Clear Creek Technical Team
Summary of Activities for Water Year 2020

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Acronyms and Abbreviations

BLM	Bureau of Land Management
BO	Biological Opinion
CCV	California Central Valley
CCRP	Clear Creek Restoration Program
CCTT	Clear Creek Technical Team
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
CLTO	Coordinated Long-term Operation
cfs	Cubic feet per second
CV	Central Valley
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
ESA	Endangered Species Act
LCCFRP	Lower Clear Creek Floodway Restoration Project
LTO	Long-Term Operations
NMFS	National Marine Fisheries Service
NPS	National Park Service
PA	Proposed Action
Reclamation	U.S. Bureau of Reclamation
RM	River Mile
RPA	Reasonable and Prudent Alternative
RWQCB	Regional Water Quality Control Board
SWP	State Water Project
USFWS	U.S. Fish and Wildlife Service
WSRCD	Western Shasta Resource Conservation District

CHAPTER 1. BACKGROUND

Clear Creek and the Technical Team

Since 1995, the Central Valley Project Improvement Act (CVPIA) and the CALFED Bay-Delta Program have undertaken anadromous salmonid habitat and flow restoration actions in Clear Creek. These actions have re-established Central Valley (CV) spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) and California Central Valley (CCV) steelhead (*O. mykiss*) within the Clear Creek watershed (Figure 1). The Clear Creek Technical Team (CCTT) has been working together since 1996 to facilitate implementation of these CVPIA and CALFED restoration actions. Most issues and projects which the CCTT has facilitated involved physical habitat restoration of Lower Clear Creek. From 2009-2019, the CCTT-facilitated implementation of management topics has included National Marine Fisheries Service's (NMFS) 2009 Coordinated Long-Term Operations (CLTO) biological opinion (BO) Reasonable and Prudent Alternative (RPA) actions, including flow and temperature management on Clear Creek. As of Water Year 2020 (WY2020; October 1, 2019 – September 30, 2020), the CCTT has continued to support Clear Creek management, but now under the 2020 Record of Decision (ROD) for the Long-term Operations (LTO) of the CVP and SWP Biological Assessment and corresponding NMFS Biological Opinion (WCRO-2016-00069).

Since being established, the Clear Creek Restoration Program identified and implemented a variety of actions to improve salmon and steelhead habitat and the ecosystem on which these species depend. Past and continued actions include increased minimum flows, summer and fall water temperature control through flow management, removal of a low-head dam, large-scale stream and floodplain restoration, gravel augmentation, spring and early summer pulse flows, and erosion control. The effects of these actions have been positive and have resulted in:

- a nearly four-fold increase in escapement of fall-run Chinook Salmon to Clear Creek (population estimate average = 1,749 from 1967 to 1991, and 7,289 from 1992-2019);
- re-established use of Clear Creek by Federal Endangered Species Act (ESA) listed threatened CV spring-run Chinook Salmon and threatened CCV steelhead;
- re-initiated sediment transport and stream channel movement processes, in some reaches, which help create and maintain fish habitat; and
- increases in the amount of salmonid spawning habitat.

Active Members in Water Year 2020

Kristin Begun, NMFS
Tricia Bratcher, CDFW
Matt Brown, USFWS
Leslie Bryan, Redding Electric Utility
Charles Chamberlain, USFWS
Alicia Herrera, Point Blue
George Low, RWQCB
Mike Memeo, DWR
Neal McIntosh, NMFS
Ross Perry, WSRCD
Derek Rupert, Reclamation
Russ Weatherbee, NPS
Leana Weissberg, BLM
Paul Zedonis, Reclamation

Additional people from various agencies and entities participate on a less frequent basis (e.g. Clear Creek Community Service District, Redding Rancheria, Horse Town-Clear Creek Preserve, Sacramento Municipal Utilities District, McBain and Associates, Graham Matthews and Associates, and U.S. Army Corps of Engineers).

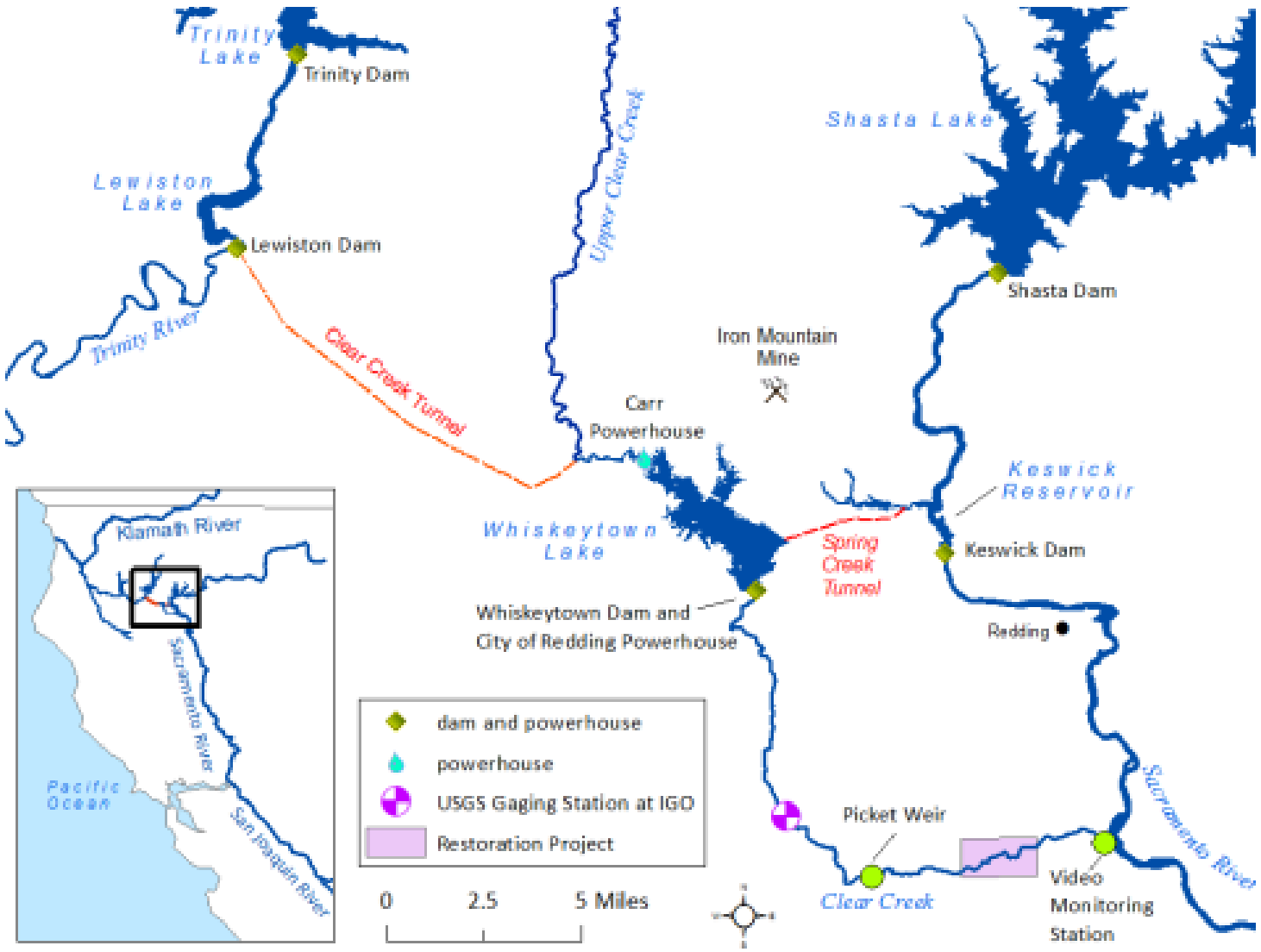

Figure 1. Location of Lower Clear Creek in Northern California, showing Trinity, Whiskeytown, and Shasta reservoirs and related CVP facilities.

List of Clear Creek Technical Team Discussions

The following CCTT meetings, with general list of discussions, occurred in WY 2020 (and since the 2019 CCTT Annual Report). The individual CCTT meeting notes provide further details.

