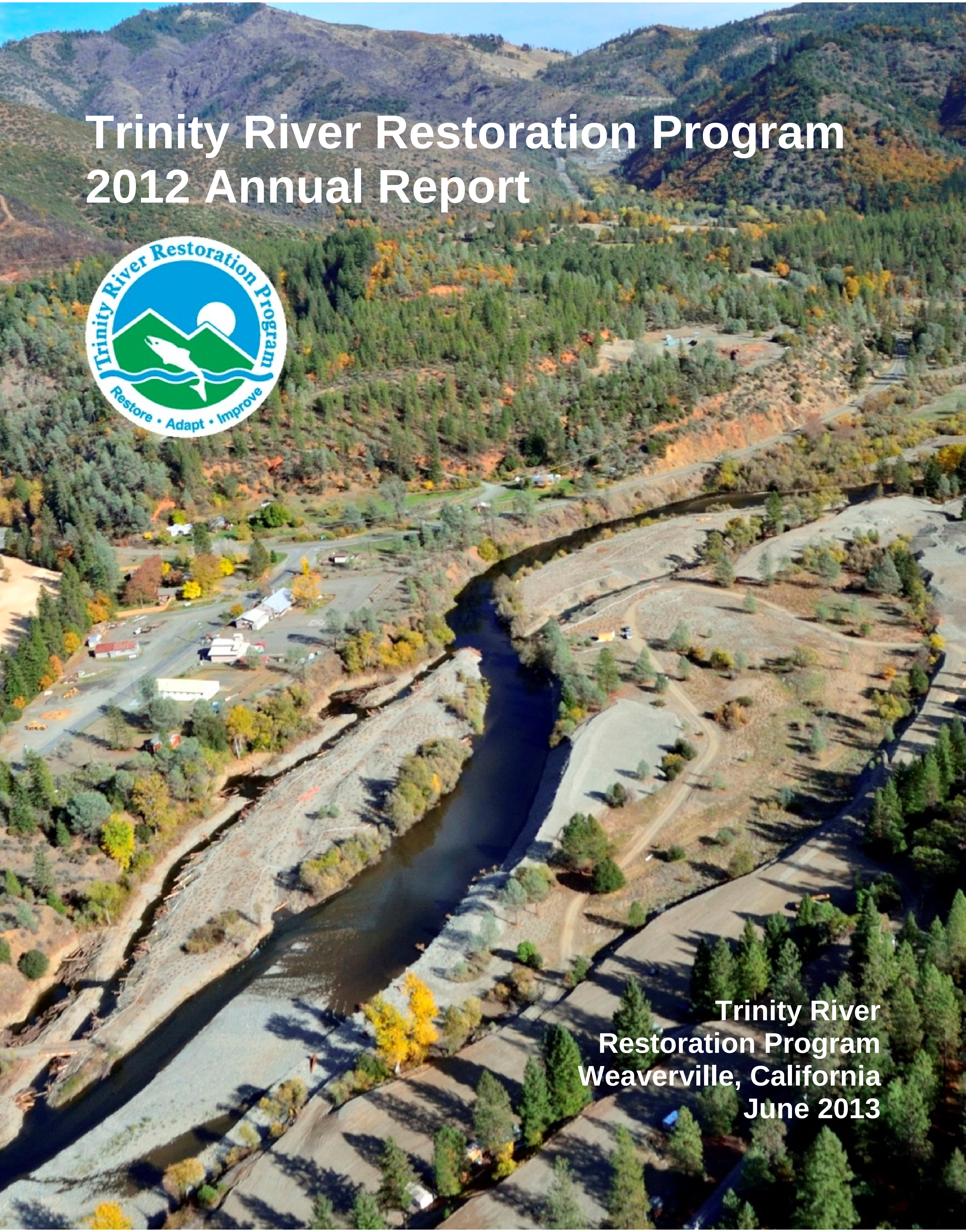
Trinity River Restoration Program 2012 Annual Report



Trinity River
Restoration Program
Weaverville, California
June 2013

Trinity River Restoration Program

Thank You

To the Trinity River Restoration Program partners for their contributions to this report.

ON COVER: Aerial view of the Upper Junction City rehabilitation site. The simple channel formerly found at this site has been transformed to provide additional fish and wildlife habitat through split flow channels, side channels, wood structures and ponds.

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Introduction

Background

The Trinity River Restoration Program (TRRP or the Program) is a 12-year-old partnership of Federal, State, Tribal, and Trinity County entities that share in the responsibility to restore the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River. The Program was formed to mitigate for effects of the dams built on the Trinity River in the 1960's, Trinity Dam and Lewiston Dam. Greatly reduced flows in the river led to a steep decline in anadromous fish in the river. The restoration of these fishery resources takes a collaborative effort with other Federal, State, and local entities to develop projects beneficial to the fish, the river, and the watershed, and to meet tribal and public trusts. TRRP was founded in 2000, based on three comprehensive foundational documents:

1. The landmark Trinity River Flow Evaluation Final Report (TRFES) prepared by the U.S. Fish and Wildlife Service and the Hoopa Valley Tribe (USFWS and HVT 1999) with technical support from the U.S. Geological Survey, Bureau of Reclamation, the National Marine Fisheries Service, and the California Department of Fish and Game;
2. The Trinity River Environmental Impact Statement Final Report (TREIS/R; U.S. Fish and Wildlife Service et al. 2000);
3. The Record of Decision (ROD; U.S. Department of the Interior 2000), which summarized the concepts found in the originating documents.

The active rehabilitation work of the Program did not begin until 2005. It encompasses seven activities outlined in the ROD: flow management, mechanical channel rehabilitation, sediment management, watershed restoration, infrastructure improvement, adaptive environmental assessment and monitoring, and environmental compliance and mitigation.

The Program is administered by the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (USFWS) — bureaus of the U.S. Department of the Interior — as co-leads. Other partner agencies share in the decision-making process through the Trinity Management Council (TMC): the Hoopa Valley Tribe (HVT), the Yurok Tribe (YT),

Laws and Guiding Documents

1955: Congress authorized Trinity River Division of the Central Valley Project

1963: Trinity and Lewiston Dams are completed

1981: Interior Secretary increased flows to ~ 300 cfs and initiated Flow Evaluation Study

1984: Congress enacted Trinity River Basin Fish and Wildlife Management Act to implement salmon restoration

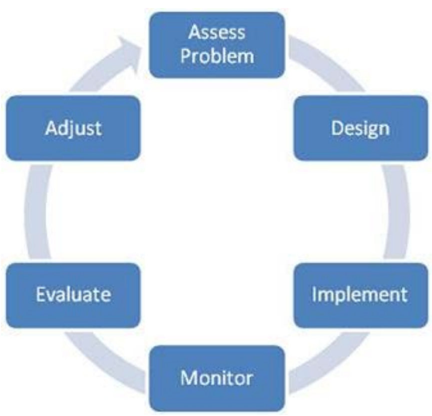
1992: Congress enacted Central Valley Project Improvement Act with 340,000 AF of water available to the Trinity River

1999: Flow Study is completed and is used as Preferred Alternative in EIS/EIR

2000: Record of Decision (ROD) signed, establishing modern TRRP with minimum water volume allocations determined annually by the water year type

Adaptive Management

The Trinity River Restoration Program was established by the Record of Decision as an adaptive management program. The Adaptive Environmental Assessment and Management (AEAM) component of the Program assesses changes in the river, providing interdisciplinary information that allows development of hypotheses about how the river has changed under past natural and man-made conditions. Teams of scientists, managers, stakeholders, and policy makers use this information to develop future management actions based on quantifiable knowledge gained from the assessments. The adaptive management process is repeated in a systematic way as management actions gradually result in the rehabilitation of the Trinity River and restoration of its fishery resources.



The steps of the adaptive management process.

Trinity County, the California Resources Agency (which includes the State of California's Department of Water Resources (CDWR) and Department of Fish and Wildlife[1]), the U.S. Forest Service (USFS), and the National Marine Fisheries Service (NMFS). The Program funds technical staff positions with partner agencies and organizations to provide the technical assistance necessary to carry out the interdisciplinary rehabilitation and science activities specified in the preferred alternative of the TREIS/R.

The ROD summarized the guidance found in the TRFES, the TREIS/R, and the Implementation Plan for the Preferred Alternative of the TREIS/R (Stalnaker and Wittler 2000). The ROD describes the permanent flow allocation for the Trinity River based on five different water-year types, varying from "critically dry" to "extremely wet" years. It also established the Trinity Management Council and stated that the TMC will establish and guide Adaptive Environmental Assessment and Management (AEAM), an adaptive management program to monitor and evaluate the physical and biological responses to restoration activities. One part of the AEAM organization is a federally appointed advisory committee under the oversight of the USFWS, the Trinity Adaptive Management Working Group (TAMWG — http://www.fws.gov/arcata/fisheries/tamwg.html). The TAMWG provides advice to the TMC; its members represent interest groups of local citizens, landowners, recreation, water users, environmental organizations, agriculture, utilities, business, and other agencies.

The Program's main office in Weaverville, California, is staffed by physical, environmental, and biological scientists, technicians, and administrative specialists drawn from the Program's partner agencies and organizations (www.trrp.net). Each partner agency designates its own technical experts to participate on the various work groups and teams that plan, design, implement, monitor, and assess TRRP restoration efforts. The technical work groups and teams report to the TMC and provide technical information to the TAMWG, stakeholders, and the public. All activities of the Program are guided by the Federal laws that authorize the Trinity River Restoration Program and by documents that outline the

[1] California's Department of Fish and Game officially changed its name to the Department of Fish and Wildlife as of January 1, 2013. This report uses the acronym CDFG to refer to activities of this agency in 2012 and earlier, and CDFW to refer to the agency's current and ongoing activities.

Program function and available alternatives for implementing restoration activities.

Mission

The mission of the Program is to restore fisheries and wildlife to the Trinity River using a set of procedures outlined in the Program's foundational documents and conceptual plans (http://www.trrp.net/?page_id=3175) while still providing beneficial flows to the Central Valley. The river was dammed and most of the flow was diverted to the Sacramento Valley beginning in 1963, as part of the Trinity River Division of the Central Valley Project, a Federal water development program for California, managed by Reclamation. The diverted water enters the Sacramento River near Redding, California, and provides for a variety of uses such as agriculture, industry, drinking water, recreation, electrical power generation, and habitat. By 1970, it became apparent that the diversion of water was a cause of the declining fisheries in the Trinity River (USFWS and HVT 1999). Federal legislation at that time and in subsequent years has called for a variety of protections to the river, including protection of pre-dam levels of fisheries and of Native American tribal rights for access to Trinity River fish, among other benefits for river users.

Studies of the river, culminating in the Record of Decision, concluded that the best option to both continue water deliveries to the Central Valley Project and recover fisheries in the Trinity would require the commitment of approximately one-half the inflow to Trinity Reservoir for instream flows in the Trinity River, as well as a set of physical restoration projects to increase habitat for fish. The Trinity River receives its flow through the Lewiston Dam, which receives water from Trinity Dam. Flows released to the Trinity River as described in the ROD are referred to as restoration flows.

Goals

The founding documents define the goal of restoring the Trinity River fishery resources in a managed river that has the characteristics of a healthy alluvial river, and TRRP's actions are designed to support this goal. The physical restoration efforts on the river, such as the Wheel Gulch Restoration Project completed in 2011, are designed to implement this goal. Environmental assessment and monitoring activities provide periodic scientific evaluations of the success of the

Record of Decision Activities for the Trinity River

1. Flow Management – a variable flow regime based on five water-year types to mimic natural flows
2. Mechanical Channel Rehabilitation – treatments to reshape the current channel form to allow physical processes to create and maintain fish habitat
3. Sediment Management – augmentation of spawning gravels and reduction in fine sediments
4. Watershed Restoration – a basin-wide program to reduce fine sediment input to the Trinity River
5. Infrastructure Improvements – modification of structures in the floodplain to allow peak flows
6. Adaptive Environmental Assessment and Monitoring – a rigorous program to monitor and improve restoration activities through experience
7. Environmental Compliance and Mitigation – measures to minimize or eliminate short-term impacts

Congressional Authorization

As early as 1955, Congress passed legislation authorizing the Trinity River Division (Public Law No. 84-386) as an integrated component of the Central Valley Project, specifically directing the Secretary of the Interior to ensure the preservation and propagation of fish and wildlife in the Trinity Basin through the adoption of appropriate measures.

Program in meeting habitat and fishery restoration goals. Partner agencies and collaborating natural resource management agencies work together to implement river and watershed projects to improve management of the river. These agencies include among others the HVT, YT, USFWS, NMFS, USFS, CDFW, CDWR, Trinity County, Bureau of Land Management (BLM), Trinity County Resource Conservation District, and the Natural Resources Conservation Service.

More information on the Trinity River, the TRRP, and the Central Valley Project is available through links provided in the References section at the end of this annual report.

The Program in 2012

In 2012 the Program completed 28 of the remaining 47 projects described in the Flow Evaluation Study. TRRP broke ground on its first project in 2005, and in the past 7 years has focused on the first five goals outlined in the ROD. The five goals place a priority on physical restoration of the river to create attributes of an *alluvial river system* (Figure 1) that are known to enhance habitat for anadromous fish species. The ROD describes expected physical and biological outcomes from rehabilitation and restoration activities. Monitoring and evaluation activities mark progress toward these desired states.

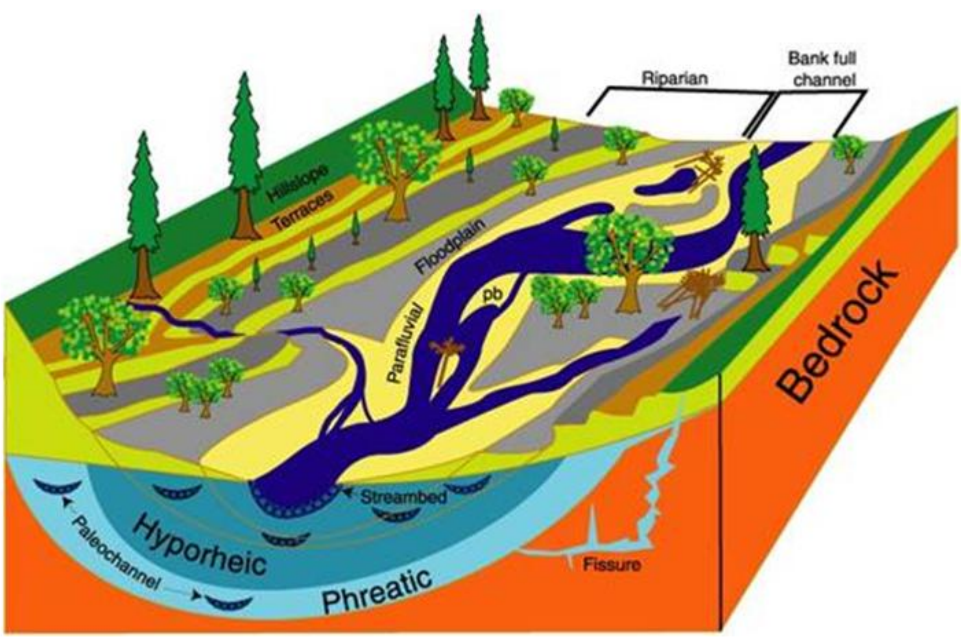


Figure 1. Conceptual view of an alluvial river (a river with bed and banks made up of mobile materials). Alluvial rivers are shaped by the magnitude and frequency of the flows and floods, and the ability of these floods to erode, deposit, and transport sediment. Alluvial rivers can assume a number of forms based on the properties of their banks, the flows they experi-ence, the local riparian ecology, and the amount, size, and type of sediment that they carry. (Source: Stanford and Lorang 2005, used by permission.)

Many new activities were implemented in 2012 to restore the river and the anadromous fisheries, including a variety of enhanced physical rehabilitation techniques that were incorporated into the 2012 Upper Junction City and Lower Steiner Flat projects. An innovative approach was used in 2012 flow scheduling: the spring release scheduled for a "normal" water year was designed to benefit restoration of riparian vegetation, a mitigation activity that is part of every rehabilitation project. Intensive assessments of the physical responses of the river to the significant restoration release of 11,000 cfs in 2011 were completed in 2012.

A Phase I review of completed projects, which had been recommended in the Implementation Plan for the Preferred Alternative of the TREIS/R (Stalnaker and Wittler 2000), began in 2011. This review is supported by both the TAMWG and TMC. Monitoring and evaluation results from all TRRP activities contributed to an expanded Phase 1 review which, at the urging of the TRRP Scientific Advisory Board (SAB), also is evaluating biological responses of the river to the rehabilitation projects completed from 2005 through 2010. The landmark 11,000-cfs restoration release in 2011 also afforded the SAB the opportunity to evaluate selected responses of the system to a restoration release equal to the maximum prescribed under the ROD.

In 2012, the insights of the ongoing SAB review were applied to redesign of 2013 projects. The final recommendations of the Phase 1 review will be applied to all future TRRP rehabilitation, restoration, and monitoring and evaluation activities.

This report provides concise summaries of major program activities with our partners, as well as citations, references, and contacts for readers who desire more information.

Phase I Channel Rehabilitation Project Review

The Program's Science Advisory Board (SAB) has been charged with overseeing a comprehensive evaluation of the first half of the planned channel rehabilitation projects (referred to as Phase I). Emphasis is to be placed on learning from past management actions, understanding ecosystem processes, development of guidance for hypothesis testing, and advancing adaptive management by the TRRP. Findings from the review will be used to plan future rehabilitation actions and to adjust the TRRP's adaptive management process. One of the emerging recommendations is that the Program should incorporate a Decision Support System to focus TRRP resources on desired outcomes.

Funding and Expenditures

Program funding has mostly varied between $10 million and $16.66 million per year since 2002. In 2012 the Program received a total of $15.36 million, as shown in the table at right.

Most of the funding supported physical modifications to the river and the associated watershed, modifications to floodplain infrastructure, and the monitoring of physical and biological

Fiscal Year 2012 Funding (in millions of dollars)	
BUREAU OF RECLAMATION	
Water & Water-Related Fund	3.0
CVPIA* Restoration Fund	10.38
U.S. FISH & WILDLIFE SERVICE	
FY 2012 Appropriations	1.98
TOTAL	15.36

*Central Valley Project Improvement Act

responses. Other partner agencies contribute in-kind services to support Program activities.

The Program budget allocations for administration, implementation, and science and monitoring were about $2.9 million, $7.4 million and $5.0 million, respectively.

Water Year Types

The official water-year type is based on the April 1 forecast (50 percent exceedance) of annual basin runoff above the Trinity River dams for the entire water year (October to September). The water forecast is jointly developed by the National Weather Service and the California Department of Water Resources and is published monthly (January through May) as the *Water Supply Outlook — California and Northern Nevada* (http://www.cnrfc.noaa.gov/water_supply.php).

Activities and Accomplishments

Flow Management

Controlling flow releases is one of the primary management actions taken to restore the Trinity River fishery resources. TRRP's Flow Workgroup, the TAMWG, and the TMC invest a significant amount of effort and coordination each winter and spring to designing the annual restoration flow release schedule for implementation by Reclamation.

Allocation of Water for Restoration

The TRRP Flow Workgroup develops annual restoration flow release scheduling recommendations through a collaborative process with public input. The focus of flow scheduling has been to develop variable spring and early summer releases that will be beneficial to fish life history, riparian habitat, and stream-channel morphology.

