corporation does not anticipate salvaging and translocating the entire populations of Lost River and shortnose suckers residing in J.C. Boyle Reservoir.

3.0 Action 1: Sampling Plan Methods and Results

3.1 Purpose

The Renewal Corporation coordinated a sucker sampling program with USFWS, ODFW, and the USGS from 2018 through 2020. Sampling was completed in fall 2018, spring and fall 2019, and spring 2020. Collected data were used to develop a better understanding of sucker demographics and genetics, population sizes, habitat use, and successful gear types and fishing methods for catching Lost River and shortnose suckers. The sampling results directly informed the salvage and translocation efforts described in *Section 4.0 Action 2: Salvage and Translocation Plan*.

3.2 Previous Efforts

The Renewal Corporation reviewed previous sampling studies completed on Upper Klamath Lake and J.C. Boyle (Oregon), Copco No. 1, and Iron Gate reservoirs as part of pre-sampling planning. The literature review focused on studies that evaluated Lost River and shortnose sucker habitat use and demographics in Copco No. 1 Reservoir and Iron Gate Reservoir. Studies of interest included Coots (1965), California Department of Fish and Game (CDFG) (1980), Beak Consultants (1987), Buettner and Scoppettone (1991), and Desjardins and Markle (2000). These studies documented shortnose suckers in Copco No. 1 Reservoir and Iron Gate Reservoir. Beak Consultants (1987) and Desjardins and Markle (2000) each captured one Lost River sucker in Copco No. 1 Reservoir. Buettner and Scoppettone (1991) referenced the decline of Lost River suckers from Copco No. 1 Reservoir since the 1950s as documented by previous CDFW studies (Coots 1965; CDFG 1980). Buettner and Scoppettone (1991) also noted there was no prior evidence of Lost River or shortnose suckers inhabiting Iron Gate Reservoir, although Desjardins and Markle (2000) subsequently captured shortnose suckers in Iron Gate

Reservoir. Sucker spawning habitat upstream from Copco No. 1 Reservoir and Iron Gate Reservoir is limited due to short riverine reaches, coarse bed material, and fluctuating river levels (Buettner and Scoppettone 1991; Desjardins and Markle 2000). Limited juvenile rearing habitat and predation by non-native fish species also likely limit the reproductive potential of Lost River and shortnose suckers in the reservoirs (Desjardins and Markle 2000). Beak Consultants documented shortnose sucker spawning in the Klamath River in the 1-mile reach of the Klamath River upstream from Copco No. 1 Reservoir (1987), but they found few larval shortnose suckers in Copco No. 1 Reservoir (1988). Identified sucker larvae were believed to be Klamath smallscale suckers or shortnose sucker-Klamath smallscale sucker hybrids (Beak Consultants 1988).

J.C. Boyle Dam and Keno Dam have fish ladders that do not meet current sucker passage criteria (ODFW OAR 412; FishPro 2000) and potentially impede the upstream migration of Lost River and shortnose suckers from the Lower Klamath Project reach to Upper Klamath Lake (PacifiCorp 2013). Desjardins and Markle (2000) noted that J.C. Boyle Reservoir tended to have smaller adult shortnose suckers and more size sucker size classes than the downstream reservoirs. Desjardins and Markle (2000) suggested fewer non-native predatory fish species and more littoral habitat could have accounted for more better juvenile recruitment compared to Copco No. 1 Reservoir and Iron Gate Reservoir.

3.3 Sampling Periods and Locations

The Renewal Corporation field crews completed sampling in J.C. Boyle Reservoir over four sampling periods (Renewal Corporation 2020). Spring sampling was completed in late March and mid-May, and fall sampling was completed in early November. Sampling typically began before dusk and ended after midnight. Sampling effort focused on habitats less than 20 ft deep as adult Lost River and shortnose suckers in Upper Klamath Lake preferentially selected habitats up to 15 ft deep (Reiser et al. 2001; Banish et al. 2009). In addition to target depth, field crews also prioritized habitats with similar depths over distances of at least 300 ft to accommodate the dimension of the deployed trammel nets. Nets were often placed to fish transitional features such as from the shallow shoreline into a submerged historical channel of a tributary or the Klamath River. Sampling locations were generally in coves and tributary confluence areas that met the sampling habitat criteria defined by water depths less than 20 ft deep and habitats with consistent elevations over a 300 ft distance. Habitats that were successfully sampled during previous efforts, and over the course of the Renewal Corporation's work, were repeatedly sampled.

3.4 Sampling Methods

The Renewal Corporation field crews deployed sampling boats[1] with a captain and two crew members on each boat. The captain was responsible for driving the boat and assisting with data recording during fish processing. Crew members were responsible for deploying and retrieving

[1] Two crews conducted sampling in fall 2018, and spring and fall 2019. One crew conducted sampling in spring 2020. Sampling level of effort was comparable across the four sampling efforts.

fishing gear, and processing captured fish. Crew members used trammel nets and boat electrofishing to sample suckers. Trammel nets were most frequently used and accounted for nearly all the sampled suckers. A boat electrofisher was used in flowing portions of the Klamath River at the head end of J.C. Boyle Reservoir and in shallow reservoir margins. Table 3-1 summarizes the sampling gear employed.

Table 3-1. Gear for sampling listed suckers in J.C. Boyle Reservoir.

SAMPLING EQUIPMENT ITEM	NUMBER	SPECIFICATIONS
Sampling Boat	1 or 2	18 ft and 19 ft sampling boats with necessary safety and anti-pollution equipment
Trammel Net	6	USGS specifications - 300 feet long, 6 feet high; two 12-inch mesh outer panels; one 1.5-inch mesh (3-inch stretch) inner panel; foam-core float line; lead-core bottom line
Electrofishing Equipment	1	3250 watt generator operated boat-mounted Smith-Root Model 1.5 KVA Electrofisher

3.4.1 Trammel Nets

Netting of suckers was predominantly completed at night by one or two boats. Each boat set between two and six nets during each net set. Each trammel net included two 12-inch mesh outer panels and one 1.5-inch mesh inner panel sandwiched between the outer 12-inch mesh panels. A foam-core float line and lead-core bottom line maintained net position. Nets were clipped to an end poly rope with a mushroom or pyramid anchor secured at the bottom of the poly rope and a buoy secured to the top of the poly rope. The distance between the top of the clipped net and the buoy was based on water depth such that nets were fished on the bottom. Nets were paid out from either the bow or the side of the boat depending on the boat. A second anchor and buoy were attached to the poly rope at the end of the trammel net. Each net set location was documented with either a handheld or on-board GPS. During spring 2020, one sampling boat was used to deploy six trammel nets.

