2020 ANNUAL REPORT

TRINITY RIVER RESTORATION PROGRAM

Published September 1, 2021

Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

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

The mission of the U.S. Fish and Wildlife Service (USFWS) is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

The purpose of The Trinity River Restoration Program (TRRP) is to mitigate impacts of the Trinity River Division of the Central Valley Project on anadromous fish populations in the Trinity River by successfully implementing the 2000 Trinity River Record of Decision and achieving Congressionally mandated restoration goals.

On the cover

Front: Dutch Creek Channel Rehabilitation Project - Looking downstream as heavy equipment operated by employees of the Yurok and Hoopa Valley Tribes puts the finishing touches on new meanders and floodplains.

Back: Dutch Creek Channel Rehabilitation Project - Looking upstream on a newly constructed meander and floodplain in a previously entrenched stretch of the Trinity River.

TMC partners work collaboratively with many other participants and stakeholders to recover a productive, naturally spawning fishery through a healthier Trinity River.

Acknowledgments

Thank you to all partner agencies and entities for their contributions to this report. TRRP partners and stakeholders work diligently, thoughtfully, and effectively to meet the terms of the 2000 Record of Decision and recover dynamic river processes that will promote natural-origin salmonid populations. Thank you to partners, stakeholders, and the public for continued involvement and interest in the restoration of the Trinity River.

Report Names (SEE LINKS TO DOWNLOAD)

Flow Study	Often referred to as the Trinity River Flow Evaluation Study. *U.S.* Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT). 1999. *Trinity River flow evaluation final report. USFWS, Arcata, California and HVT, Hoopa, California.* **http://www.trrp.net/library/document/?id=226.**
ROD	U.S. Department of Interior (DOI). 2000. *Record of Decision, Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement/Environmental Impact Report. Decision by the U.S. Department of Interior, December 2000.* **http://www.trrp.net/library/document/?id=1238.**
TREIS/EIR	*USFWS, Bureau of Reclamation (Reclamation), HVT, and Trinity County. 2000. Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement/Environmental Impact Statement.* **http://www.trrp.net/library/document/?id=1238.**
Master EIR	North Coast Regional Water Quality Control Board (North Coast RWQCB) and Reclamation. 2009. *Channel Rehabilitation and Sediment Management for Remaining Phase 1 and Phase 2 Sites, Final Master Environmental Impact Report, Final Environmental Impact Report.* **http://www.trrp.net/library/document/?id=365**

Acronyms

2D	two-dimensional
BA	Biological Assessment
BiOp	Biological Opinion
BLM	Bureau of Land Management
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CLOMR	Conditional Letter of Map Revision
DOI	Department of the Interior
ESA	Endangered Species Act
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Map
FNF	full natural flow
FONSI	Finding of No Significant Impact
FY	fiscal year
GPS	global positioning system
GRTS	Generalized Random Tessellation Stratified routine
HVT	Hoopa Valley Tribe
IDT	Interdisciplinary Team
KRTT	Klamath River Technical Team
LiDAR	light detection and ranging
LOC	Letter of Concurrence
LOMR	Letter of Map Revision
LW/rkm	large wood pieces per river kilometer
msl	mean sea level
NEPA	National Environmental Policy Act
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service (now NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration Fisheries (formerly NMFS)
NTU	nephelometric turbidity units
PT	Pear Tree Gulch rotary screw trap site
Reclamation	Bureau of Reclamation
RAD	Restoration Action Database
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SRH-2D	Sediment River Hydraulics two-dimension
SWRCB	State Water Resources Control Board
TARGETS	Tool to Assess Riparian Germination and Establishment on Targeted Surfaces
TMC	Trinity Management Council
TREIS/EIR	Trinity River Mainstem Fishery Restoration Environmental Impact Statement/ Environmental Impact Report
TRRP	Trinity River Restoration Program
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCT	Willow Creek rotary screw trap site
WY	water year (October through September)
YOY	young-of-year
YT	Yurok Tribe
YTFP	Yurok Tribal Fisheries Program

Measurements

°C	degree Celsius
°F	degree Fahrenheit
af	acre foot
cfs	cubic feet per second
rkm	river kilometer
rm	river mile

Contents

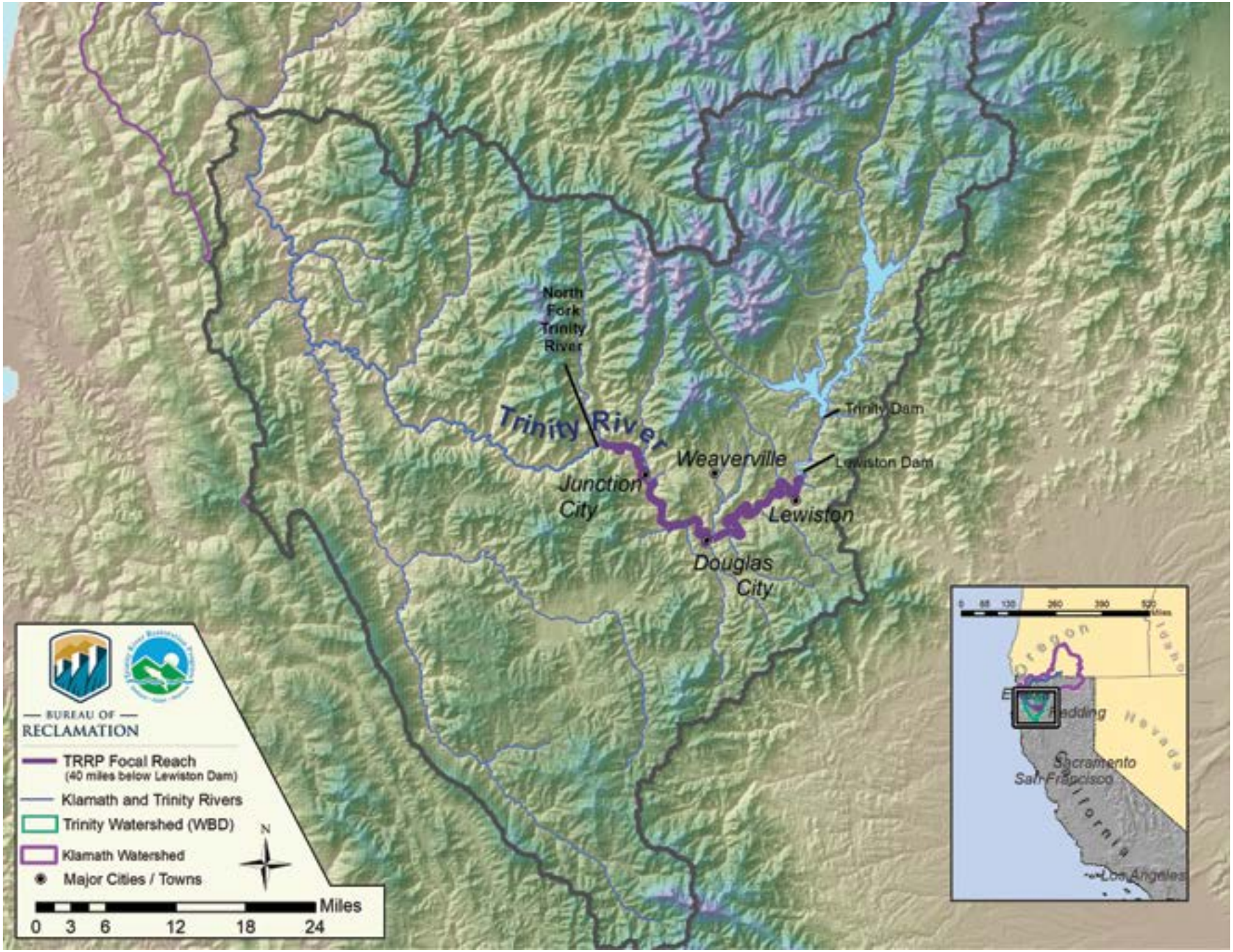


Figure 1. Map of Trinity River Restoration Program reach.

Introduction

The Trinity River Restoration Program (TRRP) is a partnership comprised of Federal and California State agencies, Hoopa Valley and Yurok Tribes, and Trinity County, California. These entities work collaboratively with stakeholders to restore the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River, California (Figure 1). The partnership is administered by two U.S. Department of the Interior (DOI) agencies: the Bureau of Reclamation and the U.S. Fish and Wildlife Service (USFWS). Partners share in the decision-making process through their participation on the Trinity Management Council (TMC). The TMC functions as a board of directors that sets priorities and schedules for strategic implementation by the Program's Executive Director.

Trinity Management Council partners include:

This 2020 annual report highlights accomplishments achieved throughout the year as well as the extensive planning activities, environmental permitting, and monitoring efforts across disciplines, including recently completed and upcoming summary synthesis reports. These comprehensive reports on various performance measures have been underway for several years as part of TRRP's work to provide quality science and modeling that will better inform management actions. To learn more about the progress on Trinity River restoration and to review more detailed reports please visit https://www.trrp.net/restoration/adaptive-management/synthesis-reports/.

TIMELINE OF TRINITY RIVER DECISIONS AND GUIDING DOCUMENTS

1955 — Congress authorizes Trinity River Division of the Central Valley Project.

1963 — Trinity and Lewiston Dams are completed.

1981 — Interior Secretary increases flows to about 300 cubic feet per second (cfs) and initiates the Flow Study.

1984 — Congress enacts the Trinity River Basin Fish and Wildlife Management Act to implement salmon restoration.

1992 — Congress enacts the Central Valley Project Improvement Act with 340,000 acre-feet of water available to the Trinity River.

1999 — The Flow Study is completed and is used as the preferred alternative in TREIS/EIR.

2000 — Secretary of the Interior signs the ROD with concurrence from the Hoopa Valley Tribe, establishing modern TRRP with minimum water volume allocations determined annually by the water year type and implemented through the TREIS/ EIR.

2009 — Master EIR provides all parts and appendices for the Draft and Final Master EIR in one document.

2009 — Integrated Assessment Plan identifies the scope of research needed to evaluate restoration of the Trinity River and its fisheries.

2014 — The Scientific Advisory Board conducts the Phase 1 Review of the Program's restoration actions through the Phase 1 channel rehabilitation sites.

TRRP Goals

The TRRP works "to restore the Trinity River's anadromous fishery resources . . . [by] . . . rehabilitating the river itself," as outlined in the U.S. Department of Interior 2000 Record of Decision (ROD).

In 2019 the Trinity Management Council (TMC) for the Trinity River Restoration Program (TRRP) adopted a new, concise goal statement:

> *The long-term goals of the TRRP are to restore the form and function of the Trinity River; restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and to facilitate full participation by dependent tribal, commercial, and sport fisheries through enhanced harvest opportunities.*

The Trinity River ROD is based on the Trinity River Mainstem Fishery Restoration Environmental Impact Statement/ Environmental Impact Report (TREIS/ EIR) which is the environmental compliance document under the National Environmental Policy Act of 1969 (NEPA). The preferred alternative of the TREIS/ EIR came from over 20 years of studies on the Trinity River and its anadromous fishery resources by various stakeholders that culminated in the Trinity River Flow Evaluation Study (Flow Study).

Trinity River Restoration Program

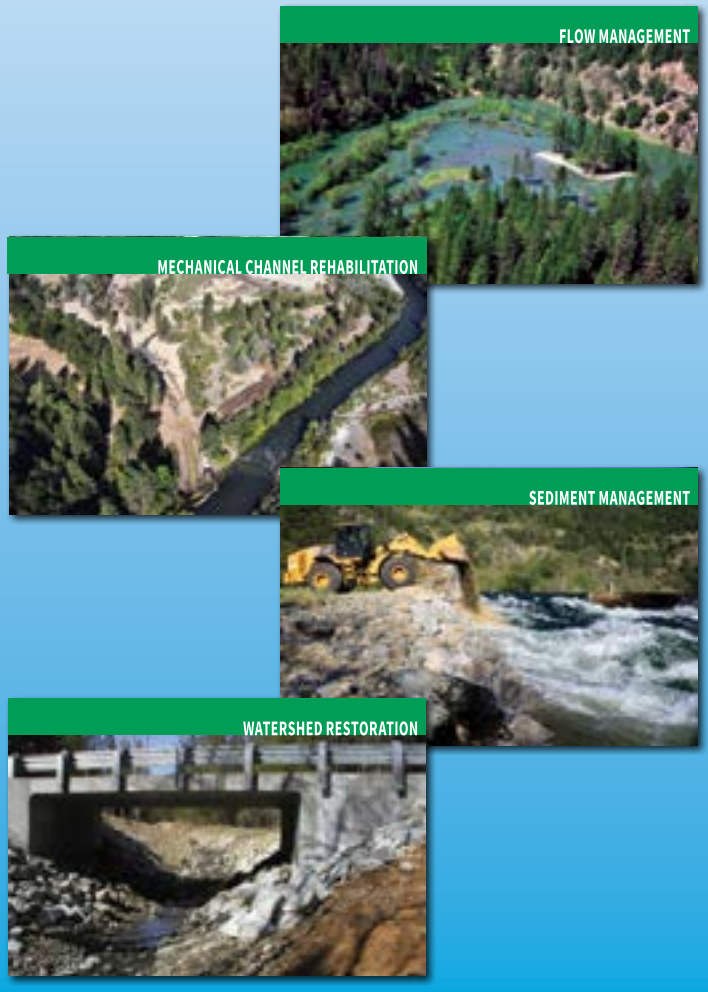
Restore • Adapt • Improve

TRRP Restoration Strategy

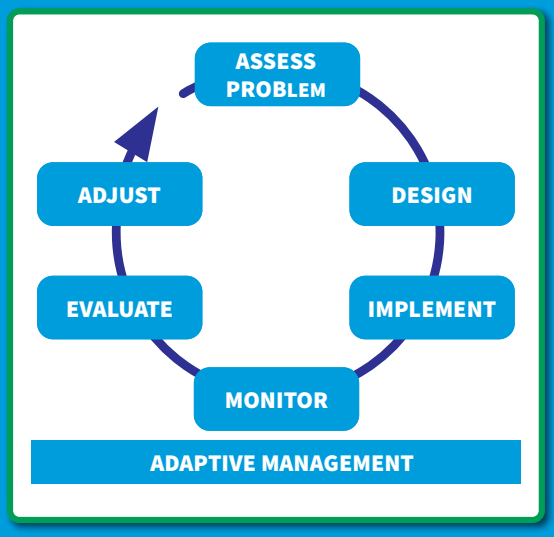
The TRRP's restoration strategy is to foster a more natural, dynamic river system that promotes all life-stages of salmonids through the following actions (sidebar):

- **FLOW MANAGEMENT.** Restoration flow releases are designed to help establish and maintain complex habitat features in the river. Flow management uses a variable flow regime based on five water year types designated by CDWR.
- **MECHANICAL CHANNEL REHABILITATION.** Channel rehabilitation projects are designed to reshape the river channel to increase fish habitat across the range of allowable flows. The Flow Study identified 47 project sites along the river below Lewiston Dam.
- **SEDIMENT MANAGEMENT.** Coarse gravel is added to the river below Lewiston Dam to form gravel bars and other elements of habitat complexity to replenish the sediment supply from the headwaters which dams cut off.
- **WATERSHED RESTORATION.** Restoration projects in tributaries reduce fine sediment input to the Trinity River and increase available salmon and steelhead habitat throughout the watershed.
- **INFRASTRUCTURE IMPROVEMENTS.** Modification of structures in the floodplain allow the peak restoration flows released from Lewiston Dam.