ROD Flow Actions

"The recommended flow regimes link two essential purposes deemed necessary to restore and maintain the Trinity River's fishery resources: (1) flows to provide physical fish habitat (i.e., appropriate depths and velocities, and suitable temperature regimes for anadromous salmonids), and (2) flows to restore the riverine processes that create and maintain the structural integrity and spatial complexity of the fish habitats."

Water allocation volumes and flow releases are provided per water year (WY), with each water year extending from October 1 to September 30. The water-year type is based on the annual runoff forecast, jointly developed by the National Weather Service and the California Department of Water Resources (CDWR)[2]. Table 1 shows the categories of water-year types, based on the forecast runoff, and the restoration water allocation for each of the water-year types.

Water Year 2012

Precipitation in the Trinity Basin from the fall of 2011 into February 2012 (early WY 2012) was infrequent and light. Approximately three small storm systems during that period provided the only significant precipitation events.

[2] http://cdec.water.ca.gov/snow/bulletin120

Consequently, when the February and March forecasts were received, an inflow volume significantly below normal was forecast for Trinity Reservoir. The Flow Workgroup planned on recommending flow release schedules for Dry and Critically Dry water year types through this period.

Table 1. Annual water volumes for in-stream flow releases, probability of occurrence, and annual basin runoff thresholds

Forecast Annual River Runoff[1]	Predicted Water Year Type	Restoration Water Allocation[1]	Annual Probability of Occurrence[2] (percent)
>2,000	Extremely Wet	815	12
1,350 to 2,000	Wet	701	28
1,025 to 1,350	Normal	647	20
650 to 1,025	Dry	453	28
<650	Critically Dry	369	12

[1] In thousands of acre-feet (1 acre-foot ≈ 1.23 million cubic meters).
[2] Probability based on data from years 1912 to 1994.

Increased precipitation over the Trinity watershed in the last two-thirds of the month of March, 2012, resulted in substantial inflows into Trinity Reservoir and increases in the forecasted annual inflow. On April 7, 2012, TRRP received the April 1, 50-percent Inflow Forecast from the California Department of Water Resources (CDWR). At the 50-percent level, the predicted annual inflow was 1,025 thousand acre-feet (CDWR 2012). As specified in the TRFES and TREIS/R, and shown in Table 1, this volume corresponds to a Normal water year. The volume of the restoration release to the river in a Normal water year is 647,000 acre-feet.

The change in the forecast water-year type required reconsideration of the restoration flow release recommendation by the Flow Workgroup. After consultation at a mid-April, 2012, meeting, the consensus of the Flow Workgroup was that the TRRP recommend a hydrograph that reflected an improved understanding of riparian vegetation establishment. Figure 2 illustrates the recommended hydrograph alongside the ROD Normal hydrograph.

Other Recommendations

Klamath Supplemental Flows Request

Reclamation requested technical advice on a proposed dam release in August and September to minimize the risk of a fish disease outbreak and subsequent fish kill in the Lower Klamath

River. The 2012 Klamath Basin fall-run Chinook escapement was projected to be significantly larger than any other year on record. The Pacific Fishery Management Council's Salmon Technical Team estimated that more than 380,000 adult fall-run Chinook salmon could return to the Klamath River — nearly 2.4 times the run size associated with the 2002 fish kill and more than 50 percent greater than the highest recorded run size in 1995.

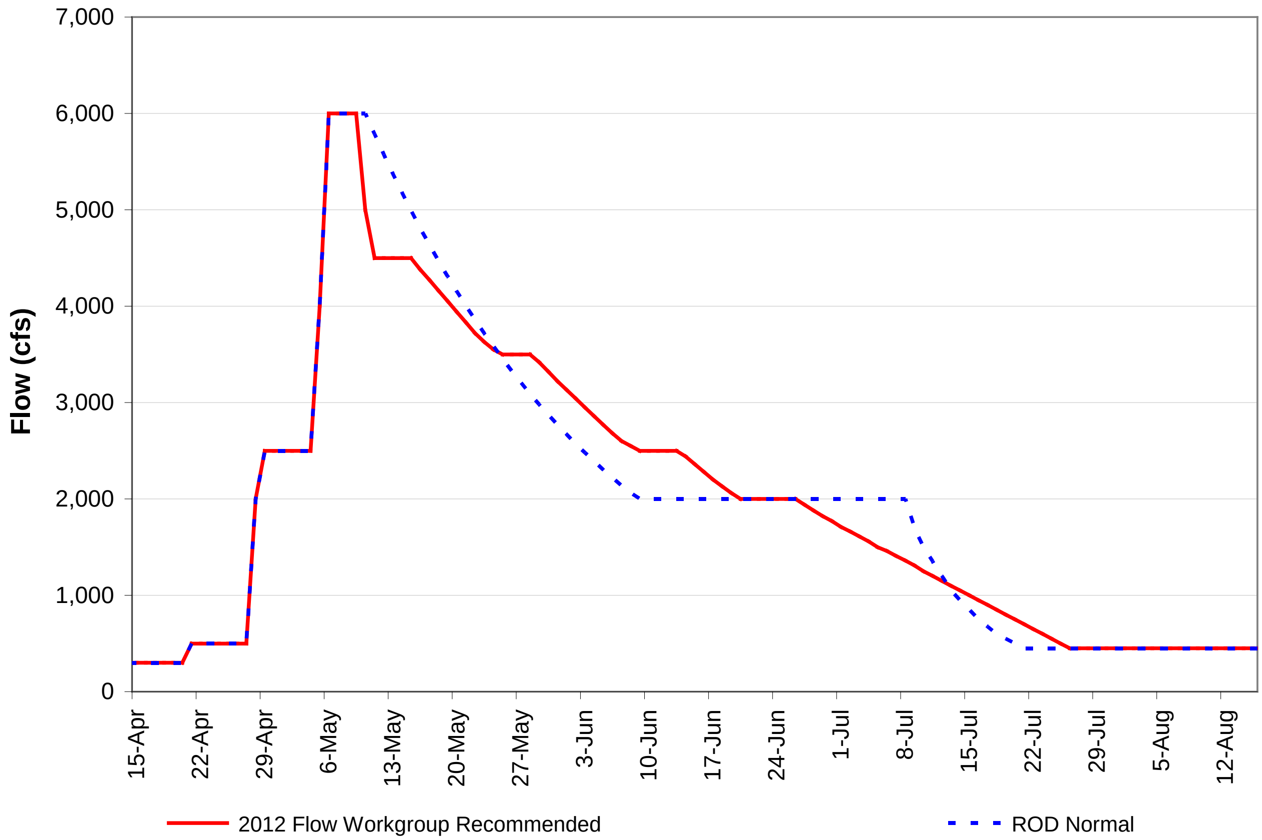


Figure 2. Restoration flow releases recommended to the TMC for WY 2012.

TRRP Recommendation for preventative fall flow releases

Utilizing the best available information, a subgroup of the Flow Workgroup developed preventative flow release criteria designed to reduce the risk of disease outbreaks in order to reduce the probability of a fall-run Chinook salmon fish kill in the lower Klamath River (Table 2). Memoranda detailing these recommendations are included in TRRP (2012a).

Table 2. Summary of 2012 Preventative Fall Flow Release Criteria and Management Actions

Preventative Fall Flow Release Criteria	Management Action
Flows projected to be above 3,200 cfs in the Klamath River (Rkm 13) during the primary adult fall-run Chinook salmon migration season (Aug. 15–Sept. 21)	No preventative fall flow release
Flows projected to be below 3,200 cfs at Klamath River (Rkm 13) during the migration season	Increase base flows to at least 3,200 cfs during primary fall Chinook salmon migration season (Aug. 15–Sept. 21). If water temperature exceeds 23°C (73°F) after September 21, maintain at least 3,200 cfs until (1) September 30 or (2) water temperature recedes below 23°C.

Restoration Releases in Water Year 2012

Implementation of Restoration Flow Schedule

Outcome of Hydrograph Implementation

Figure 3 illustrates the performance of Reclamation's implementation of the recommended 2012 hydrograph, as measured by the USGS stream gage below Lewiston Dam (11525500, Trinity River at Lewiston, CA). Apparent deviations from the recommendation within the elevated flow period from April through July were small relative to stream-gage accuracy, and actual deviations were due to operational constraints of the gates at Lewiston Reservoir. The deviation in August and September was the result of Reclamation delivering supplemental flows to the lower Klamath river.

Figure 4 shows the actual flow releases from Lewiston Dam to the Trinity River for water year 2012. The flows above 450 cfs (12.7 m^3/s) in August and September supplemented flows in the lower Klamath River. Figure 4 also shows the estimated unregulated flow at Lewiston, as if no dams were in place.

Water-Year History

Table 3 lists a summary of flow statistics beginning in WY 2000.

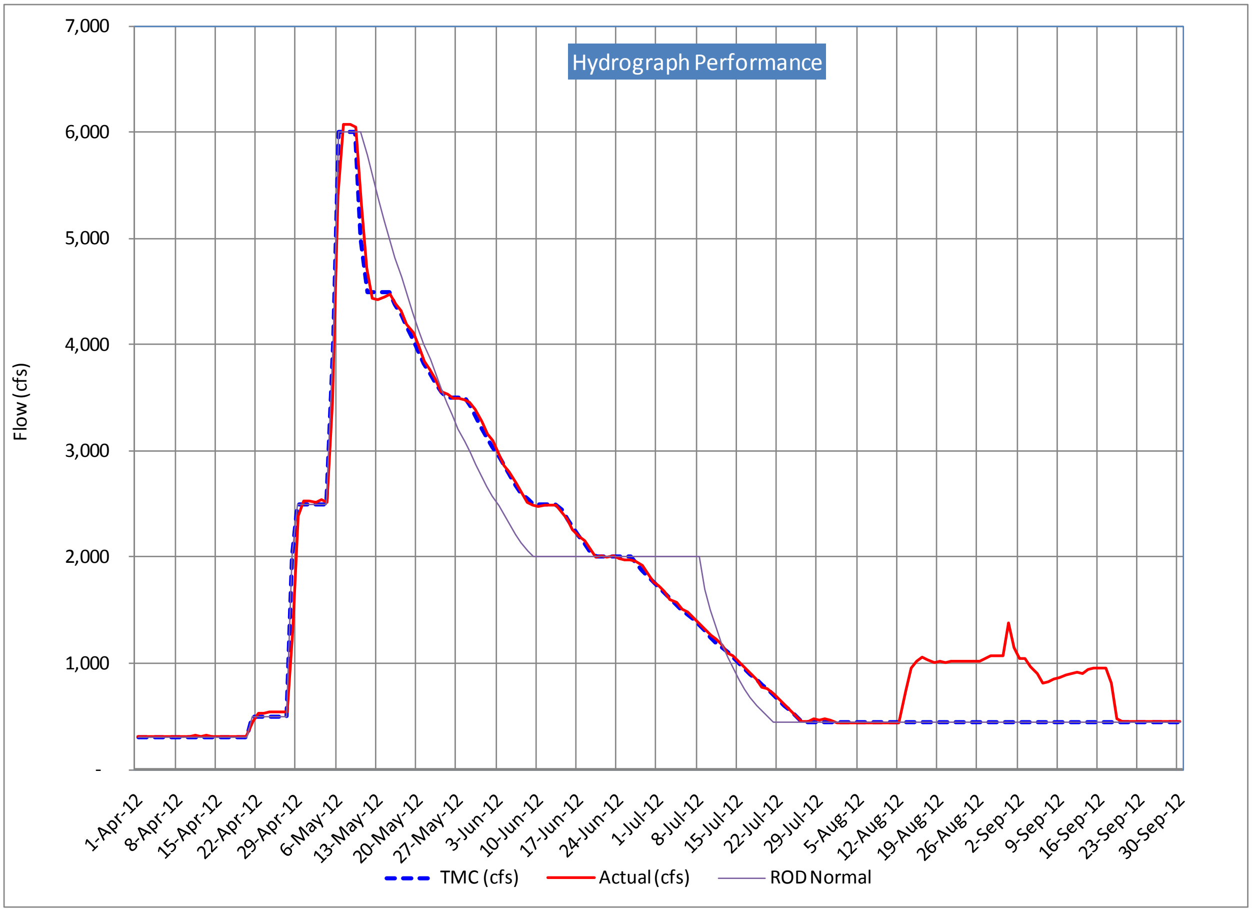


Figure 3. Spring high-flow release — actual vs. recommended. Actual release based on the average daily streamflow record from the Trinity River at Lewiston, CA, stream gage (USGS stream gage #11525500).

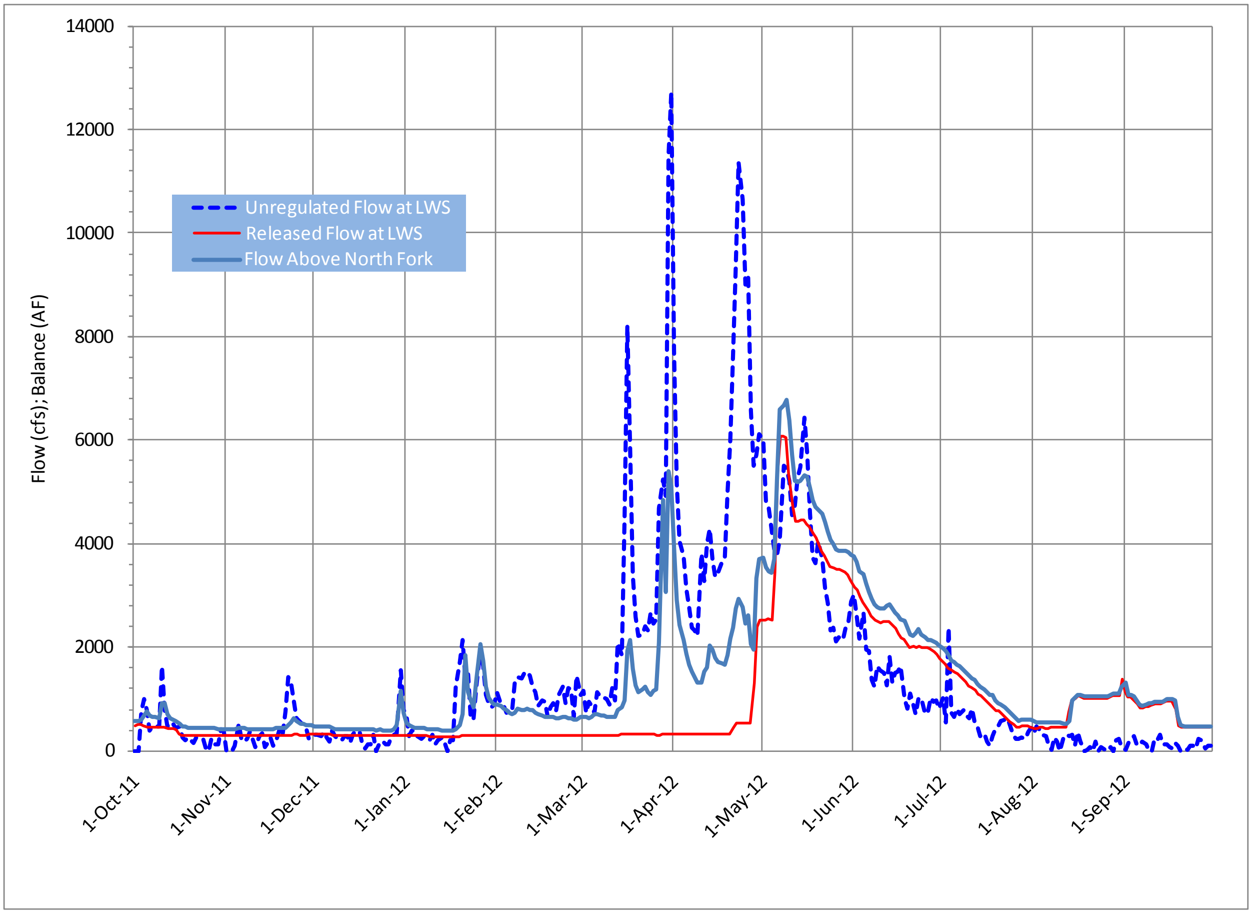


Figure 4. Actual releases from Lewiston Dam to the Trinity River in WY 2012. Actual release based on the average daily streamflow record from the Trinity River at Lewiston, CA, stream gage (LWS; USGS stream gage #11525500). Unregulated river runoff is the estimated flow at Lewiston, CA, if no dams had been in place. Flow above North Fork is the average daily streamflow record from the Trinity River above North Fork Trinity River near Helena, CA (USGS stream gage #11526400).

Table 3. Water Volume Summary for Trinity River Releases and Diversions Since 2000

Water Year	Forecast Water-Year Type	Actual Water Year Type	Restoration Water Allocation (acre-feet)	Water Allocation Notes	Actual Restoration Release (acre-feet)	Stream-gage Measurement Accuracy	Actual Release Within Allocation Given Measurement Accuracy	Safety of Dams Releases (acre-feet)	Ceremonial Releases (acre-feet)	Other Releases (acre-feet)	Total Release to Trinity River (acre-feet)	Peak Release Magnitude (cfs)	Total Diversion thru Carr Tunnels (acre-feet)	Unregulated River Runoff at Lewiston (acre-feet)
Notes	[G]	[I]			[A]	[A]	[A]	[A, B]	[A, B]	[A, B]	[A]	[A]	[C]	[C, F, I]
2000	Wet	Wet	340,000	[D]	359,600	10%	Yes	200,400	-	-	560,000	5,310	1,108,600	1,726,600
2001	Dry	Dry	369,000	[E]	379,600	10%	Yes	-	4,200	-	383,800	1,760	669,400	818,200
2002	Normal	Normal	470,000	[E]	482,700	10%	Yes	-	-	-	482,700	6,040	629,000	1,293,500
2003	Wet	Wet	453,000	[E]	448,100	10%	Yes	68,300	5,700	34,000	556,100	2,610	857,600	1,868,900
2004	Wet	Wet	647,000	[E]	651,000	10%	Yes	81,100	-	36,200	768,300	6,200	987,500	1,512,000
2005	Normal	Wet	647,000	[H]	647,600	10%	Yes	-	3,600	-	651,200	6,970	466,700	1,476,000
2006	Ex Wet	Ex Wet	815,000	[H]	809,900	10%	Yes	406,300	-	-	1,216,200	10,100	1,350,600	2,496,300
2007	Dry	Dry	453,000	[H]	453,700	10%	Yes	-	4,100	-	457,800	4,750	614,400	752,400
2008	Normal	Dry	647,000	[H]	648,700	10%	Yes	-	-	-	648,700	6,470	555,000	874,900
2009	Dry	Dry	453,000	[H]	445,500	10%	Yes	-	11,100	-	456,600	4,410	539,200	834,500
2010	Normal	Wet	647,000	[H]	656,700	15%	Yes	-	-	-	656,700	6,840	274,700	1,602,200
2011	Wet	Wet	701,000	[H]	721,800	15%	Yes	-	10,800	-	732,600	11,600	473,100	1,855,900
2012	Normal	Normal	647,000	[H]	648,300	10%	Yes	-	-	39,000	687,300	6,080	709,800	[J] 1,075,400
TOTAL			*6,642,000*		*6,704,900*			*756,100*	*39,500*	*109,200*	*8,258,000*		*9,235,600*	*18,186,800*

Notes: The water year spans Oct. 1 to Sept. 30. All water-volume values are rounded to the nearest 100 acre-feet.