December 12, 2019

- Lower Clear Creek Floodway Restoration Project (LCCFRP) Phase 3C (P3C) updates
    - Permit Status update
    - Showed draft 2019-2020 schedule
- CVPIA Charters.
    - Charters submitted in Spring 2019
    - Annual CVPIA work plan published for FY20
    - Not 100%, but we are confident that 2020 gravel augmentation and program management charters will be funded, uncertain for others
- Wetlands Delineation from EnviroPlan Partners, Inc.
    - Presentation on the results of the wetlands delineation
    - Area covered LCCFRP (w/o P3C), Reading Bar area, and Old Mill sites.
    - Data to be used in 3B Completion Project
    - Much lower wetlands in areas than expected
- DWR Fish Restoration Project Review
    - DWR gave a review of the 2019 restoration project on the Sacramento River
    - Data displayed that shows changes in fish habitat quantity
    - Sites included Market Street, Keswick, Rio Vista, Reading Island, and Anderson River Park
- Clear Creek Steelhead Monitoring Review
    - CDFW gave presentation on tributary monitoring
    - Scale analysis and acoustic tagging data discussed
    - Deer and Mill Creek's smolt data shown
- Review of 2019 Long-term Operations of the CVP and SWP Biological Assessment; elements relevant to Clear Creek include:
    - Water temperature management
    - Flow management
    - Spring pulse flows
    - Channel maintenance flows (new)
    - Restoration programs
- Gravel augmentation planning for 2020
    - Suggestion for implementation at the following sites:
        - Whiskeytown Dam
        - Reading Bar
        - 2A/Gold Dredge
        - Placer Bridge
        - Clear Creek Road Bridge
    - Permitting notes discussed
    - Photos of current conditions shown
- General Update
    - Moderate run of fall-run Chinook Salmon expected (~5,000 fish)
    - 58 spring-run Chinook Salmon redds counted in 2019
    - USFWS estimates 30% of Chinook upstream of the Red Bluff diversion dam were attributed to Clear Creek

- Carr Fire Update
    - CDFW presented overview of monitoring efforts post-Carr Fire

March 19, 2020

- CCTT moved to online meeting application due to COVID-19 pandemic
- Paige Bar Gravel Augmentation Monitoring
    - CDFW presented data on the 2018 project at Paige Bar
    - Two hydraulic models were built to evaluate pre- and post-project conditions
    - At 200 cfs, the project increased:
        - Spring-run fry habitat by 62%
        - Steelhead fry habitat by 49%
        - Spring-run and steelhead juvenile habitat by 14%
    - Flows above 500 cfs saw a decrease in habitat, as the floodplain was already inundated at a lower flow
- Clear Creek Flow Pulses
    - USFWS provided update on flow planning
    - No channel maintenance flow, as a Dry year is expected
    - WY2020 spring pulse flows scheduled for:
        - May 8th start, with 500 cfs peak
        - June 19th start, with 800 cfs peak
    - Snorkel surveys to occur before, between, and after
- Gravel Augmentations for 2020
    - Reclamation presented a recommendation for:
        - Guardian Rock 2,500 tons and 8 boulders
        - Clear Creek Road Bridge 1,000 tons
        - Phase 2A 5,000 tons (via 3 size stocks) and 12 large wood
- General Updates
    - USFWS
        - Surveys delayed due to COVID-19
        - Steelhead are emerging
        - Unknown how COVID-19 will impact monitoring
    - CDFW
        - CDFW captured 19 “steelhead” and tagged them with acoustic tags
        - Receiver located in Phase 3B area below Phase 3B rootwads
        - CDFW may seek other receiver sites in Clear Creek

June 18, 2020

- Lower Clear Creek Fisheries Restoration Project (LCCFRP) Phase 3C updates
    - Schedule of implementation shared
    - Biological surveys should be completed by June 22
    - Mobilization on July 1
    - Still need Clear Water Act Section 401 permit
    - Construction should be completed in late-September
- Pre-augmentation modeling of the Phase 2A/Gold Dredge site
    - CDFW used drone data to build hydraulic model of the site and maximum gravel quantities of the 5 proposed transverse bars
    - Model showed decreased floodplain inundation thresholds
    - CDFW suggested looking at creating more side channels rather than proposed action

    - Discussion about what flow to design the project to in terms of when water would start to enter existing floodplain
        - Should we target a flow higher than 300 cfs?
        - Could the project increase stranding?
- LCCFRP Phase 3B completion
    - Wetlands delineation contract awarded
    - Discussed next steps and possible design features
- Birds of Clear Creek
    - Point Blue Conservation Science presented previous bird monitoring completed on Clear Creek
    - The response to restoration actions presented
    - Key findings
        - Lack of understory and other suitable substrates limit use of restoration sites
        - Remnant vegetation/forests provide vital nesting sites
        - Restoration and natural processes provide nesting habitat within 4-10 years
    - Recommendations
        - Reduce roads or vegetation gaps associated with roads
        - Increase number and size of scour channels
        - Promote natural revegetation
        - Encouraging channel migration will maintain some level of early successional vegetation
        - Increase understory foliage by planting herbaceous and shrubby plants were planted trees have developed
- Gravel augmentations
    - Reclamation provided an overview of upcoming augmentations
    - Reclamation's Denver Technical Service Center to provide additional analysis in coming years
- Freshwater habitat of spring-run Chinook Salmon and steelhead
    - NMFS presented information
    - Historical overview of independent population
        - 19 spring-run Chinook Salmon (now 3)
        - 81 steelhead (now 24)
    - Key threats
        - Dams and water diversions
        - In-river predation
        - Climate change
        - Habitat loss and fragmentation
        - Commercial fishing
        - Water quality
    - Stressors in Clear Creek
        - Lack of spawning habitat
        - Spring-run/fall-run hybridization
        - Lack of data
    - Clear Creek restoration efforts do address threats and promote recovery
- Phase 3B Completion
    - Some aspects of 3B were not completed due to 2008 CA bond crisis
    - CVPIA funding available

    - Suggestion that old irrigation be removed
- General Updates
    - USFWS
        - Monitoring largely canceled
        - Hopeful to complete spawning surveys
        - Hopeful to complete Phase 3C efforts
        - Deeper thermocline developing in Whiskeytown Dam, may have less cold water pool

September 17, 2020

- LCCFRP Phase 3C Updates
    - Reclamation and Yurok Tribe Design Team review P3C progress
    - Clay layer causing blue-colored turbidity slowed progress
    - Fish rescue efforts occurred in old channel and pond area
- Clear Creek water management
    - Reviewed flow management actions to be implemented by Reclamation
        - 150-200 cfs base flows
        - Temperature management
- Gravel augmentation post-project overview
    - Reclamation showed information on 2020 augmentation completed
    - Guardian Rock
        - 2,505 tons placed as lateral berm
        - 8 boulders placed in two clusters
        - Site requires high flows to see positive change
    - Clear Creek Road Bridge
        - 1,006 tons placed as talus cone
        - High decomposed granite load upstream of site
    - 2A/Gold Dredge
        - Used only 2,896 tons of the proposed 5,000
        - Used three size stocks (large, medium, and small)
        - Place 12 pieces of large wood
            - High quality, old, dense, long, and great rootwads
            - Wood was intertwined with existing live trees/vegetation
        - Water surface elevation increased about 8-12 inches within site boundaries
        - Monitoring by CDFW showed increased fry/juvenile habitat at all modeled flows
- Discuss Phase 3B Completion Project
    - Reclamation shared info about the possible efforts that would complete tasks left undone at the end of the Phase 3B project (2008)
    - Key project items include removing old irrigation, building wetlands, revegetation, and road decommissioning
- Fisheries Monitoring
    - USFWS provided overview of recent fish monitoring
        - Potential Spawning Area Mapping (PSAM) completed
        - Spawning habitat appearing to start to recover from 2018 Carr Fire
        - August index showed 59 spring-run Chinook Salmon
- Other Notes
    - Reclamation to give tour of Phase 3C on Oct 13

CHAPTER 2. CLEAR CREEK MANAGEMENT ACTIONS

Summary of Actions addressed in WY2020

	Management Action Item	Progress in WY2020
1.	Minimum Base Flows	Completed
2.	Thermal Stress Reduction	Implemented w/ some unavoidable excursions
3.	Spring Attraction Flows	Completed
4.	Channel Maintenance Flows	Not Completed
5.	Fish Habitat Restoration and Management ("Gravel Augmentation")	Completed
6.	Construction of the Phase 3C Habitat Restoration Project	Completed
7.	Fish Monitoring and Operations	Completed

Implementation of Management Actions in WY 2020

The following sections highlight the management actions that occurred in Clear Creek during Water Year 2020 (WY20: October 1, 2019 – September 30, 2020). Occasionally, additional information is included that covers other water years (e.g. WY2021) for continuity, as some actions cross water years (e.g. water temperature management).