Nets were generally set perpendicular to the shoreline in water depths ranging from 3 ft to 50 ft, but nets were most commonly set in 20 ft or less of water. Nets were typically fished for approximately 2 hours, but up to 6 hours during the spring 2020 sampling. At the end of each net soak, the nets were retrieved, and captured fish were removed from the nets and placed in live wells for processing. Non-target species were identified, enumerated, and released.

3.4.2 Tangle Nets

The Renewal Corporation field crew deployed two tangle nets in the transitional reach at the upstream end of J.C. Boyle Reservoir. The nets included one net measuring 100 feet long by 6 feet deep with 3-inch stretch mesh size and one net measuring 50 feet by 8 feet with 3-inch stretch mesh size. Both nets were fitted with a foam core float line and lead core bottom line. Tangle nets were fished through a lower velocity reach where water depths ranged from 6 feet

to 8 feet. Tangle nets were not fished upstream from Copco Reservoir or Iron Gate Reservoir due to coarse bed material or low sucker presence determined while boat electrofishing. One Klamath smallscale sucker was caught using the tangle nets.

3.4.3 Boat Electrofishing

Boat electrofishing was an added gear type for fall 2019 and spring 2020 sampling. The electrofishing equipment included dual bow-mounted anode/cathode arrays (each with a terminal 4 wire umbrella). Dual cathode arrays were hung from each side of the boat, each with 14 terminal wires. The electrofisher components were mounted on a 17-foot jet boat. The anode/cathode arrays were operated by a Smith-Root electrofisher control module (Model 1.5 KVA) with electricity provided by a gas-powered generator (Generac GP 3250) with a maximum output of 3250 running watts. The Smith-Root 1.5 KVA electrofisher has a maximum output power of 1,700 watts and can be set to pulsed AC or DC current that draws between 0 and 10 amps. The AC mode produces 60 Hz alternating current between the anode and cathode wires. The DC position produces direct current, pulsing at 120 pulses per second. There is no wattage adjustment on the Smith-Root 1.5 KVA electrofisher.

Per the USFWS Incidental Take Permit for listed suckers, only the DC setting was used. Following the user manual, the Smith-Root 1.5 KVA electrofisher controller was set to DC current and the voltage was set to the lowest setting. The electrofisher was then activated to determine the amount of current (amperage) drawn at the lowest voltage setting. Test electrofishing was conducted and the voltage was increased in a stepwise manner until the desired level of electrotaxis to facilitate capture was exhibited by the target species, while also minimizing injury and mortality of target and non-target species. The effective DC voltage for the Klamath Reservoir surveys was approximately 150 volts, which drew about 5 amps. During electrofishing, two fish netters were stationed in the bow who controlled the electrofisher via a foot switch.

3.4.4 Sucker Processing Procedures

Crew members processed captured Lost River and shortnose suckers on the boat of capture. Fish processing involved the following observations and other measurements of each captured shortnose sucker.

- Identified the fish species and sex, noting the presence of tubercles and anal fin shape as sex characteristics.
- Identified any external abnormalities including parasites, lamprey marks, and fin and scale anomalies.
- Measured fork length to the nearest millimeter using a wetted PVC measuring board.
- Collected a fin clip to serve as a genetic material sample.
- Confirmed absence of existing PIT tag, then inserted a PIT tag into the ventral musculature anterior to the pelvic girdle using pre-loaded single use 12-gauge hypodermic needles (HPT12 PLT) fitted onto an implant device (MK-25). Existing or inserted PIT tag numbers were recorded

- Collected photographs of each sucker's mouth, lateral body view, and features of concern such as lesions or parasites.

Measurement data were recorded on field sheets and photographs and GPS data were transferred from field equipment to laptop computers following sampling. Processed fish were returned to the reservoir away from the immediate sampling area to minimize repeat capture. All efforts were made to minimally handle suckers and release fish in good condition. No direct sucker mortality was observed in J.C. Boyle Reservoir.

3.4.5 Sucker Genetics

In 2020, the USFWS-Abernathy Lab compiled genetic libraries for the four Klamath sucker species including Lost River suckers, shortnose suckers, Klamath largescale suckers (*Catostomus snyderi*), and Klamath smallscale suckers (Smith et al. 2020). Genetic results suggested genetic variation within each of the four sucker species was primarily partitioned among subbasins (Smith et al. 2020). Smith et al. (2020) also determined there are potentially thousands of genetic markers for species and population differentiation that will be useful in the recovery of Lost River and shortnose suckers. USFWS will use the genetic results to develop assays that will likely allow managers to distinguish among the four Klamath Basin sucker species, providing an important tool for species conservation (Smith et al. 2020). USFWS is currently developing the assays and will apply the assays to fin clips collected by the Renewal Corporation in the Lower Klamath Project reservoirs to determine sucker genetics.

3.5 Sampling Results

Results for the four sampling efforts completed between 2018 and 2020 on J.C. Boyle Reservoir are provided below. Results for Copco No. 1 Reservoir and Iron Gate Reservoir are provided in the California Adaptive Management Plan-Suckers.

3.5.1 Level of Effort

Table 3-2 and Table 3-3 include the level of effort for the trammel net sets and boat electrofishing, respectively.

Table 3-2. Level of effort for trammel net sets.