These actions are guided by an adaptive environmental assessment and management process (Adaptive Management)—a rigorous monitoring and analysis program to improve restoration activities. The first four elements place a priority on physical restoration of the river to create the attributes of an alluvial river system known to enhance habitat for anadromous fish species. Monitoring and evaluation under an adaptive management process show progress toward the expected physical and biological changes from restoration activities.



The ROD includes an Adaptive Management program guided by the TMC, using sound scientific principles to ensure that "the restoration and maintenance of the Trinity River anadromous fishery continues based on available scientific information and analysis" (DOI 2000). Work Groups in the TRRP collaborate to conduct interdisciplinary analyses and support Adaptive Management efforts.



COMPLEXITY IS KEY

A complex of gravel bars and deep pools on the upper Trinity River contains the elements necessary for salmonid habitat. (Photo by Ken DeCamp for Reclamation).

An Alluvial River

These healthy river attributes in a natural river system are used to inform the design and implementation of TRRP restoration actions:

- Variable annual flows create and maintain channel complexity, which creates diverse aquatic habitat that benefits fish
- The river channel bed is frequently mobilized
- Alternating gravel/cobble bars are periodically scoured and redeposited
- Fine and coarse sediment supply from the watershed is balanced by river transport
- The mainstem channel periodically migrates across its floodplain
- Floodplains are created, frequently inundated, and provide area for fine sediments to deposit
- Infrequent, large floods move the mainstem channel and associated floodplains and side channels, as well as scour away riparian vegetation
- Riparian vegetation is spatially and structurally diverse and self-sustaining
- Groundwater beneath the floodplains is frequently recharged by high flows in the mainstem channel.

These attributes found in natural river systems create and maintain channel complexity, which creates habitat complexity, which benefits fish.

2020 HIGHLIGHTS

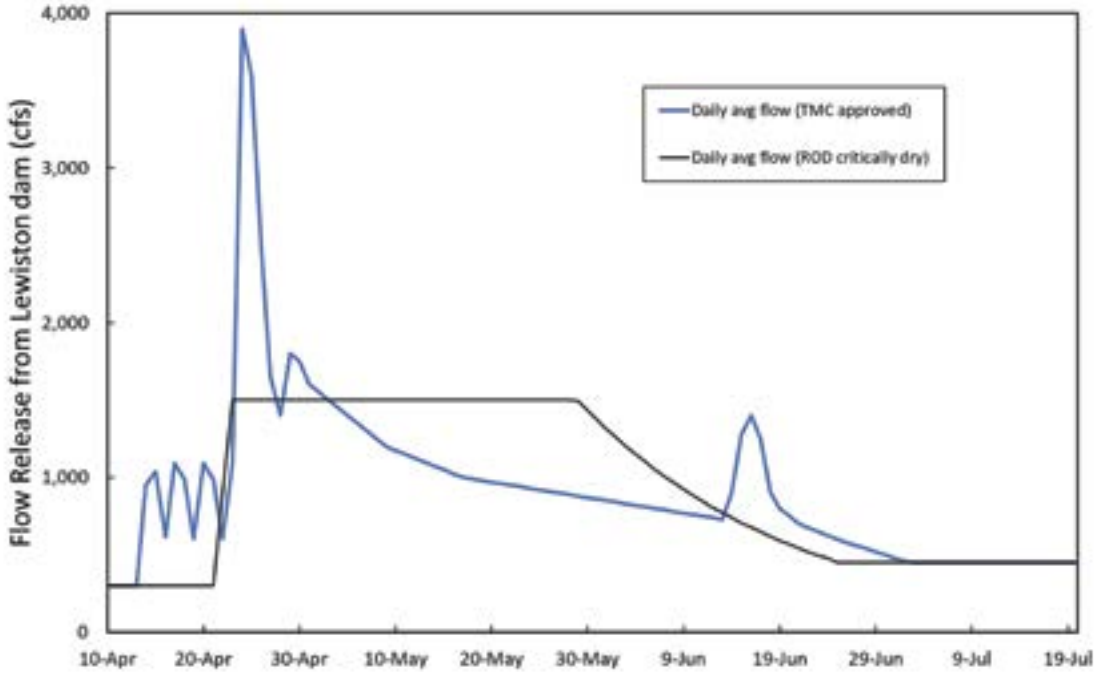
Operational Changes Due to COVID-19

TRRP adapted throughout 2020 to meet the challenges brought on by COVID-19 and adjusted office operations, restoration result monitoring, and channel rehabilitation implementation to continue its goal of restoring the Trinity River. The year posed a unique set of challenges during construction of the Dutch Creek channel rehabilitation site. On August 13, the crews stopped worked for four days and quarantined after one of the equipment operators tested positive for COVID-19. Employees on the project worked quickly with county health officials and the Yurok Tribe Public Health Officer on testing and contact tracing. Based on testing and tracing results, the crew was able to resume work the following week on August 18 and keep the project on schedule with enhanced COVID-19 safety protocols. With several Saturdays of work and extra-long days, civil construction work was completed in early October and revegetation work finished October 15.

The TRRP also had to adjust how we interacted with the public and each other. The office closed to the public in March for the duration of the year, with public visits by appointment only. The program office also entered a “maximize telework” directive, wherein employees who could do their jobs remotely were required to do so, and all meetings were held virtually.

Restoration Flows

As water year 2020 was forecast as a Critically Dry Water Year, the TRRP coordinated and scheduled the release of 369,000 acre feet of water from Lewiston Dam allowed in a critically water year, with a peak release of approximately 3,900 on April 24, 2020.



Spring restoration flow release in 2020 had a peak release of 3,900 cfs on April 24, which was targeted to achieve flow objectives in the critically dry water year.

The Dutch Creek site was constructed throughout the summer and early fall of the 2020.

Dozens of whole trees are used during the construction of the Dutch Creek log jam.

The Indian Creek restoration project was partially funded through the TRRP's Watershed improvement Program with an initial phase implemented in 2020.

Restoration Monitoring and Synthesis Reporting

The publication and review of synthesis reports on various monitoring efforts undertaken by TRRP's interdisciplinary work groups. Completed reports are available here: https://www.trrp.net/restoration/adaptive-management/synthesis-reports/.

Dutch Creek Channel Rehabilitation Project

The Dutch Creek project was constructed in the summer and fall of 2020 to promote lateral erosion, deposition, and seasonal floodplain inundation; increase channel complexity; and enhance salmonid habitat and the riparian corridor. This was the first channel rehabilitation project constructed partially on National Forest System Lands (Top photo).

Noteworthy components of the Dutch Creek project included extensive floodplain lowering and a large structured logjam that was constructed using entire trees harvested from the site and structurally positioned to force the river into a new meander bend (Center photo).

TRRP Refinements

Began the process to draft a single comprehensive TRRP "program document" and develop a new Science & Monitoring Plan

Watershed Improvements

Selected five grant recipients for watershed improvement projects in the Trinity River basin worth a total funding amount of $537,000. The projects will help reduce fine sediment runoff into the Trinity River and improve fish habitat and passage in Trinity River tributaries (Bottom photo).

Continued design, review, and environmental permitting to advance channel rehabilitation work at the remaining sites within the TRRP Focal Reach (on the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River) as described in the Flow Study.

Funding and Expenditures

Funding levels have varied between $10 million and $16.66 million per year since the Program's inception. In fiscal year (FY) 2020, the Program received a total of $12.2 million, as shown in Table 1.

Table 1. Bureau of Reclamation Fiscal Year 2020 Funding

BUREAU OF RECLAMATION FUNDING	
Water and Related Resources Account	$9,991,000
Central Valley Project Improvement Act Restoration Fund	$1,500,000
FY 2019 Funds provided to TRRP for use in FY 2020	$687,000
TOTAL	$12,178,000

The FY 2020 budget allocations went to three primary areas as shown in Table 2.

Table 2. FY 2020 TRRP Budget Allocations

Trinity River Restoration Program Budget Allocations	
TRRP Administration	$2,931,025
Implementation	$5,690,624
Science Program	$3,473,661

Funding supported physical modifications to the river and the associated modeling, designing, permitting, and monitoring of physical and biological responses. Other partner agencies were funded and/or contributed in-kind services to support TRRP activities. It should be noted that staff positions and agency assistance funding can shift between categories so the level of funding in Administration, Implementation, and Science are not directly comparable between years.

TRRP ACTIVITIES AND

Flow Management

Restoration Releases

Each water year (WY), the TRRP's Flow Work Group and the TMC recommend a schedule for releasing restoration flows on the Trinity River. Selection criteria for determining the year's hydrograph include:

- Providing suitable temperatures for all salmonid life stages;
- Reducing the travel time to the Klamath River for outmigrating smolts;
- Managing riparian seed germination and plant growth;
- Mobilizing sediment in the river and scouring pool depths; and
- Providing monitoring opportunities to support learning and adaptive management strategies.

The water volume for the restoration flow release to the Trinity River below Lewiston Dam is based on the California Department of Water Resources (CDWR) April 1 forecast of the total annual inflow to Trinity and Lewiston Reservoirs, grouped into five water year types. Forecasts are used because the actual water year type is not known when the annual release schedules are developed. The CDWR forecast that the water year type for 2020 was Critically Dry. The approved daily average flow schedule for the Critically Dry WY was a modification of the hydrograph prescribed for this water year type in the ROD (Figure 2). Changes from the ROD hydrograph were designed to:

- Elevate flows at the beginning of the hydrograph to disperse steelhead (*Oncorhynchus mykiss*) smolt released from Trinity Hatchery in this period;
- Provide variable flows that increase habitat diversity and benefit fish and other organisms;
- Maximize the variability in shear stress to increase sediment transport and river bed scour;
- Variably inundate floodplain areas to recruit nutrients to the channel; and
- Slightly elevate flows in early June to disburse Chinook Salmon fingerlings that volitionally migrate from Trinity Hatchery in this period.

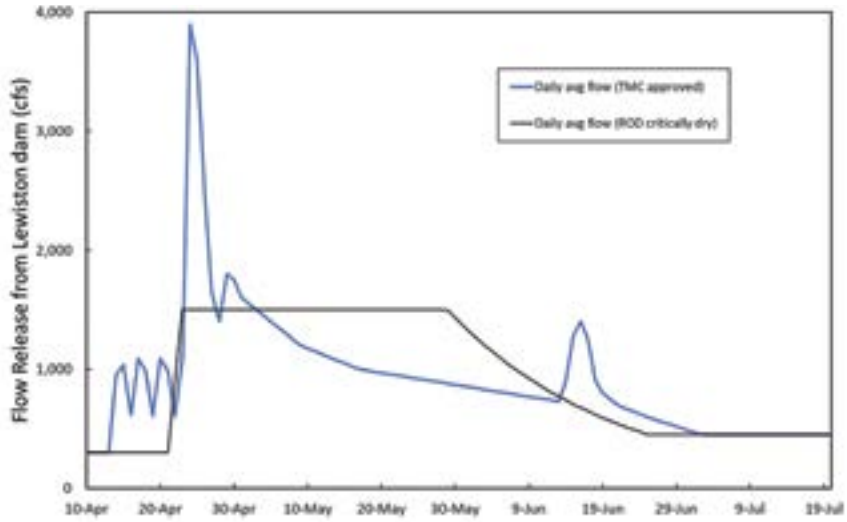


Figure 2. Daily average flows scheduled in spring for the Critically Dry WY2020 and ROD flows for this water year type shown for comparison.

ACCOMPLISHMENTS

Flow Release Rates from Lewiston Dam

Figure 3 shows the daily average WY2020 flow releases from Lewiston Dam to the Trinity River based on the Lewiston gage (USGS #11525500). In early September, Reclamation released flows above the baseline 450 cfs in summer to aid salmon in the lower Klamath River. Except for these flows, all other discharges were released for restoration purposes (TMC recommended TRRP restoration flow release).

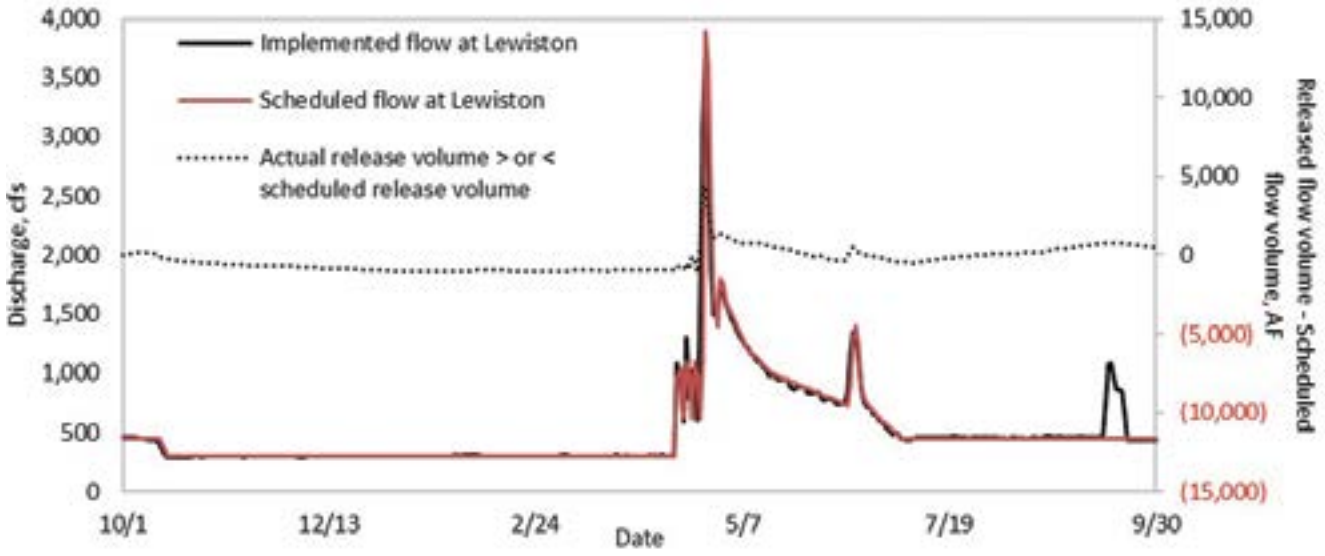


Figure 3. Plots of the TMC recommended flow release and the implemented flow, which includes fall flows to aide salmon in the lower Klamath River. The dotted line indicates how closely the implemented releases matched the schedule flow releases (i.e., the volume of water in acre-feet [af] that is released to the Trinity River in excess or above that targeted on a cumulative daily basis).