1. Minimum Base Flows

Objective: *Provide flows to allow for sufficient spawning, incubation, rearing, and migration for salmon and steelhead.*

Action: *"Reclamation proposes a minimum base flow in Clear Creek of 200 cfs from October through May and 150 cfs from June to September in all year types except Critical year types. In Critical years, Clear Creek base flows may be reduced below 150 cfs based on available water from Trinity Reservoir." (Section 4.10.2.4. of the PA)*

Results: In WY2020, Clear Creek's minimum base flows were met or exceeded throughout the year.

Lower Clear Creek has a relatively small watershed with few significant tributaries and is highly reliant on water releases from Whiskeytown Dam. Whiskeytown Dam can provide controlled releases of water to Clear Creek via the City of Redding powerhouse and/or the bypass. The bypass's coarse level of control makes fine-tuning difficult. As such, CVO makes coarse bypass adjustments which are often followed up by several smaller adjustments for fine-tuning of flows. There are also measurement discrepancies between the Whiskeytown Dam flow gage and the U.S. Geological Survey (USGS) Igo gage, with preference placed on the Igo gage's readings.

Uncontrolled releases can occasionally occur through the gloryhole spillway. There were no gloryhole spills in WY2020.

From October 2019 through March 2020, Whiskeytown Dam releases to Clear Creek were elevated, running at approximately 270 cfs (Figure 2). These flows were a continuation from the adjustments required to meet water temperature criteria in WY2019. The elevated flows were maintained to reduce the chance of redd dewatering per the request of the CCTT. Flows were finally reduced to 200 cfs on March 31, 2020, prior to the spring pulse flows.

From April through June, Whiskeytown Dam releases remained at approximately 150 to 200 cfs except during the two spring attraction pulse flows which occurred (see section 3. Spring Attraction Flows for more information).

From June through September 17, Whiskeytown Dam releases remained at approximately 150 cfs. Following September 15, the temperature criteria dropped from 60 °F to 56 °F and required an increase in flows to meet the criteria on September 17. Several flow increases, in 25 cfs increments, were made to decrease water temperatures at the Igo gage (see section 2. Water Temperature Management for more details). Flows were increased up to approximately 225 cfs. Due to concerns about diminishing cold water pool, flows were reduced back to 200 cfs base flow on October 9 (note this action occurred in WY2021).

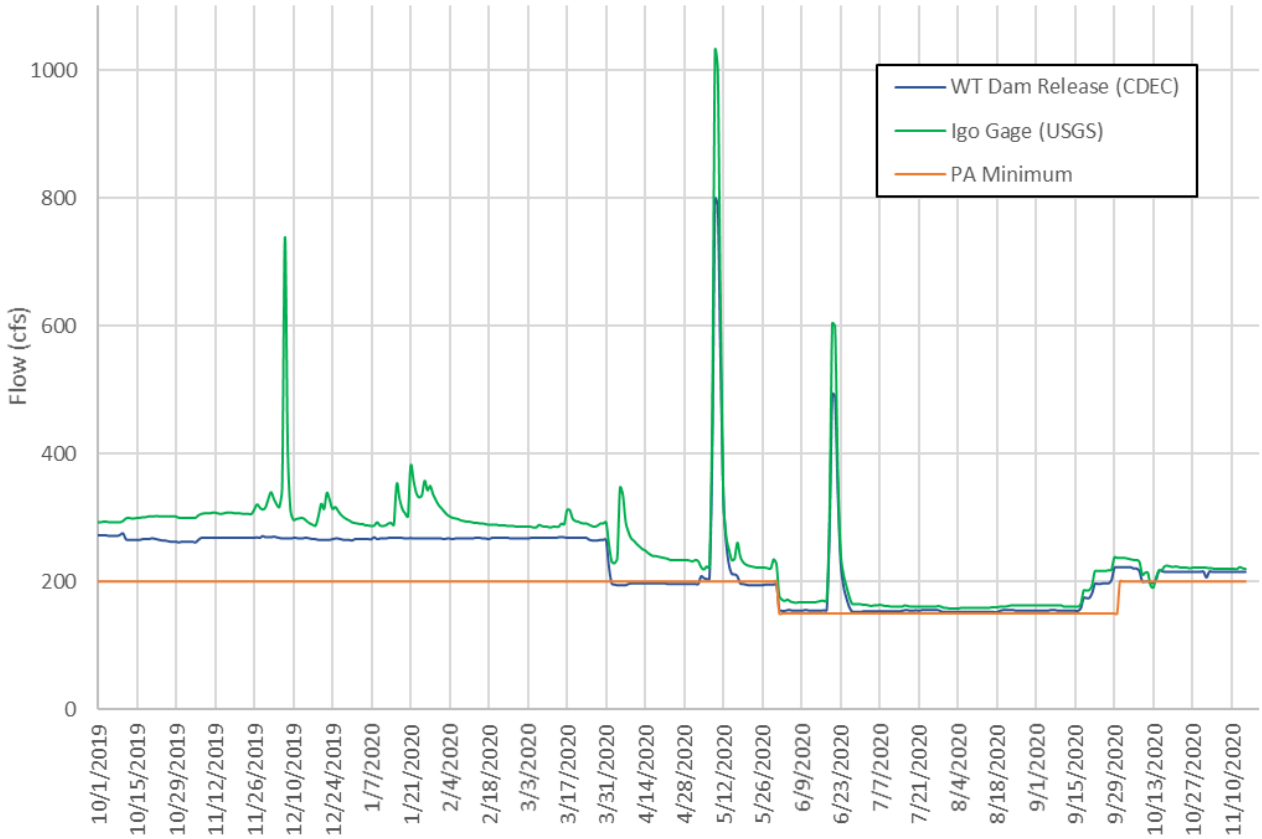

Figure 2. Flow on Clear Creek measured at Whiskeytown Dam (green line) and at Igo gage (USGS 11372000; Blue line). The Proposed Action's base flow minimums are shown as orange line.

2. Water Temperature Management

Objective: *To reduce thermal stress to over-summering steelhead and spring-run Chinook Salmon during holding, spawning, and embryo incubation.*

Action: "*Reclamation proposes to manage Whiskeytown releases to meet a daily average water temperature of:*

(1) 60°F at the Igo gage from June 1 through September 15; and

(2) 56°F at the Igo gage from September 16 to October 31.

Reclamation may not be able to meet these temperatures in Critical or Dry water year types. In these years, Reclamation will operate to as close to these temperatures to the extent possible."

Results: In WY2020, water temperature criteria were met at Igo gage with varying compliance. WY2020 was a "dry" year and this coupled with hot and dry environmental conditions making water temperature management difficult. Considering these difficulties, water temperatures over the management season (June 1-October 31) remained below or near the thresholds.