METRIC	SAMPLING EVENT	NET SET VALUES
Total Net Sets (#)	Spring 2020	7
	Fall 2019	19
	Spring 2019	40
	Fall 2018	30
	Total	**96**
	Spring 2020	49.7

METRIC	SAMPLING EVENT	NET SET VALUES
Total Net Soak Time (hours)	Fall 2019	36.0
	Spring 2019	55.1
	Fall 2018	57.9
	Total	**198.8**
Average Net Soak Time (hours)	Spring 2020	7.1
	Fall 2019	1.9
	Spring 2019	1.4
	Fall 2018	1.9
	Average	**3.1**

Table 3-3. Boat electrofishing level of effort for J.C. Boyle Reservoir from fall 2019 and spring 2020 sampling.

SAMPLING EVENT	BOAT ELECTROFISHING EFFORT (SECONDS)
Spring 2020	2792
Fall 2019	2999
Total	**5791**

3.5.2 Catch Composition

3.5.2.1 Trammel Nets

The Renewal Corporation field crews caught 3,645 fish during the four sampling periods. Fish counts and native and non-native species composition are included in Table 3-4 and Table 3-5, respectively.

Table 3-4. Total trammel net catch for J.C. Boyle Reservoir.

SAMPLING EVENT	TOTAL FISH CAUGHT
Spring 2020	1184
Fall 2019	716
Spring 2019	829
Fall 2018	916
Total	**3645**

Table 3-5. The most common native and non-native fish species caught using trammel nets in J.C. Boyle Reservoir.

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Tui Chub (*Siphatales bicolor bicolor*)	1464
	Blue Chub (*Gila coerulea*)	451
	Smallscale Sucker (*Catostomus rimiculus*)	131
	Rainbow Trout (*Oncorhynchus mykiss*)	80
	Shortnose Sucker (*Chasmistes brevirostris*)	64
	Lost River Sucker (*Deltistes luxatus*)	26
Non-native Species	Crappie (*Pomoxis* spp.)	386
	Brown Bullhead (*Ameiurus nebulosus*)	384
	Goldfish (*Carassius* spp.)	338
	Yellow Perch (*Perca flavescens*)	245
	Redear Sunfish (*Lepomis microlophus*)	23

3.5.3 Boat Electrofishing

The Renewal Corporation field crews caught 2,347 fish during fall 2019 and spring 2020 boat electrofishing. Fish counts and native and non-native species composition are included in Table 3-6 and Table 3-7, respectively.

Table 3-6. Total boat electrofishing catch for J.C. Boyle Reservoir.

SAMPLING EVENT	TOTAL FISH CAUGHT
Spring 2020	215
Fall 2019	74
Total	**289**

Table 3-7. The most common native and non-native fish species caught using boat electrofishing in J.C. Boyle Reservoir in 2019 and 2020 sampling.

NATIVE/NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Chubb sp. (*Siphatales bicolor bicolor* and *Gila coerulea)*	218
	Rainbow Trout (*Oncorhynchus mykiss*)	14
	Smallscale Sucker (*Catostomus rimiculus*)	2
	Shortnose Sucker (*Chasmistes brevirostris*)	2
Non-native Species	Goldfish (*Carassius* spp.)	44
	Largemouth Bass (*Micropterus* sp.)	6
	Brown Bullhead (*Ameiurus nebulosus*)	3

3.5.4 Trammel Net and Boat Electrofishing Summary

Table 3-8 includes the total catch for the four sampling periods in J.C. Boyle Reservoir. Table 3-9 includes the most common native and non-native fish species caught in J.C. Boyle Reservoir using trammel nets and boat electrofishing.

Table 3-8. Total trammel net catch and boat electrofishing catch for J.C. Boyle Reservoir.

SAMPLING EVENT	TOTAL FISH CAUGHT
Spring 2020	1399
Fall 2019	790
Spring 2019	1109
Fall 2018	274
Total	**4548**

Table 3-9. The most common native and non-native fish species caught using trammel nets and boat electrofishing in J.C. Boyle Reservoir.

NATIVE/ NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
Native Species	Tui Chub (*Siphatales bicolor bicolor*)	1464
	Blue Chub (*Gila coerulea*)	451
	Chubb sp. (*Siphatales bicolor bicolor* and *Gila coerulea)*	218
	Smallscale Sucker (*Catostomus rimiculus*)	133

NATIVE/ NON-NATIVE SPECIES	SPECIES NAME	TOTAL FISH CAUGHT
	Rainbow Trout (*Oncorhynchus mykiss*)	94
	Shortnose Sucker (*Chasmistes brevirostris*)	66
	Lost River Sucker (*Deltistes luxatus*)	26
Non-native Species	Brown Bullhead (*Ameiurus nebulosus*)	387
	Crappie (*Pomoxis* spp.)	386
	Goldfish (*Carassius* spp.)	338
	Yellow Perch (*Perca flavescens*)	245
	Redear Sunfish (*Lepomis microlophus*)	23

3.5.5 Sucker Catch, Size, and Condition

The Renewal Corporation caught Lost River suckers in J.C. Boyle Reservoir (Table 3-10) over the four sampling periods. Potential hybrid suckers were individuals that had intermediate characteristics suggesting hybridization with other sucker species. Genetic samples taken during the sampling will be used to confirm sucker genetics once genetic assays are available.

Table 3-10. Listed suckers and potential hybrid suckers caught using trammel nets and boat electrofishing J.C. Boyle Reservoir.

SPECIES[1]	SAMPLING EVENT	TOTAL SUCKERS CAUGHT
Lost River Suckers	Spring 2020	9
	Fall 2019	4
	Spring 2019	10
	Fall 2018	3
	Total	**26**
Shortnose Suckers	Spring 2020	15
	Fall 2019	9
	Spring 2019	19
	Fall 2018	21
	Total	**64**

SPECIES[1]	SAMPLING EVENT	TOTAL SUCKERS CAUGHT
Potential Hybrid Suckers	Spring 2020	0
	Fall 2019	1
	Spring 2019	1
	Fall 2018	3
	Total	**5**
Total Suckers	Spring 2020	24
	Fall 2019	14
	Spring 2019	30
	Fall 2018	27
	Total	**95**

[1]: Only includes maiden captures (i.e., first capture), does not include recaptured fish.