A. Total annual water volume is computed from the final daily average flow record published by the USGS for the Trinity River at Lewiston stream gage 11525500. The measurement error applies to the accuracy of the published streamflow record for a given day within the water year. The total error of a sum of values tends to be less than the error associated with an individual value because positive and negative errors may cancel each other when summed. The USGS has not conducted the statistical analysis to understand how streamflow measurement errors behave when summed. Consequently, the listed accuracy for published daily average streamflow record is used for the cumulative annual water volume. The true error for the annual water volume totals are expected to be less than those listed.

B. Volume estimate for flows above the summer or winter base-flow release for restoration.

C. Computed from daily average record provided by Reclamation. Reported negative daily inflow values included "as is" in calculations.

D. Restoration water allocation prior to implementation of the 2000 Trinity River Mainstem Fishery Restoration Record of Decision.

E. Restoration water allocation limited by court order from 2001 to 2004. Court-ordered volumes varied by year. Court-ordered release restrictions between 2001 and 2004 resulted in a cumulative reduction of 540,600 acre-feet during that time period, as compared to full Record of Decision flow releases.

F. Long-term average annual inflow to Trinity Reservoir (acre-feet/year) from 1911 to 2007 as provided by Reclamation = 1,254,000 acre-feet.

G. Water-year type based on the April forecast (50% exceedance) from the *Water Supply Outlook — California and Northern Nevada* published by the California Nevada River Forecast Center, National Weather Service.

H. Restoration water allocation as prescribed by the Trinity River Mainstem Fishery Restoration 2000 Record of Decision.

I. The unregulated river runoff is computed by multiplying estimated inflow to Trinity Reservoir by 1.04 to account for the local watershed area between Trinity Dam and the Lewiston stream gage. The estimated inflow to Trinity Reservoir is computed by Reclamation based on changes in reservoir storage, evaporation, and dam releases. Uncertainty in the reservoir storage and evaporation estimates can lead to negative inflow values being reported. Negative inflow values are erroneous and have been excluded from the calculation of the unregulated river runoff.

J. In 2012, the unregulated river runoff at Lewiston is the sum of the change in Trinity Reservoir storage plus the Lewiston releases, plus the Carr Tunnel diversions, plus the annual evaporation from Lewiston and Trinity Reservoirs; Inflow = ΔS + LEW + JCR + Evap; ΔS = Trinity Storage Sept. 30, 2012, less Trinity Storage Oct. 1, 2011.

Mechanical Channel Rehabilitation

In 2012, Phase II projects (the second half of the 47 ROD projects) continued with construction at the Lower Steiner Flat and Upper Junction City Channel Rehabilitation Sites. Activities are intended to promote aquatic habitat for anadromous fish under a range of flow conditions by reconnecting the river's floodplain with the river, establishing or expanding side channels, and enhancing the bed and banks (wetted edge habitat) of the Trinity River. These rehabilitation activities are described in the Master Environmental Impact Report (Master EIR). Combined with the ROD flow releases, they contribute to the restoration of the Trinity River mainstem fishery.

The Lower Steiner Flat Rehabilitation Site (Figure 5) is on the Trinity River (RM 90.2–91.3) near Douglas City, California. The site is 21 miles downstream of Lewiston Dam and 4 miles downstream of the Douglas City Bridge. The TRRP interdisciplinary design team identified discrete activity areas within the boundaries of the Lower Steiner Flat Rehabilitation Site, which included in-channel, riverine, and upland restoration features, and established a suite of specific objectives for the site that conformed with the overall goals and objectives outlined for the TRRP.

Work at the Lower Steiner Flat Rehabilitation Site is occurring in two phases: Phase A was completed in 2012, and Phase B will be done within 5 years (Future Proposed). The 2012 activities included the construction of low-flow side channels separated from the main channel by either unvegetated medial bars or vegetated islands, enhancing the habitat value by directing a larger proportion of the flow into the new side channels and providing more lateral connections. These actions are designed to increase the quality, quantity, and frequency of the available rearing habitat within the rehabilitation site reach. Some existing high-flow side channels on the right bank, which already provided low-velocity refugia during high flows, were retained. The project also included two alcoves, which provide high-quality rearing habitat at the exits of side channels.

Figure 5. Aerial oblique view of the Lower Steiner Flat project site, looking upstream. This project involved extensive side channel development. A large constructed gravel bar is in the front center of the photo.

The work at this site also included the removal of some riparian berms — sand-dominated features that have been colonized by dense vegetation. Berm removal creates an expansion zone, allowing for more dynamic alluvial processes. The Lower Steiner Flat design included the partial removal of a berm within an island element, which created a separate low-flow channel and will allow a portion of the island to evolve in response to high flows. Some riparian and herbaceous vegetation is important for providing cover and contributing to quality fish habitat by providing roughness, shade, and hydraulic complexity. Therefore, berms and vegetation were not removed from the lower half of this island, in order to protect the existing resource.

Finally, hydraulic structures were constructed of large wood and large rocks. These elements serve multiple complementary purposes: creating local hydraulic complexity, initiating scour holes, contributing hydraulic roughness, and retaining gravel.

Figure 6. Aerial oblique view of the upstream end of the Upper Junction City Rehabilitation Site. In the foreground, note the extensive revegetation effort. The brown "dots" are container stock plantings, the thin white lines are pipes of the irrigation system. The undulating terrain was intentionally constructed to re-create functions of a floodplain, including providing hydraulic roughness and retaining fine sediments and moisture. At the right is a constructed island and a "split flow" channel, which benefits juvenile fish. Through the middle of the photo is an alcove and a high-flow side channel with wood placements to provide cover for fish.

The Upper Junction City Rehabilitation Site (Figure 6) is adjacent to Junction City, California, next to State Route 299, approximately 8 miles west of Weaverville. The rehabilitation site is located on the Trinity River (RM 79.8–80.4) upstream from the Dutch Creek Road Bridge. The Upper Junction City site included some innovative approaches to reestablishing the characteristics of a pre-dam river, within the geomorphic bounds of the limited releases of restoration flows. A subsurface water inlet was constructed to allow groundwater infiltration into a refugia region, creating year-round rearing habitat for juvenile salmonid species. The infiltration gallery conveys subsurface flow into the pond and side channel complex during low-flow and base-flow periods. This feature was created by excavating the existing floodplain material and replacing it with a matrix of coarse gravels, creating a permeable lens for subsurface flow that maintains water quality when no surface flow can enter. At higher flows, the water overtops the infiltration gallery and allows a controlled overflow that delivers velocities preferred by juvenile salmonids. Meanwhile, stream power in the main channel remains sufficient to maintain deep pools that provide holding habitat for adult anadromous fish.

Wetland elements associated with low-flow side channels were also constructed. One area is associated with the subsurface water inlet pond/side channel described above. The others are semi-perpendicular ponds along a separate side channel, created by a split-flow, constructed island complex designed to divert and shear water for rearing habitat development. The ponds are approximately 4–6 feet deep and have slow water habitat features including existing and revegetated riparian areas, large wood, slash, and whole trees. The ponds contain deeper pools that have a connection to groundwater to supply needed cold, clean water.

One of the more state-of-the-art features was a skeletal bar complex designed to work in concert with an engineered wood structure at its upstream end, creating a forced meander in the channel's primary flow region. The area near the wood structure and along the existing left bank of the river pushed flows toward the right bank, causing scour and increasing channel sinuosity. Working within the excavated floodplain bench, dynamic hydraulic forces will continue to cause bank re-contouring and increase geomorphic complexity. The area was replanted with native riparian species, enhancing topographic diversity for terrestrial species and providing improved aquatic habitat during high flow periods.

Construction of engineered wood structure at the Upper Junction City site.

Excavation activities associated with construction of each of the sites generated approximately 65,500 cubic yards (yd^3) of earthen materials: 15,500 yd^3 at Lower Steiner Flat and 50,000 yd^3 from the Upper Junction City site. Processing and cleaning of the coarse sediment allowed for re-use in construction of the mid-channel islands and bars at both rehabilitation sites.

Sediment Management and Watershed Restoration

The third and fourth elements of the Program's restoration strategy relate to management of coarse and fine sediments. As these sediments compose both the bed and banks of the river channel, as well as upslope areas, managing their supplies is key to developing complex channel topography and diverse physical aquatic habitat. Reduction of fine sediment input into the river is an important component of watershed restoration,

ROD Sediment Actions

"Sediment management includes the supplementation of spawning gravels below the Trinity River Division and reduction in fine sediments which degrade fish habitats."

along with activities such as improving fish passage and habitat.

Coarse Sediment

Trinity and Lewiston dams trap the supply of coarse sediment (gravel and cobble) above Lewiston Dam. The Record of Decision directs implementation of a coarse sediment augmentation program below Lewiston Dam to replace the coarse sediment trapped behind the dams and balance the coarse sediment transported during high-flow releases. The combination of the high-flow releases and coarse sediment augmentation is intended to increase the availability and quality of physical habitat by promoting the processes of scour and fill that maintain bars, pools, juvenile rearing habitat, spawning beds, and other elements of channel complexity (figure 7). Progress toward these goals is assessed by measuring coarse sediment transport, estimating sediment fluxes, and geomorphic mapping and surveying activities.

Figure 7. Winter base flows reveal the thick gravel layer that blankets the valley floor in the Lowden Ranch reach area. Gravel provides habitat complexity by forming riffles, bars, and spawning habitat.

The current recommendations for coarse sediment additions suggest that programmatic objectives can be attained by adding about 7,000 cubic yards to 10,000 cubic yards of coarse sediment per year to the upper river. In 2012, no coarse sediment was added to the Trinity River. The Program took one year off from adding coarse sediment to the river to allow time to conduct a study to address public concern on the effects of coarse sediment augmentation on pool depths. A one year break from coarse sediment augmentation was not considered detrimental for the river, given that (1) recent channel rehabilitation projects in the Lewiston area increased the average sediment augmentation just above the minimum recommended amount, and (2) the 2012 spring high-flow releases were expected to be modest, so little sediment transport was anticipated.

Fine Sediment

The Program teamed with the Trinity County Resource Conservation District (TCRCD) and local stakeholders to implement six priority watershed projects in 2012 using $492,300 from the Program and $627,000 in matching funds. These projects reduced fine sediment inputs to the Trinity River by reducing sediment production from roads and other controllable sediment sources and limiting their delivery to tributary streams and to the mainstem (Figure 8). Project work implemented in 2012 included a floodplain sediment control project on Indian Creek, assessments of sediment production in the Browns Creek and West Weaver Creek drainages, upgrading a major stream crossing near the mouth of Conner Creek, and upgrading or decommissioning numerous Forest Service road segments throughout the middle Trinity River area.

The program also funded five watershed projects to be implemented in 2013 using $496,000 from the Program and $115,500 in matching funds. Two projects are feasibility studies to look at costs versus benefits of improving fish passage and habitat quality at the mouth of Conner Creek and in Sidney Gulch. Two projects are sediment-reduction projects located at Lower East Weaver Creek and along USFS and BLM roads where controllable road-related sediments can be reduced. The last project is a Data Acquisition project to collect high-resolution LIDAR (light detection and ranging) data for both Weaver Creek and Browns Creek watersheds for the purpose of establishing baseline monitoring and current

ROD Watershed Actions

"Watershed restoration efforts, addressing negative impacts which have resulted from land use practices in the Basin."

surface topography data for the development of future project and monitoring needs within the watersheds.

Infrastructure Modification and Improvements

The Trinity River restoration strategy includes assistance to landowners whose potable water systems are affected by the higher ROD flows associated with river restoration. Initially, infrastructure modification and improvements involved upgrades to bridges and other publicly owned structures. However, some riverfront landowners experienced adverse impacts to their private wells and septic systems from the fishery restoration flows. In response, the TRRP initiated the Potable Water and Sewage Disposal System Assistance Program, or "Well Grant" Program, to provide eligible landowners with financial assistance to relocate, replace, upgrade, or otherwise improve their private potable water and sewage disposal systems.

To be eligible for financial assistance under this program, applicants (1) must be U.S. Citizens or legal residents, (2) must own land in Trinity County upon which they own and operate either an existing potable water system (water suitable for drinking and cooking) or a sewage disposal system that utilizes surface or subsurface waters of the Trinity River between Lewiston Dam and the confluence with the North Fork Trinity River, and (3) must have documented legal access to the water source. The assistance program does not apply to irrigation systems, fire suppression systems, non-potable water systems, or unimproved parcels of land.

Figure 8 (on facing page). Sediment-control project on a forest road in the watershed. ►

Before **(top photo), the outlet pipe is too small and is in the wrong location. The man is standing where water overtops the road and erodes the bank, causing a large sediment load to enter the waterway.**

After **(bottom photo), a larger pipe, capable of conveying a much greater volume of runoff, has been installed in the proper place to accommodate the flow. Also, the rock added above and below the affected area will slow the water velocity and allow sediment to filter through during flood events, thus reducing both turbidity and the erosion of the hillside.**

Applicants submit a conceptual design and cost estimate signed by a licensed contractor or licensed engineer. Designs and cost estimates are reviewed by the TRRP for conformance with the intent of the program and to ensure funding availability. Applicants determined to be qualified are reimbursed on a “first-come, first-served” basis up to $10,000 per parcel for potable water systems and up to $5,000 for sewage disposal systems. Applicants may receive assistance only one time per system/parcel for capital improvements.

In 2012, 22 applicants who applied to the program were deemed eligible and qualified. Of these, 16 completed the improvements and were reimbursed from Well Grant funding. More than $130,000 was dispersed to Trinity County residents.

The remaining 2012 qualified applicants that did not complete the improvements before the end of 2012 may receive reimbursement upon submitting the required paperwork. The Well Grant program continues into fiscal year 2013.

In addition to well and septic system replacement, the restoration strategy also includes improvements to existing public infrastructure. The TRRP and Trinity County identified a need for a long-term infrastructure solution to concerns over the sustainability of the Bucktail Bridge, located on the Trinity River near Lewiston, California. The TRRP has been working closely with Trinity County’s Department of Transportation and a contracting firm to develop a cost-benefit analysis for the Bucktail Bridge, evaluating the existing conditions and forming alternatives for replacement, while working within the constraints of the project site and stakeholder concerns.

Browns Mountain Road serves a small community via the Bucktail Bridge, a 73-foot-long single-span steel girder bridge approximately 6.5 miles downstream of the Lewiston Dam, owned and maintained by Trinity County. Residents use the bridge as their primary access point. Based on analysis, the Bucktail Bridge will not efficiently pass a 100-year storm event (14,910 cfs), and its associated concrete box culvert creates a hydraulic flow restriction during flow events associated with higher velocity flows released during “wet” water years. Erosion at existing abutments, potential bridge overtopping, and salmonid habitat limitations caused by hydraulic pressures all indicate the need for a replacement bridge.

A new design was developed for a 155-foot single-span, weathering-steel truss bridge over the existing channel, with an overflow control structure constructed immediately upstream. The longer span will alleviate the hydraulic constriction. Additionally, regrading the river channel and side channel and removing the existing overflow structure provide an opportunity to develop beneficial fisheries habitat.

The project area includes associated design elements such as the Trinity River mainstem alignment, an existing upstream island/side channel complex, lowering of the left-side flood plain, an overflow control structure, a low-flow side channel through the existing box culvert, upstream and downstream floodway recontouring, improvements to Browns Mountain Road and adjacent parcels, and upstream and downstream erosion control systems for the abutments.

Habitat enhancement includes improved conditions for juvenile salmonids, expected to increase juvenile rearing and productivity on lowered floodplain areas and within side channels. The partners will review project status, design standards, and environmental considerations with Trinity County and associated agencies to facilitate efficient project completion.

Physical and Biological Responses to Restoration Flows

The Trinity River, like other alluvial river systems, is complex and dynamic. Our understanding of the Trinity River and how it will respond to restoration actions is continually improving. AEAM, the sixth element of the Trinity River restoration strategy, is a systematic approach for improving future management decisions by learning from outcomes of past actions.

Sediment Monitoring

Annual sediment transport monitoring in the mainstem Trinity River continued for the 9th consecutive year in 2012 with measurements at four sampling locations during the spring flow release. Water year 2012 was a “normal” year in which a moderate spring high flow with a maximum daily mean discharge of 6,080 cfs was released from Lewiston Dam, and sediment transport rates measured during the release were relatively low. As a result, coarse sediment storage volumes remained nearly constant in the upper river, even though no coarse sediment augmentations were performed in 2012. Sediment fluxes calculated from the 2012 sediment transport measurements also indicate that the volume of the finer sandy sediments that can compromise spawning success continued to decrease in the upper river.

Implementation Monitoring and Analysis

Implementation monitoring is applied to a range of implementation actions, including rehabilitation site design and gravel augmentation. In recent years, implementation monitoring has concentrated on an assessment of the potential impacts of rehabilitation actions and gravel augmentation on pool habitats. The issue is being addressed using bed elevation data collected in approximately 140 pools and runs located throughout the 40-mile reach between Lewiston Dam and the North Fork Trinity River. Major data reduction and analysis was completed in 2012, and preliminary results have been shared with Program staff and management. Preliminary findings suggest a tendency for pools to fill slightly in some river reaches and a tendency for them to deepen in other reaches. A complete report will be available following technical review.

Bed Mobility and Scour Monitoring

Bed mobility and bed scour were monitored as a part of the 2012 Interdisciplinary Habitat Assessment Project, and the monitoring was structured to evaluate Integrated Assessment Plan Objective 6P: Monitor bed mobility and scour thresholds.

Bed mobility and scour experiments were installed in fall 2011 (prior to high flow season), monitored following winter storms in early spring 2012, and monitored again in summer 2012 following the spring ROD release. The monitoring made use of a combination of painted tracer rocks, scour chains, and topographic cross-section surveys. It was conducted at 16 GRTS[3] systemic sampling sites throughout the system and at five channel rehabilitation sites that were constructed between 2005 and 2010. The monitoring was cross-section-based, involving a total of 42 cross sections: two cross sections were used at each GRTS site (*n*=32 cross sections), and one to three cross sections were used at the five channel rehabilitation sites (*n*=10 cross sections).

[3] Sampling was conducted using a generalized random-tessellation stratified (GRTS) sampling design, as described in Stevens and Olsen (2004).

Water Year 2012 was classified as “normal,” with a corresponding spring ROD peak magnitude of 6,000 cfs (170 m^3/s) that lasted for four days (May 6–9, 2012). The distribution of monitoring sites spanned 37.3 river miles, from RM 72.9 to RM 110.3, and the peak ROD release ranged from 6,200 cfs (175 m^3/s) at Lewiston Dam to 7,000 cfs (198 m^3/s) at our farthest downstream site, RM 72.9. Experiments at each monitoring site were placed along cross sections that spanned mobile bars, and experiments were placed with particular emphasis in the riparian encroachment risk zone (i.e., between the 450- and 2,000-cfs (13- and 57-m^3/s) inundation zones).

Data review and analyses from the spring 2012 ROD release are not completed, but preliminary results can be summarized relative to Objective 1.2.2 of the Integrated Assessment Plan:

- With exception of one site (Reading Creek XS 1903+50, discussed below), bed mobility monitoring showed the water year (WY) 2012 ROD release achieved partial (≥20%) to full (≥80%) D_{84} mobilization (D_{84} = particle diameter which exceeds the diameter of 84 percent of the sampled particles) at the monitoring sites, meeting the TRFES “normal” water year objective of mobilizing the D_{84} on channel-bed surfaces and along bar flanks. Mobilization increased with distance downstream of Lewiston.