Monitoring water temperatures on Clear Creek was difficult in WY2020 due to several reasons. In normal years, mean daily water temperatures are telemetered to USGS's online database and can be monitored in real-time. On July 26, the Igo temperature gage was vandalized, removing the real-time water temperature monitoring capabilities. The water temperature gage was not repaired until October 21, 2020, due to a variety of reasons, including downed trees, COVID-19 lockdown, and the Zogg wildfire. During the time that the gage's telemetering was down, Reclamation and USFWS staff made almost weekly visits to the Igo gage location to manually download raw temperature logger data. This data was then sent to the CCTT and Reclamation's Central Valley Office (CVO) for review and adjustments as necessary.

The Oak Bottom Temperature Control Curtain remained in place and operational during WY2020. This curtain discourages the mixing of cold water coming from the Carr Tunnels with the warm epilimnion of the Whiskeytown reservoir, helping to extend the cold water pool resource through the summer months.

Mean daily water temperatures at Igo gage remained below 60 °F for 100% of the 107-day adult spring-run holding period (June 1 – September 15; Table 1 and Figure 3). The 60 °F criterion is hypothesized to work in conjunction with spring pulse flows to exert thermal gradients in stream temperatures and encourage the migration of spring-run Chinook Salmon. The relatively large amount of water diverted from the Trinity River from the Carr Tunnels helped maintain the cold water pool in Whiskeytown Reservoir.

The temperature criteria transitioned from 60 °F to 56 °F for the spawning/egg incubation period of September 16 to October 31. A Whiskeytown Dam gate adjustment was made on September 15 to withdraw from the lower guard gate in order to provide the coldest possible water from Whiskeytown Reservoir. However, the gate adjustment was insufficient to meet the 56 °F criterion temperature at Igo gage. Release from Whiskeytown Dam was subsequently increased from 150 to 175 cfs on September 17, but mean daily water temperature at Igo gage remained above 56 °F. Another increase from 175 to 200 cfs was implemented on September 21. This was followed by another flow increase from 200 to 225 cfs on September 29. Dam releases remained at 225 cfs through October 8, when they were decreased back down to the 200 cfs base flow. Cooler air temperatures and thick smoke from the prominent 2020 California wildfires helped

maintain water temperatures below the 56 °F criteria for the remainder of the spawning/egg incubation period. During the spawning/incubation criteria period, mean daily water temperatures were met for 34 of 46 days (74%; Table 1 and Figure 3). All of the daily water temperature exceedances were relatively minor, with mean water temperatures within 1 °F of the 56 °F target.

Table 1. Proportion of days that water temperatures at Clear Creek IGO gage met the criteria.

Year	Holding temperature ≤60°F June 1 to Sept 15	Spawning temperature ≤56°F Sept 16 to October 31
Pre-2009 (average)	99%	93%
2009	100%	26%
2010	100%	26%
2011	100%	62%
2012	100%	64%
2013	100%	96%
2014	100%	0%
2015	100%	0%
2016	98%	15%
2017	100%	100%
2018	99%	87%
2019	98%	67%
2020	100%	74% (34 of 46 days)

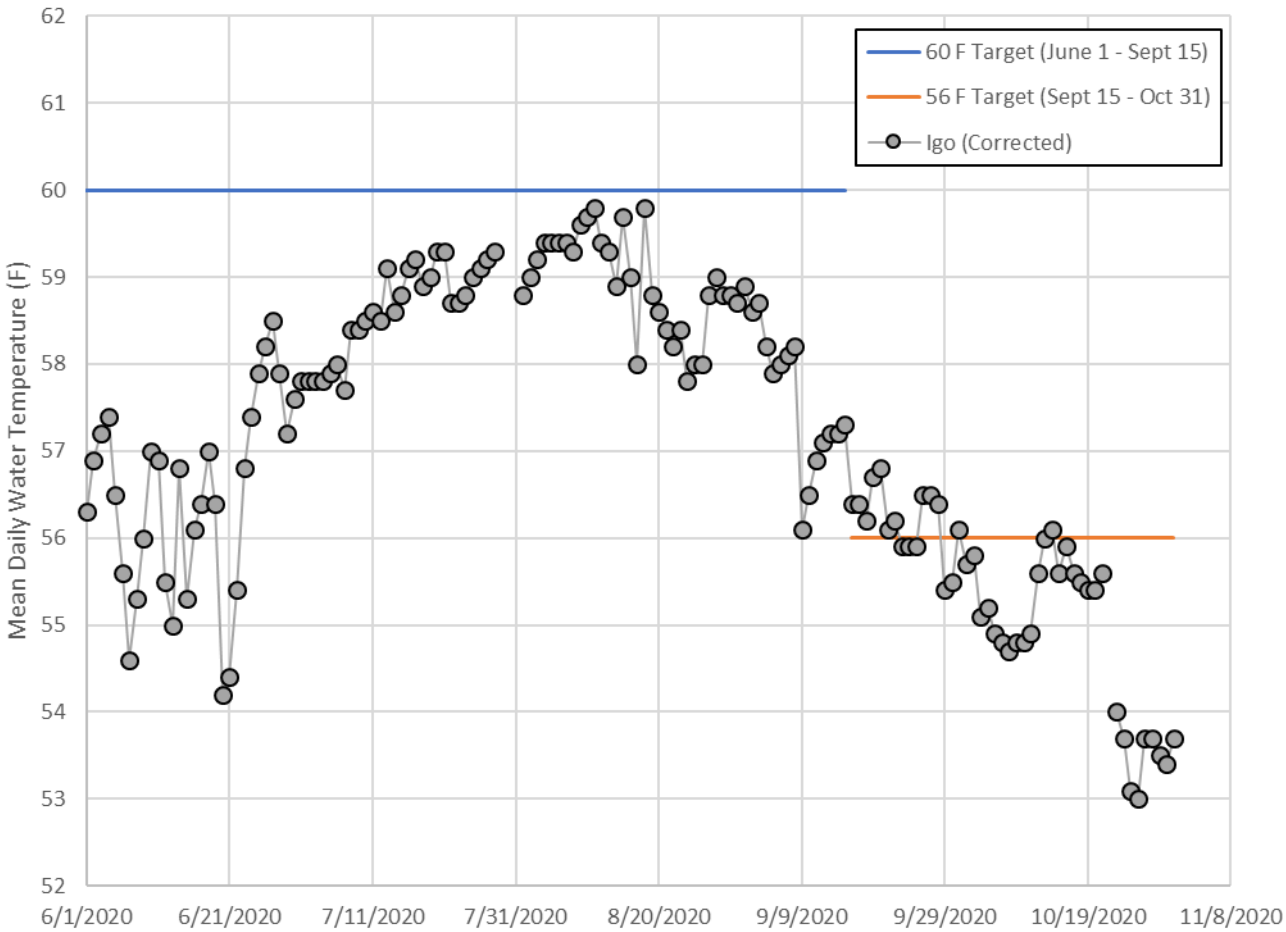

Figure 3. Water temperature at Igo in 2020 compared to the daily average temperature criteria for spring-run Chinook Salmon holding (60 °F June 1 to September 15) and spawning and incubation (56 °F September 16 to October 31). This data spans water years.

3. Spring Attraction Flows

Objective: *Encourage spring-run Chinook Salmon to migrate to upstream Clear Creek habitats for holding and spawning.*

Action: *"For spring attraction flows, Reclamation would release 10 TAF (measured at the release), with daily release up to the safe release capacity (approximately 900 cfs, depending on reservoir elevation and downstream capacity), in all year-types except for Critical year-types to be shaped by the Clear Creek Implementation Team in coordination with CVO. … In Critical [Dry] years, Reclamation would release one spring attraction flow of up to the safe release capacity (approximately 900 cfs) for up to 3 days." (Section 4.10.2.4. of the PA)*

Results: In 2020, two pulse flows were provided from Whiskeytown Dam (Table 2 & Figure 4). The timing was chosen to coincide with previously observed peak adult spring-run Chinook Salmon migration and replicate the spring-run Chinook Salmon attraction success observed during past pulse flows. Video monitoring results of previous years have suggested that spring-run Chinook Salmon passage into Clear Creek is greater in the earlier portion of prolonged pulse flows, and shorter duration pulses may provide the same attraction benefit and use less water.