Lost River sucker and shortnose sucker length statistics recorded over the four sampling periods are provided in Table 3-11.

Table 3-11. Lost River and shortnose sucker length statistics for suckers caught using trammel nets and boat electrofishing in J.C. Boyle Reservoir over the four sampling periods.

SPECIES	STATISTIC	VALUE
Lost River Suckers	Count	26
	Maximum (mm)	765.0
	Median (mm)	534.5
	Mean (mm)	534.1
	Minimum (mm)	375.0
	1 SD (mm)	90.8
Shortnose Suckers	Count	64
	Maximum (mm)	520.0
	Median (mm)	428.0
	Mean (mm)	427.9
	Minimum (mm)	313.0
	1 SD (mm)	35.2

Based on length-age relationships for shortnose suckers in Upper Klamath Lake, shortnose suckers sampled in J.C. Boyle Reservoir are likely older fish. Prior to the Renewal Corporation's sampling, sucker populations downstream of Keno Reservoir had not been sampled since the late 1990s (Desjardins and Markle 2000) and early 2000s (Desjardins and Markle, unpublished data). In four sampling years, Desjardins and Markle (2000; unpublished data) caught 4 adult Lost River suckers and 61 adult shortnose suckers in J.C. Boyle Reservoir. A comparison of shortnose sucker lengths from sampling in 1998-1999 (Desjardins and Markle 2000) and 2000-2001 (Desjardins and Markle, unpublished data), and the Renewal Corporation's sampling (2018-2020) is shown in Figure 3-1.

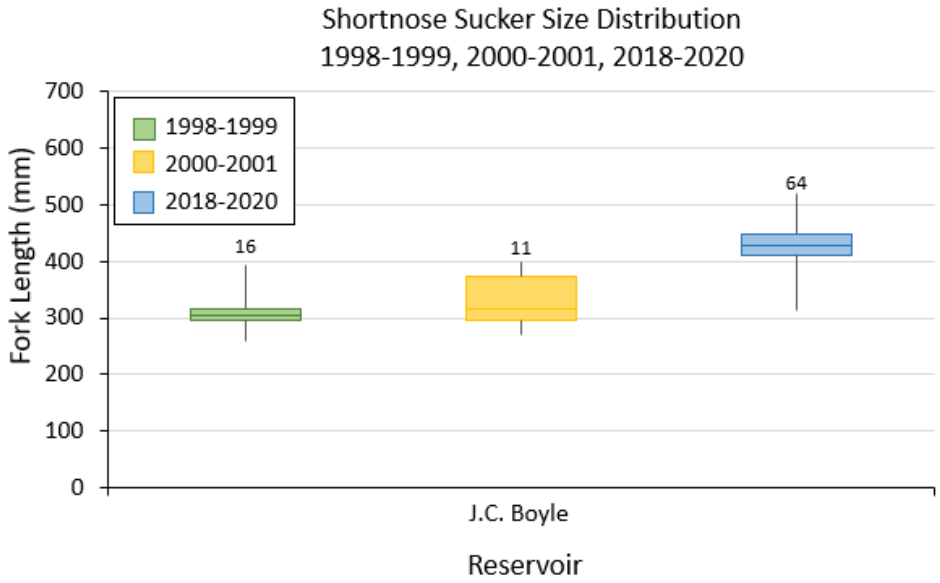

Figure 3-1. Comparison of shortnose sucker fork lengths for fish sampled by Desjardins and Markle (1998-1999 and 2000-2001) and the Renewal Corporation (2018-2020) in J.C. Boyle Reservoir. Sample sizes are posted above each box plot.

Renewal Corporation field crews noted the occurrence of wounds, deformities, and growths/tumors on listed suckers in the reservoirs. Common afflictions included worn fins, caudal fin deformities, parasites, wounds from lamprey attachment, and growths/tumors (Figure 3-2). Between 11% and 33% of suckers had afflictions across the four sampling periods. Due to small sample sizes, affliction patterns across the sampling periods were not apparent. Sucker afflictions in J.C. Boyle Reservoir included wounds, deformities, tumors, and parasites.

Figure 3-2. Example Lost River sucker (upper left) and shortnose sucker (upper right) sampled in spring 2020. Example of tumors and growths (lower left) and deformities (lower right) afflicting suckers in the Lower Klamath Project reservoirs.

3.5.6 Sucker Catch Per Unit Effort

Table 3-12 includes a comparison of catch per unit effort (CPUE) for maiden (i.e., first capture) shortnose suckers over the four sampling events, and the previous sampling completed by Desjardin and Markle in 1998 and 1999 (Desjardins and Markle 2000). Including both Lost River suckers and shortnose suckers, the CPUE in J.C. Boyle Reservoir over the four sampling periods is 0.44 fish/net-hour. The CPUE for Lost River suckers and shortnose suckers individually, was 0.13 and 0.31 fish/net-hour, respectively.

Table 3-12. Shortnose sucker catch per unit effort for the Renewal Corporation sampling and the Desjardins and Markle sampling (2000) in J.C. Boyle Reservoir.

SAMPLING EFFORT[1]	CPUE (FISH/NET-HOUR)
Desjardins and Markle – 1998 and 1999[2]	0.06
Renewal Corporation – Spring 2020	0.26
Renewal Corporation – Fall 2019	0.25
Renewal Corporation – Spring 2019	0.34
Renewal Corporation – Fall 2018	0.36
Renewal Corporation - All Events Combined	0.31

[1]: Catch per unit effort does not include recaptured fish.
[2]: Desjardins and Markle 2000

3.5.7 Sucker Population Estimate

The Renewal Corporation used recaptured suckers (trammel net data only) to develop population estimates for the three reservoirs, as well as a total population estimate across the three reservoirs. Three different methods were used to develop population estimates, all yielding comparable results.