Restoration Flow Schedule

Outcome of Hydrograph Implementation

In addition to showing actual water releases, Figure 3 compares the releases from Lewiston Dam to the TMC-specified release schedule, as measured by the Lewiston gage (USGS #11525500). Central Valley Project operations quite accurately implemented the allocated flow volume despite difficulties with Trinity and Lewiston dams. Of the 369,000 af allocated for the critically dry water year, 369,157 af was released to the Trinity River for restoration purposes—an overage of only +0.04%.

Temperature Targets and Compliance

Temperature targets are specified for three locations on the Trinity River to help ensure Lewiston Dam releases benefit—and do not detract from—the health of adult and juvenile salmonids. River temperature is measured at Douglas City and above the confluence with the North Fork Trinity River to meet regulatory compliance targets specified in State Water Resources Control Board (SWRCB) Order WR 90-5 (SWRCB 1990). The TREIS/EIR added targets for Douglas City and Weitchpec to aide juvenile salmonids in their downstream migration to the Klamath River (Table 1 - next page).

Table 1. Trinity River Temperature Targets by Reach and Date

Source	Target Reach	Dates	Target
Basin Plan for the North Coast Region (North Coast RWQCB 2011) NMFS (2000) and WR 90-5 (SWRCB 1990)	Lewiston to Douglas City	July 1 - September 14	≤60 °F (15.5 °C)
		September 15 - 30	≤56 °F (13.3 °C)
	Lewiston to North Fork Trinity River	October 1 - December 31	≤56 °F (13.3 °C)
ROD Springtime Objectives for the Trinity River (TREIS/ EIR)	Lewiston to Weitchpec	**Normal and Wetter Water Years: Optimum**	
		April 22 - May 22	≤55.4 °F (13.0 °C)
		May 23 - June 4	≤59.0 °F (15.0 °C)
		June 5 - July 9	≤62.6 °F (17.0 °C)
		Dry and Critically Dry Water Years: Marginal	
		April 22 - May 22	≤59.0 °F (15.0 °C)
		May 23 - June 4	≤62.6 °F (17.0 °C)
		June 5 - July 9	≤68.0 °F (20.0 °C)

RWQCB = Regional Water Quality Control Board
NMFS = National Marine Fisheries Service (now NOAA Fisheries)
°F = degree Fahrenheit
°C = degree Celsius

The target to not exceed 60 °F at Douglas City from July 1 to September 14 supports summer holding for spring run Chinook Salmon and for rearing juvenile Coho Salmon (*O. kisutch*). The compliance mandate set forth by WR 90-5 (SWRCB 1990) from September 15 through September 30 (56 °F) supports spawning Chinook Salmon and migrating adult Coho Salmon. River temperatures at Douglas City during the target period are influenced by the release temperatures at Lewiston Dam and local weather. Given the extremely hot summer that was experienced, water temperatures remained above the historic daily average values until fall. As a result, in WY2020, water temperature targets at Douglas City were met in only 76 of 91 days and the sum of °F exceedance was 33 °F in the target period (Figure 4) .

The target to not exceed 56 °F on the Trinity River above the North Fork (NF) Trinity River from October 1 through December 31 supports spawning Chinook and Coho Salmon, and steelhead. Water temperatures above the NF Trinity River were substantially below the targeted values and no exceedances occurred (Figure 5).

The temperature objectives for the Trinity River at Weitchpec in dry and critically dry water years are intended to provide marginal rearing conditions for juvenile Chinook Salmon. Water temperature monitoring in real time is undertaken by the U.S. Geological Survey at Hoopa (USGS #11530000) for in-season tracking and the U.S. Fish and Wildlife Service (USFWS) measures water temperatures at Weitchpec and usually publishes these values around a year after they are collected. Therefore, to evaluate success meeting the objective in this report, we adjust Hoopa water temperatures by the average observed warming that occurs while flow travels the 12 river miles downstream to Weitchpec, which is about 1 °F. Again, owing to the hot summer, estimated water temperatures at Weitchpec exceeded the targets in 37 of the 76-day compliance period by a total of 229 °F (Figure 6).

Figure 4. Daily average water temperatures at the Douglas City compliance point. Observed water temperatures are plotted with compliance targets and the average and range of daily temperatures for the period of record (WY 2005-2019).

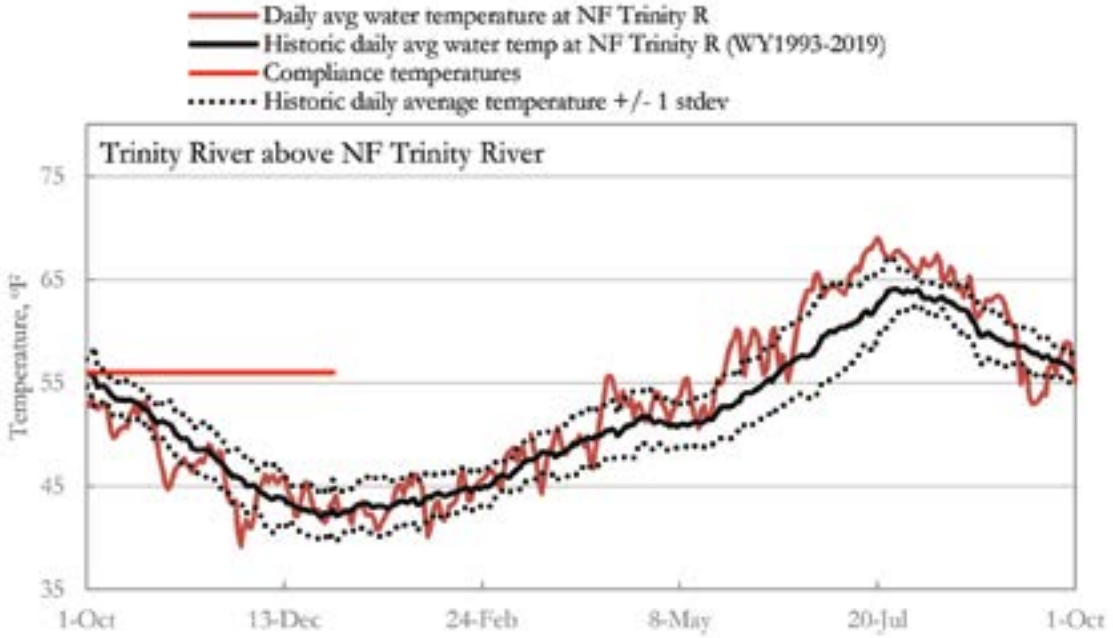


Figure 5. Daily average water temperatures at the compliance point above the NF Trinity River. Observed water temperatures are plotted with compliance targets and the average and range of daily temperatures for the period of record (WY 1993-2019).

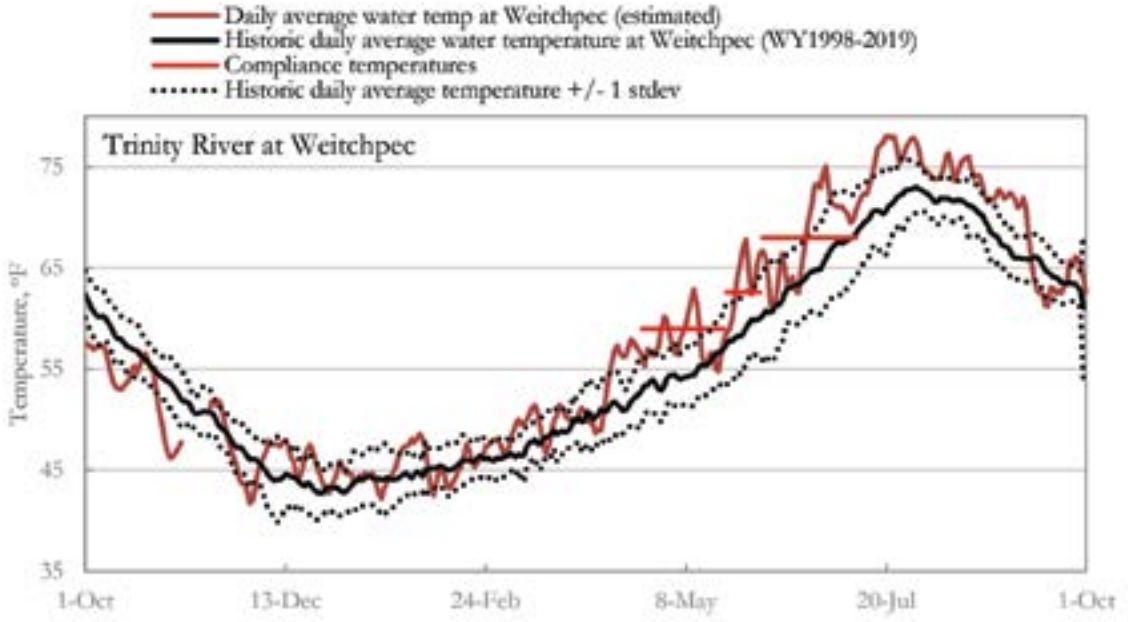


Figure 6. Daily average water temperatures for the Trinity River at Weitchpec and the historic daily average and range (+/- 1 standard deviation) of daily temperatures for the period of record (WY 1998-2019).

Water Volume Accounting

Table 2 lists flow releases in 2020. Implemented restoration volume (369,157 af) and the scheduled volume for river restoration (369,000 af) differed by +0.04%, which is less than the ±10% accuracy of the stream gage record. Therefore, the volume of the restoration flow releases was equivalent to the allocated volume when measurement error is considered.

Table 2. Flow Releases in WY2020

Flow release	Acre feet
The total volume of water released from Lewiston Dam to the Trinity River	376,048
Water released to the Trinity River for restoration purposes	369,157
Water released to the Trinity River for salmon in the lower Klamath River	6,891
Water exported from the Trinity River basin via Clear Creek Tunnel	811,333

Reclamation exported 811,333 af of water from the Trinity River to the Sacramento River in WY2020 via the Judge Carr Tunnel and Power Plant. Exports in WY2020 to the power plant were approximately 216% more than the volume of water released to the Trinity River (Table 2). A summary of restoration releases and export volumes for WY2001 to 2020 is provided in Table 3.

Table 3. Water Releases and Diversions as a Percent of the full natural flow at Lewiston. The full natural flow (FNF) is the quantity of water that would have passed the gage at Lewiston if Trinity and Lewiston Dams and other diversions or impedances had not been in place. Percentages above or below 100% are possible due to changes in reservoir storage across water years.

Water Year and WY Designation	Restoration Releases to the Trinity River	Diversions to the Sacramento River	All Other Releases to the Trinity River[1]	Total Releases and Diversions
2001 – Dry	46.4%	81.8%	0.5%	128.7%
2002 – Normal	37.3%	48.6%	0.0%	85.9%
2003 – Wet	24.0%	45.9%	5.8%	75.6%
2004 – Wet	43.1%	65.3%	7.8%	116.1%
2005 – Normal	43.9%	31.6%	0.2%	75.7%
2006 – Extremely Wet	32.4%	54.1%	16.3%	102.8%
2007 – Dry	60.3%	81.7%	0.5%	142.5%
2008 – Normal	74.1%	63.4%	0.0%	137.6%
2009 – Dry	53.4%	64.6%	1.3%	119.3%
2010 – Normal	41.0%	17.1%	0.0%	58.1%
2011 – Wet	38.3%	25.1%	0.6%	64.0%
2012 – Normal	60.2%	66.0%	3.6%	129.8%
2013 – Dry	53.0%	99.9%	3.4%	156.2%
2014 – Critically Dry	93.5%	156.1%	16.4%	266.0%
2015 – Dry	50.1%	50.1%	6.4%	106.5%
2016 – Wet	48.6%	19.1%	2.7%	70.5%
2017 – Extremely Wet	35.3%	27.0%	1.9%	64.2%
2018 – Critically Dry	69.0%	71.4%	6.2%	146.6%
2019 – Wet	41.4%	25.0%	0.5%	66.9%
2020 – Critically Dry	86.8%	190.7%	1.6%	279.1%
Average (2001 - 2020)	*56.2%*	*66.6%*	*2.6%*	*125.5%*
5-Year Average (2016 - 2020)	*51.8%*	*64.2%*	*3.8%*	*119.6%*

[1]Includes Trinity Reservoir storage management releases, supplemental flow releases for the lower Klamath River, and tribal ceremonial releases to the Trinity River.

Reservoir Conditions

Water year 2020 began October 1, 2019 with Trinity Reservoir holding 2,040,000 AF and ended the year on September 30, 2020 holding 1,354,100 AF (Figure 7). Current elevations of the water reservoir at Trinity Lake are available on http://www.trrp.net/restoration/flows/lake-conditions/.