- Bed scour monitoring showed variable results. Most sites recorded scour and redeposition depths less than 1.0 D_{84} (scour and redeposition are normalized to the local site D_{84} diameter) and both scour and deposition patterns along the cross section were variable. Few sites recorded no scour at all, and Reading Creek XS 1093+50 (Figure 9) recorded scour >2.0 D_{84} (Figure 10.) These results suggest the spring release did not fully meet the TRFES “normal” water year bed scour objective, despite some scour and redeposition occurring at each monitoring site. Similar to bed mobility, scour depth and abundance (percentage of cross section scoured) increased with distance downstream of Lewiston.

Figure 10. Cross section 1093+50 at Reading Creek on 7/26/12. From approximately station 75 looking toward the right bank bar.

Figure 9. Scour chain at station 106.5 on cross section 1093+50 at Reading Creek on July 26, 2012. Chain is fully scoured with only the chain anchor remaining in the bed. Chain is exposed to full length (63 cm or 24.8 in); exposed length was 17 cm (6.7 in) on April 12, before the spring ROD release, so scour during the release amounted to 46 cm (18 in.).

- Results of cross section surveys show only minor topographic changes resulted from the WY ROD 2012 release, with some cross sections showing no detectable change, to some cross sections showing up to approximately 0.6 meters of both vertical (net scour and aggradation) and/or lateral changes (e.g., bank erosion, thalweg shifts).

- Reading Creek channel rehabilitation site, XS 1093+50: experiments were installed on a right bank point bar that formed from the 11,000-cfs (311-m^3/s) WY 2011 ROD release. Topographic surveys show the bar was removed by the WY 2012 ROD release and the bed lowered to approximately the pre-bar (i.e., pre-11,000-cfs release) elevation. Two scour chains installed across the bar had scour >2.0 D_{84}. Bed mobility experiments were vandalized and results are unavailable, but it is assumed the bed surface was fully mobilized given that the bar scoured >2.0 D_{84}.

Based on preliminary results, the WY 2012 spring ROD flow release appears to have been large enough to mobilize the bed surface, but not large enough to scour or redeposit material in sufficient quantity to create large geomorphic changes. Results also suggest similar-scale geomorphic changes and channel response compared to results from WY 2010, which was also a "normal" water year release.

Riparian Vegetation Monitoring

During WY 2012, riparian vegetation monitoring was conducted at sites coincident with fish habitat and geomorphic assessments. Specific riparian monitoring tasks included vegetation and large wood mapping and band transect sampling. Riparian vegetation was monitored at five channel rehabilitation sites constructed between 2005 and 2010 and at 16 systemic sampling sites (transects). Monitoring was conducted in fall 2011, before winter storms, and again in summer 2012 after the 6,000-cfs (170-m^3/s) spring ROD release.

Water Year 2012 was classified as a "normal" water year. The receding limb of the ROD "normal" water year class hydrograph was modified to include short periods of consistent streamflows punctuated with slower streamflow recession. This was done to create adequate soil moisture away from the summer water's edge that would meet the seed germination and early growth requirements for riparian woody plants. During the late summer, streamflows were increased to above 1,000 cfs (28 m^3/s) for 20 days, with a one-day peak above 1,300 cfs (37 m^3/s). Riparian vegetation monitoring did not document the effect of the late summer streamflow increases on fine sediment deposition or seedling mortality.

Band transect sampling was conducted along one cross section at each of the systemic sampling sites, and at eight cross sections within the five channel rehabilitation sites (Figure 11). Vegetation measures included structural complexity, extent, species richness, age diversity, and riparian woody regeneration within distinct inundation zones. Data gathered during riparian monitoring was related to hydrology and to changes in channel morphology, channel bed and bank mobility, and channel bed scour. Riparian vegetation monitoring in 2012 followed the strategy identified in the Integrated Assessment Plan (TRRP and ESSA 2009). The data was used to evaluate the hypothesized linkages in the current riparian vegetation conceptual model and to evaluate whether the TRFES riparian scour and regeneration objectives for “normal” water year classes were being met (TRRP 2004, HVT and USFWS 1999). Results of the 2012 spring ROD peak flows and prolonged recession included:

- The richness of regenerating riparian woody plant seedling species increased within the 450- to 2,000-cfs (13- to 56-m^3/s) and the 2,000- to 4,500-cfs (56- to 127-m^3/s) inundation zones;

- Riparian woody plant seed germination and growth (i.e., regeneration) was promoted over a wider elevation range above the 2,000-cfs (56-m^3/s) water surface elevation than has been previously documented; and

Figure 11. Band transect sampling of vegetation near cross-section 260+05 at Conner Creek on August 7, 2012. View from downstream looking upstream. Numerous willow (*Salix* sp.) seedlings are visible in the center of the photograph. Inset photograph shows root lengths of seedlings that germinated in 2011 at this location.

- Many 2010 and 2011 riparian woody-plant seedlings within the 450- to 2,000-cfs (13- to 56-m^3/s) inundation zone along the low flow channel margin at GRTS sites were scoured, effectively inhibiting woody plant densities from exceeding detrimental encroachment thresholds within the 450- to 2,000-cfs (13- to 56-m^3/s) inundation zones.

The widespread fine sediment deposition noted after the spring 2011 ROD release was not observed again in WY 2012. In contrast, it appeared that the WY 2012 flows removed much of the fine sand deposits in the interstitial spaces between the gravels and cobbles on exposed bars that had been deposited during the receding limb of the spring 2011 ROD release. Lower numbers of woody plant seedlings regenerated in bank locations below the 4,500-cfs inundation level after the 2012 high flows than had been documented in 2011. Previous work in the Trinity River riparian corridor showed that woody plant seedlings require a substrate with a certain amount of fine sediment to become established; so the lower numbers documented in 2012 are thought to be a result of less available fine sediment substrate on surface deposits across bars and on floodplain surfaces.

Riparian woody plant species richness continued to increase systemically, as a result of the spring 2012 ROD releases. Narrowleaf willow was still the most frequently sampled woody plant, and most sampled woody plants were growing within the 450- to 2,000-cfs inundation zones. However, cottonwoods, shiny willow, and red willow successfully regenerated in higher numbers than previously documented, and many were sampled above the 2,000-cfs water-surface level on naturally formed bars and some constructed floodplain surfaces. The modification to the receding limb of the ROD hydrograph in “normal” and wetter years is apparently successful in promoting broader woody riparian plant richness in the riparian corridor. Furthermore, current trends in seedling establishment suggest that managed spring ROD releases are inhibiting woody plant seedling densities from crossing detrimental encroachment thresholds within the 450- to 2,000-cfs inundation zones in many locations; however, berms are re-forming above the 2,000-cfs water surface at some locations, which is higher on the bank than they had formed under pre-ROD conditions (i.e., at 450- to 2,000-cfs levels). The re-forming, higher elevation riparian berms may still have the potential to induce channel simplification, but that has not yet occurred.

Large wood was mapped at the systemic sampling sites. An average of 27 pieces of wood greater than 4 inches in diameter were mapped at GRTS sites. White alder was the most abundant type of wood of those pieces that could be identified, making up 40.2 percent of the sample. Conifer wood (including Douglas-fir, ponderosa pine, and incense cedar) made up 10.1 percent of the sample, and willow wood made up 9.7 percent. Unidentified wood made up 35.3 percent of the sample. Overall, large wood storage increased by about 19.5 percent at systemic sampling sites between 2011 and 2012.

Fisheries

Juvenile Salmonid Outmigrant Abundance

To estimate the abundance of naturally produced age-0 Chinook salmon outmigrating from the upper Trinity River, the HVT Fisheries Department conducted sampling at Pear Tree Bar, located approximately 39 miles (63 km) downstream of Lewiston Dam. A second site located near Willow Creek, operated by the YT Fisheries Program, was used to monitor annual age-0 Chinook salmon production, and to assess Program performance objectives for outmigrating juvenile Chinook salmon, juvenile coho salmon, and steelhead smolts. For both sites, an extensive mark-recapture effort was employed with USFWS conducting the fish marking and CDFG providing fish from the Trinity River Hatchery.

From January through August, 2012, abundance estimates of natural age-0 Chinook salmon were: 4,987,106 (±240,428) at the upriver site and 3,512,974 (±412,303) at the lower river site. The mean migration rate between the two sites was 11.2 miles (18.0 km) per day (±6.3 miles or 10.1 km per day). The 80-percent population outmigration date for juvenile Chinook Salmon at the lower river site was July 8, which met the outmigrant objective of July 9. The 80-percent population outmigration date objectives for juvenile coho salmon (June 4) and steelhead (May 22) at the Willow Creek trap were met in 2012. While earlier outmigration timing may enhance fish survival, as it allows them to pass through the lower Trinity River and lower Klamath River before the temperature increases later in the season, additional rearing time and the associated growth may also have a positive benefit on survival.

Juvenile Chinook Salmon Disease Monitoring

Fish disease outbreaks in the lower Klamath River have a detrimental effect on outmigrating juvenile Trinity River salmon and steelhead. From May 1 through August 8, 2012, juvenile Chinook salmon migrating through the lower Klamath River were examined for the incidence of two infectious diseases caused by parasites. The YT Fisheries Program collected 3,511 juvenile Chinook salmon, including 85 coded-wire-tagged (i.e., hatchery-raised) Chinook for laboratory analysis. Lab analysis detected *Ceratomyxa shasta* in 42.6 percent (23/54) and *Parvicapsula minibicornis* in 57.4 percent (31/54) of Trinity River origin juvenile Chinook salmon caught below the Trinity-Klamath confluence. Data collected for the years 2007–12 is presented in Table 4. Detection of pathogenic organisms does not necessarily mean the fish will succumb to the disease. See the final California/Nevada Fish Health Center laboratory report at: http://www.fws.gov/arcata/fisheries/projectUpdates.html

Salmonid Spawning Escapement and Harvest

The TRRP supports spawning escapement and harvest monitoring projects for Trinity River spring and fall-run Chinook and coho salmon, and for adult fall-run steelhead to evaluate progress towards restoration goals. The preliminary adult escapement estimates and the corresponding TRRP escapement goals are presented in Table 5. The adult fall Chinook salmon spawning escapement for the Trinity Basin was 70,148 fish, of which 17,461 returned to the Trinity River Hatchery and 52,687 spawned in the mainstem Trinity River and its tributaries (Figure 12). The large return of fall Chinook salmon to the Trinity is just one component of the record fall Chinook salmon return to the entire Klamath/Trinity Basin in 2012.

Table 4. Prevalence of *Ceratomyxa shasta* infection in juvenile Chinook salmon caught in the Trinity and lower Klamath Rivers, 2007–2012

Year	Dates Sampled	Catch Per Unit Effort[1]	Total Chinook Catch	Chinook with Coded Wire Tags[2]	Prevalence of *C. shasta* on the Trinity River	Prevalence of *C. shasta* in lower Klamath[3]
2007	6/14/07 – 8/10/07	38.30	7,698	219	2.8%	13.9%
2008	5/28/08 – 8/8/08	119.44	10,152	224	1.3%	3.1%
2009	6/1/09 – 8/12/09	152.75	9,012	290	12.1%	13.0%
2010	5/5/10 – 8/16/10	116.21	11,737	147	0%	2.2%
2011	4/15/11 – 8/19/11	104.67	5,338	54	0.5%	8.2%
2012	5/1/12 – 8/8/12	100.31	3,511	85	(4) 3.8%	(4) 42.6%

[1] Number of fish caught per hour.
[2] Indicates hatchery-raised fish.
[3] Includes only Trinity-origin Chinook caught in the lower Klamath.
[4] 2012 data is preliminary.

Table 5. Preliminary 2012 adult escapement estimates for Trinity River salmonids (CDFW 2013)

Species	Natural Escapement		Hatchery Escapement	
	2012 Run	Program Goal	2012 Run	Program Goal
Spring Chinook Salmon	17,730	6,000[a]	6,712	3,000
Fall Chinook Salmon	52,687	62,000	17,461	9,000
Coho Salmon	7,939	1,400	7,356	2,100
Fall Steelhead adults	14,666	40,000	5,737	10,000

[a] The natural spring Chinook salmon spawning escapement goal is for the entire Trinity Basin, but the run-size estimate only accounts for the population above the Junction City Weir and does not include spawning escapement into the South Fork of the Trinity, the North Fork of the Trinity, the New River, or Canyon Creek.

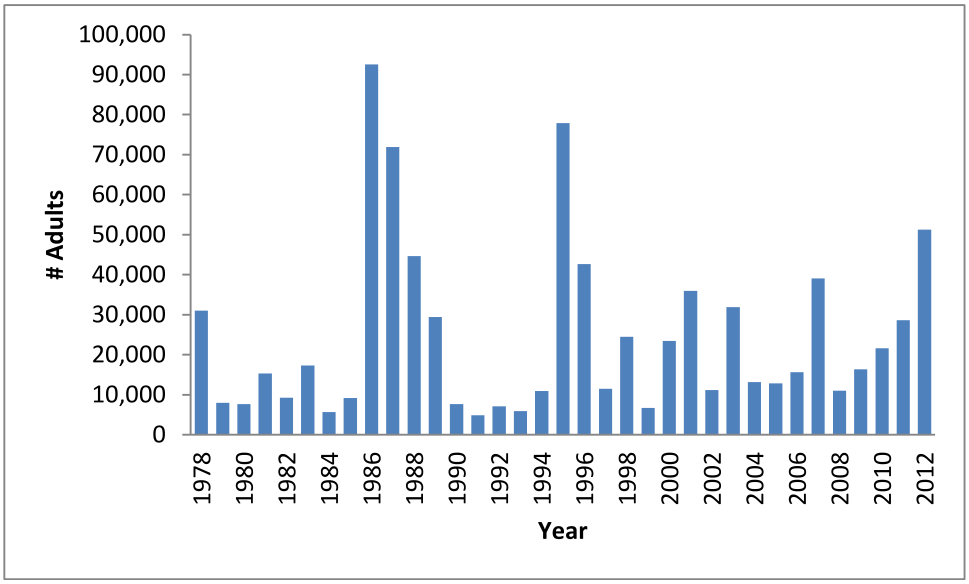


Figure 12. Adult natural fall Chinook salmon spawning escapement above the Willow Creek Weir, 1978-2012.

Adult Fall Run Chinook Salmon Harvest

A component of the TRRP's goal to restore anadromous fish populations is to support dependent ocean fisheries, as well as in-river recreational and tribal fisheries. Natural and hatchery-produced 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 Yurok Tribal fishery in the lower Klamath River below its confluence with the Trinity.

In 2012, the estimated adult fall Chinook salmon harvest for the recreational fishery is 1,737 fish on the Trinity River and 7,870 fish on the lower Klamath River. The estimated tribal harvest of adult fall Chinook salmon was 4,145 fish by the Hoopa fishery and 97,331 fish by the Yurok fishery.

Redd Distribution and Abundance

The mainstem Trinity River is surveyed each fall to determine the geographic distribution of spawning salmon. Improved fry-rearing habitat created through Program activities are anticipated to lead to changes in both the distribution of natural-origin Chinook salmon spawning and the relative run size of natural versus Trinity River Hatchery origin fish. From September 11 to December 19, our fall 2012 survey mapped a total of 7,588 redds (Chinook and coho salmon), from Lewiston Dam to Weitchpec (excluding the reaches from Pigeon Point to Big Flat River Access, and from Cedar Flat to Hawkins Bar). Using the distribution of 1,271 fresh spawned female carcasses recovered over the same survey interval, we *tentatively* estimate 5,880 of these redds were constructed by natural-origin Chinook salmon females and 1,558 were constructed by hatchery-origin Chinook salmon females (Figure 13). For these estimates, we assume an exact 25-percent mark rate at Trinity River Hatchery. Actual mark rates vary slightly from 25 percent and differ year to year. Coded wire tags from hatchery-marked Chinook salmon recovered during our survey are being read at the time of this report. From tag codes recovered on the spawning grounds, project investigators will determine appropriate expansion factors to estimate the quantity and distribution of Trinity River Hatchery-origin Chinook salmon females that contributed to the construction of redds in the Trinity River.

Fish Habitat Assessment

Restoration Reach Evaluation — Flow and channel rehabilitation actions are anticipated to create changes in rearing habitat availability through the 40-mile (64-km) restoration reach. Rearing habitat availability was mapped at 32 randomly selected sites annually between 2009 and 2012 as part of a multiyear study. The total area of rearing habitat within the restoration reach in 2012 was about 3.61 million square feet (335,800 m^2) for fry, and 4.70 million square feet (436,700 m^2) for presmolt (Figure 14).

Adult Salmonid Monitoring Evaluation

Between October 2011 and March 2012, Dr. Mike Bradford, Simon Fraser University, and Dr. David Hankin, Humboldt State University, conducted a review of the TRRP’s adult salmonid monitoring program. The goal of the review was to evaluate the effectiveness of Program-supported adult salmonid assessments and monitoring projects. Adult monitoring data are used by the TRRP to evaluate the performance of salmonid populations relative to the goals of increasing catch and escapement, and to evaluate the response of the Trinity River ecosystem to management actions designed to improve the flow regime and habitat conditions. The reviewers offered both overarching recommendations and project-level suggestions. The primary recommendation for many of the field projects related to improving the analysis and reporting.

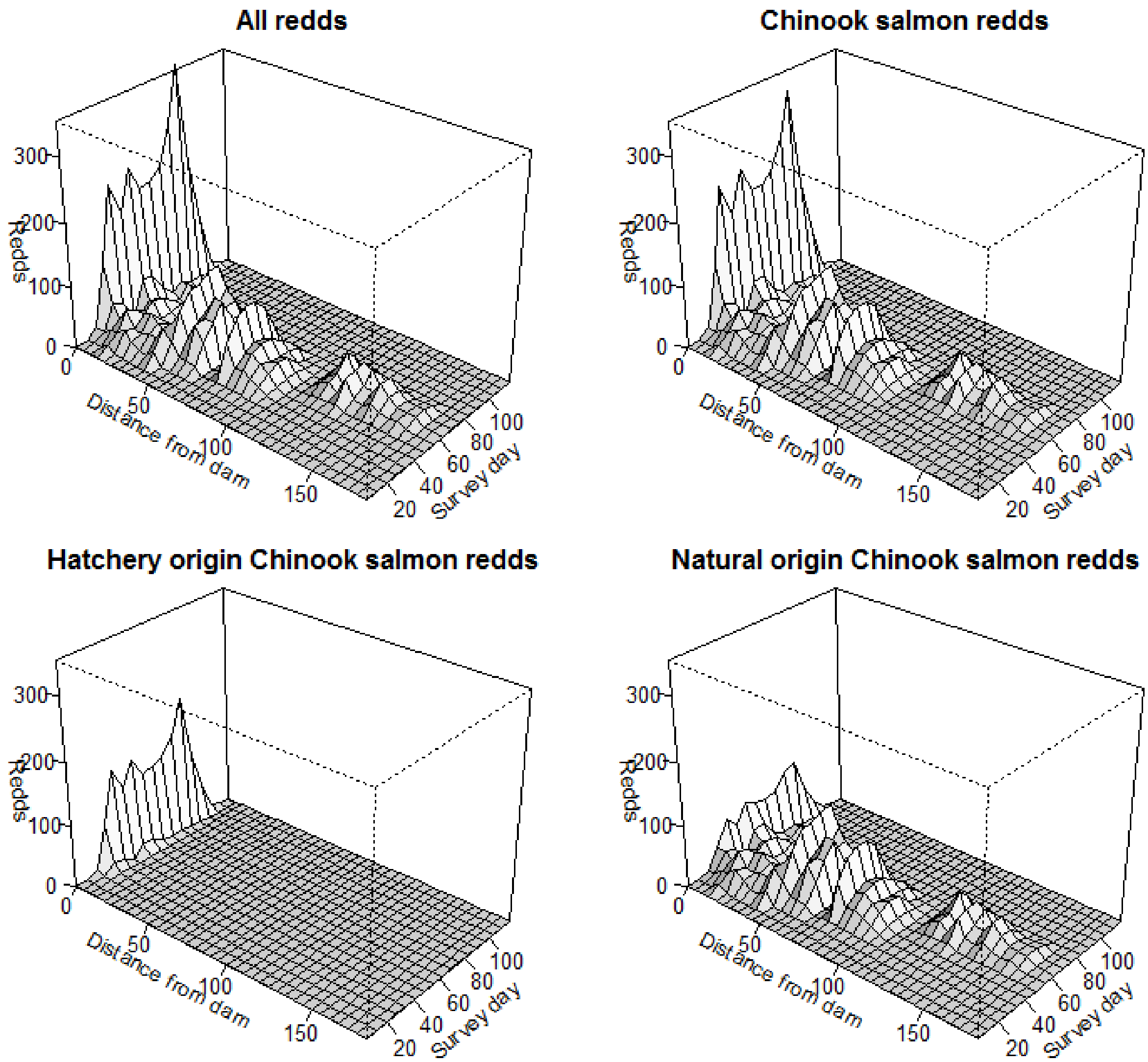


Figure 13. Spatiotemporal distributions, Lewiston Dam to Weitchpec, of mainstem Trinity River redds, fall 2012. Pigeon Point to Big Flat River Access and Cedar Flat to Hawkins Bar not surveyed. Survey day 1 = September 1, survey day 120 = December 29.