3.5.7.1 Methods

The Renewal Corporation used the PIT tag mark-recapture data to produce abundance estimates for listed suckers inhabiting each reservoir, and for the three reservoirs combined. Due to the relatively low recapture rates, mark-recapture data for shortnose, Lost River, and potential hybrid suckers were combined. All listed sucker mark-recapture data were aggregated to determine total population estimates. Any listed sucker recaptured at least one day (or longer) after initial capture, tagging, and release was considered a recapture for the determination of the population estimates. Population estimates were then calculated using the following methods.

The Chapman method (Chapman 1951; Johnson et al. 2007) reduces small sample size bias and estimates the total population as:

$$\hat{N} = \frac{(M)(n+1)}{(m+1)}$$

Where:

$\hat{N}$ = Estimated size of the population

n = Number of fish initially marked and released

M = Number of unmarked fish captured during subsequent survey

m = Number of recaptured fish that were marked

Meridian Environmental, Inc. (Renewal Corporation subcontractor) also used a nonparametric bootstrap method (Efron and Tibshirani 1986; Manly 2007) to calculate mean population estimates and estimate variance to produce 95 percent confidence intervals. The bootstrap was run 10 times for each estimate, with 1,000 iterations per run. Population and variance estimates represent the mean of each 10-run set. The Renewal Corporation calculated the 95 percent confidence interval as the square root of the mean bootstrap variance multiplied by 1.96.

Total population estimates were also calculated using the super-population parameterization (Schwarz and Arnason 1996) of the Jolly-Seber model to estimate listed sucker abundance while accounting for subsampling for marking. Abundance is quantified by Schwarz and Arnason (1996) as the total number of gross “births” in the area of interest, which includes listed suckers present at the beginning of the study, those that move into the study area during the monitoring period, and those that do not survive to the end of the monitoring period. The super-population parameterization (Schwarz and Arnason 1996) of the Jolly-Seber model (POPAN model) was applied with the RMark package (Laake 2013) to the capture histories of each

individual PIT-tagged sucker with at least one resighting (recapture) opportunity. Intercept-only models were used for capture and survival probabilities due to the low number of recaptured individuals. Because survey occasions were distributed across a period of 18 months, the estimated abundance represents a mean for that time period. Bootstrapping was initially applied to obtain reasonable (i.e., non-negative and finite) confidence interval limits. However, bootstrapped confidence intervals resulted in unrealistically-large upper bounds, so confidence intervals based on asymptotic normality were constructed.

The mark-recapture estimates include the following assumptions: 100 percent PIT tag retention (i.e., no tag loss); mortality of tagged target suckers is the same as untagged target suckers; no emigration of tagged target suckers occurs from the reservoirs between the first and last survey; and trammel net set locations are representative of habitats used by suckers in the three reservoirs. Combining shortnose sucker, Lost River sucker, and potential hybrid sucker mark-recapture data also assumes that the trammel net catchability of these three categories of fish is the same.

An additional assumption is that each sucker species identification is correct. The field teams have collected genetic samples from all shortnose sucker, Lost River sucker, and potential hybrid suckers captured during the three survey efforts, and all target suckers were PIT-tagged. Once these samples are processed, reservoir mark-recapture population estimates can be further refined based on species genetic assignment of each fish in the dataset.

3.5.7.2 Results

The Renewal Corporation's population estimates suggest that the total number of adult listed suckers is highest in Copco No. 1 Reservoir, slightly less in J.C. Boyle Reservoir, and lowest in Iron Gate Reservoir (Table 3-13). The 95 percent confidence intervals suggest that there are several thousand adult suckers in Copco No. 1 Reservoir and J.C. Boyle Reservoir, and several hundred adult suckers in Iron Gate Reservoir. Based on sampling results, shortnose suckers are more abundant than Lost River suckers in J.C. Boyle Reservoir, and Lost River suckers are at low population levels in Copco No. 1 Reservoir and potentially absent from Iron Gate Reservoir. Due to the low number of recaptured suckers over the sampling effort, the 95 percent confidence intervals for the population estimates are large compared to the magnitude of the population estimate (i.e., confidence interval widths greater than ±100 percent of the population estimate for Copco No. 1 Reservoir and J.C. Boyle Reservoir).

Using the Chapman Method, the Renewal Corporation estimated 4,509 listed suckers in all three reservoirs. The bootstrap method yielded a mean estimate of 5,540 listed suckers and a 95% confidence maximum estimate of 11,531 listed suckers across the three reservoirs. The Jolly-Seber model estimated 2,201 listed suckers and a 95% confidence maximum estimate of 4,615 listed suckers across the three reservoirs.

Table 3-13. Population Estimate attributes and estimates for listed and potential hybrid suckers in the Lower Klamath Project reservoirs.

POPULATION ESTIMATE ATTRIBUTES	RESERVOIRS			
	J.C. BOYLE	COPCO NO. 1	IRON GATE	RESERVOIRS COMBINED
Total Maiden Suckers Captured (Fall 2018 through Spring 2020)	95	98	29	222
Total Target Suckers PIT-tagged and Available for Recapture (Fall 2018, Spring 2019, Fall 2019, Spring 2020)[1]	71	83	27	181
Total Tagged Suckers Recaptured (Fall 2018 through Spring 2020)	3	3	2	8
Recapture Efficiency (# Recaptured / # Tagged)	4.2%	3.6%	7.4%	4.4%
Chapman Method - Population Estimate	1,727	2,078	279	4,509
Bootstrap Method - Mean Population Estimate	2,766	3,371	399	5,540
Bootstrap Method - 95% Confidence Interval	±3,730	±4,508	±544	±5,991
Jolly-Seber Model - Mean Population Estimate	864	1,235	102	2,201
Jolly-Seber Model - 95% Confidence Interval	±951	±1,374	±89	±2,414

[1]: Although all target suckers captured on the final night of sampling at each reservoir were PIT-tagged, they were not available for subsequent recapture, and therefore, they were excluded from the total number of target suckers PIT-tagged and released for the mark-recapture estimate.

4.0 Action 2: Salvage and Translocation Plan

4.1 Purpose

The purpose of the salvage and translocation effort will be to remove adult listed suckers from J.C. Boyle Reservoir prior to reservoir drawdown and dam removal to reduce project effects on listed suckers residing in the reservoir.