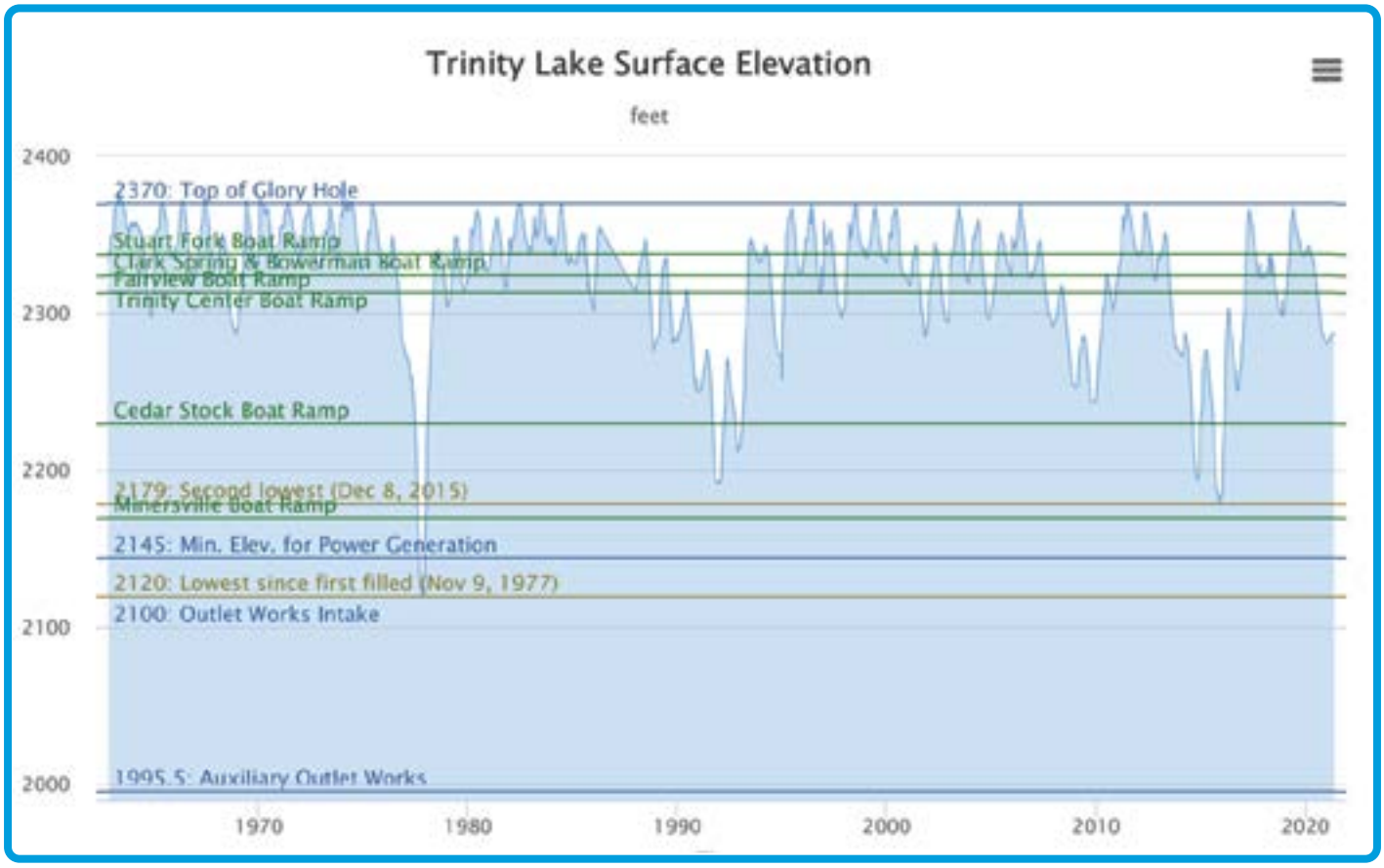


Figure 7. Historic to current elevation levels for Trinity Lake.

The full natural flow (FNF) is the quantity of water that would have passed the gage at Lewiston if Trinity and Lewiston Dams and other diversions or impedances had not been in place.

Mechanical Channel Rehabilitation

Dutch Creek Channel Rehabilitation

The Dutch Creek project was constructed in the summer and fall of 2020 to promote lateral erosion, deposition, and seasonal floodplain inundation; increase channel complexity; and enhance salmonid habitat and the riparian corridor.

Located 25.5 miles downstream from Lewiston Dam, the site spanned approximately a 1.5-mile river section that devolved into a straight, narrow and simplified channel with little habitat value for juvenile salmonids (Figure 8). The entire project encompassed roughly 100 acres, including 48 acres of National Forest System land, 32 acres of land managed by Bureau of Land Management (BLM), and 12 acres of private land. This project set a milestone by becoming the first channel rehabilitation project constructed partially on National Forest land and is a testament to years of close cooperation with the Shasta-Trinity National Forest (USFS), the BLM-Redding Field Office and other stakeholders.

The design, led by the California Department of Water Resources (DWR), sustained years of review from the Design Team, as well from public stakeholders. The project was jointly constructed by the Yurok Tribe and Hoopa Valley Tribe.

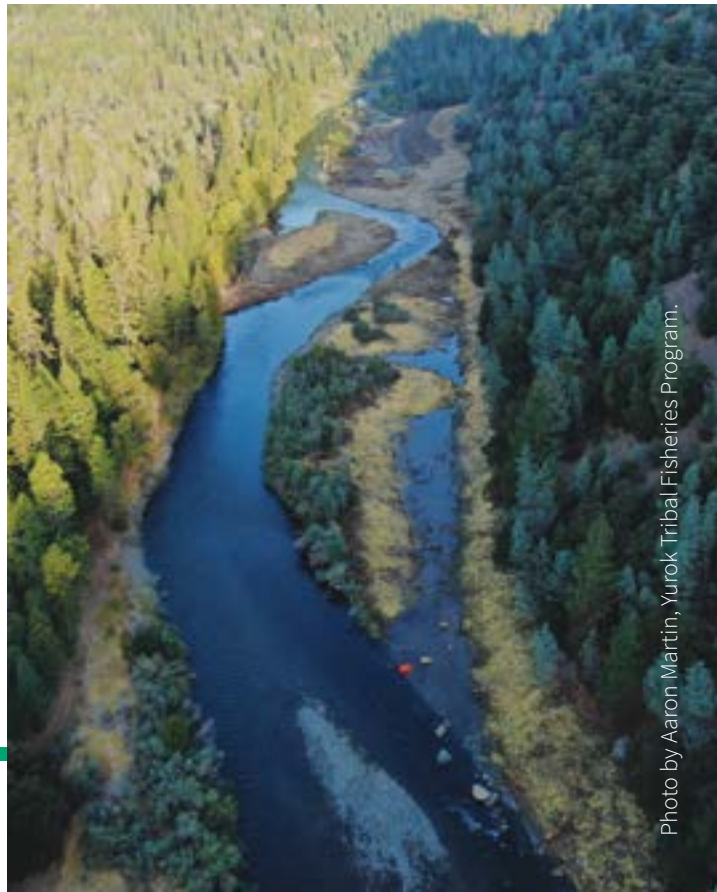


Photo by Aaron Martin, Yurok Tribal Fisheries Program.

Figure 8. Perspective looking downstream at the Dutch Creek project site in 2016 (top) and after construction in 2020 (bottom). The barren land terraced above the river on the right side of the river contained predominantly non-native grasses and was largely disconnected from the river before the project. During the project the elevation was lowered to reconnect it to the river at much lower flows and provide critical salmonid habitat and biological diversity.

Noteworthy components of the Dutch Creek project included extensive floodplain lowering and a large structured logjam that was constructed using entire trees harvested from the site and structurally positioned to force the river into a new meander bend (Figure 9 next page).

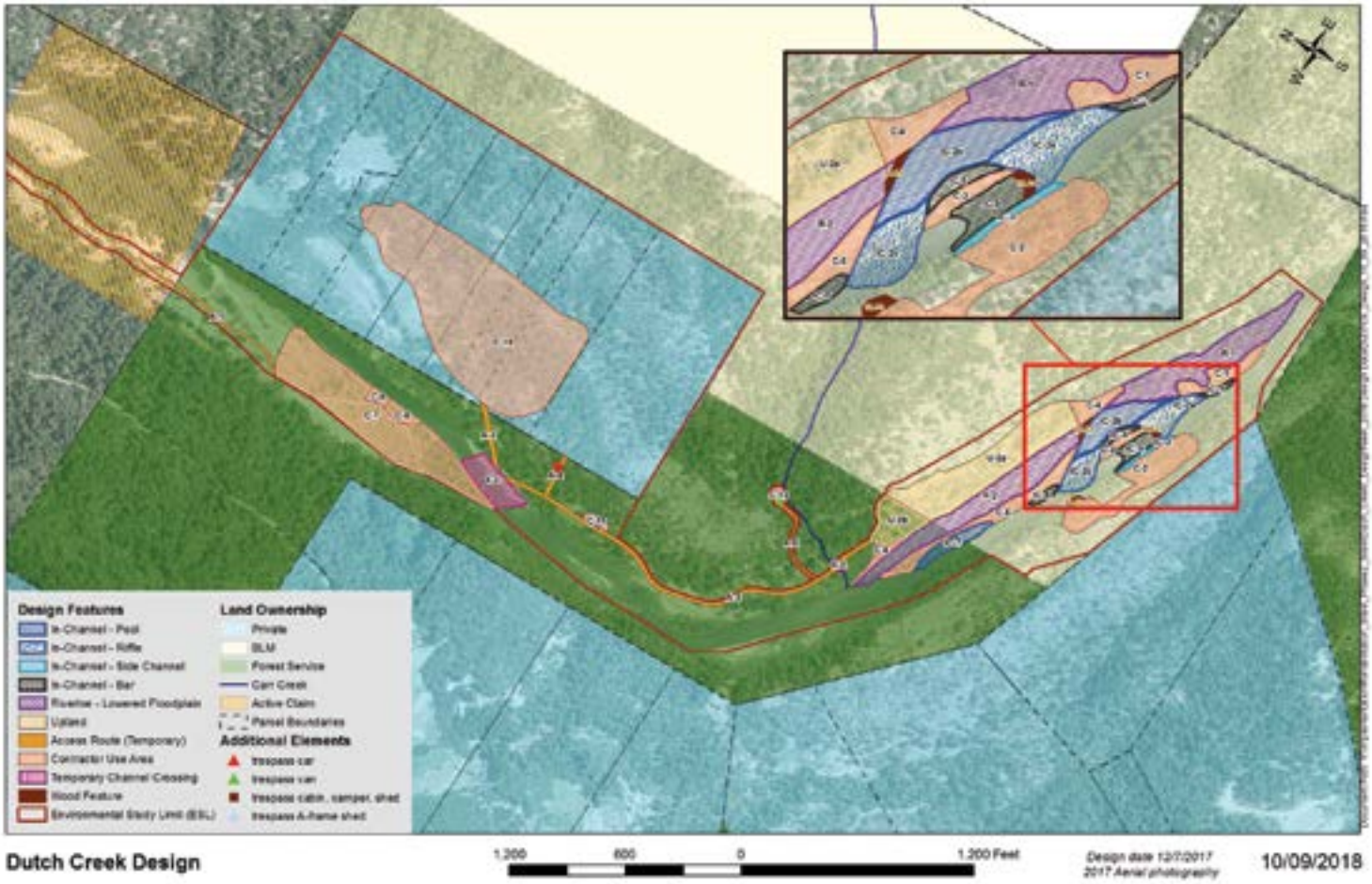


Figure 10. Map of the Dutch Creek site with original design features and activity areas.

Mechanical Channel Rehabilitation (continued)

Site Characteristics

For the purposes of documenting the existing conditions, the site was broken into three main areas where restoration activities were planned. Activity areas included an upper bar and berm feature on river left, a prominent gravel bar and floodplain feature on river right, and a lower bar on river left. Before construction, the left bank of the project site consisted mainly of bedrock and boulder clusters, with mature alders and willows along the entire length. A long, terraced floodplain on the right bank existed with minimal native vegetation and was perched several feet above the water table. Few areas within the project site were less than four feet above the baseflow water surface elevation and was largely unoccupied by vegetation. Much of the area in the middle of the site, on river right, was between four and ten feet above the baseflow water surface elevation and also did not support native vegetation.

Initial Concept

Positioned at the top end of a valley reach, the site offered an opportunity to significantly lower floodplain elevations and force the river into a new meander with a structured logjam and gravel bars. The terraced floodplain on the right bank provided a chance to re-connect a large portion of the reach to the river across a broad range of flow conditions. Extensive floodplain lowering allowed for fine sediment deposition to enhance soil composition and encourage riparian vegetation growth thus increasing the biological complexity of the reach in both the near-term and long-term.

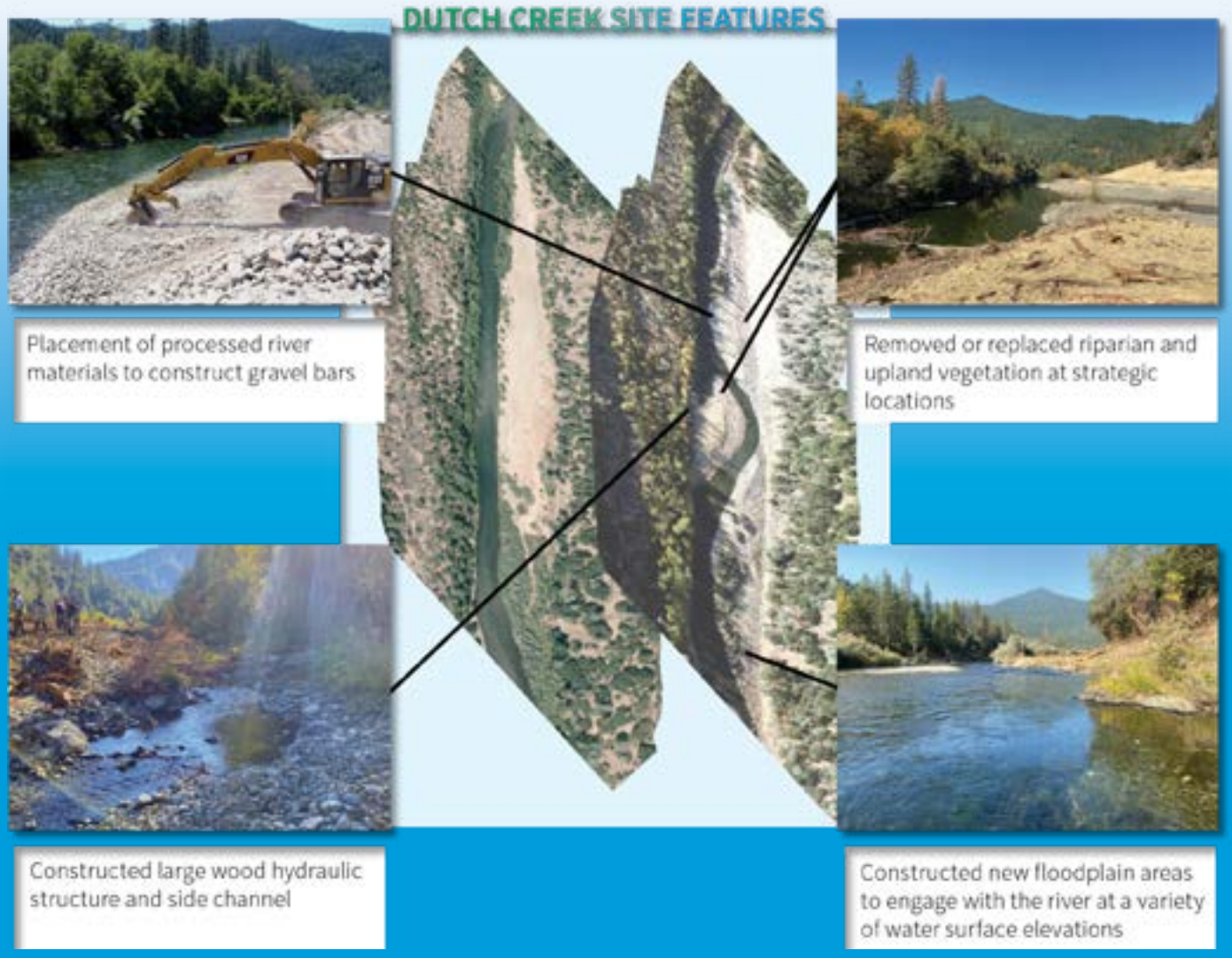


Figure 11. By strategically excavating confining vegetated berms and realigning the river channel, TRRP has facilitated natural streambank formation and dynamic, healthy river processes including significant variability in flow velocity distribution, floodplain connectivity and coarse gravel recruitment.