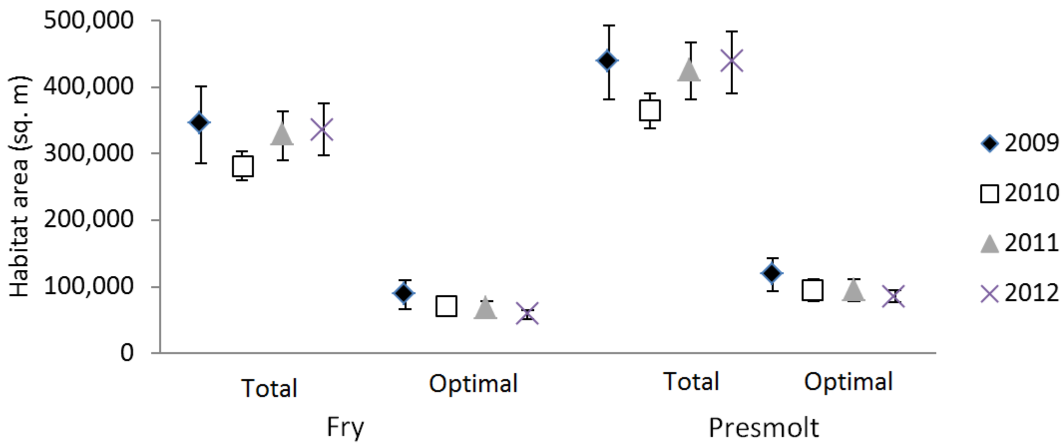


Figure 14. Total and optimal fry and presmolt rearing habitat area between 2009 and 2012. Data presented is preliminary and subject to change. Error bars indicate a 95-percent confidence interval.

The reviewers recommended that the TRRP adjust the monitoring programs from their origins in fisheries management for the Klamath Basin, to a structure that allows for the evaluation of TRRP objectives. Importantly, the reviewers suggested the formation of an analytical group within the TRRP to synthesize information from the various adult monitoring projects into a form that can be used to evaluate the TRRP hypotheses and objectives identified in the Integrated Assessment Plan. The reviewers' report is available on line at http://odp.trrp.net/Data/Documents/Details.aspx?document=1433.

Juvenile Salmonid Density Monitoring – Juvenile Snorkel Surveys

Snorkel surveys were conducted from January through April of 2012 to document the spatial and temporal variation in juvenile salmonid density over the restoration reach. Early in the season, January through February, juvenile salmonids were more abundant higher in the system and weakly associated with optimal habitat, inasmuch as small fish are generally subject to the whim of the river. Later in the season, March through April, juvenile salmonids were more spread out over the restoration reach, and a statistically significantly association with optimal fry habitat was observed. Multiple assumption tests were performed investigating the factors that introduce variability in fish counts, such as diver variability, diver efficiency, time of day, visibility, and day versus night. Figure 15 shows a diver enumerating juvenile salmonids in optimal fry habitat.

Figure 15. Snorkeler enumerating juvenile salmonids in optimum fry habitat in restoration reach.

Results from the 2012 study have been used to answer some basic questions about the distribution of juvenile salmonids across the TRRP restoration reach and have been used in an adaptive management framework to guide 2013 study efforts.

Data Management

The ultimate products of the Program will be threefold: a more functional river, increased fish populations, and quantifiable information about the river. As shown by the diversity of data presented in the AEAM section, data management in TRRP and its use for conducting adaptive management is complex because partners and collaborators all contribute to sampling efforts, so the need for efficient and timely data sharing is critical. A data team brought together across the partnership completed the TRRP Data Management and Utility Plan (http://odp.trrp.net/Data/Documents/Details.aspx?document=1510), which establishes procedures for the development, sharing, and dissemination of data packages to promote collaboration and efficient adaptive management.

The Program's online data portal (ODP) at http://odp.trrp.net is a key component in TRRP's information repository. The ODP is a data storage and access system continually under development to provide equal access to Program information products for Program partners, stakeholders, and the public. The ODP now provides convenient access to over 1,000 reports, other documents and products; over a hundred meeting agendas and summaries; 26 data packages; and millions of data points on streamflow, water temperature, and reservoir operations. Many of the reports and documents are scanned items dating back as far as 1900. Using web services to automatically provide up-to-date information on data and document holdings, the ODP interacts with the Program's general website at http://www.trrp.net. The mapping component of the ODP now works more fluidly and includes aerial photography from 1944. We invite you to explore!

Remote Sensing: Aerial Photography and Aerial LIDAR

High-resolution aerial photography may be the most widely used data across the Program partnership, as it provides context for documenting changes in the river channel, designing restoration actions, planning scientific investigations, and communicating both within the Program and with the public. The annual collection of aerial photography provides a reliable census of the visual form of the river from a standardized point of view, which enables a variety of analyses of change over time. Detailed topographic data has similarly widespread utility and can be collected over large areas by aerial LIDAR (Light Detection And Ranging). LIDAR costs are significantly greater than aerial photography, so LIDAR data will not be collected across the entire 40-mile reach every year. The Program intends to use LIDAR to document rehabilitation sites each year and to do reach-wide collection less frequently.

Aerial photography showing the as-built condition of the Wheel Gulch rehabilitation site was collected in December 2011, prior to the first release of restoration flows for the newly constructed site. New reach-wide orthorectified aerial photography was collected on July 30, 2012, after the river returned to its summer base flow, and included near-infrared imagery to improve vegetation analyses.

LIDAR was also collected in December of 2011. This collection was reach-wide and will be combined with extensive sonar bathymetry to construct a 2011/12 detailed topographic model for the 40-mile reach. The last one was from 2009.

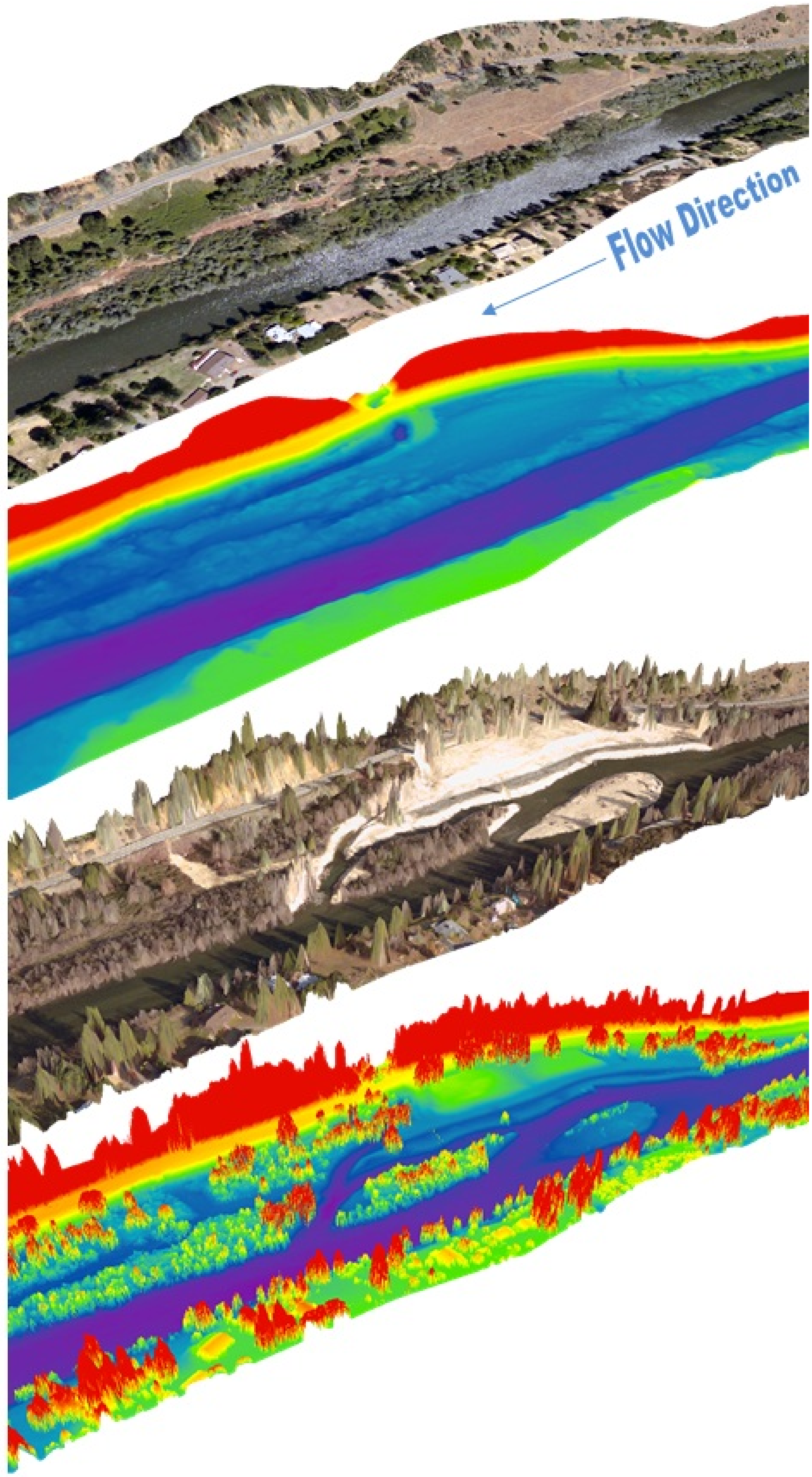
The program now has 17 reach-wide aerial photography datasets, ranging from 1944 to 2012, and 3 topographic models ranging 2001 to 2011/12. These data provide context for recent and current river restoration challenges, and enable change analyses of the effects of restoration actions (Figures 16 and 17).

Implementation Monitoring and Analysis

Bathymetric survey using a Ross Labs 7-channel sweep system.

Implementation monitoring informs a range of implementation actions, including rehabilitation site design and gravel augmentation. In recent years, implementation monitoring has concentrated on an assessment of the potential impacts of rehabilitation actions and gravel augmentation on pool habitats. The issue is being addressed using bed elevation data collected in approximately 140 pools and runs throughout the 40-mile reach between Lewiston Dam and the North Fork Trinity River (e.g., Figure 18). Major data reduction and analysis were completed in 2012, and preliminary results have been shared with Program staff and management. Preliminary findings suggest a tendency for pools to fill slightly in some river reaches and a tendency for them to deepen in other reaches. Instances of significant pool aggradation were found to be limited to a few local areas. A complete report will be available following technical review.

Figure 16 (opposite). Three-dimensional views of the Wheel Gulch site before and after rehabilitation, constructed from 2009 and 2011 LIDAR and bathymetric sonar topography data. Coloring of topographic surfaces is by elevation and is matched between images. ▶



Before

Photography:
2010

Topography:
2009
(ground surface)

After

Photography:
2011

Topography:
2011
(preliminary,
vegetation not
distinguished from
ground surface)

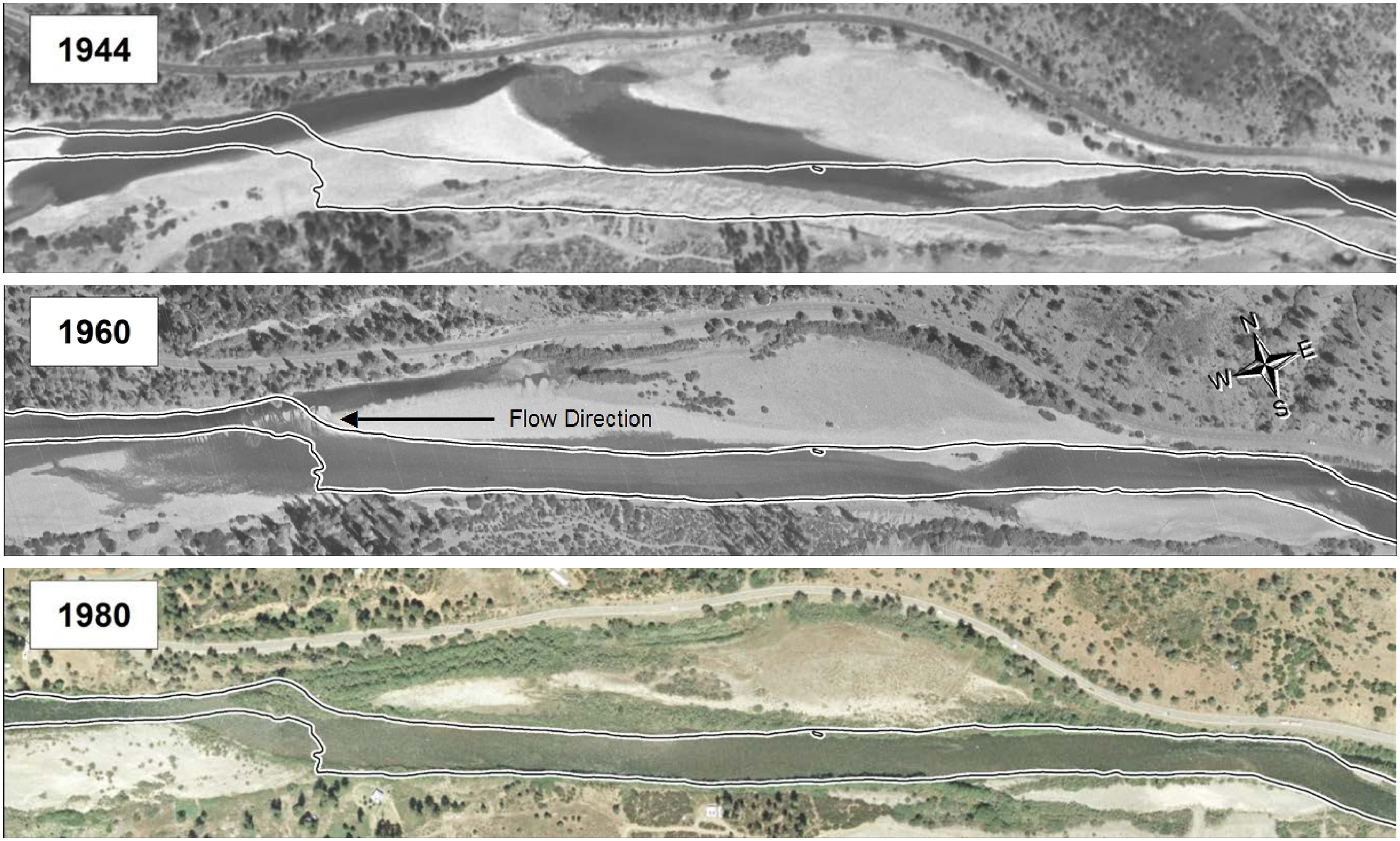

1944
1960
Flow Direction
N
E
W
S
1980

Figure 17. Comparative aerial photographs of the Wheel Gulch reach of the Trinity River with 2009 bank lines for reference. In 1944, dredge mining is evident along the southerly bank, but the stream shows diverse and dynamic geomorphology. In 1960, tailings had been reduced and reworked into high banks, presumably by the 1955 flood. By 1980, flow regulation had enabled thick vegetation to grow over much of the lower banks. The 2001 photo demonstrates how continuous low flow simplified the channel and encouraged growth of a uniform bank of riparian vegetation. The 2012 photo shows changes at the Wheel Gulch channel rehabilitation site, after one 6,000-cfs restoration flow release, resulting in more variable geomorphology than the reach has had in decades.

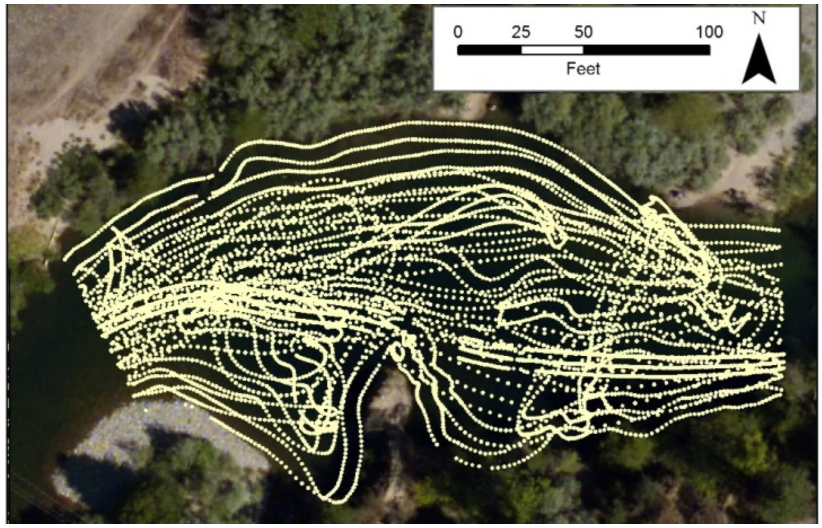


Figure 18. This example of the sonar data used to evaluate changes in pool depths shows about 9,000 individual sonar measurements collected at Bucktail Hole in the summer of 2011.

Applicable Environmental Laws and Authorizations:

- The National Environmental Policy Act (NEPA)
- California Environmental Quality Act (CEQA)
- Endangered Species Act of 1973
- Clean Water Act
- Wild and Scenic Rivers Act
- Executive Order (EO) 11988 for floodplain management
- EO 11990 for the protection of wetlands
- EO 13112 for invasive species
- EO 12898 for environmental justice

Environmental Compliance and Mitigation

The seventh element of the restoration strategy involves activities that require Program compliance with various environmental laws. (See sidebar.)

Projects performed on public lands managed by the USFS or the BLM must also meet guidelines of the Northwest Forest Plan and the Aquatic Conservation Strategy. Just as the TRRP works with private landowners to implement mutually beneficial projects on their lands, on BLM or USFS managed locations, the TRRP works with these Federal partners to ensure that agency needs are met for each project.