During the development of the sampling and salvage plan, the Renewal Corporation coordinated with the ATWG to develop aquatic resource plan components. The Renewal Corporation originally proposed salvaging 100 Lost River and 100 shortnose suckers from each of the three reservoirs for a total of 600 suckers (Klamath River Renewal Corporation 2017). With the sampling information presented in *Section 3 Action 1: Sampling Plan Methods and Results,* the Renewal Corporation now believes the original proposal is not feasible especially for Lost River suckers which are at low numbers in Copco No. 1 Reservoir and potentially absent from Iron Gate Reservoir.

This revised plan consists of salvaging suckers over a 14-day period including a total of 5 days on Copco No. 1 Reservoir and 2 days on Iron Gate Reservoir, and 7 days on J.C. Boyle Reservoir. Based on catch efficiencies from the sampling effort, the Renewal Corporation anticipates catching up to 300 listed suckers from Copco No. 1 Reservoir and Iron Gate Reservoir, and 300 listed suckers from J.C. Boyle Reservoir. The 300-sucker salvage target equates to between 11 percent and 35 percent of the sucker mean population estimates calculated for J.C. Boyle Reservoir (see *Section 3.5.7 Sucker Population Estimate*). Salvage will continue for 7 days even if the 300-sucker target is exceeded. Salvaged suckers will be translocated to the Klamath National Fish Hatchery, the Klamath Tribes' sucker rearing facility, and possibly other translocation sites that may be identified based on further planning and agreement between USFWS, ODFW, CDFW, and the Renewal Corporation.

4.2 Regulatory Compliance

This Plan is designed to support compliance with the federal Endangered Species Act of 1973 (ESA).

4.3 Salvage Period

The Renewal Corporation will perform sucker salvage and translocation in either spring or fall prior to reservoir drawdown. The Renewal Corporation proposes to focus the salvage efforts during the spring when Lost River and shortnose suckers congregate in shallower habitats in advance and during the spring spawning period. Initiation of the Lost River and shortnose sucker spawning runs in Upper Klamath Lake coincides with water temperatures approaching or exceeding 10 °C and 12 °C, respectively, in the Williamson River (Hewitt et al. 2017). A similar temperature-related spawning migration pattern was documented by Beak Consultants (1987) for shortnose suckers in Copco No. 1 Reservoir. In the Beak Consultants study, shortnose suckers began spawning when average water temperatures exceeded 12 °C on April 15, 1987. Spawning peaked between April 22 and April 30 and spawning ended approximately May 15, 1987 (Beak Consultants 1987). Therefore, a spring salvage period would be completed between mid-April and early May. The Renewal Corporation previously sampled J.C. Boyle Reservoir in late March 2019, and mid-May 2020 and captured the target species. These previous efforts likely bracketed the primary listed suckers spawning periods.

The fall salvage period is less dependent on water temperature-related sucker behavior and habitat use, although suckers inhabited deeper habitats in a study conducted on Upper Klamath Lake (Reiser et al. 2001). The fall salvage period takes place after water temperatures decrease to less than 16 °C and reservoir microsystin levels decline to concentrations below human health advisory levels. A fall salvage period would occur between late October and early November. The Renewal Corporation previously sampled J.C. Boyle Reservoir in early November 2018 and 2019 and captured the target species.

4.4 Salvage Locations

J.C. Boyle Reservoir salvage locations will correspond to the previous sampling locations and include shallower habitats associated with reservoir margins, and deeper habitats associated

with the historical Klamath River channel. During a spring salvage, field crews would target the upper 0.25 miles of the J.C. Boyle Reservoir where the Klamath River joins the reservoir. Similar reservoir locations would be targeted in a fall salvage period.

4.5 Salvage Methods

The Renewal Corporation will employ similar methods for processing salvaged suckers as were used during the sucker sampling effort. The Renewal Corporation will use trammel nets and boat electrofishing and will fish largely at night, although daytime boat electrofishing may also be used. Two boats will each deploy four trammel nets in J.C. Boyle Reservoir. Fewer nets will be deployed in J.C. Boyle Reservoir compared to Copco No. 1 Reservoir and Iron Gate Reservoir due to the abundant bycatch in J.C. Boyle Reservoir. Additional trammel nets with larger mesh openings will also be used to reduce bycatch and make fishing for the listed suckers more efficient.

The Renewal Corporation will set trammel nets sequentially and fish the nets for 2-3 hours in previously sampled reservoir habitats. Four net sets will be completed per night depending on catch efficiency and bycatch. Electrofishing will focus on shallow reservoir areas and the upstream end of J.C. Boyle Reservoir. Tangle nets may also be used in riverine reaches if congregations of shortnose suckers are encountered during electrofishing. Captured Lost River and shortnose suckers will be identified to species and sex, measured, fin clipped, photographed, and PIT tagged. Each sucker will also be scanned to detect existing PIT tags. Salvaged suckers will be held in aerated live wells and periodically transferred to net pens near boat access sites where suckers will be held until transport.

The Renewal Corporation may also use tangle nets or a resistance board weir to salvage suckers from the upstream extent of J.C. Boyle Reservoir, or in flowing portions of the Klamath River at the head end of J.C. Boyle Reservoir.

The Renewal Corporation will acquire current information on water quality to better anticipate water quality conditions in J.C. Boyle Reservoir, the Klamath National Fish Hatchery, the Klamath Tribes' sucker rearing facility, Upper Klamath Lake, and Tule Lake Sump 1A as needed. The information will be used to understand water quality conditions in the salvage and translocation sites. Water quality constituents of interest include water temperature, dissolved oxygen, salinity concentrations, and pH levels. Acquiring this information in advance of the salvage will be necessary to condition the water in the transport live well and to plan the acclimation period at the release locations.