Rehabilitation Design Process

From 2011 to 2019, the California state design team, working with the USFS Enterprise team, used multi-disciplinary and multi-organizational approach that focused on including stakeholder input early in the design phase. This structured design process helped to foster better communication and transparency—and created a collaborative environment that allowed for innovated ideas and important recommendations.

Design Features and Implementation

The features of the Dutch Creek channel rehabilitation are shown in Figures 10-11. A section of new floodplain now inundates at flows as low as 700 cubic feet per second (cfs), which will provide young salmon frequent access to a more complex food-web and rearing habitat. The remaining area of lowered floodplain now engages with the river at 2,500-6,000 cfs. Before construction this section of floodplain only inundated periodically at much higher flows and provided limited and dysfunctional habitat for young fish.

Mechanical Channel Rehabilitation (continued)

A number of rehabilitation activities at the site were completed, including:

- Physically altered alluvial features to create a large meander bend
- Placement of processed river materials to construct gravel bars
- Constructed large wood hydraulic structure and side channel
- Removed or replaced riparian and upland vegetation at strategic locations
- Constructed new floodplain areas to engage with the river at a variety of water surface elevations

This season posed a unique set of challenges with COVID-19 and USFS closures due to extreme fire behavior. Civil construction work was largely completed by the beginning of October 2020 with revegetation work and mitigation measures extending into late October.

A previously straight and nearly featureless section of the river now has a new meander bend, a logjam, and floodplains that will connect with the river at much lower flows. These new features will provide immediate and long-term habitat for salmon and steelhead. Following project implementation, the river will continue to do the lion's share of the work to evolve the site and create a more productive section of river for salmon and steelhead.

Top Left: Fully constructed mid-channel bar/plug complex and structured log jam placed in the existing mainstem channel.

Top Right: Dutch Creek project looking upstream during construction 2020. Photo courtesy of the Yurok Tribe.

Bottom: Downstream perspective of structured jog jam, mid-channel bar/plug complex, point bar feature, and meander channel complex.

Sediment Management

Trinity and Lewiston Dams not only trap water but also the supply of sediment from areas upstream of Lewiston Dam. High-flow releases are used together with gravel augmentations to increase the availability and quality of physical habitat in the river channel by promoting scour and fill processes that maintain bars, pools, juvenile rearing habitat, spawning beds, and other elements of channel complexity. As with flow management, optimizing the gravel management strategy through applied science is an ongoing priority.

Water year 2020 was a "critically dry" year in which the annual spring high flow release from Lewiston Dam topped out with a maximum release of 3,900 cfs. As these lower flows cannot transport coarse sediment transport, no coarse sediment was added to the river in 2020. Thus, no mainstem Trinity River sediment transport monitoring was conducted in 2020.

The Physical Work Group is developing several science synthesis reports on management of physical river processes including coarse sediment management, fine sediment management, and channel complexity. The synthesis reports will support on-going development of physical process objectives and targets to refine management actions.

Physical and Biological Responses to Restoration Flows

Riparian Species Monitoring and the Riparian and Aquatic Ecology

Much of TRRP's actions for wildlife are guided by the 1984 Trinity River Basin Fish and Wildlife Management Act (Public Law 98-541) that acknowledged the loss of habitat for deer and other wildlife species caused by inundating riparian and upland areas behind Lewiston and Trinity Dams. Congress directed the Secretary of the Interior to take appropriate actions to maintain and propagate such wildlife.

Conventional TRRP monitoring for wildlife and riparian vegetation paused during 2020, while researchers took time to assess data in several draft synthesis reports as part of a programmatic effort to use long-term data sets to answer long-standing questions. The riparian encroachment synthesis report has been peer-reviewed and is forthcoming (HVT and McBain Associates 2021, in prep). The cottonwood seed dispersal synthesis report has been peer-reviewed and finalized (Bair et al. 2020).

SYNTHESIS REPORT

FINE SEDIMENT SYNTHESIS REPORT

Dams on rivers block sediments from traveling downstream, which usually leads to a deficit in coarse sediments. However, the reduction of large flows due to reservoir management often leads to a buildup of fine sediments (sand and silt) in the river below.

A recently completed synthesis report (Buxton 2021) analyzed numerous data sources to carefully examine the history and current situation for fine sediments.

We have long known that flow regulation beginning in 1960 led to impairment of river ecology by fine sediments. Flushing flows in the 1990s demonstrated an ability to clear fine sediments from the upper river.

The synthesis report finds that after nearly 20 years of restoration flows, fine sediments have been greatly reduced in the upper river and are now in a deficit from Lewiston Dam to at least Rush Creek. This deficit may be impairing ecology of the upper river and augmentation of fine sediments in this reach is being considered.

VEGETATION ENCROACHMENT AND COTTONWOOD DISPERSAL SYNTHESIS REPORTS

Is all the beautiful, green vegetation along the Trinity River a good thing, or a bad thing? It depends on where and how much. Naturally flowing rivers like the Trinity have rather sparse vegetation on lower banks and floodplains due to bed mobility and scour (see sidebar next page).

Regulated flows from Trinity and Lewiston dams initiated severe vegetation encroachment in the 1960s, which confined the river and helped fix the channel in place.

The Vegetation Encroachment synthesis report found that with the restoration flows under the ROD, colonization of woody plants along the low water's edge is infrequent, but that encroachment remains a major factor for the river channel (HVTFD & MA 2021).

On the other hand, vegetation on floodplains above bars is beneficial for generating food for young fish, providing shelter and slow water when the river is up, and providing wood for river hydrodynamics; cottonwoods are of particularly good value for these functions. But cottonwoods need to seed onto floodplains with gradually receding water.

TRRP flow management has been adapted over the last decade to provide better conditions for cottonwood seeding. The timing of cottonwood seeding is quite variable. The Cottonwood Dispersal synthesis report (Bair et al. 2020) analyzed several years of dispersal data to better target the timing of dispersal and more reliably configure flow releases to support cottonwood germination on floodplains.

Flow Scheduling for Riparian Vegetation

In addition to providing numerous benefits to fish as a source of cover, shade and food for insects, riparian vegetation also provides habitat elements for songbirds and other wildlife species and is an important component of the Program's strategy to restore natural processes.

Planting cottonwoods, willows, and other species at individual channel rehabilitation sites is a very visible method of promoting vegetation. In addition to revegetation methods at channel rehabilitation sites, the TRRP also relies on flow releases from Lewiston Dam to manage vegetation. The TRRP models the vegetation responses to proposed flow schedules using the computer model, Tool to Assess Riparian Germination and Establishment on Targeted Surfaces (TARGETS). TARGETS models the bank location where cottonwoods and willows are likely to grow along different cross-sections of river channel, based on the flow patterns of a proposed dam release schedule. This model, first created in the early 2000s, was updated in 2018 and has been applied during flow scheduling since 2019.

Riparian Encroachment

Native vegetation provides many resources to the river. However, in regulated rivers such as the Trinity River below Lewiston Dam, the loss of large floods, coupled with stable summer flows, can result in continuous bands of unnaturally dense vegetation along the summer water line. This vegetation shapes bars and banks into areas that are unfavorable for rearing salmonids and can hasten the development of steep berms along the banks. Using managed streamflows to discourage woody plant encroachment was a primary objective identified in the TRFE and is a long-standing TRRP goal. Vegetation monitoring has indicated that managed streamflows releases have discouraged woody plant encroachment as described in a riparian encroachment synthesis report (HVT and McBain Associates 2021, in prep).

Bed Mobility and Scour

One important aspect to restoration flows is the refreshing of gravel bars and scour of willows along the river's edge to maintain bars. Sediment transport studies have long suggested that restoration flows mobilize gravels less than anticipated by the Trinity River Flow Evaluation study (USFWS & HVT 1999). In a recently completed synthesis report, Hales et al. (2020) developed a predictive model for the ability of restoration flows to mobilize gravels where it may count the most: on gravel point bars.

Left: Willow growth along the Trinity River.

Right: Alcove at Bucktail constructed in 2016, where seedlings of multiple species and age classes were observed during WY 2019 riparian recruitment monitoring.

The WY20 hydrograph was reflective of a critically dry year. No woody plant recruitment or seedling scour objectives are associated with a Critically Dry Year (Reclamation, HVT and USFWS 1999). Past results of annual riparian band transect and exposed bar monitoring showed that, in most years, riparian hardwoods will be scoured from the low water edge by winter storms (tributary-generated floods) and spring ROD releases.

Seedlings become established after four growing seasons, after which their root systems are too extensive to be scoured by ROD flow releases alone. Since 2000 at least one cohort (WY 2006) has been documented to have survived to establishment, and is, therefore, beyond the ability of ROD releases to remove via scour. Allowing 2 out of every 13 cohorts to survive to establishment could rapidly lead to further encroachment along the low water channel, especially at newly created habitat within rehabilitation sites.

Survival and mortality patterns have been estimated since 2017 (Table 6). Estimates are based on relationships between flood peak magnitude and seedling scour and have not been verified through filed sampling.

Physical and Biological Responses (continued)

Table 6. Peak Flow Magnitudes Related Riparian Seedling Scour. Cohort survival and mortality are estimated in years with an asterisk (*).

Water Year	Instantaneous Maximum Lewiston Discharge (cfs)	Cohorts Scoured	Surviving Cohorts	Established Cohorts
2005	7,640	2004 cohort	None	1993, 1998, 2000, and 2002 cohorts
2006	10,400	2003, 2004, and 2005 cohorts		1993, 1998, 2000, and 2002 cohorts
2007	4,810	None	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2008	6,890	2007 cohort	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2009	4,630	None	2006 and 2008 cohorts	1993, 1998, 2000, 2002, 2006, and 2008 cohorts
2010	7,480	2009 cohort	2006 and 2008 cohorts	1993, 1998, 2000, 2002, 2006, and 2008 cohorts
2011	12,300	2008, 2009, and 2010 cohorts	2006 cohorts	1993, 1998, 2000, 2002, and 2006 cohorts
2012	6,180	2011 cohort	2006 cohorts	1993, 1998, 2000, 2002, and 2006 cohorts
2013	4,590	None	2006 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 cohort
2014	3,460*	None	2006, 2012, and 2013 cohorts	1993, 1998, 2000, 2002, 2006, 2012, and 2013 cohorts
2015	8,830	2013 and 2014 cohorts	2006 and 2012 cohorts	1993, 1998, 2000, 2002, 2006, and 2012 cohorts
2016	9,600	2014 and 2015 cohorts	2006	1993, 1998, 2000, 2002, and 2006 cohorts
2017*	12,000	2015 and 2016 cohorts	2006 cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2018*	2,040	None	2006 cohort and 2017 cohorts	1993, 1998, 2000, 2002, 2006, and 2017 cohorts
2019*	10,800	2017 and 2018 cohorts	2006cohort	1993, 1998, 2000, 2002, and 2006 cohorts
2020*	3,970	None	2006 and 2019 cohorts	1993, 1998, 2000, 2002, 2006, and 2019 cohorts

*The peak discharge of 2014 was not associated with spring ROD flows, rather it occurred on September 22, 2013, and was associated with Lower Klamath temperature and health flows.

Fisheries Monitoring

Juvenile Salmon Habitat Assessment

In 2018, the habitat assessment team adopted two-dimensional (2D) hydrodynamic modeling as its primary tool to monitor the effectiveness of channel rehabilitation for increasing juvenile habitat availability. This transition aligned methodologies for site design and monitoring with the intention of facilitating closer collaboration between the Science Program, the habitat assessment team, and the rehabilitation site design team.

Recently, the habitat team developed models of the Deep Gulch and Sheridan Creek sites and is currently developing a report to assess the effect of construction on habitat availability at those sites. In collaboration with the Yurok Tribe, the team will also include metrics of channel complexity related to depth variation and the surface area of the wetted channel to help explain differences between predictions made during the design process and as-built conditions at the close of construction.

Large Wood Monitoring

The TRRP places large wood at channel rehabilitation sites that interact with streamflow to enhance natural river processes and provide juvenile salmonid rearing habitat (Figure 12 next page). In 2020, the habitat team surveyed large wood installations at Chapman Ranch (Figure 13 next page), which was constructed in 2019 and also re-surveyed the Lower Junction City (2014) and Wheel Gulch (2011) rehabilitation sites to fulfill the TRRP's ongoing commitment to long-term restoration monitoring.

Excavator placing willow cluster amongst wood slash material and cobbles at Dutch Creek Site - Sept 2020.

SYNTHESIS REPORT

HABITAT MONITORING SYNTHESIS REPORTS

In July 2020, the habitat team completed a synthesis report entitled *Streamflow and Juvenile Salmonid Habitat Availability at Six Rehabilitation Sites on the Trinity River, California 2008-2017.* This report examined habitat available across a range of flows at six rehabilitation sites before, immediately after, and several years after construction.

While all sites had more habitat after channel rehabilitation, the restoration benefit reduced from the immediate post-construction condition due to reductions in bed relief; however, the sites still had significantly more habitat than their pre-restoration condition (Boyce et al 2020).

This report provides insight into the evolution of features constructed during channel rehabilitation that will enhance future rehabilitation design.