Coarse Sediment Augmentation

In 2009, the Program, working with staff at the North Coast Regional Water Quality Control Board (NCRWQCB), completed the Master Environmental Impact Report (Master EIR) and Environmental Assessment for channel rehabilitation and sediment management activities (NCRWQCB et al. 2009). In 2012, this programmatic EIR, along with the 2000 Trinity River Mainstem Fishery Restoration EIS, streamlined the CEQA, NEPA, and permitting requirements (e.g., USACE, NMFS, CDFG, NCRWQCB, and Trinity County). However, due to the high flows of 2011 and the resulting enhanced movement of gravel throughout the restoration reach, some pools were filled, raising concerns of the fishing public.

As the TRRP is more than halfway through implementation of the original 47 channel rehabilitation sites, our activities have affected much of the river. Through implementation the Program has the potential to create short-term impacts, and to make long-term positive impacts on protected Trinity River resources. Direct and cumulative effects of large-scale implementation need to be monitored, and potentially mitigated if required, to ensure long-term beneficial results.

Stakeholders have seen river changes and request assurances that these will result in mutually beneficial results for the fishery resources, for the river, and for the tribal and public trusts. Consequently, the implementation group continues to collaborate with Program partners in order to minimize and monitor impacts to non-target species (e.g., birds and other wildlife) and to cultural resources. What is more, in order to meet NEPA and CEQA needs for full public disclosure, the TRRP has again increased our outreach efforts to inform the community of restoration program intentions and to include all partners, collaborators, and public and private stakeholders early in Project design and gravel augmentation planning.

As part of the public outreach and environmental review for 2012 projects at Lower Steiner Flat and Upper Junction City Channel Rehabilitation Sites, special attention was given to design features that did not compromise restoration efforts, while considering existing pools habitats in the project reaches.

As described in the Master EIR (NCRWQCB et al. 2009), a new, site-specific Environmental Assessment/Initial Study is completed each year, and it indicates, among other things, whether or not the proposed projects are within the scope of the Master EIR and whether additional mitigation measures might be required. In 2012, the NCRWQCB, CEQA lead for the Master EIR, worked with the TRRP to ensure that short-term impacts from gravel augmentation and channel rehabilitation on pool habitat were minimized in support of the North Coast Region Water Quality Control Plan (Basin Plan). The Basin Plan protects the beneficial uses of water resources, including migration and spawning habitat, for anadromous fish.

Riparian Wildlife Species

The Master EIR was developed to ensure that environmental impacts were minimized and that CEQA requirements are met. The Master EIR's mitigation and monitoring program requires that negative impacts to the environment (e.g., air quality and historic resources), fish, and wildlife be mitigated during construction and for the long-term. TRRP monitoring of sensitive State and federally listed species ensures that these species' conservation and restoration needs are met. These short- and long-term monitoring requirements ensure that any cumulative negative impacts from ROD implementation are mitigated. As an example, the Program must replace riparian vegetation, which it lawfully removes during project implementation, and must monitor/evaluate the success of replanted riparian vegetation. Many migratory birds rely on riparian vegetation for shelter, food, and nesting, and these birds are monitored to ensure that project implementation is not causing a long-term decline in key species throughout the restoration reach.

In 2011, the Klamath Bird Observatory (KBO) initiated their bird monitoring program along the 40-mile Trinity River reach and at selected rehabilitation sites. So far their data support conclusions of earlier bird studies (Miller et al. 2010) that Program implementation has not negatively affected Trinity River bird populations. KBO continues to collect data on five focal bird species along the Trinity.

Photos © Jim Livaudais

The Focal Birds

Five bird species – one resident and four migrants – were selected as riparian focal species for the Trinity River Restoration Program. In combination, these species represent key structural components of a riparian ecosystem capable of supporting numerous other species.

Song Sparrow (Resident)—
This heavily streaked russet, gray, and white bird is perhaps the most familiar native sparrow in the United States. It is also our most common focal species. Song sparrows keep relatively low to the ground as they utilize grasses and shrubs for nesting and foraging. They feed on seeds, berries, and a variety of invertebrates. As habitat generalists, song sparrows will inhabit both early successional and mature riparian habitat. They are our first focal species expected to inhabit restored riparian and our first indication that young habitat is on a successful trajectory.

Black-Headed Grosbeak (Migrant)—
A large bill combined with a black, white, and cinnamon pattern helps identify males of this species. Black-headed grosbeaks occur in a variety of habitats and show a preference for areas that contain a deciduous component. They are often

most abundant in riparian zones, mixed conifer-hardwood forests, and at the interface between these two habitat types. They conceal their nests in the midstory and feed mainly on insects, seeds, and berries. On the Trinity, grosbeak abundance in the riparian zone is an indication of an intermediate successional stage containing deciduous shrub and lower tree layers.

Photos © Jim Livaudais

Yellow Warbler (Migrant)—
This bird with rich yellow plumage sports a prominent black eye. Yellow warblers can be found in dense thickets of willow- or cottonwood-dominated riparian habitat. They nest in midstory vegetation, typically between 1 and 14 feet off the ground. They feed almost exclusively on insects. Yellow warblers are indicators of well-developed riparian habitat.

Yellow-Breasted Chat (Migrant)—
White “spectacles” adorn the grayish head of this vocal bird with a bright yellow chest. Yellow-breasted chats occur at thicket edges with an open canopy overstory. They nest in the understory, often fewer than 5 feet off the ground. Their diet includes both insects and berries. Similarly to the yellow warbler, this focal species prefers structural features that indicate a well-developed riparian habitat.

Tree Swallow (Migrant)—
Iridescent blue-green above and snow-white below, the tree swallow is often seen in flight. Tree swallows occur near mature riparian forests due to their dependence on standing dead trees for nesting cavities. They also require open areas with ready access to water. The bulk of their diet is formed from insects taken on the wing, but berries are eaten too. This focal species indicates mature riparian components retained within restoration areas.

Population Trends—
We detect stable or increasing populations for our five focal species over the past 10 years at three landscape scales: the regional scale (northwestern California), the 40-mile program area scale, and the restoration site scale. That said, there is also evidence of short-term reductions in bird abundance in response to channel rehabilitation activities that removed riparian vegetation.

At the regional scale of northwestern California, an analysis of Breeding Bird Survey data from the years 2002–09 did not indicate increasing or decreasing trends for the five focal species.

In contrast, at the 40-mile program area scale during the same time period, populations increased for four of the five focal species (song sparrow, black-headed grosbeak, yellow-breasted chat, and yellow warbler); no trends were detected for the tree swallow.

At the restoration site scale, we had sufficient data for trend analysis at only one site — Hocker Flat — and even here results should be interpreted cautiously due to a small sample size. We analyzed population trends for the five focal species from 2005, the year channel rehabilitation occurred, through 2011. For one species, the song sparrow, we detected an increasing trend following channel rehabilitation, such that its population reached pre-rehabilitation levels 5 years after restoration (Figure 19).

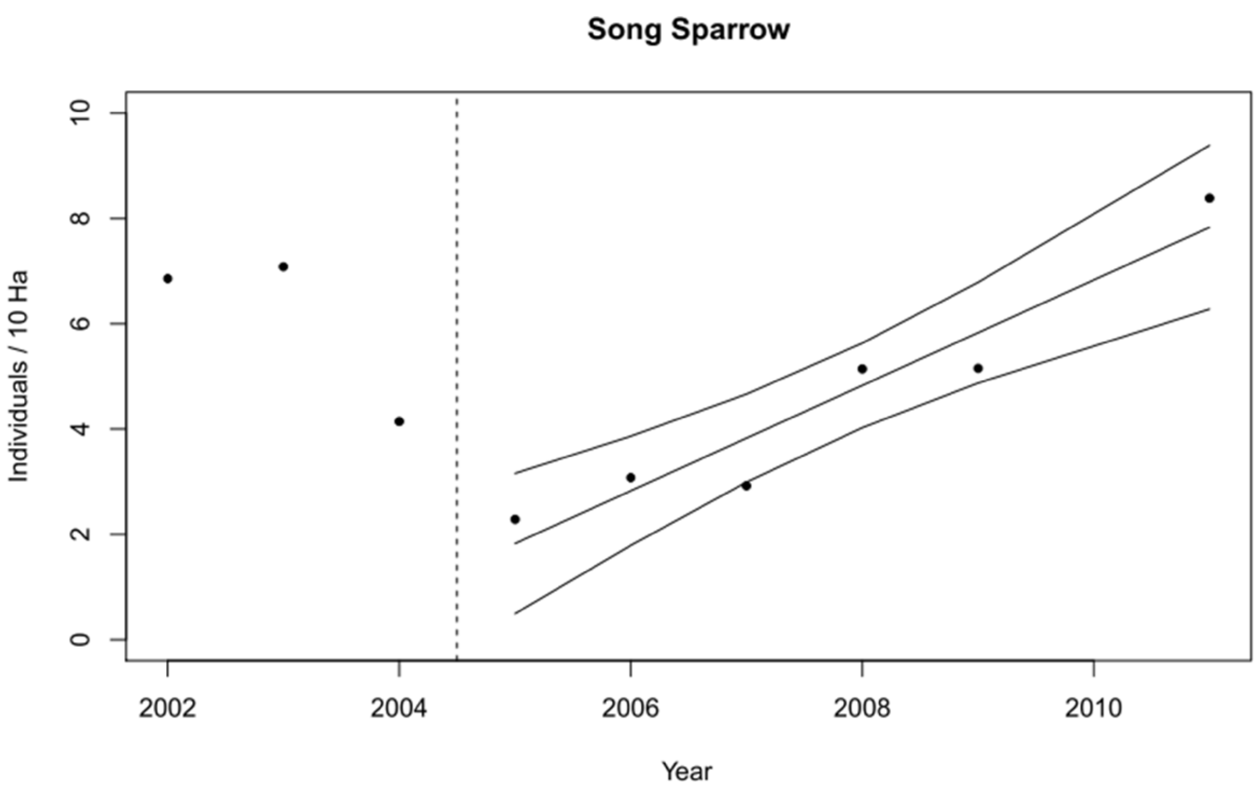


Figure 19. Abundance trends and 95-percent confidence bands for song sparrow at Hocker Flat, 2002–11. The trend is estimated for the years following site construction. The vertical dashed line marks the year of construction.

Ten years into the Program, increasing or stable populations of five focal riparian bird species within the restoration reach indicate that channel rehabilitation activities, including removal of riparian berms and construction of river channels and floodplains, have not led to significant degradation of riparian habitat.

In addition to summarizing previously collected bird data, evaluating bird utilization of constructed floodplain features and revegetated areas, and maintaining a 40-mile monitoring program, KBO has now initiated several new scientific inquiries. These refined studies, which include productivity estimates (nest searches), spot mapping of bird territories, and intensive vegetation monitoring, are meant to provide results to link potential management with the health of focal bird populations. It is hoped that the ultimate result will provide direction to the TRRP so that our management activities (e.g., flow releases, revegetation efforts, or excavation and floodplain management) may be used to directly benefit targeted avian species.

Herpetofauna

In 2012, Humboldt State University and USFWS researchers completed their two-year study at the Lowden Ranch rehabilitation site. This research was funded to monitor population health and terrestrial movement patterns of western pond turtles living in pond habitats. The study was conducted to provide a better understanding of how turtles utilize these systems, and if these habitats provide a favorable alternative to the Trinity River — which is much colder than it was historically due to spring Chinook summer holding requirements.

The study showed that turtles quickly find and use newly created pond habitats, but that non-native species, most importantly bullfrogs, were likely a deterrent to the recruitment of turtles to the adult population. Long-term monitoring of four constructed Lowden Ranch ephemeral wetlands (which dry in late summer) will be important to understanding how these lentic habitats affect the survival of native turtles and amphibians in the area. Turtles and native amphibians do not require permanent water, but bullfrogs require two years on continual moisture to reach adulthood. Though the bullfrog will not be able to reproduce in the new ponds, it is unclear whether this will reduce their negative impacts on the native amphibians. The primary investigator for the Lowden Ranch work, Leah Sloan, has completed her thesis, which is on line at http://humboldt-dspace.calstate.edu/bitstream/handle/2148/960/Sloan_Thesis_Western_Pond_Turtles_2012.pdf. A short management recommendation summary report is also posted at http://odp.trrp.net/Data/Documents/Details.aspx?document=1819 . The results and recommendations will be used to help inform future construction of western pond turtle habitat at channel rehabilitation sites.

Riparian Vegetation Assessments and Wetland Mitigation

As part of its environmental mitigation requirements, the Program has been charged with areal replacement of all riparian vegetation disturbed during channel rehabilitation site construction. Preliminary results of 2011 revegetation monitoring at all rehabilitation sites indicates that some riparian revegetation is occurring along wetted areas and the river edge. However, diverse stands of TRRP pole plantings (1) are difficult to monitor because they are intermixed with “volunteer plants” (which often grow faster than planted poles) and (2) often have poor growth and survival because of harsh floodplain growing conditions. The floodplains are hot and dry, and they have been disturbed by mining so often that soil is rare. Some plantings survive well, but in areas that are farther from the river and farther from groundwater, survival of planted riparian vegetation is unreliable. An internal draft report notes that 1:1 areal replacement of impacted riparian vegetation has been achieved at many of the channel rehabilitation sites, but that the majority of the revegetation is attributable to regrowth of existing plants and recruitment of new seedlings — not TRRP pole plantings. The report also quantifies non-construction-related losses of vegetation (from erosion or removal on private lands) and finds that these losses may also be extensive.

Although there is an overall increase in riparian vegetation at the constructed and revegetated sites (those constructed between 2005 and 2009; Hocker Flat through Sawmill), this is primarily a result of river processes and maintenance/restoration of these processes, which maintain vegetation, not because of the survival of planted stock. Consequently in 2012, the TRRP reinvigorated its commitment to revegetation and maintenance of both riparian and upland vegetation, which work together in support of fish and wildlife objectives. At Upper Junction City and Lower Steiner Flat project construction sites, the TRRP hired a professional revegetation contractor to plant all of the floodplain areas and to ensure survival of the vegetation over the first three years of growth. Concurrently, the TRRP is working with the CDFW to redefine the replanting requirements so that they are simplified and easy to measure. The newly agreed-upon requirements will be met when 70 percent of the planted stock has survived 3 years and when areal 1:1 replacement goals are achieved within 10 years of disturbance.

To ensure revegetation success of hardwood plantings (e.g., willows and cottonwoods) on the harsh (hot, dry, and mined) Trinity River floodplain, the Program continues to update its planting techniques. In 2012, more than 15 acres were planted using freshwater emergent plants and primarily container stock plants, which could be planted and watered during the summer heat. The plantings included a more diverse assemblage of species than the TRRP had used before, including California wild rose (*Rosa californica*), American dogwood (*Cornus sericea*), mugwort (*Artmesia douglasiana*), California coffeeberry (*Frangula californica*), etc.

The plantings were placed in the riparian zones identified as being favorable for each species (e.g., toe of slope, slope, or wetland) to help ensure success and promote specific riparian function at different planting locations. In addition, clumps of willows were transplanted for reuse. Willows were salvaged from lowered floodplains and replanted on new constructed surfaces and also on slopes to help prevent erosion. By watering these clumps and restoring the plants to vigor after transplant shock, cuttings were secured from the clumps and reused for additional pole plantings, thus increasing the value and reuse of each plant.

To help stabilize eroding banks along newly constructed pond and side-channel habitats at Upper Junction City, fascines (bundles) of live willow sticks were installed so that their root growth would secure the side slopes from slumping into the ponds. Trench plantings of willows were also filled with organic material (e.g., large woody debris) to maintain moisture through the dry season. To maintain all plantings and rooted stock, irrigation systems were set up and run through the dry season. Finally, as deer began to browse on the newly planted green material, tree protectors were placed to help preserve these preferred plants on the floodplain at both sites. Plans are now in place to remove some of the tree protectors before high flows might wash them away.

In 2012, an enhanced revegetation design was recommended to restore ecosystem function at both sites. Overall, a mixture of container plants, pole cuttings, and salvaged plant material was planted at each of the 2012 channel rehabilitation sites. At Lower Steiner Flat, approximately 2,400 native plants were placed over approximately 3 acres (1.5 acres of upland and 1.5 acres of riparian). At Upper Junction City, more than 10,500 native plants were placed over about 12.2 acres (4.4 acres of upland and 7.8 acres of riparian ground).

The TRRP is concerned not only with its own planted vegetation but also with invasive plants that may not be wanted at the channel rehabilitation sites. Prior to implementation of channel rehabilitation work, the TRRP conducts botanical surveys, both to locate and protect rare species and to determine if any high-priority invasive species are present so that management options might be considered for their control. For many of the Trinity River's non-native species (e.g., Himalayan blackberry and Dalmatian toadflax (*Linaria dalmatica*)), construction activities may temporarily reduce their abundance, but options to permanently control the populations are not considered viable. These intruders are ubiquitous within the restoration reach and will continually reinvade the construction sites. However, at Upper Junction City, dyer's woad (*Isatis tinctoria*) was found to occupy the site. Due to the plant's noxious weed status, relatively low abundance in Trinity County, abundant seed production, and adaptability to thrive in disturbed areas, all necessary measures were implemented to eradicate the plant from the site and to prevent its spread. Prior to construction, the TCRCD visited the site several times to map and manually remove plants from the site. During construction, excavated floodplain material (free from dyer's woad) was placed on one of the largest areas from which dyer's woad had been manually removed. Follow-up trips in subsequent years by the TCRCD will ensure that the species is permanently removed from areas where it previously grew and that it does not become established in the newly constructed floodplains or spread downstream.

Turbidity

Turbidity, a measure of the cloudiness of water, is typically low in the Trinity River during summer conditions but is a natural occurrence in rivers during storms or other runoff events. The permits needed for restoration projects, such as gravel augmentation or mechanical channel rehabilitation, require the permittee to avoid increased turbidity to protect the

Trinity River's "beneficial uses" (e.g., domestic supply, aesthetic enjoyment, and preservation of fish, wildlife, and other aquatic resources or preserves; as defined in NCRWQCB 2011). The permits also require the Program to monitor turbidity released from channel rehabilitation sites during the first high flow post-construction. The impact of channel rehabilitation on mainstem Trinity River water clarity is often evident as the first high flows move through the rehabilitation sites after construction, especially in areas close to the dam where mainstem water clarity has not been degraded by tributary input.

The 2011 constructed Wheel Gulch channel rehabilitation project is located downstream of the Canyon Creek tributary. In this location, turbidity impacts during the first spring high flows of 2012 were not as evident at Wheel Gulch as at upstream sites for two reasons:

1. Much of the Wheel Gulch work had been completed in summer 2011 prior to the release of the August 2011 ceremonial flows, which reached 2,700 cfs in the reach and did the first "rinsing" of the lower elevation areas on the newly built project. (Figure 13 in the 2011 Annual Report shows that the higher ceremonial flows resulted in short-term spikes of turbidity 500 feet downstream of the project.)
2. A large natural landslide occurred during winter 2011 in the Weaver Creek drainage (Figure 20) and continues to deliver silt and fines to the river during storm events and high snowmelt periods (Figure 21).

Turbidity readings at the mouth of Weaver Creek were quite high (measured at over 100 formazin nephelmetric turbidity units (FNUs)) during April 2012 and were sufficiently elevated that turbidity measurements downstream at the North Fork Trinity near Helena (NFH) water-sampling site primarily mimicked the timing of turbidity spikes measured in Weaver Creek (Figure 22).