Table 2. 2020 Clear Creek pulse flow timing, duration, and magnitude.

Date (includes ramping)	**Peak**
May 8 – 17	800 cfs
June 19 – 27	500 cfs

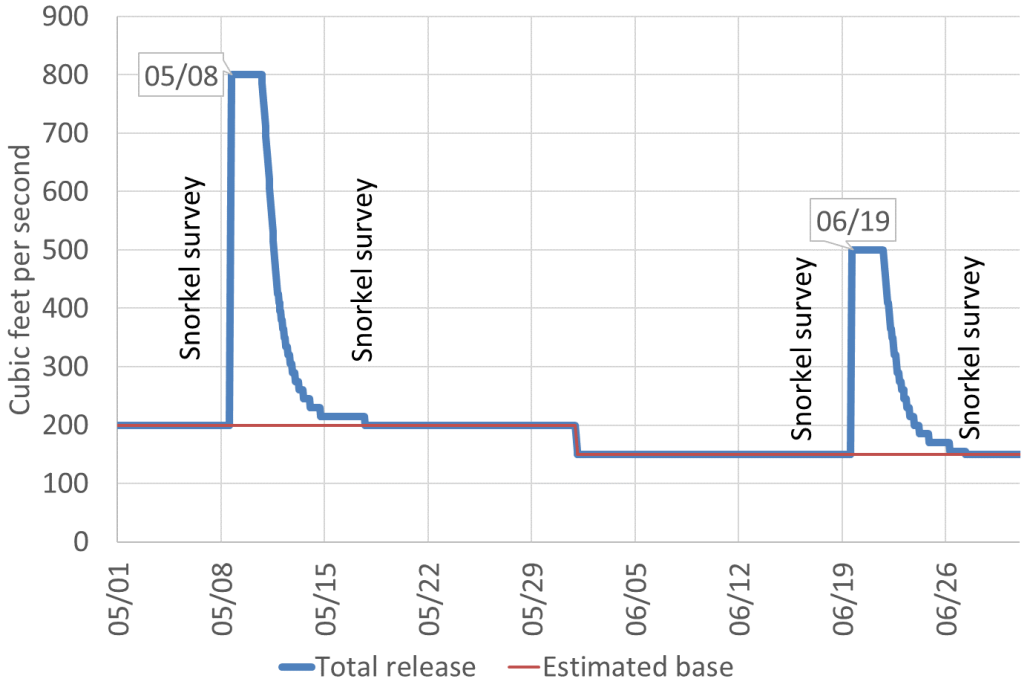

Figure 4. Proposed release schedule for 2020 spring pulse flows from Whiskeytown Dam.

Adult spring-run Chinook Salmon upstream passage into Clear Creek is monitored at a video station near the confluence with the Sacramento River. During high turbidity events when visibility on the underwater and overhead cameras is low to zero, ARIS sonar is used to record Chinook Salmon passage. Video and sonar data are being evaluated by the Red Bluff U.S. Fish & Wildlife Office (RBFWO) to characterize spring-run Chinook Salmon passage through the entire emigration period and to look for a detectable response to the spring pulse flows. Those analyses will be completed over the winter.

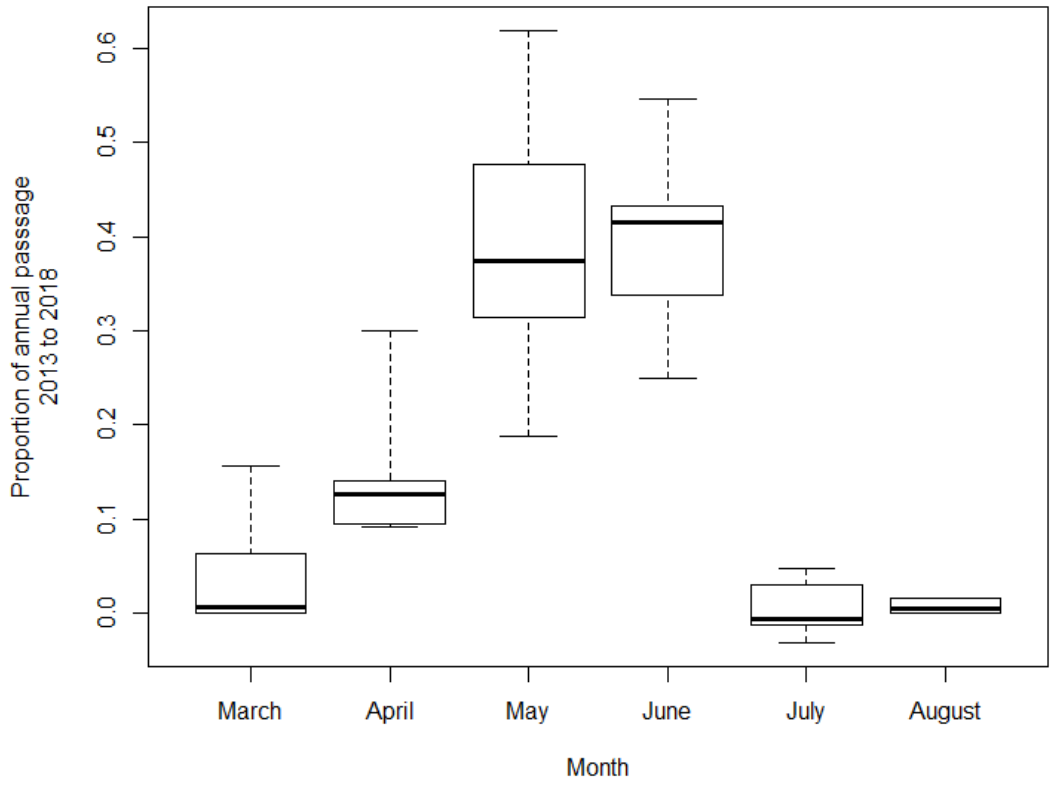

Figure 5. Proportion of annual spring-run Chinook Salmon passage by month at the Clear Creek Video Station (CCVS) from 2013 to 2018. Passage data from 2019 and 2020 are being summarized at the time of this report.

Snorkel surveys are conducted before and after each pulse flow to help determine the response of spring-run Chinook Salmon to the flow action. These surveys provide an index of abundance of adult spring-run Chinook Salmon (diver efficiencies are not determined), and spatial information on the distribution of adults within Clear Creek. Unfortunately, in 2020, the COVID-19 lockdown procedures prohibited all but the August index snorkel surveys. This marked two years in a row without snorkel surveys to assess the spring attraction flows (Carr Fire-related turbidity impacted the 2019 snorkel surveys).

The annual adult spring-run Chinook Salmon population index snorkel survey count occurs in late August just prior to spawning. In 2020, the spring-run Chinook Salmon population index was 59 (Figure 6). Of those observations, 24 (41%) occurred below the location of the segregation weir; this is the largest proportion of the August index ever observed downstream of the segregation weir (Figure 7). The segregation weir was closed on August 21 to isolate the spring-run Chinook Salmon adults upstream and limit the potential for interbreeding and redd superimposition with fall-run Chinook Salmon which typically begin to enter Clear Creek in mid to late August. The separation weir location is at about river mile 8.2.