Fisheries Monitoring (continued)

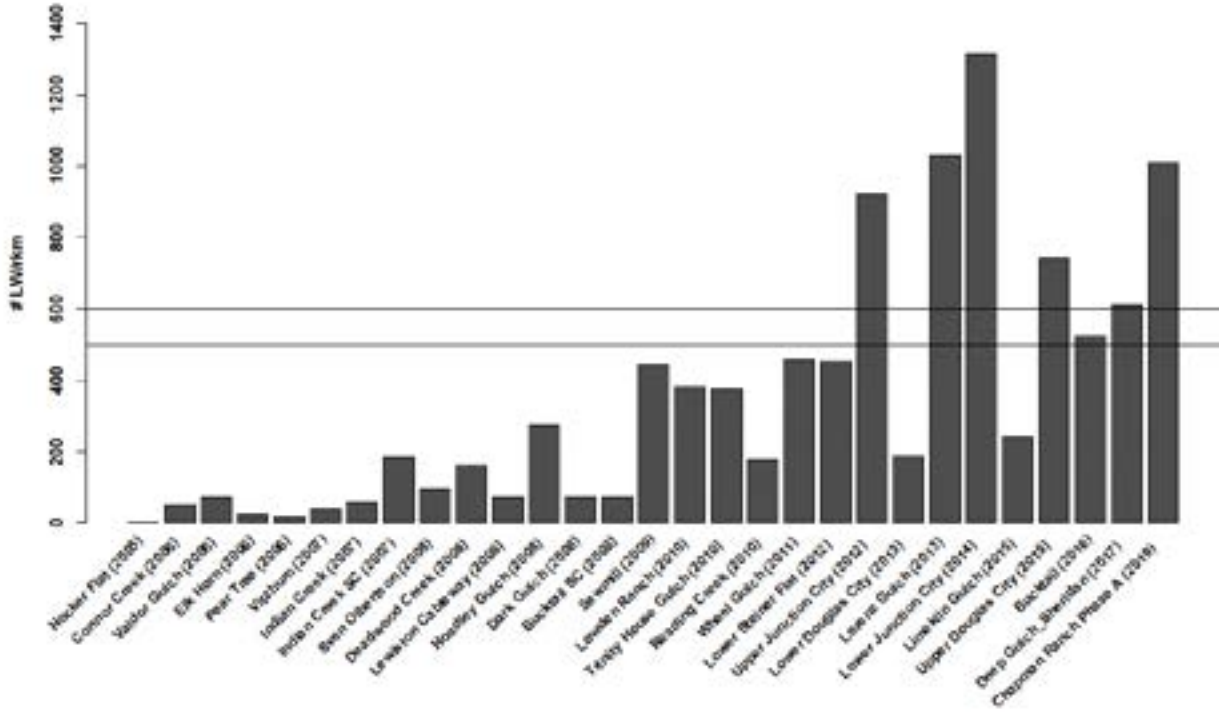


Figure 12. The total number of installed large wood pieces per river kilometer (LW/rkm) for each rehabilitation site after construction. The lines indicate the range of Trinity River-specific recommendations for large wood loading (Cardno Entrix and CH2MHill 2011). Sites are ordered chronologically by year of construction.

Figure 13. Yurok tribe fisheries technician, Axel Erickson, surveying large wood installations at Chapman Ranch Phase A.

Juvenile Chinook Salmon Abundance

Monitoring of juvenile Chinook Salmon on the Trinity River in 2020 was conducted by the Hoopa Valley Tribal Fisheries Department at the Pear Tree Gulch Monitoring Site, and Yurok Tribal Fisheries Program at the Willow Creek Monitoring Site.

Monitoring at the Pear Tree Site began in January 2020 but was interrupted due to the COVID-19 pandemic from roughly mid-March through the end of May 2020. Although it was recognized that sampling at the Pear Tree Site would not generate a season-wide population estimate of juvenile Chinook Salmon, sampling resumed in late May to test monitoring assumptions utilizing juvenile Chinook Salmon obtained from Trinity River Hatchery (TRH). In a normal year, these juvenile salmon from the hatchery are used to estimate weekly trapping efficiency of the monitoring equipment (rotary screw traps) to generate season-wide population estimates.

Monitoring at the Willow Creek Site was able to continue through the COVID-19 pandemic and therefore will be able to generate a season-wide population estimate. However, juvenile Chinook Salmon were not coded-wire-tagged at TRH due to the COVID-19 pandemic. Coded wire tagged (CWT) salmon are essential for estimating the proportion of hatchery fish in the season-wide estimate of juvenile Chinook Salmon. The lack of the CWT salmon in 2020 is precluding us from estimating abundance of naturally produced juvenile Chinook Salmon, but we are working on developing an estimation method based on fork length of captured fish to estimate the proportion of hatchery reared fish in the catch.

This process is ongoing and expected to be completed by end of summer 2021; the 2020 estimates of naturally produced juvenile Chinook Salmon will be released as soon as estimates can be generated.

Salmon Redd Distribution and Abundance

Since 2002 the USFWS, USFS, CDFW, HVT, and YTFP have conducted annual salmon spawning surveys on the mainstem Trinity River to evaluate the distribution and abundance of Chinook Salmon spawning activity.

JUVENILE OUTMIGRATION SYNTHESIS REPORT

For several years we have known that the numbers of young Chinook migrating out of the Trinity River has increased. However, that increase has not resulted in a similar increase in returning adults.

The question of why has many facets and may include factors of fish health as they exit the Trinity River, traveling through the Lower Klamath and many points beyond.

Analysis of juvenile Chinook growth and the timing of their outmigration, in relation to flows and water temperatures, found that early spring flows correspond to better consumption and growth conditions while the cold temperature of releases in May corresponds to lower consumption and growth (Gast Associates 2021), suggesting the need for better control of the temperature of water released from the reservoirs.

Fisheries Monitoring (continued)

Surveyors located 1,739 salmon redds and examined 1,169 salmon carcasses during the 2020 survey season. Of the carcasses, 423 were fresh Chinook Salmon and 4 were fresh Coho Salmon. Natural-origin Chinook Salmon built an estimated 1,296 redds, hatchery-origin Chinook Salmon built 337 redds, and Coho Salmon built the remaining 106 redds (Table 7). The number of redds observed in 2020 was the third lowest since the survey, in its current iteration, was initiated in 2002 (Figure 14).

Hatchery-origin Chinook Salmon tended to spawn relatively close to the Trinity River Hatchery located at the base of Lewiston Dam. A large proportion of natural-origin Chinook Salmon spawned in the area just below the dam as well; however, their redds were more distributed downstream, mainly throughout the restoration reach (Figure 15 next page).

Table 7. Estimated Numbers of Chinook and Coho Salmon Redds Observed in the Mainstem Trinity River in 2020.

Species	Origin	2020
Chinook Salmon	All	1,633[b]
	Natural	1,296[b] (1,085-1,450)
	Hatchery	337 (183-548)
Coho Salmon[a]	All	106[b]
	Natural	N/A[c]
	Hatchery	N/A[c]

Bootstrap-generated 95% confidence intervals are in parentheses.
[a] The survey season only partially covers the Coho Salmon spawning period.
[b] Confidence intervals are generated with both Chinook and Coho Salmon data. Not enough female Coho Salmon carcasses were found in 2020 to calculate a confidence interval.
[c] Not enough fresh female Coho Salmon carcasses were found in 2020 to calculate separate estimates for natural- and hatchery-origin Coho Salmon redds.

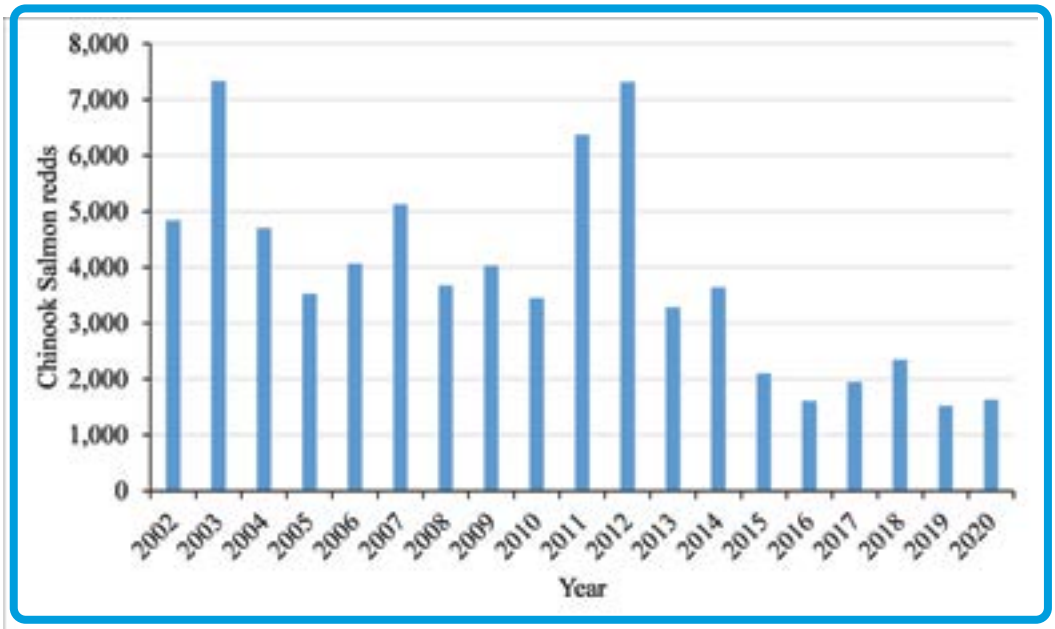


Figure 14. Estimated numbers of Chinook Salmon redds in the mainstem Trinity River, California, from 2002 to 2020.

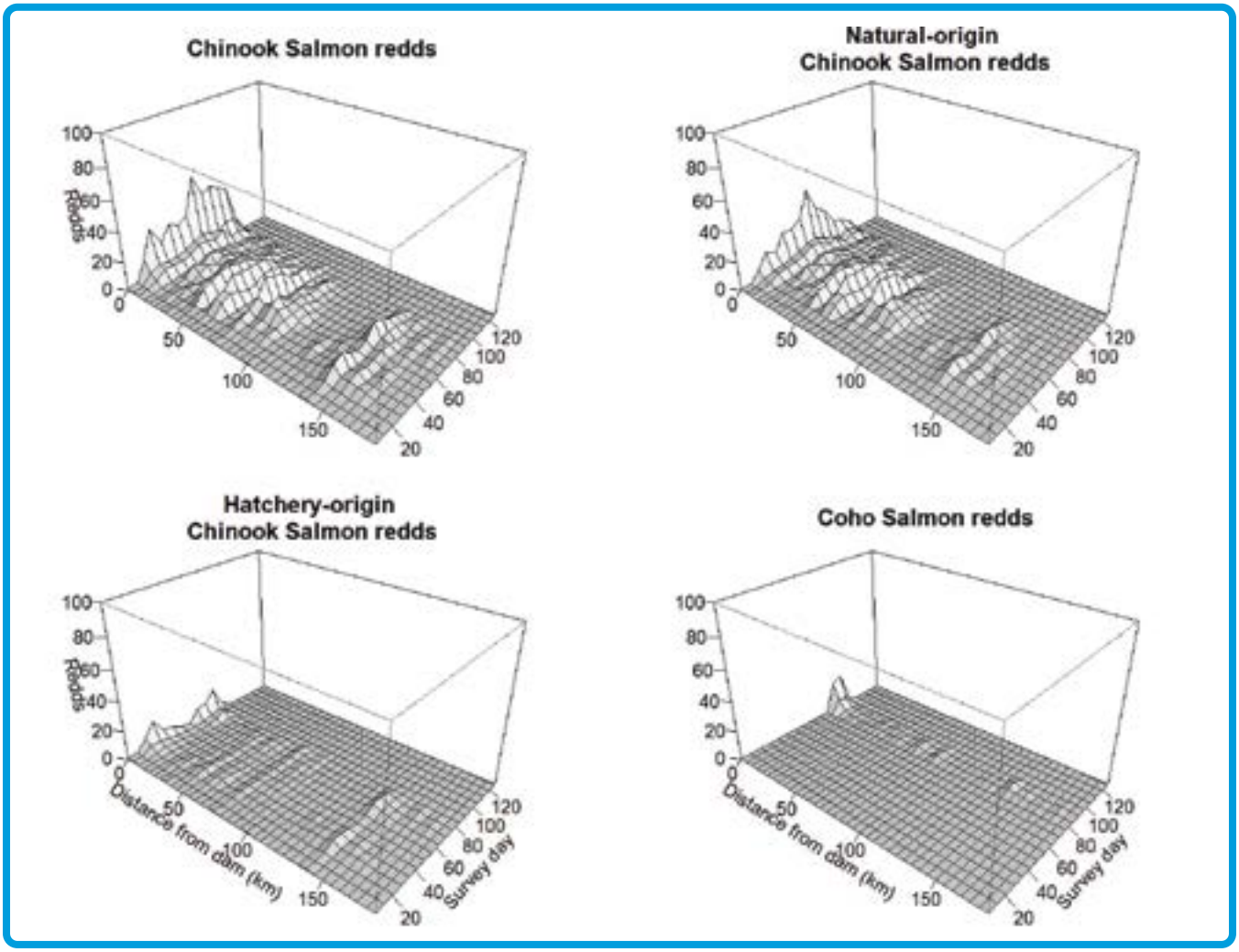


Figure 15. Spatiotemporal distribution of salmon redds observed in the mainstem Trinity River, California, in 2020. Pigeon Point and Burnt Ranch whitewater reaches were not surveyed. Survey Day l = September 1.

The USFWS survey crew searching for salmon redds and carcasses in the Trinity River. The first weeks of the 2020 surveys coincided with extensive wildfires in California and Oregon.

A 'fresh' Chinook Salmon carcass is spotted during a Trinity River spawning survey.

Salmonid Spawning Escapement and Harvest

Each year, TRRP supports monitoring for run-size, escapement and harvest of natural origin (NOR) and Trinity River hatchery origin (HOR) fall run Chinook Salmon in the Trinity River.

An estimated run-size of 24,957 (95% CI 18,553 – 34,996) fall Chinook Salmon migrated upstream of Willow Creek weir in 2020, with an additional 633 spawning in the mainstem river and tributaries downstream of Willow Creek weir (Kier et al, 2021, in prep., KRTT 2021). The run consisted of an estimated 6,607 age-2 jacks (2,504 NOR and 4,103 HOR) and 18,350 adults (7,779 NOR and 10,571 HOR). An estimated harvest of 0 jack and 328 adult fall Chinook Salmon yielded an adult escapement of 18,022, including 13,734 (7,113 NOR and 6,621 HOR) estimated natural area spawners and 4,288 (527 NOR and 3,761 HOR) that entered Trinity River Hatchery (Figure 16).

Escapement of 7,640 NOR adult fall Chinook Salmon is 12.3% of the 62,000 fish Trinity River Restoration Program goal. Details on the 2020 Trinity River adult salmonids monitored incidentally to the fall Chinook Salmon are provided in Table 8.

Species	Natural-Origin Escapement		Hatchery-Origin Escapement	
	2020	Program Goal	2020	Program Goal
Spring Chinook Salmon	535	6,000	1,989	3,000
Fall Chinook Salmon	7,640	62,000	10,382	9,000
Coho Salmon	224	1,400	3,197	2,100
Fall Steelhead	2,029	40,000	1,463	10,000

Table 8. Preliminary 2020 adult escapement estimates for Trinity River salmonids upstream of Willow Creek Weir (Kier et al. 2021, in preparation).