Figure 20 (left). Slide in the East Branch drainage of East Weaver Creek. East Weaver Creek is a tributary to Weaver Creek, and sediment and turbidity input from this drainage are expected to affect Trinity River mainstem water clarity during winter storms into the foreseeable future.

Figure 21 (below). Weaver Creek tributary flows into the Trinity River during spring run-off conditions. During these periods, Weaver Creek can substantially increase mainstem Trinity turbidity readings.

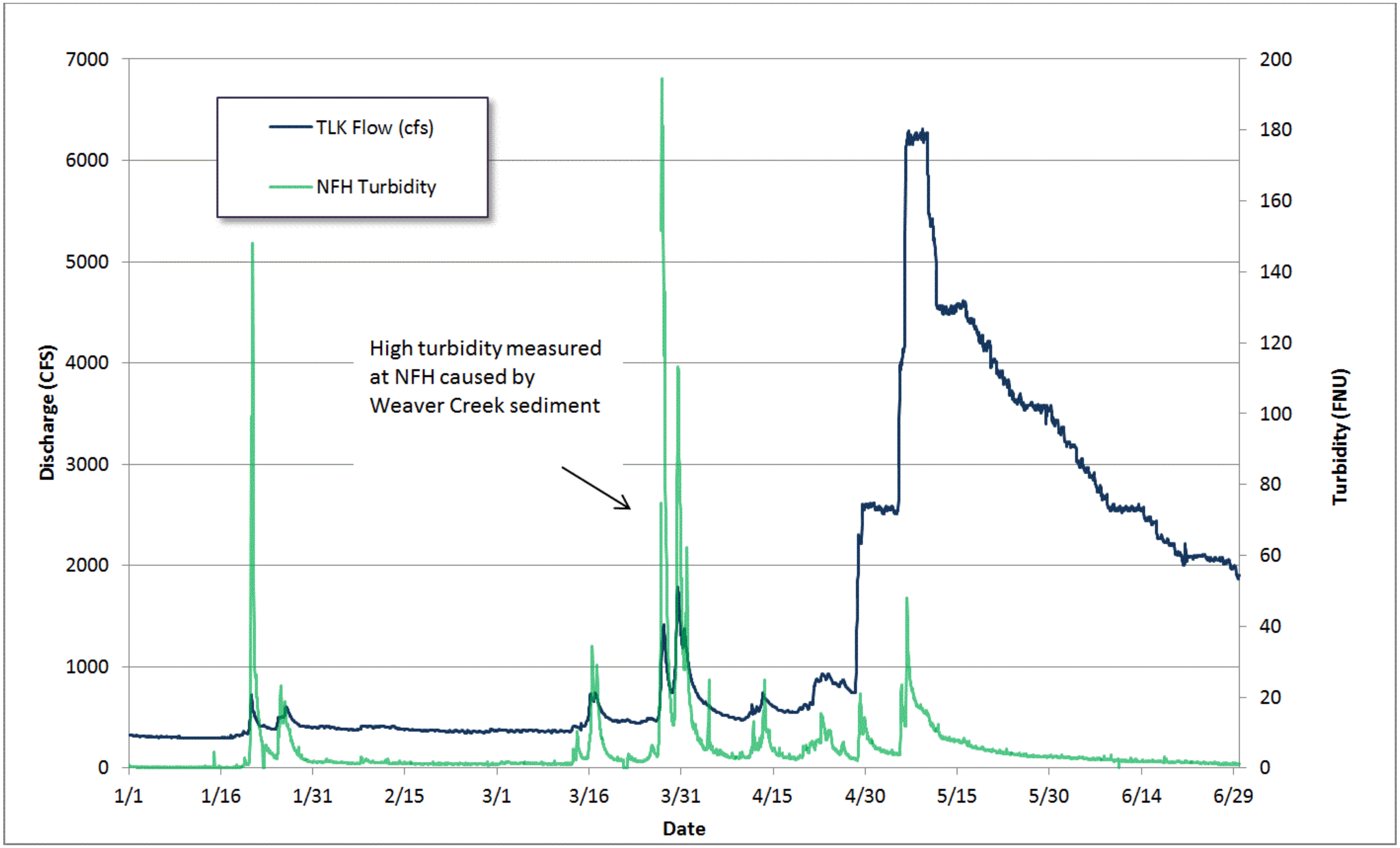


Figure 22. Turbidity measured at the North Fork Trinity near Helena (NFH) during spring 2012. Flows measured near Douglas City at the Trinity Limekiln (TLK) gauge near the confluence of Weaver Creek and the Trinity River.

The slide in the Weaver Creek drainage is expected to contribute sediment and turbidity to the mainstem Trinity River during large storms for the foreseeable future. While this turbidity will impact fishing during storms, much of the fine material will settle in the floodplain, where it is expected to support the growth of riparian vegetation.

In 2012, the Program continued to increase its capability to control turbidity during channel rehabilitation construction activities. Construction of the 2012 projects included creation of side channels, split-flow conditions, wetlands, and placement of large wood and skeletal bar features. This summer the contractors at both the Upper Junction City and Lower Steiner Flat Project areas were able to isolate low-flow construction features and to wash those areas prior to reconnecting them to the mainstem river.

By pumping turbid water through adjacent upland sedimentation ponds, and by closely metering turbidity released into the river, large and potentially lengthy turbidity pulses were reduced to lower level turbidity releases. The turbidity levels generally remained below the permit requirement of 20 FNUs at 500 feet (150 m) downstream. The highest peaks in turbidity released during construction correlate to opening of isolated construction areas to the river and/or to the initial period of increased flows over freshly constructed areas. In mid-August 2012, additional increased flows for the fishery of approximately 1,000 cfs resulted in brief periods (several hours) of increased turbidity downstream of the Lower Steiner Flat construction site. At Upper Junction City, because of the wider floodplain and downstream location, the increased releases did not translate into increased sediment washing from the construction site.

Water Temperatures and Compliance

2012 was a “normal” water year (TRFES, Sections 7.1.1 and 8.1). The water year began October 1, 2011, with Trinity Reservoir holding a total volume of 2,166,835 acre feet (2.673 km^3), roughly 89.5 percent capacity. The water year ended on September 30, 2011 with Trinity Reservoir holding a total volume of 1,799,600 acre feet (2.220 km^3), roughly 73.5 percent capacity.

Table 6 lists the ROD Trinity River water temperature targets. Reclamation (Central Valley Operations), the Program, and the USFWS actively track water temperatures in the Trinity and Lower Klamath Rivers (Scheiff and Zedonis 2011) to understand how dam releases meet those targets. Low reservoir levels can lead to increased water temperature, resulting in warmer water releases from Trinity Dam. This jeopardizes the ability to comply with downstream water temperature criteria.

The Trinity River temperature is measured at Douglas City and above the confluence with the North Fork Trinity River for regulatory compliance specified in State Water Resources Control Board Order WR 90-5 (SWRCB 1990).

Water Year Background

The 2012 water year began inauspiciously dry. Precipitation in the Trinity basin in the fall of 2011 (early WY 2012) was infrequent and light. Three or four small storm systems between October 1, 2011, and mid-February 2012 were the only significant precipitation events. Consequently, when the first seasonal forecast was received from the California Nevada River Forecast Center, it was no surprise that Trinity Reservoir was predicted to have a Dry water year, based on inflow volume. Figure 23 shows the record of inflow forecasts for the 2012 season.

The March forecast was less optimistic than February's. The 50-percent forecast volume dropped to 648,000 acre-feet in March from 760,000 acre-feet in February. Flow Scheduling Workgroup plans were adjusted to prepare for either a "dry" or "critically dry" water year.

Table 6. Trinity River Temperature Targets by Reach and Date

Source	Target Reach	Dates	Target
Basin Plan for the North Coast Region (NCRWQCB 2011)		***All Years***	
	Lewiston to Douglas City	July 1–September 15	≤60 °F (15.5 °C)
	Lewiston to Douglas City	September 15–30	≤56 °F (13.3 °C)
	Lewiston to North Fork	October 1–December 31	≤56 °F (13.3 °C)
Springtime Objectives of the Record of Decision for the Trinity River EIS/EIR (USFWS et al. 2000)	Lewiston to Weitchpec	***Normal & Wetter Water Years — Optimum***	
		April 15–May 22	≤55.0 °F (12.8 °C)
		May 23–June 4	≤59.0 °F (15.0 °C)
		June 5–July 9	≤62.5 °F (17.0 °C)
		Dry & Critically Dry Water Years — Marginal	
		April 15–May 22	≤59.0 °F (15.0 °C)
		May 23–June 4	≤62.5 °F (17.0 °C)
		June 5–July 9	≤68.0 °F (20.0 °C)

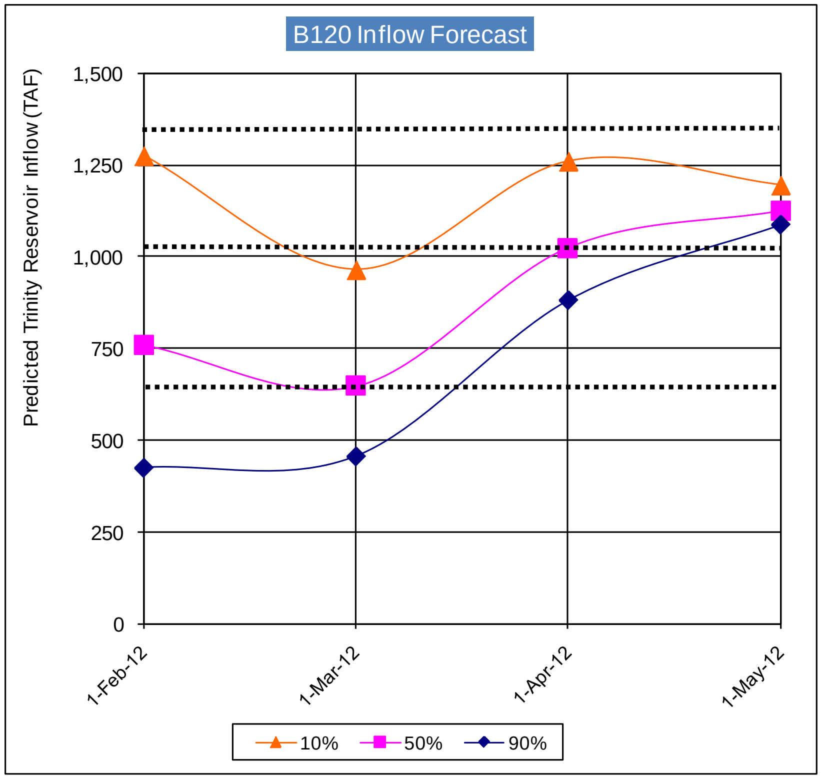


Figure 23. Record of inflow forecasts by the California Nevada River Forecast Center and the CDWR.

Significant precipitation over the Trinity watershed in the last two-thirds of March 2012 resulted in substantial inflows into Trinity Reservoir and increases in the predicted annual inflow. On April 7, 2012, CDWR issued the April 1st 50-percent inflow forecast. At the 50-percent exceedence level, the forecasted annual inflow was 1,025,000 acre-feet. Per the language of the Flow Study (TRFES 1999) and the EIS (2000), this volume corresponds to a "normal" water year. The ROD volume of the restoration release to the river in a "normal" water year is 647,000 acre-feet.

After the water year ended, the inflow record for the Trinity Reservoir indicated that the actual annual runoff was 1,075,400 acre-feet, corresponding to a "normal" water year.

Water Temperature Modeling

All of the planning, including temperature modeling, as of April 7 had been for either a "critically dry" or "dry" water year. The final forecast of a "normal" water year activated the TRRP Flow Scheduling Workgroup backup meeting in mid-April, 2012.

"B2" and "B120" Forecasts

The B2 operations forecast by Central Valley Operations takes its name from the section of the Central Valley Project Improvement Act — 3406(b)(2) — that addresses flow-related efforts.

Bulletin 120 is a publication issued four times a year, in the second week of February, March, April, and May, by the California Department of Water Resources. It contains forecasts of the volume of seasonal runoff from the State's major watersheds, and summaries of precipitation, snowpack, reservoir storage, and runoff in various regions of the State.

Because of time limitations, the absence of an updated B2 forecast (the latest available were the February 50% and 90% forecasts), and rapidly changing reservoir conditions, no additional temperature modeling was conducted. The Temperature Workgroup concluded that additional restoration releases to the river under a "normal" year, as compared to either a "dry" or "critically dry" year, would most likely result in greater certainty of meeting the ROD temperature targets in spring, summer, and fall target periods.

Water Temperature Compliance

The following figures show temperature compliance in WY 2012.

Weitchpec – Spring 2012—
The TRRP monitors temperature down river during the spring for salmonid emigration and juvenile growth potential. The temperature target is at the confluence of the Trinity and Klamath Rivers (just upstream from Weitchpec on the Trinity River) from April 15 to July 9. The purpose of the springtime temperature targets is to facilitate optimal or marginal growth rates for juvenile fish as they migrate to the ocean.

This year river temperatures at Hoopa substituted for Weitchpec. The USGS Hoopa gage (11530000) is roughly 12 river miles (19.5 river kilometers) upstream of Weitchpec. In general, the substitution of temperatures at Hoopa does not present a quantitative issue, as this far downstream from Lewiston dam, almost 100 river miles, equilibrium temperatures due to weather trends may dominate the heating and cooling processes in the river.

Figure 24 shows the trace of river water temperatures at Hoopa during the target time frame. The springtime targets are shown in purple, and delineate three ranges of temperature. The coolest range indicates river temperatures optimum for juvenile salmonid growth. The middle range indicates marginal river temperatures for fish growth, and the upper range indicates unsuitable river temperatures.

In WY 2012, the Trinity River temperatures at Hoopa followed a typical pattern. There were three periods when temperatures entered the marginal range. Then in late June to the end of the target period river temperatures warmed towards equilibrium due to the onset of summertime weather. At no times were unsuitable temperatures recorded at Hoopa.

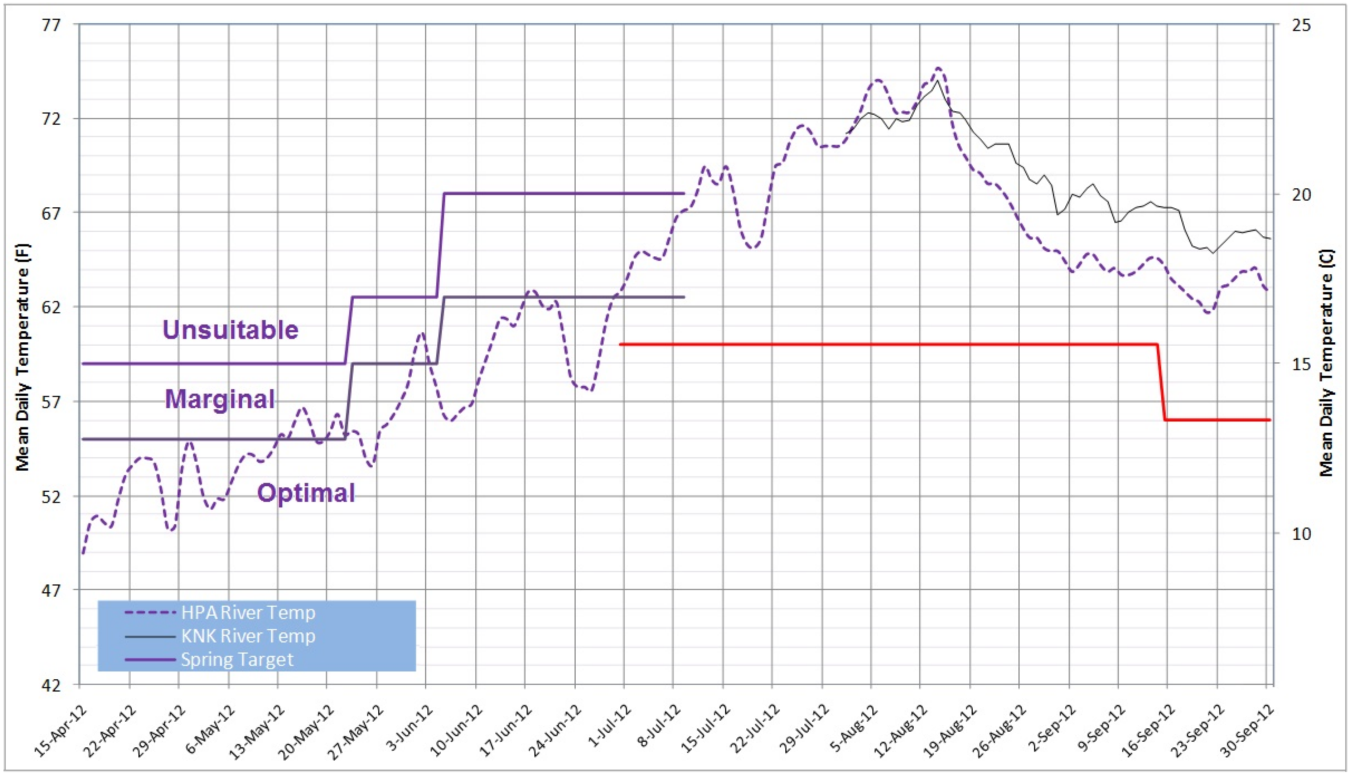


Figure 24. Trinity River springtime temperatures at Hoopa (HPA, USGS 11530000 Trinity River at Hoopa, CA; KNK, Klamath River near town of Klamath).

Douglas City – Summer 2012—
The summer temperature targets for salmonids facilitate adult holding and spring-run Chinook. The temperature target at Douglas City is 60°F from July 1 to September 15 and 56°F from September 15 to September 30.

River temperatures at Douglas City in the target period are highly influenced both by release temperatures at Lewiston Dam and by local weather. Figure 25 shows the trace of river water temperatures at Douglas City during the target time frame. The summertime target is shown in red.

In WY 2012, the Trinity River temperatures at Douglas City followed a pattern slightly cooler than typical. At no time did mean daily temperature at Douglas City exceed the target.