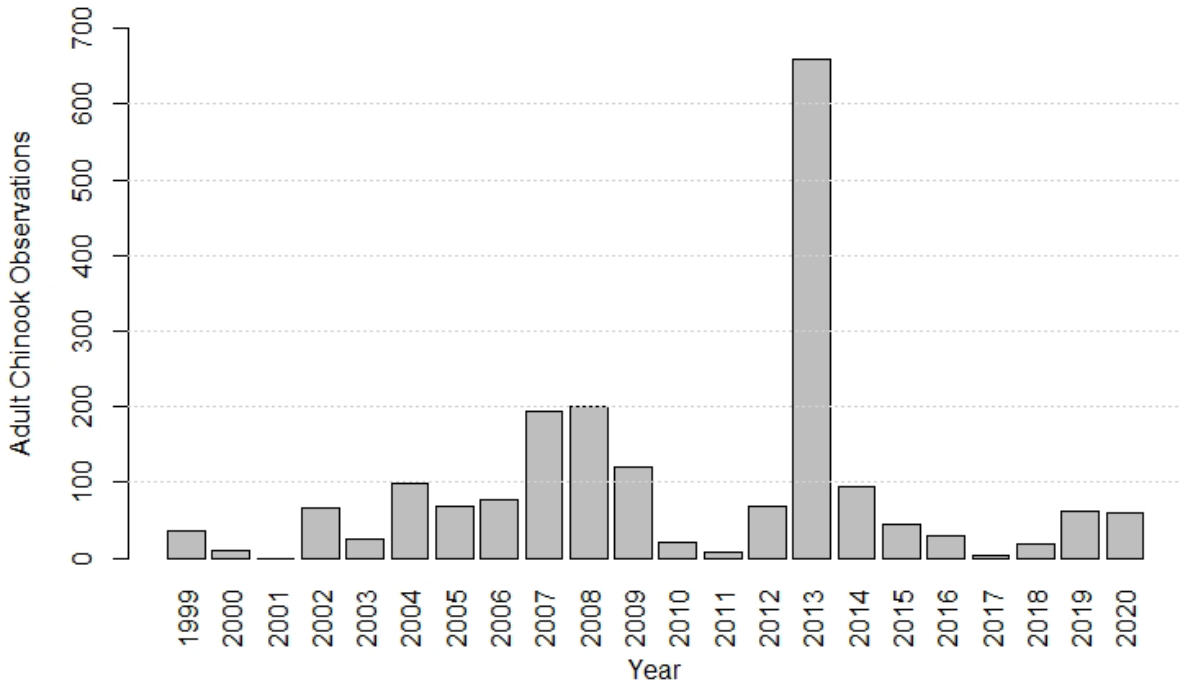

Figure 6. Clear Creek spring-run Chinook Salmon August Index 1999 to 2020.

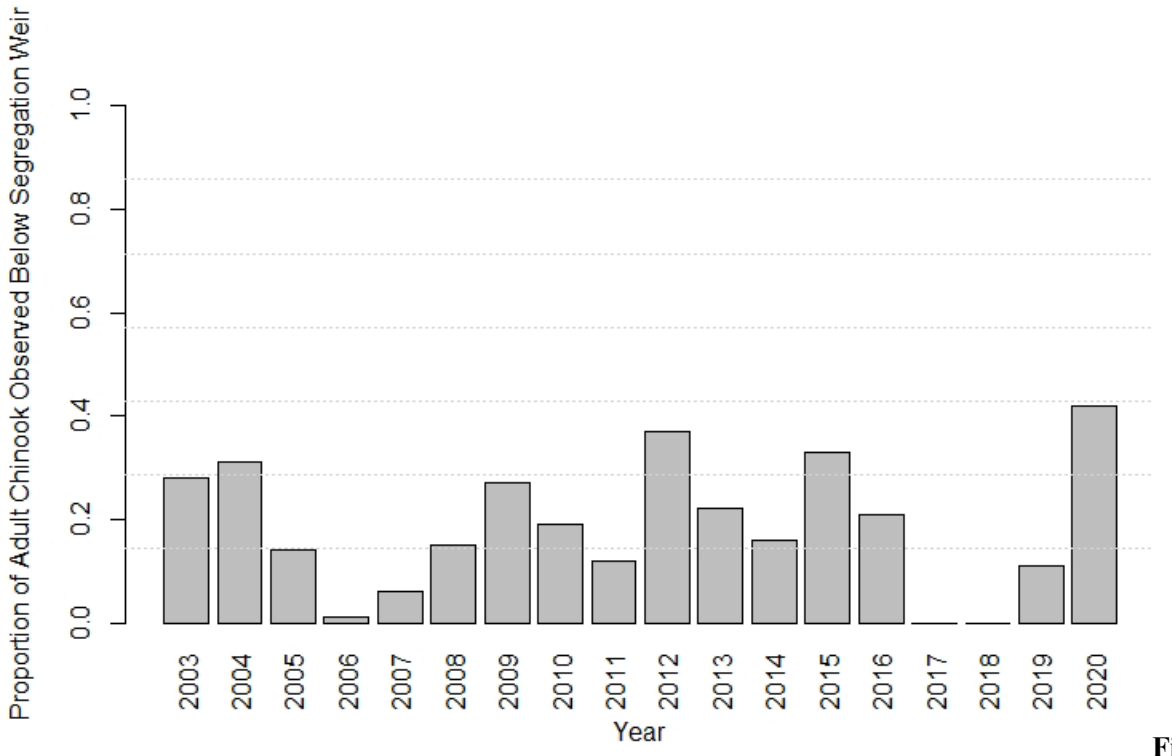

Figure 7. Proportion of adult Chinook Salmon observed below segregation weir 2003-2020.

4. Channel Maintenance Flows

Objective: *Provide pulse flows that will induce desirable geomorphic processes, which build and maintain fish habitat.*

Action: *"… Reclamation would release 10 TAF from Whiskeytown, with a daily release up to the safe release capacity, in all year-types except for Dry and Critical year-types (based on the Sacramento Valley index) to be shaped by the Clear Creek Implementation Team in coordination with CVO. Pulses would be scheduled with CVO. No channel maintenance flows would be scheduled before January 1. For each storm event that results in a Whiskeytown Gloryhole spill of at least 3,000 cfs for 3 days, Reclamation will reduce the channel maintenance flow volume for this year or the following year by 5,000 acre-feet. If two Gloryhole spills occur that meet this criterion in a year, additional channel maintenance flows would not be released in that year. In Critical years, Reclamation would release one spring attraction flow of up to the safe release capacity (approximately 900 cfs) for up to 3 days and would not release any channel maintenance flows. Reclamation could instead, or in addition, use mechanical methods to mobilize gravel or shape the channel if needed to meet biological objectives." (Section 4.10.2.4. of the PA)*

Results: No Channel Maintenance Flows were released in 2020, as it was designated a "dry" water year type. There were no Gloryhole spills in WY20.

The CCTT is developing a plan for implementation of geomorphic flows in WY21 if an appropriate water year materializes.

5. Fish Habitat Restoration and Management ("Gravel Augmentation")

Objective: *Enhance and maintain previously degraded habitat for anadromous salmonids, through the placement of desirable materials such as coarse sediment ("gravel") and large wood.*

Action: "*Reclamation and DWR propose to continue channel maintenance under the Clear Creek Restoration Program."*

Results: The gravel augmentation program on Clear Creek continues to enhance the spawning habitat available for spring- and fall-run Chinook salmon and CCV steelhead. A total of 6,407 tons of coarse sediment (e.g. gravel) were injected in July and August 2020 at three sites in Clear Creek (Table 3). Other desirable materials included in the 2020 augmentations were 12 pieces of large wood (trees) and 8 boulders (Table 3 & Figure 8), both of which were used for the first time in this long-standing project. The WY2020 augmentation increased the total amount of coarse sediment placed into Clear Creek to 191,594 tons (1996-2020).

Table 3. Clear Creek materials augmented in 2020.

Location	Coarse Sediment (tons)	Boulders	Large Wood (trees)
Guardian Rock	2,505	8	-
Clear Cr Road Bridge	1,006	-	-
2A/Gold Dredge	2,896	-	12
Total	6,407	8	12

Figure 8. A post-augmentation photograph of the 2A/Gold Dredge site, showing a gravel-augmented transverse bar and placed large wood.

The gravel augmentation program's influence on spawning habitats in Clear Creek is assessed empirically by identifying the habitat used by spring-run Chinook Salmon and steelhead for spawning, and by annually surveying the amount of habitat available for spawning by these species. Data from 2013 through 2020 show the proportional use of injected gravels vs. native gravels has increased for both spring-run Chinook Salmon and steelhead (Figure 9).