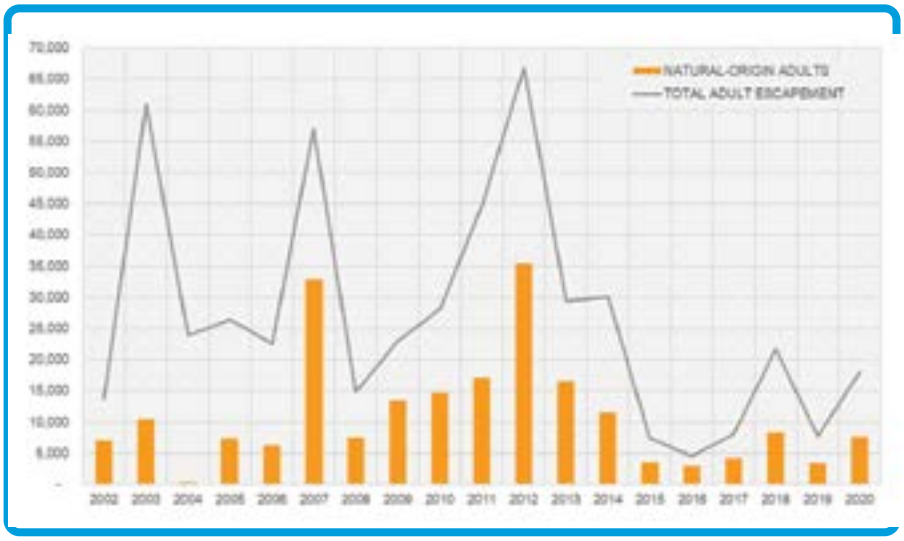


Figure 16. Natural-origin adult fall Chinook Salmon escapement upstream of Willow Creek Weir, 2002 - 2020 (includes returns to natural spawning areas and Trinity River Hatchery).

Adult Fall Run Chinook Salmon Harvest

TRRP supports dependent ocean fisheries, as well as in-river recreational and tribal fisheries as part of the goal to restore anadromous fish populations. Natural and hatchery-origin fall Chinook Salmon from the Trinity River support the recreational fishery and the Hoopa Valley Tribal fishery on the Trinity River and contribute to the recreational fishery and the Yurok Tribal fishery in the lower Klamath River below its confluence with the Trinity River.

In 2020, an estimated 376 adult fall Chinook Salmon were harvested in the recreational fishery on the Trinity River and 3,152 were harvested on the lower Klamath River (river mouth to Weitchpec). The estimated tribal harvest of adult fall Chinook Salmon was 979 fish by the Hoopa Valley Tribal fishery and 4,233 fish by the Yurok fishery. These estimates include both natural-origin and hatchery-origin fish.

Data Management

Data forms the basis for assessing restoration performance, measuring progress towards goals and objectives, and designing channel rehabilitation projects and hydrographs. Effective data management ensures that TRRP has the resources needed to analyze past actions and plan for future actions, yielding better adaptive management and decision support.

Data stewardship practices encompass quality assurance and quality control, information security, public and partner accessibility, and usable documentation to preserve data's value through time.

The Program's primary outlet for data is our DataPort, which fosters the usability of data and information across the partnership by making it accessible to restoration professionals and to the public. A growing number of data resources are managed through the DataPort, many of which are integrated into other portions of the website.

Aerial Photography

High-resolution aerial photography may be TRRP's most widely used type of data since it provides the context for documenting changes in the river channel, designing restoration actions, planning scientific investigations, and communicating both within the TRRP and with the public. Aerial photography data sets going as far back as 1944 allow the public and TRRP partners to view changes on the river over time and are available in our DataPort maps (https://www.trrp.net/dataport/map).

Aerial photography for the restoration reach was collected July 17, 2020. In addition to aerial photographs, detailed topographic models from data collected by aerial LiDAR (light detection and ranging), photogrammetry from unmanned aerial systems (UAS, a.k.a. "drones"), and boat-based bathymetric sonar are often completed to document changes at rehabilitation sites or other locations along the river. Reach-wide data collection occurs less frequently due to the cost of data collection. However, TRRP staff collected topographic data at two pools in 2020 to support a temperature stratification study. Data collection included traditional manual surveys, high-accuracy GPS, sonar, and photogrammetry, including underwater photogrammetry of a pool upstream of Trinity Lake (Figure 17 next page).

DATAPORT

https://www.trrp.net/dataport

Over 1,600 reports and other documents, and over 100 data packages, including reports and documents dating back to 1900, are searched and downloaded from the DataPort Document and Data Library.

DATA RESOURCE LINKS

- **DataPort library**
  https://www.trrp.net/library
- **TRRP.net home page**
  https://www.trrp.net
  (Scroll to see a table of current river flows and multiple graphs that are resourced from the DataPort.)
- **The Restoration Action Database (RAD)**
  https://www.trrp.net/dataport/rad
  A collection of tabular data on completed projects within the TRRP focal reach and also includes watershed improvement projects and previous non-TRRP efforts.
- **A mapping application**
  https://www.trrp.net/dataport/map
  Access to aerial photography, restoration designs and as-builts, modeled flow extents, and a variety of other geospatial data.
- **The RiverView Application**
  https://www.trrp.net/dataport/river-view-launch
  Provides an oblique point-of-view for the restoration reach and a virtual float down the river.
- **TRRP Synthesis Reports**
  https://www.trrp.net/restoration/adaptive-management/synthesis-reports/
  These reports are organized according to three categories that can be used to monitor responses to restoration actions: 1) Physical, 2) Fisheries, and 3) Riparian and Biological.

Data Management (continued)

Other localized aerial photography and topography data collections are now performed by TRRP tribal partners using UAS (unmanned aerial systems, or “drones”). UAS activities for TRRP are reported on our website (https://www.trrp.net/dataport/uas).

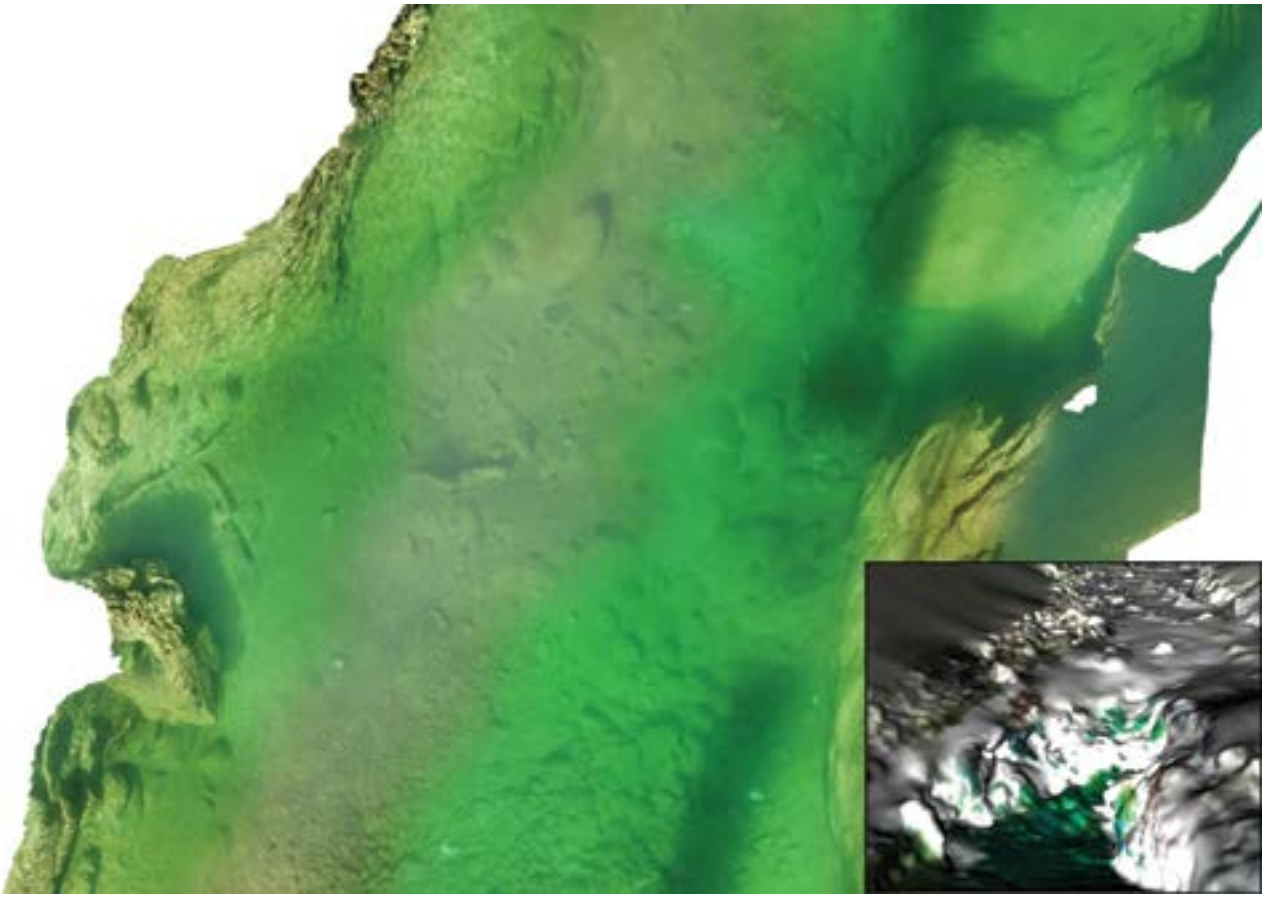


Figure 17. Upper Trinity Pool. A study of temperature stratification in pools was initiated in 2020. A variety of data were collected at one pool located upstream of Trinity Lake that lacked prior high-resolution topographic data. This shows the photogrammetric orthoimagery derived from underwater photography at the pool along with a view of 3D topography data (inset).

TRRP Staff surveying the Upper Trinity Pool in September, 2020.

Environmental Compliance and Mitigation

NEPA, CEQA, and Other Mandates

A multitude of statutes, Acts, and Executive Orders, in addition to NEPA and CEQA, provide regulatory guidance and broadly define the type and intensity of actions that the TRRP may perform to benefit the health of the Trinity River fishery. The Regulatory Framework is broadly described in Section 3 of the 2009 Master Environmental Impact Report (2009 Regional Water Board and Reclamation[1]).

The TRRP works with numerous partners, collaborators, and public and private stakeholders to meet legal guidance requirements and inform decision making. As part of this effort, Reclamation staff work with Federal land managers (e.g., BLM and USFS) and the North Coast Regional Water Quality Control Board (the Regional Water Board), as our CEQA Lead Agency, to meet federal, state, and local requirements for implementation activities. The TRRP works with our permitting agencies (the Army Corps of Engineers, Trinity County, etc.) to facilitate implementation and monitoring of restoration projects so that our projects may quickly bring meaningful support to beneficial uses in the watershed. In 2020, TRRP office staff worked with federal partner agencies (the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) who administer the Endangered Species Act for wildlife and ocean fisheries) to develop programmatic coverage for potential project implementation impacts to federally threatened and endangered species. The resulting Biological Assessments (BA), and Opinions (BiOps), and Letter of Concurrence (LOC), could simplify permitting of restoration-based projects within the Trinity River watershed as described below.

Biological Assessments

Since the signing of the ROD and implementation of restoration projects, new information has been evaluated and initial approaches to restoration refined, so that the TRRP is better able to implement the ROD. In addition to new implementation techniques, the status of several species and their designated critical habitat have also changed so that re-initiation of consultation with the NMFS pursuant to Section 7 (a)(2) of the ESA on the ongoing implementation of TRRP activities was required. The TRRP's Programmatic Biological Assessment (BA[2]) was provided to the NMFS in December 2019 and analyzes the effects of TRRP activities associated with physical channel rehabilitation, sediment management, watershed restoration activities, infrastructure improvements or modifications, and the adaptive management process, specifically fish monitoring and handling activities (collectively, the action).

A new biological opinion (BiOp[3]) to cover TRRP's non-flow related restoration and monitoring activities was received from the NMFS in August 2020.

[1] https://www.trrp.net/library/document/?id=476

[2] https://www.trrp.net/library/document?id=2471

[3] https://www.trrp.net/library/document?id=2472

Environmental Compliance (continued)

One exciting aspect of this new BiOp is that the Army Corps of Engineers, U.S. Fish & Wildlife Service, Bureau of Land Management, and U.S. Forest Service all formally signed as participating agencies in the consultation, so our incidental take coverage can extend to them. Also, the BiOp allows Reclamation (the TRRP office) to adopt other projects (e.g., proposed by NGOs or local agencies), even those not funded or permitted by any of the federal agencies, as long as they do not exceed our annual take allotment and provided that they conform to the required TRRP conservation measures. This will streamline much needed implementation of restoration within the watershed.

For instance, the recently implemented Indian Creek stage-0 project (by the Yurok Tribe) was partially funded by TRRP Watershed funding and explicitly included in our biological assessment, so that ESA consultation requirements were met for this project before the rest of the permits were obtained.

In 2020, the TRRP also completed a separate ESA section 7 consultation with the USFWS on Threatened, Endangered, and Proposed Wildlife Species that May be Affected by the Trinity River Restoration Program's Mechanical Channel Rehabilitation, Sediment Management and Watershed Restoration, and Monitoring Actions. In our BA for this work,[1] Reclamation (TRRP office) determined that the proposed action "May Affect, is Not Likely to Adversely Affect" (MANLAA) the federally threatened Northern Spotted Owl (*Strix occidentalis*; NSO) and Marbled Murrelet (*Brachyramphus marmoratus*; MAMU) and that ongoing implementation of the TRRP is "Not Likely to Adversely Affect," their critical habitats.

In their Letter of Concurrence,[2] the USFWS supported the TRRP's MANLAA determination for the owl, murrelet, and gray wolf (*Canis lupus*) and noted that proposed TRRP activities are expected to support substantial long term gains in habitat and riverine function that will benefit the river ecosystem and ecological processes that support it. Similar to the BiOp for listed SONCC Coho Salmon, the USFWS' LOC is meant to be flexible so that it may facilitate ecologically sound projects, that utilize TRRP Best Management Practices, within the watershed.

Channel Rehabilitation

In 2020, TRRP staff worked closely with the BLM, USFS, Trinity County, and the Regional Water Board to meet environmental compliance and permitting requirements, for the Chapman Ranch Phase B and Oregon Gulch channel rehabilitation projects. The Chapman Ranch Phase B Project Environmental Assessment/Initial Study, to meet NEPA and CEQA requirements, was completed in September 2020. After the USFS completed its final posting of the EA and their proposed Finding of No Significant Impact (FONSI) Decision Notice, the project was authorized for construction in March 2021.

The Oregon Gulch channel rehabilitation project kicked off its environmental compliance efforts with a virtual Scoping Meeting in October 2020; NEPA and CEQA were completed in May 2021. The Oregon Gulch project is different from other TRRP efforts because its valley-wide scale and the need to dispose of large amounts of excavated mine tailings off site. At Oregon Gulch, the TRRP proposes to move up to 500,000 cubic yards of old tailings out of the river so that more area is available for habitat and riverine processes. Specifically, the Oregon Gulch project proposes to create up to 1,000 times more juvenile rearing habitat for small salmon at the site.