4.6 Transport and Translocation Methods

The Renewal Corporation will remove suckers after the third day, fifth day, and seventh day of salvage, and transport them to the translocation sites. The Renewal Corporation will remove suckers from net pens and scan them for PIT tag identification prior to loading fish into aerated live wells (approximately 200-300 gallons) for transport. The Renewal Corporation will coordinate with USFWS, CDFW, ODFW, U.S. Bureau of Reclamation, The Klamath Tribes, and the Yurok Tribe to access transport vehicles. Large live wells will be fiberglass, steel, or

polyethylene and will be sized to fit in the open bed of a standard pickup truck or on a trailer. Live wells will be baffled to limit sloshing during transport. The live well will be filled to 75% capacity (about 150 gallons) with J.C. Boyle Reservoir water in the vicinity of the net pens. Transported fish will be large (>300 mm) and care will be required to minimize overstocking the live well. Densities should be the equivalent of approximately 1 lb of fish per gallon of water. Based on an average 3.0 lb weight, no more than 50 shortnose suckers would be transported at one time. The transport density will be adjusted as conditions and sucker response dictate. The following methods will be used to prepare the transport tanks (BOR, 2008; USFWS, unpublished report).

- Live wells are to be disinfected using a Virkon (1.3 oz/gallon) solution or other approved disinfectant. Live wells are to be disinfected daily and thoroughly rinsed following disinfection.
- Water will be pumped from J.C. Boyle Reservoir into the live well using a portable pump. A handheld YSI meter will be used to measure water quality constituents including water temperature, dissolved oxygen, salinity, and pH prior to adding suckers to the live well. The live well will be refilled at J.C. Boyle Reservoir prior to each transport.
- Water temperature will be monitored in the live well during transport at least during initial transport runs. Water temperature in the live well should remain within 4 °C of the initial ambient water temperature during the transport. Water temperature will be modified by chillers or heaters.
- Dissolved oxygen concentrations will be monitored in the live well during transport at least during initial transport runs. Dissolved oxygen levels should be maintained at approximately 100 percent saturation. If needed, a portable aeration system will be installed to maintain dissolved oxygen levels at approximately 100 percent saturation.
- Salinity levels should be approximately 0.5%. Coarse ground sodium chloride will be added in small increments to the live well until a 0.5% salinity level is achieved. Since Tule Lake Sump 1A is more saline than the Klamath River, additional ground sodium chloride may need to be added to the live well. Additional coordination with USFWS will be completed prior to the salvage.
- To acclimate suckers at the receiving waterbody, reservoir water in the live well will be replaced with recipient waterbody water over the course of at least an hour. Approximately a quarter to a half of the reservoir water will be drained from the live well and replaced with recipient waterbody water that will be pumped into the live well. Tempering the live well will be important for acclimating the suckers to the recipient waterbody's water quality constituents. Live well water will be drained away from Tule Lake Sump 1A to avoid discharging salvage reservoir water directly to Tule Lake Sump 1A. Other live well discharge strategies will be coordinated with USFWS. Water quality constituents should be consistently measured during the tempering process. USFWS suggests the target suckers can tolerate a 1 °C temperature change every 15 minutes and temperature changes should not exceed 4 °C per 15 minutes. Releasing fish into the recipient waterbody after dusk is recommended to maximize survival (M. Yost,

USFWS, personal communication), although this may require additional personnel to achieve.

4.6.1 Translocation Sites

The Klamath National Fish Hatchery and the Klamath Tribes sucker rearing ponds will be the translocation sites for suckers salvaged from J.C. Boyle Reservoir. Salvaged suckers will first be taken to the Klamath National Fish Hatchery where they will be isolated and receive an external parasite treatment before they are integrated into hatchery groups. The Klamath National Fish Hatchery has capacity for approximately 100 salvaged adult suckers. USFWS has requested a ratio between 60:40 and 70:30 shortnose suckers to Lost River suckers be provided to the hatchery, of which, half of the salvaged shortnose suckers originate in J.C. Boyle Reservoir and half originate in Copco No. and/or Iron Gate reservoirs. All Lost River suckers are anticipated to come from J.C. Boyle Reservoir as the species is in low numbers in Copco No. 1 and Iron Gate reservoirs. The Renewal Corporation therefore anticipates providing between 30 and 35 shortnose suckers and 30 to 40 Lost River suckers from J.C. Boyle Reservoir to the hatchery.

The Renewal Corporation will translocate salvaged Lost River and shortnose suckers exceeding the Klamath National Fish Hatchery's capacity, to the Klamath Tribes' sucker rearing facility east of Chiloquin, Oregon. The Klamath Tribes' rearing facility currently includes two ponds and several more ponds are planned for development in 2021-2022. The capacity for adult salvaged suckers is unknown at this time, but the Klamath Tribes could provide capacity for up to 2,000 adult suckers. Suckers delivered to the Klamath Tribes' ponds will be placed in separate ponds including one pond for Lost River suckers, one pond for shortnose suckers, and one pond for suckers that are not easily identifiable. Translocated suckers will be genetically tested and fish health investigations may be conducted by the Klamath Tribes, ODFW, or USFWS before fish are released in the future. Rearing pond effluent will be discharged to a dry basin so that no pond effluent will discharge to the Sprague River. Delivered suckers will also receive an external parasite treatment before release into the rearing ponds. The Klamath Tribes anticipate holding translocated suckers for up to three to five years before suckers are released either into Upper Klamath Lake or another location to be determined in the future.

Other translocation sites may be identified based on further planning and agreement between USFWS, ODFW, CDFW, and the Renewal Corporation.

4.6.2 Transport Route

Travel from J.C. Boyle Reservoir to the Klamath National Fish Hatchery is approximately 22 miles. Directions include traveling east on Highway 166 to Keno (6 miles), turning south on the Keno-Worden Road (7 miles), turning east on Township Road (8 miles), then traveling north on Lower Klamath Lake Road to Klamath National Fish Hatchery (1 mile).

Travel from J.C. Boyle Reservoir to the Klamath Tribes sucker rearing facility is approximately 50 miles. Directions include traveling east on Highway 66 to Highway 97 (15 miles), turning north on Highway 97 and continuing to Chiloquin (28.3 miles), continue east on the Sprague River Highway to the Klamath Tribes' sucker rearing facility (5.1 miles).