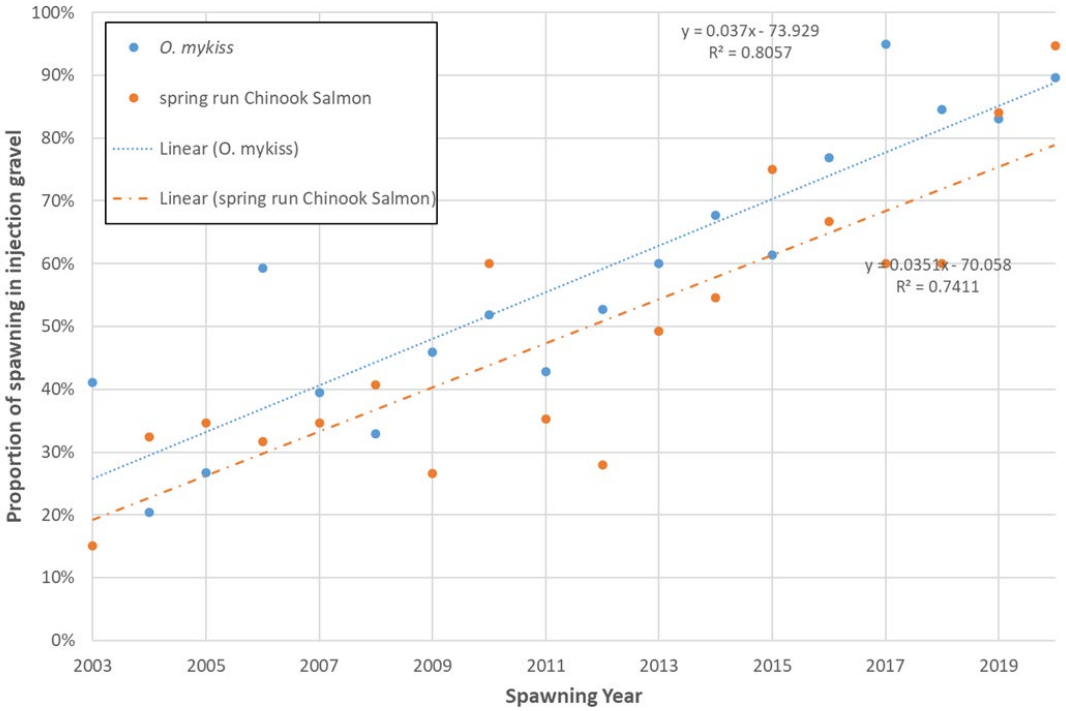

Figure 9. Annual proportion of spring-run Chinook Salmon and steelhead spawning in injection gravels, 2003-2020. Results limited to Clear Creek upstream of the spring- and fall-run Chinook Salmon segregation weir.

6. Clear Creek Phase 3C Restoration Project

Objective: *Continue the Lower Clear Creek Floodway Restoration Project by constructing the Phase 3C project.*

Action: *"Reclamation and DWR propose to continue channel maintenance under the Clear Creek Restoration Program." (Section 4.10.2.6. of the PA)*

"… The Clear Creek Restoration Program is working on restoration of a 2-mile section of Clear Creek floodplain and stream channel degraded by aggregate and gold mining, dams and diversions, …" (Section 2.3.6.1. of the PA)

Results: In WY 2020, Reclamation, in partnership with the USFWS, completed the construction phase of the Lower Clear Creek Floodplain Restoration Project (LCCFRP) – Phase 3C. Phase 3C marks the final major phase of this ambitious project and represents a culmination of two decades of work to restore more than two miles of highly degraded stream channel in Clear Creek. The Phase 3C project was funded through the CVPIA and was guided by technical input from CCTT. The Yurok Tribe helped develop the site's design and completed all the construction for the Phase 3C project. The project is on public lands administered by the Bureau of Land Management.

Initiated in 1999, the LCCFRP was divided into several manageable phases. Each phase was designed to remedy one or more negative aspects of Lower Clear Creek (which was in very poor condition) within the project boundary. Early phases filled in remnant gravel-mining pits (which stranded juvenile salmon), redirected the channel around shallow hard-pan clay layers (which inhibited salmon spawning), and lowered floodplains (which limited juvenile salmon rearing habitat), while building or restoring important riverine and riparian habitats. The overall purpose of the LCCFRP is to improve fish habitat for several runs of Chinook Salmon and steelhead and restore key ecological functions.

One of the major goals of Phase 3C was to return Clear Creek to its historic channel alignment. In its pre-construction condition, this section of Clear Creek ran through a man-made ditch that was built to divert the stream around a gravel deposit in the 1950s. Ever since, Clear Creek has been trapped within this ditch. The Phase 3C project addressed this problem by placing a large earthen plug at the top end of the ditch, allowing the stream to flow through its original channel location (Figure 10). The remaining portion of the ditch was transformed into a series of step pools, separated by beaver dam analogs, that provide additional fish habitat and will hopefully attract a colony of beavers. The newly created channel has a variety of fish-friendly habitat features such as side channels, alcoves, wood jams, and more. Pre-construction hydraulic modeling showed that the Phase 3C project would increase the amount of salmon and steelhead rearing habitat by 250% at 200 cfs within the project boundaries.

The Yurok Tribe team began major construction (e.g. earthwork) in June of 2020 and continued through early October (Figure 11). Some vegetation grubbing occurred in 2019 and revegetation efforts (e.g. irrigation) will continue into 2021 and 2022.

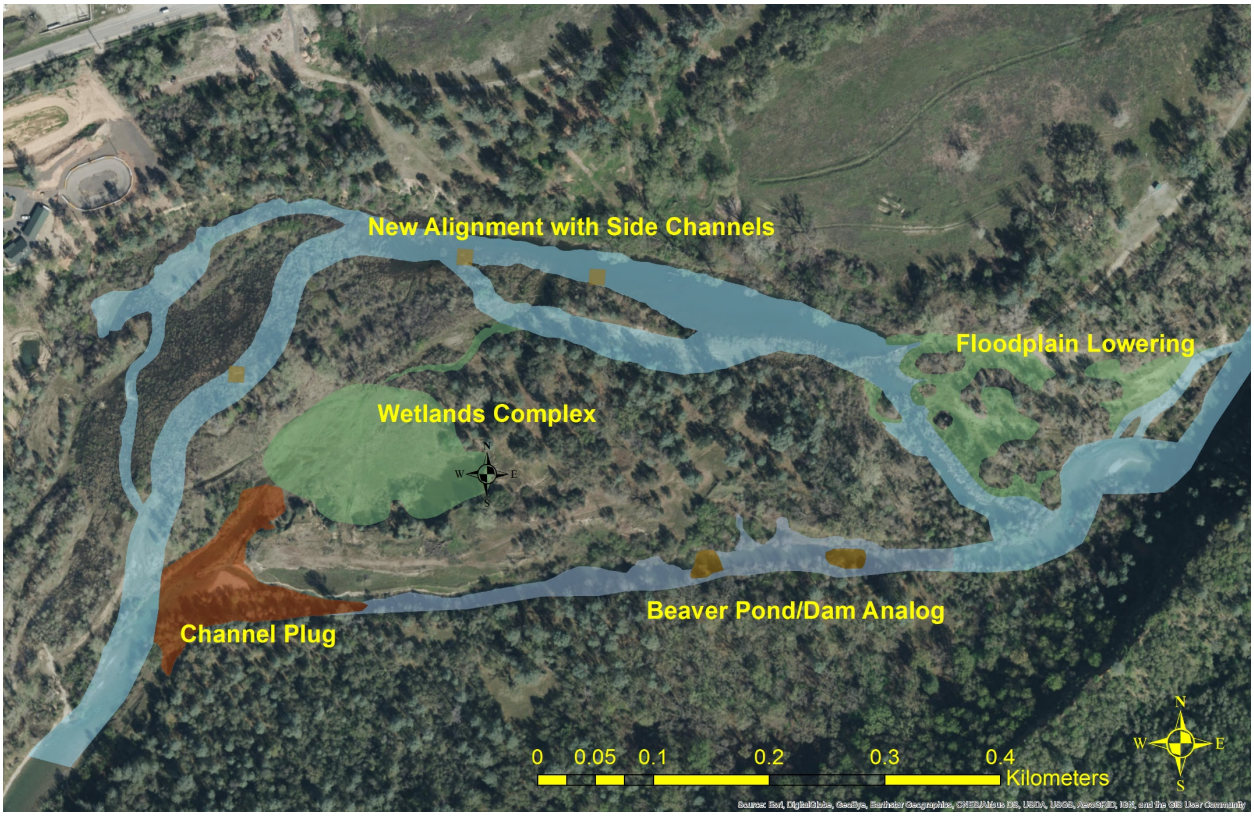

Figure 10. A simplified overview of the Phase 3C project design.