[1] https://www.trrp.net/library/document/?id=2485

[2] https://www.trrp.net/library/document?id=2486

Environmental Mitigation

To ensure that functioning wetland and riparian habitats are maintained after project construction, the TRRP avoids, minimizes, and mitigates native vegetation impacts, but this can be difficult when the project requires large-scale floodplain lowering (excavation) of the earth on which the plants live. Through vegetation monitoring, we have learned much of what is needed to initiate self-sustaining native vegetation and have increased plant colonization and survival on our newly constructed surfaces. New techniques have improved the success of both planted and naturally regenerated plants at restoration sites and will hopefully allow vegetative self-maintenance in the future.

TRRP permits require 1:1 replacement of riparian habitat and wetlands. In 2020, the TRRP completed Army Corps restoration permit reporting for our channel rehabilitation project that enumerated our impacts on wetlands and "Waters of the U.S." (e.g., ephemeral streams, perennial streams, and seasonal wetlands) through the 2014 Lower Junction City (LJC) Project.

Accounting through the 2014 LJC project, TRRP reports a cumulative total increase in "Waters of the U.S." at our channel rehabilitation sites of 76.3 acres. Though we predicted that "Waters" would increase with implementation of the ROD this reporting indicates site specific ways that "waters" increase at each site. In some cases, the channel of the river has scoured and increased in size, in others, wetlands and side channels have resulted in the increase.

TOP: Indian Creek "stage-0 " watershed project in November 2020. The Trinity River watershed project was constructed by the Yurok Tribe in 2019 using the 2020 Biological Opinion for ESA coverage. The project is expected to increase water availability in the reach and to benefit salmon (including listed SONCC Coho Salmon) and steelhead habitat.

CENTER: Willow cuttings at Indian Creek "stage -0 " watershed project. The Trinity River watershed project was constructed by the Yurok Tribe in 2019 using the 2020 Biological Opinion for ESA coverage. This trench, with straw used to increase water holding capacity of the soils, is planted to support willow growth which would in turn provide shade and cooling for the Indian Creek site.

BOTTOM: Black Cottonwoods thriving at the 2011 constructed Wheel Gulch channel rehabilitation site.

Environmental Compliance (continued)

Turbidity

Turbidity, a measure of suspended solids in water, in the Trinity River naturally increases during storms or other runoff events and may also be caused by construction or other human activities in the river. As the CEQA lead agency for the Master EIR, the Regional Water Board worked with TRRP to develop water quality mitigation measures for TRRP activities, such as gravel augmentation or channel rehabilitation.

In 2020 the Regional Water Board reissued the TRRP's General Water Quality Certification for channel rehabilitation (now R1-2020-0025) (Pursuant to Section 401 of the Clean Water Act (33 USC 1341) and the TRRP's gravel augmentation certification (now WDID 1A09154WNTR). Both these permits state that "Project Impacts shall not increase turbidity levels at the point of compliance (500 linear feet downstream of the point impact) greater than 20 percent above naturally occurring background or 20 NTUs whichever is greater" (California WQCB, 2015). The summer construction period and general permit condition requirements ensure that TRRP restoration activities minimize impacts to the Trinity River ecosystem.

Cultural Resources

Much of TRRP's work is confined to the floodplain, where historic resources have lost much of their integrity during flood events. However, the large scope of the channel rehabilitation projects and the remaining historic sites along the river (e.g., Trinity Historical Mining District) highlight the need for a comprehensive analysis of historic resources throughout the restoration reach. Pre-project surveys at channel rehabilitation sites enable TRRP to design around areas that might be of historic interest. Cultural resource surveying at the proposed Sky Ranch project site is sorting through recorded history on the LaGrange mine and its activities. As field surveys are completed in the area, historical details concerning what activities were tied to the LaGrange mine are sorted through so that a better picture of mining activity on site is available before the landscape is changed by channel rehabilitation.

Archaeological excavation test unit within residential locus at Hager Haas Placer Mine, within the proposed Sky Ranch channel rehabilitation site. Based on this testing, it was determined that the residential use of this location came well after the hydraulic mining and did not appear associated. Artifacts found included personal items, hardware, auto parts, and other residential items.

Close up of the archaeology sampling screen showing many round wire nails and other items. These items are indicative that the site was inhabited after the period of hydraulic mining when nails were square.

Photos courtesy of William Rich and Associates Cultural Resource Consultants

FEMA Floodplain Mapping and County Floodplain Development Compliance

Updated Flood Insurance Rate Maps (FIRM), also called Flood Hazard Maps, became effective for the Trinity River in 2016. The TRRP continues to work with Reclamation's Technical Service Center, Trinity County, and the Federal Emergency Management Administration (FEMA) to update the FIRMs to include changes from projects constructed in 2017 and 2019 through the Letter of Map Revision (LOMR) process.

For current projects, Trinity County submits a Conditional Letter of Map Revision (CLOMR) application prior to construction and follows up with a LOMR application based on surveyed conditions and hydraulic modeling post-construction to ensure that projects perform as predicted by the CLOMR. Reclamation conducts hydraulic modeling of the design condition to evaluate impacts of the proposed project on flood elevations and assists the County in submitting the CLOMR application. In December 2020, a CLOMR application to FEMA was submitted and the Chapman Phase B Project CLOMR was received in June 2021. The CLOMR is currently the TRRP's most time-consuming permit.

Dutch Creek project looking upstream during construction 2020. Photo courtesy of the Yurok Tribe.

Public Outreach in 2020

The TRRP strives to inform and collaborate with a diverse group of stakeholders. In 2020 the TRRP continued its commitment to engage with stakeholders in a variety of ways and increase participation through educational opportunities, public meetings, and informational resources.

Community Engagement

In the first part of 2020 the TRRP sponsored and participated in several community events with informational booths on restoration monitoring and channel rehabilitation design development. As events transitioned to virtual and socially distanced in early 2020, the TRRP continued to engage with stakeholders in new ways through locally produced nature videos highlighting salmonids and native riparian plants, by sponsoring a socially distanced river clean-up event, and a watershed focused photo contest.

Public Meetings

On November 5, 2020 the TRRP held a virtual public scoping meeting for the proposed Oregon Gulch channel rehabilitation project. The meeting provided an important venue for the community to ask questions and provide input on the proposed restoration activities at Oregon Gulch. In addition to meetings to describe proposed projects and their potential environmental impacts, TRRP staff regularly met with various stakeholders to discuss broader TRRP actions and implementation plans.

Program Informational Materials

A new TRRP programmatic overview brochure was revamped in 2020 to reflect monitoring results, evolution in channel rehabilitation design strategy, and flow scheduling priorities. The TRRP continued funding the publication and distribution of Trinity County Resource Conservation District's newsletter, the Conservation Almanac to reach a wider audience within the Trinity River watershed. In collaboration with staff from Reclamation's Columbia-Pacific Northwest regional office the TRRP produced a video highlighting channel rehabilitation efforts at the Dutch Creek project.

TRRP Booth at the (pre-pandemic) 2020 Trinity County Art Cruise

In addition to resources on Trinity River flows, calendar announcements, scientific data, technical papers, and other information are regularly updated on TRRP the website, http://www.trrp.net/.

Environmental Education

The TRRP continued its support of environmental education in partnership with the Trinity County Resource Conservation District. In place of in-person learning events, the TRRP expanded interactive learning opportunities to connect youth with the Trinity River watershed by developing and sharing educational videos, and nature guidebooks distributed to students in local schools.

Every year the TRRP and TCRCD host the annual Trinity River Salmon Festival to celebrate the return of the fall salmon. Although this event could not be in-person, staff created a month-long virtual event, Salmon Season in November. This event allowed educational efforts to reach a wide audience through online platforms and created materials that will last for years to come.

To access the videos and other online materials, visit Trinity River, CA on YouTube and at the website: www.trinityriver.org.

TRRP & RCD Staff at the (pre-pandemic) 2020 Trinity County Art Cruise

Dissect a salmon with Coho Kevin and Elizafish.

Tour the recently completed restoration project at Indian Creek with Kyle DeJulio, Fisheries Biologist for the Yurok Tribe.

Explore why forests need fish.

Learn about the salmon life cycle with Watershed Stewards Program members placed with the Watershed Research and Training Center.

LOOKING AHEAD:

2021 Program Activities

In 2021, the Program continues to execute the restoration strategy based on its foundational documents while pursuing ways to evolve through adaptive management as new information is collected and evaluated. Actions planned for 2021 include:

- Provide flow schedule modeling, planning, and implementation
- Continue supporting efforts to identify priority watershed improvement projects
- Develop recommendations for coarse sediment augmentation locations and amounts, depending on the water year type and how much water is available to mobilize it, and explore possible alternative gravel augmentation sites
- Examine the influence of naturally variable winter and summer flows on Trinity River fisheries health and production
- Finalize and integrate the synthesis reporting work to plan the future restoration monitoring activities

Flow Management

At the direction of the TMC, the program continues to explore how to optimize use of our restoration water volume to better meet ROD objectives. Presently, the program cannot release water above constant 300 cfs base flow during the winter and early spring period (specifically until after the April water year forecast is made by CA DWR), a time when the river would naturally be fluctuating in response to rain and snow storms and when some very important runs of salmonids are growing and migrating out to sea.

In 2021, the TRRP will be initiating analyses and NEPA review of a proposal to shift water-year specific volumes earlier in the year. The intent is to mimic a more natural hydrograph to have better stream temperatures for fish and wildlife growth, better food availability from floodplain inundation, and get more geomorphic change in the channel by piggybacking winter releases with high flow events in tributaries.

Channel Rehabilitation

TRRP will begin construction on Phase B of the Chapman Ranch Channel Rehabilitation Project approximately three miles upstream from Junction City, California. In addition to implementation of Chapman Ranch Phase B TRRP design groups will continue developing and reviewing designs and moving forward the permitting for the Upper Conner Creek, Sky Ranch, and Oregon Gulch channel rehabilitation projects.

Environmental and Other Compliance

Primary emphases in 2021 will be on completing the permitting of the Oregon Gulch Channel Rehabilitation Project and completing an Environmental Assessment of the winter flow variability proposal described above. TRRP will also continue to update post-construction wetland monitoring reports, and work with Trinity County to finalize LOMRs for previous channel rehabilitation projects.

2021 ACTIVITIES

Stakeholder Involvement

Outreach and other forms of stakeholder involvement continue through:

- Updating and adding new features to the TRRP website to share program information in easily accessible platforms
- Working with river-front property owners and private landowners on rehabilitation projects in the Junction City area
- Working with TMC partners and the Headwaters Corporation on the TRRP Refinements process, which will include a proposal for a new stakeholder advisory council to replace the disbanded Trinity Adaptive Management Working Group.

Annual Trinity River Public Float. TRRP and the Trinity County Resource Conservation District host an annual float to discuss the Trinity River and our restoration efforts with the general public.

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Additional Web Resources

http://www.trrp.net/background
The TRRP website with information on the Trinity River and the Program.

http://www.trrp.net/program-structure/foundational-documents/
A chronological list with links to foundational and other pertinent documents.

http://www.fws.gov/arcata/fisheries/activities/habRestoration/default.html
Describes the TRRP on the Arcata Fish and Wildlife Service web site.

https://www.usbr.gov/mp/cvp/
The Bureau of Reclamation's website for the Central Valley Project.

http://en.wikipedia.org/wiki/Central_Valley_Project
A description of the Central Valley Project available on Wikipedia.

http://www.trrp.net/program-structure/background/rod
Record of Decision and Legislative history on TRRP website.

http://www.fws.gov/arcata/fisheries/reports/technical/Trinity_River_Flow_Evaluation_-_Chapter_1-2.pdf
Legislative history from Chapter 2 of the Flow Study.

http://www.fws.gov/arcata/fisheries/reports/technical/treis/draft/trin_eir/ch_1.pdf
Legislative history from Sec 1.4 of the Draft TREIS/EIR.

http://www.trrp.net/program-structure/program-structure/trinity-management-council
Trinity Management Council information.

https://www.fws.gov/arcata/fisheries/reports/tamwg/Charter%20&%20Bylaws/SIGNED%20harter,%20Trinity%20River%202017.pdf
Trinity Adaptive Management Working Group Charter.

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Important Terms

ANADROMOUS FISH. Fish that spawn in fresh water, migrate to the ocean to grow, and then return to fresh water to spawn (e.g., salmon and steelhead).

FOSSILIZATION. The process of stabilization and "hardening" of gravel bars by rooted riparian vegetation, which also contributes to increased deposition of alluvial silts on the bars, promoting establishment of yet more vegetation and so on.

GEOMORPHOLOGY. The science of landforms, with an emphasis on their origin, evolution, form, and distribution across the physical landscape.

HYDRAULIC ACTION. Moving or wearing down of material by flowing water. In geologic processes, hydraulic action is also known as erosion.

HYDROGRAPH. A chart that displays the change of a hydrologic variable over time. A discharge hydrograph, for example, shows the rate of flow (discharge) past a specific point in a river on the horizontal axis and the time on the vertical axis.

HYPORHEIC ZONE. A region beneath and alongside a streambed where shallow groundwater and surface water mix.

LIDAR—LIGHT DETECTION AND RANGING. An optical remote-sensing technique that uses laser light to densely sample the surface of the earth, producing highly accurate depth, width, and height measurements.

MORPHODYNAMIC. The study of landscape changes due to erosion and sedimentation.

POINT BARS. Features of alluvial river channels formed by the deposition of sediment on the convex bank of a curve in the channel as erosion of the opposite concave bank occurs.

POINT CLOUD. A set of three-dimensional point locations that provide a digital representation of an object or surface. Point clouds for natural resource sciences are typically derived from laser scanning methods, including aerial light detection and ranging (LiDAR) and ground-based scanners, sonar methods for bathymetry (underwater topography), and recent methods for processing photographs with computer vision techniques. Point clouds often include thousands to millions of points.

PROGRAMMATIC ENVIRONMENTAL DOCUMENT. A programmatic environmental impact statement evaluates the effects of broad proposals or planning-level decisions that may include any or all of the following: a wide range of individual projects; implementation over a long timeframe; and implementation across a large geographic area.

RECORD OF DECISION (ROD). A legally binding document that identifies a Federal agency's decision on how it will proceed with the proposed action identified in an environmental document prepared to comply with the National Environmental Policy Act.

RESTORATION FLOWS. All ROD-mandated flows, including summer and winter base flows and peak flows in the spring.

RIPARIAN. On the bank of a river or other water body or the area of direct two-way interactions between aquatic and terrestrial systems.

Trinity River Restoration Program
PO Box 1300
Weaverville,CA 96093