4.7 Reporting

The Renewal Corporation will process sucker salvage data including information on the salvaged and transported suckers and water quality constituents. Sucker genetic material will be linked to the individual unique PIT tag identification numbers. The Renewal Corporation will provide USFWS, ODFW, USGS, and the Klamath Tribes with an electronic copy of the Microsoft Excel data workbook and photographs. The genetic material will be provided to USFWS for sucker genetics processing. Summary reports will be submitted within three months of completing the salvage. The Renewal Corporation's sucker salvage responsibilities end once suckers are released at the prescribed translocation sites. USFWS and ODFW will maintain management responsibilities for Lost River and shortnose suckers through and after the salvage effort.

4.8 Salvage Plan Summary

The Renewal Corporation completed four sampling efforts to gain a better understanding of current sucker demographics and population sizes in the project reservoirs. The Renewal Corporation will conduct 7 days of salvage and translocation of listed suckers from J.C. Boyle Reservoir. Based on catch efficiencies from the sampling effort, the Renewal Corporation anticipates relocating up to 300 listed suckers from J.C. Boyle Reservoir. The Renewal Corporation will continue to coordinate sucker salvage planning with USFWS, ODFW, and the Klamath Tribes.

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Appendix G

Consultation Record

Consultation Record

Aquatic Resources Management Plan				
Sub-Plan	**Agency**	**Date of Agency Plan Submittal**	**Agency Comments Received Date**	**Date of Call to Resolve Agency Comments**
Spawning Habitat Availability Report and Plan	National Marine Fisheries Service	January 22, 2021	February 16, 2021	Pending
	United States Fish and Wildlife Service	January 22, 2021	February 5, 2021	Pending
	California Department of Fish and Wildlife	January 22, 2021	February 3, 2021	Pending
	California State Water Resources Control Board	January 22, 2021	Pending	Pending
	Oregon Department of Fish and Wildlife	January 22, 2021	February 6, 2021	Pending
	Oregon Department of Environmental Quality	January 22, 2021	Pending	Pending
	Yurok Tribe	January 22, 2021	Pending	Pending
	Karuk Tribe	January 22, 2021	Pending	Pending
California AR-6 Adaptive Management Plan (Suckers)	United States Fish and Wildlife Service	January 22, 2021	Pending	Pending
	California State Water Resources Control Board	January 22, 2021	Pending	Pending
	California North Coast Regional Water Quality Control Board	January 22, 2021	Pending	Pending
	California Department of Fish and Wildlife	January 22, 2021	Pending	Pending

Aquatic Resources Management Plan				
Sub-Plan	**Agency**	**Date of Agency Plan Submittal**	**Agency Comments Received Date**	**Date of Call to Resolve Agency Comments**
	California Department of Water Resources	January 22, 2021	Pending	Pending
	Oregon Department of Fish and Wildlife	January 22, 2021	Pending	Pending
	Oregon Department of Environmental Quality	January 22, 2021	Pending	Pending
	Yurok Tribe	January 22, 2021	Pending	Pending
	Karuk Tribe	January 22, 2021	Pending	Pending
Oregon AR-6 Adaptive Management Plan (Suckers)	United States Fish and Wildlife Service	January 22, 2021	Pending	Pending
	Oregon Department of Fish and Wildlife	January 22, 2021	Pending	Pending
	Oregon Department of Environmental Quality	January 22, 2021	Pending	Pending
Tributary-Mainstem Connectivity Plan	United States Fish and Wildlife Service	January 22, 2021	February 5, 2021	Pending
	National Marine Fisheries Service	January 22, 2021	February 4, 2021	Pending
	California State Water Resources Control Board	January 22, 2021	Pending	Pending
	California Department of Fish and Wildlife	January 22, 2021	February 5, 2021	Pending
	California North Coast Regional Water Quality Control Board	January 22, 2021	February 8, 2021	Pending

Aquatic Resources Management Plan				
Sub-Plan	**Agency**	**Date of Agency Plan Submittal**	**Agency Comments Received Date**	**Date of Call to Resolve Agency Comments**
	California Department of Water Resources	January 22, 2021	Pending	Pending
	Oregon Department of Fish and Wildlife	January 22, 2021	Pending	Pending
	Oregon Department of Environmental Quality	January 22, 2021	February 4, 2021	Pending
	Yurok Tribe	January 22, 2021	Pending	Pending
	Karuk Tribe	January 22, 2021	Pending	Pending
Fish Presence Monitoring Plan	United States Fish and Wildlife Service	January 22, 2021	February 5, 2021	Pending
	National Marine Fisheries Service	January 22, 2021	February 11, 2021	Pending
	California State Water Resources Control Board	January 22, 2021	Pending	Pending
	California Department of Fish and Wildlife	January 22, 2021	February 5, 2021	Pending
	California Department of Water Resources	January 22, 2021	Pending	Pending
	California North Coast Regional Water Quality Control Board	January 22, 2021	February 8, 2021	Pending
	Yurok Tribe	January 22, 2021	Pending	Pending
	Karuk Tribe	January 22, 2021	Pending	Pending

Aquatic Resources Management Plan				
Sub-Plan	**Agency**	**Date of Agency Plan Submittal**	**Agency Comments Received Date**	**Date of Call to Resolve Agency Comments**
Juvenile Salmonids and Pacific Lamprey Rescue and Relocation Plan	United States Fish and Wildlife Service	January 22, 2021	February 5, 2021	Pending
	National Marine Fisheries Service	January 22, 2021	February 4, 2021	Pending
	California State Water Resources Control Board	January 22, 2021	Pending	Pending
	California Department of Fish and Wildlife	January 22, 2021	February 5, 2021	Pending
	California North Coast Regional Water Quality Control Board	January 22, 2021	February 8, 2021	Pending
	California Department of Water Resources	January 22, 2021	Pending	Pending
	Yurok Tribe	January 22, 2021	Pending	Pending
	Karuk Tribe	January 22, 2021	Pending	Pending