Figure 11. An aerial view of the Phase 3C project site during late-construction. Photograph credit: Aaron Martin (Yurok Design Team).

7. Fisheries Monitoring

Objective: *Monitor and evaluate the response of fisheries to the restoration action occurring in Lower Clear Creek.*

Action: *The USFWS monitors salmonid habitat and adult and juvenile life history populations in Clear Creek.*

The USFWS operates rotary screw traps at two location on Clear Creek, at river mile (RM) 8.2 and RM 1.7. The upper trap focuses on spring-run Chinook Salmon and steelhead, while the other captures all anadromous runs of Clear Creek. In fiscal year 2020, traps were on the water from November 1, 2019, to March 26, 2020, and redeployed on October 27, 2020. The traps are usually deployed November through June, but trapping was truncated by COVID-19 restrictions. Estimates of brood year (BY) 2020 juvenile production indices are in progress.

The USFWS and CDFW jointly operate a video weir at the mouth of Clear Creek (RM 0.1). In fiscal year 2020, CDFW operated the weir from December 16, 2019, to June 23, 2020, and the USFWS operated the weir from June 23, 2020, to present. Population estimates are in progress.

The USFWS operated a separation weir at RM 8.2 to prevent fall-run Chinook Salmon from negatively impacting spring-run Chinook Salmon upstream of the weir. In 2020, the weir was operated from August 21 to November 6. The weir was fish-tight the entire season and no schooling of fish was observed on either side of the weir. There were ten Chinook Salmon carcasses collected and sampled from the upstream side of the weir between September 18, 2020, and October 19, 2020. Of those, nine were intact enough to collect tissues for genetic analysis, with all nine of these having an intact adipose fin.

The USFWS completes an annual survey of Clear Creek spawning habitat available to salmon and steelhead. Data collected in July 2020 indicates a continuing “recovery” following the fine sediment inundation from the 2018 Carr Fire, with more spawning habitat mapped in 2020 when compared to 2019 (Figure 12). Effort in this survey was reduced due to COVID-19 restrictions therefore, only a subset of the creek was surveyed.

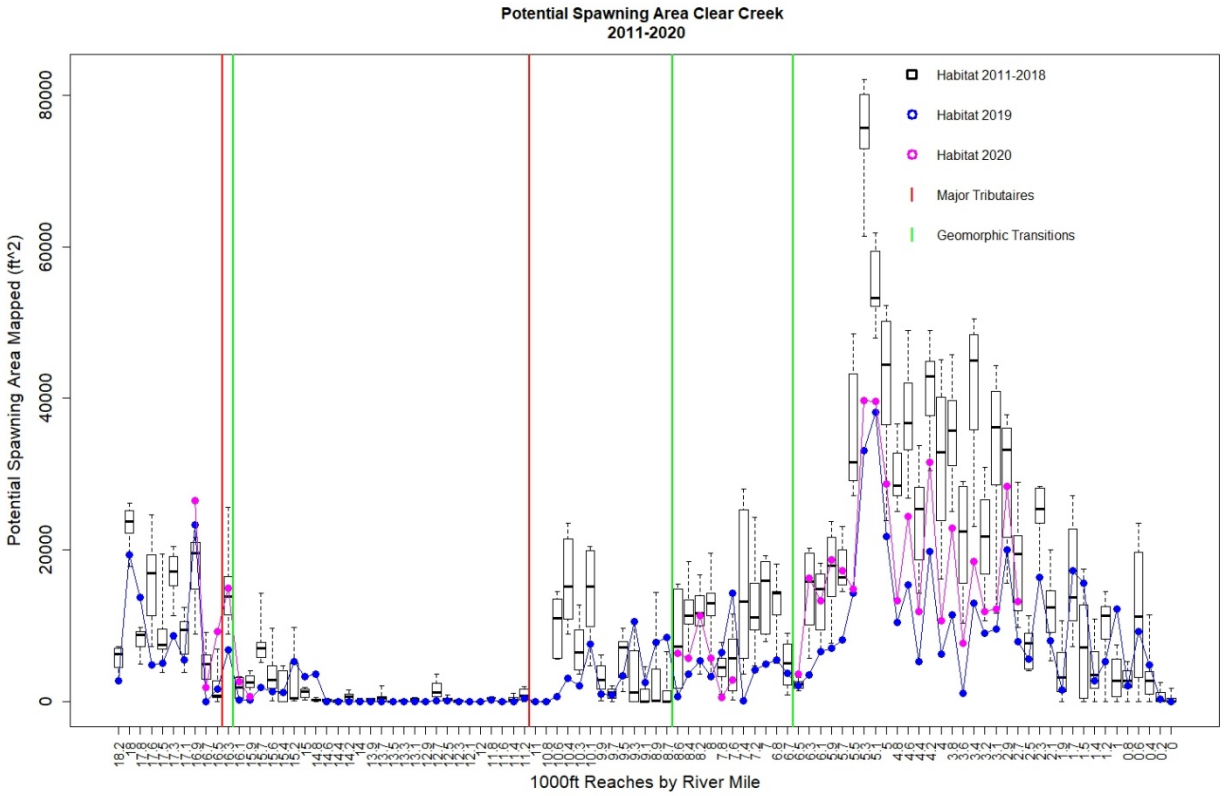

Figure 12. Anadromous spawning habitat mapped on Clear Creek 2011-2020. The X-axis indicates river mile breaks of roughly 1,000 ft. The Y-axis indicates the magnitude of habitat within each break. Years 2011-2018 are displayed by boxplot, 2019 and 2020 are presented as points.

The USFWS completes two spawning surveys on Clear Creek annually. The "kayak" spawning survey with the intent of quantifying late fall-run Chinook Salmon and steelhead spawning and the "snorkel" survey with the intent of quantifying spring-run Chinook Salmon spawning. In the 2019-2020 kayak season, six surveys were completed between early December 2019 and late March 2020. The surveys observed 54 late-fall Chinook Salmon and 375 *O. mykiss* redds. A single *O. mykiss* carcass was sampled on February 13, 2020. In 2020, the snorkel survey spawning effort was reduced from four surveys, the average in previous years, to two surveys. On these two surveys, 22 Chinook Salmon redds were mapped. Of these, 19 redds were above the picket weir and were attributed to spring-run Chinook Salmon. Three carcasses were observed on these surveys. Two fish were assessable for inspection of possible adipose clip, and both had an intact adipose fin.

The USFWS annually completes two surveys specific to monitoring fall-run Chinook Salmon. The Salmonid Area Mapping (SAM) survey is completed each October and December and spatially delineates the area disturbed by fall-run Chinook Salmon spawning in Lower Clear Creek. The "1000FT" spawning survey is completed early in the fall-run Chinook Salmon spawning period, provides an early metric of the run size, and is comparable to a long-term dataset. To date, the 1000FT survey and October SAM survey have been completed of BY 2019 fall-run Chinook Salmon. Findings of these surveys are yet to be synthesized but the 1000FT survey metric indicates a large return of fall-run Chinook Salmon to Clear Creek. During this year's survey, the count of live fall-run Chinook Salmon, carcass, and redds was relatively high, with over 10 times more observations in each category than since before the drought (2014-2016); however, the survey was completed a few weeks later than the average survey period.

Additional details on USFWS monitoring of Clear Creek can be found in published reports or by contacting Charlie Chamberlain.