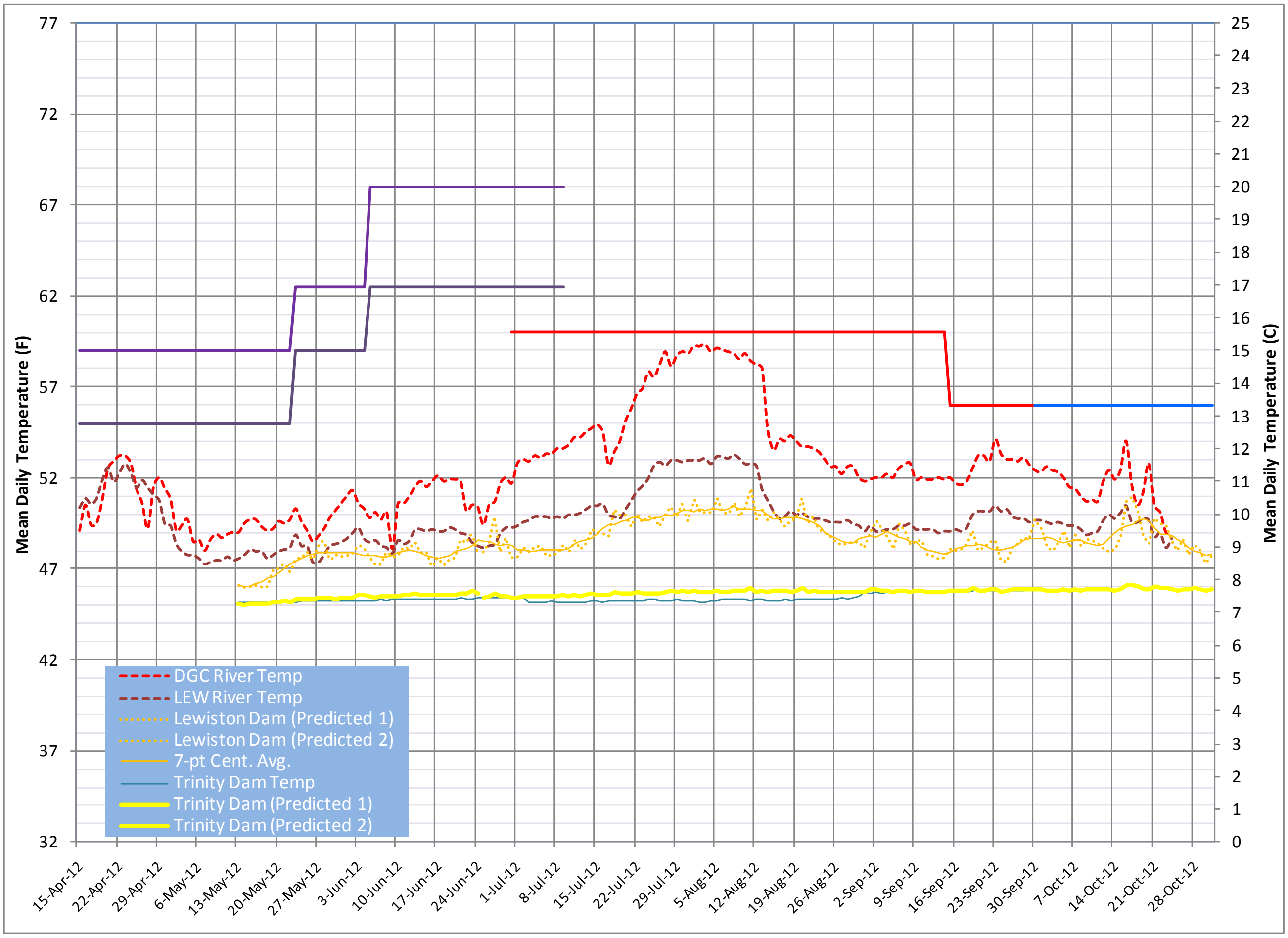


Figure 25. Trinity River summer temperatures at Douglas City (DGC) and Lewiston (LEW).

Trinity River at Confluence with North Fork—
The Trinity River temperature target is 56°F (13.3°C) from October 1 to December 31 at the confluence with the North Fork Trinity River near Helena, CA. River temperatures at the North Fork in the target period are influenced by release temperatures at Lewiston Dam and more strongly by local weather. Figure 26 shows the trace of river water temperatures at the North Fork during the target time frame. The fall target is shown in blue.

In WY 2012, the Trinity River temperatures at the North Fork followed a typical pattern. At no time did mean daily temperature at the North Fork exceed the target.

Summer temperature targets for salmonids are to facilitate adult holding and spring-run Chinook.

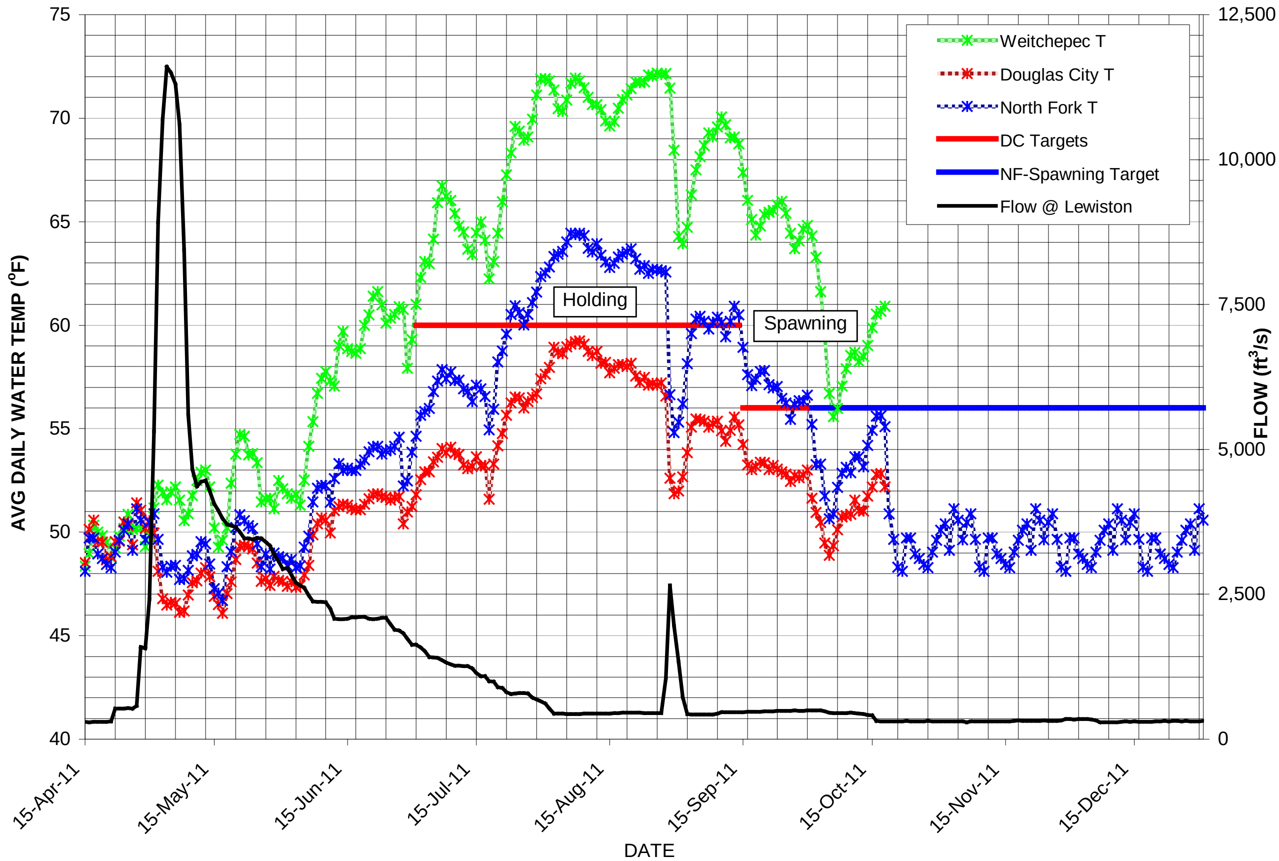


Figure 26. Trinity River temperatures at the North Fork confluence through the summer of WY 2011 and the fall of WY 2012 (NFH, North Fork near Helena.) October 1 through December 31, 2011, is the WY2012 temperature performance period specified in SWRCB (1990).

Major temperature findings in 2012 include:

- The North Coast Region Basin Plan (NCRWQCB 2011) springtime objectives for emigrating smolts focus on Trinity River temperatures at Weitchpec (Table 6). Restoration flows contribute to water temperatures below Lewiston Dam. During the spring and early summer (mid-April to July 9), the water temperature regime of the lower Trinity River at Hoopa was mostly within the optimal thermal regime, as Figure 24 illustrates (TRFES, appendix K). Water temperatures increased to marginal from June 30 to July 9 and, as a result, exceeded the targeted optimal temperature regime (into the marginal regime) for this water year by a maximum of 4.1˚F (2.3˚C).

- The North Coast Region Basin Plan adult holding temperature target of 60 °F (15.6 °C) at Douglas City was met during 100 percent of the period July 1 to September

15. The North Coast Region Basin Plan temperature target of 56°F (13.3°C) at Douglas City was met during 100 percent of the period September 15 to September 30. The temperature objective for spawning of 56 °F (13.3 °C) at the North Fork Trinity River was met during 100 percent of the period October 1 to December 31, 2011. Figure 26 illustrates the temperature performance during this period.

Cultural Resources

The Program works with BLM and Reclamation archeologists to evaluate the status of cultural resources (e.g., old homesteads, apple orchards, tailings piles, etc.) at proposed rehabilitation sites and to determine whether these might make a significant contribution to our understanding of history and whether they might be eligible for inclusion in the National Register of Historic Places.

As implementation of the ROD was considered, the potential impact to cultural resources in the restoration reach was realized. To ensure preservation of historic resources, a programmatic agreement was developed between the Federal agencies, the HVT, and the California State Historic Preservation Office. Though much of the Program's work is confined to the floodplain, where historic resources have been inundated and have lost much of their integrity during floods, the large scope of channel rehabilitation and the interrelatedness of historic sites along the river (e.g., mining operations) has continued to impress researchers and to suggest the need for a comprehensive analysis of historic resources throughout the restoration reach.

To date, cultural resource studies have included archeological surveys within the project areas, plus significance evaluations of recorded properties within rehabilitation project site boundaries. However, as part of Phase II work, a historic context report and map are under development to survey and report on planned impact areas (i.e., the environmental site limits) for all planned channel rehabilitation projects and adjacent areas). The map-based mining context report will substantially facilitate future site-specific surveys because, as each new site is evaluated, its historic background will already be documented.

As a site-specific example, on the left side of the river at the Lower Steiner Flat site, where Phase B of the project was planned but not constructed in 2012, archeologists determined that some resources were eligible for inclusion in the National Register. At this and at other sites, resources within the project site boundaries (e.g., orchards, and tailings) have been linked to other artifacts (e.g., drainage ditches, homesteads, and hydraulic ditches) which occur outside of the work areas but are obviously interrelated. The Program will utilize its resources to ensure that these historic resources are evaluated in accordance with applicable laws and to better document the interesting history and environmental legacy of mining along the Trinity River. A draft historic context for mining along the Trinity River was developed in 2012 (Krause 2012). Documentation of the historic context will speed subsequent cultural evaluations of significance, may point out the best places to preserve as historic records of mining history, and will also serve as mitigation for some cumulative implementation impacts that may be unavoidable.

Public Outreach in 2012

The Program completed an ambitious public outreach schedule in 2012 with both new and continuing efforts, including:

- **Public Meetings and Workshops –** Many public meetings and workshops were held to preview designs for upcoming projects; to discuss project features, objectives, and approaches; and to explain environmental impact compliance requirements for rehabilitation sites.

- **Expanded Presence at Community Events –** TRRP staff volunteered at the Trinity Salmon Festival, the Return of the Salmon Festival (Coleman National Fish Hatchery), the Trinity County Fair, Weaverville Elementary School's Day at the Wetlands, and other community events.

- **Direct Solicitation of Community Feedback –** Community conversation meetings were held at six different locations in the county. Members of the public were encouraged to ask questions regarding any aspect of the Trinity River and the Program. Answers were thoroughly researched, were provided to attendees, and were posted on the Program's website (www.trrp.net).

- **Printed Brochures and Outreach Material –** Two new brochures (*So You Think You Know Trinity County?* and *Want to Get Nose to Nose With a Fish?*) and one new map (*Trinity River Guide to Restoration and Recreation Sites*) were produced and distributed regionally. Three new public outreach briefs on restoration topics (*Water Releases and River Restoration*, *Gravel and the Trinity River*, and *Trinity River Rehabilitation Site Construction*) were published and distributed. Based on community feedback, all of the printed materials produced in 2012 were written for nonscientific audiences.

- **In-Person Contact and Response –** At the Weaverville TRRP office, inquiries were welcomed from walk-ins, telephone callers and email messages. We received a wide range of questions, most often regarding flow release schedules, duration and maximum peak, and ramping rates.

- **One-on-One Meetings –** Individual meetings with private landowners were held on their properties to arrange for rights of entry for projects and monitoring of revegetation at previous project sites.

- **TRRP.net (official TRRP Web site) –** Additional information was distributed through TrinityRiver.org (a community-based Web site), Facebook, and other digital media channels.

- **Traditional Media Presence –** A number of articles regarding TRRP ran in various regional media outlets.

Looking Ahead: 2013 Program Activities

The Program will continue to execute the restoration strategy in 2013, as described in the Record of Decision (U.S. Department of the Interior 2000), the Trinity River Environmental Impact Statement (USFWS et al. 2000), and the Trinity River Flow Evaluation Report (USFWS and HVT 1999). Proposed activities include the construction of two channel rehabilitation projects (Lorenz Gulch, Douglas City), WY 2013 flow schedule planning and implementation, completion of five priority watershed projects, coarse sediment augmentation, and continuation of monitoring and assessment projects. Other noteworthy activities planned for 2013 include:

- Phase I Review of the Channel Rehabilitation Projects – The SAB has invested more than a year in an intensive evaluation of channel rehabilitation actions between 2005 and 2010. Their findings, expected in 2013, will serve as a foundation for the remaining rehabilitation projects and for enhancement of monitoring and evaluation activities. The findings will also facilitate full implementation of adaptive management as the program assesses new information, designs and implements new restoration actions, and monitors and evaluates its own short-term and long term success.

- Coarse sediment augmentation – The Physical Workgroup plans to review, update, and evaluate long-term sediment augmentation recommendations.
- Desired riparian conditions – TRRP staff are developing a comprehensive and quantitative definition of desired riparian conditions. This will provide an objective basis for refining riparian assessments, for linking potential riparian outcomes to management actions and the subsequent geomorphic, fish, and wildlife responses, and for relating desired riparian conditions to regulatory requirements.
- Revegetation Plan and Riparian Vegetation Recovery Strategy – In partnership with the California Department of Fish and Wildlife, TRRP staff will document the strategy to ensure the recovery of riparian vegetation affected by restoration actions.
- Stakeholder involvement continues through the advisement of the Trinity Adaptive Management Working Group, frequent outreach updates and products, continuing improvements to the website www.trrp.net, public meetings and seminars, and private landowner cooperation in rehabilitation projects.

References

Reports and Publications

CDWR (California Department of Water Resources). 2012. Water Conditions in California, April 1, 2012. California Department of Water Resources, Bulletin 120. <http://cdec.water.ca.gov/snow/bulletin120/>

Krause, A.F. 2012. History of mechanical sediment augmentation and extraction on the Trinity River, California, 1912–2011. Trinity River Restoration Program, Weaverville, California. Technical Report TR-TRRP-2012-2 (Revised). <http://odp.trrp.net/Data/Documents/Details.aspx?document=1807>

Miller, S.L., Ralph, C.J., Wolfe, J.D., and Ollivier, L.M. 2010. Trinity River Restoration Program riparian and riverine bird monitoring report 2002-2009. USDA Forest Service, Redwood Sciences Laboratory, Arcata, CA. <http://odp.trrp.net/Data/Documents/Details.aspx?document=485> (On-line version does not include appendix D.)

NCRWQCB (North Coast Regional Water Quality Control Board). 2011. Water Quality Control Plan (“Basin Plan”) for the North Coast Region. May 2011. Santa Rosa, CA. <http://www.swrcb.ca.gov/northcoast/water_issues/programs/basin_plan/basin_plan.shtml>

NCRWQCB (North Coast Regional Water Quality Control Board), Trinity River Restoration Program, Shasta-Trinity National Forest, Bureau of Land Management, Hoopa Valley Tribe, and Yurok Tribe. 2009. Channel Rehabilitation and Sediment Management for Remaining Phase 1 and Phase 2 Sites. Master Environmental Impact Report, Environmental Assessment/ Environmental Impact Report. August 2009. SCH#2008032110. Trinity River Restoration Program, Weaverville, CA. <http://odp.trrp.net/FileDatabase/Documents/TRRP_FEIR.pdf>

Sloan, L. M. 2010. Population structure, life history, and terrestrial movements of western pond turtles (*Actinemys marmorata*) in lentic habitats along the Trinity River, California. Master’s Thesis, Humboldt State University, California. <http://odp.trrp.net/Data/Documents/Details.aspx?document=1613>

Sloan, L., and Marks, S. 2012. Summary of management implications for the project on western pond turtles (*Actinemys marmorata*) in lentic habitats along the Trinity River, California. Report to the U.S. Bureau of Reclamation, Trinity River Restoration Program, from Humboldt State University, Department of Biological Sciences, Arcata, CA. <http://odp.trrp.net/Data/Documents/Details.aspx?document=1819>

Stevens, D. L., and Olsen, A. R. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association, 99, 262-278. <http://www.epa.gov/nheerl/arm/documents/grts_asa.pdf>

TRRP. 2012. Development of the Trinity River Restoration Flow Release Schedule for Water Year 2012. Trinity River Restoration Program, Weaverville, CA. Technical Report TR-TRRP-2012-3.

<http://odp.trrp.net/Data/Documents/Details.aspx?document=1871>

U.S. Department of the Interior. 2000. Record of Decision, Trinity River Mainstem Fishery Restoration, Final Environmental Impact Statement/Environmental Impact Report. December 19, 2000. <http://odp.trrp.net/Data/Documents/Details.aspx?document=227>

U.S. Fish and Wildlife Service and Hoopa Valley Tribe. 1999. Trinity River Flow Evaluation — Final Report. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, CA. <http://www.fws.gov/arcata/fisheries/reports/technical/Trinity_River_Flow_Evaluation_-_Final_Report_Full_Version.pdf>

U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Hoopa Valley Tribe, and Trinity County. 2000. Trinity River Mainstem Fishery Restoration Final Environmental Impact Statement / Environmental Impact Report. <http://www.fws.gov/arcata/fisheries/reports/technical/treis/final_document_new.html>

U.S. Geological Survey. 2013. Water-resources data for the United States, Water Year 2012. U.S. Geological Survey Water Data Report WDR-US-2012, site 11525500. <http://wdr.water.usgs.gov/wy2012/pdfs/11525500.2012.pdf>

Web Sources

- http://www.trrp.net/?page_id=23
  The TRRP website with information on the Trinity River and the Program.
- http://www.trrp.net/?page_id=3175
  A chronological list with links to foundational and other pertinent documents.
- http://www.fws.gov/arcata/fisheries/activities/habRestoration/
  Describes the TRRP on the Arcata Fish and Wildlife website.
- http://www.usbr.gov/mp/cvp/
  The Bureau of Reclamation's website on 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/background/legislative-history/
  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 EIS/EIR
- http://www.trrp.net/?page_id=413
  TMC information including bylaws
- http://www.fws.gov/arcata/fisheries/reports/tamwg/2011/CharterJanuary142011.pdf
  Trinity Adaptive Management Working Group Charter
- http://www.fws.gov/arcata/fisheries/reports/tamwg/Charter & Bylaws/BylawsrevisedMay242011.pdf
  Trinity Adaptive Management Working Group Bylaws
- http://www.trrp.net/?page_id=2291
  Trinity River Science Symposia, 2007 and 2010
- http://www.wetlandsandstreamrestoration.org/
  U.S. Forest Service, Center for Wetlands and Stream Restoration, Morehead, KY

The 2012 Annual Report of the Trinity River Restoration Program is available electronically at www.trrp.net and includes web links to reference material and agencies.

Appendix A: Acronyms

AEAM	Adaptive Environmental Assessment and Management
BLM	Bureau of Land Management
°C	degrees Celsius
CDFG	California Department of Fish and Game (changed to CDFW as of January 1, 2013)
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic feet per second
EIR	Environmental Impact Report (required under CEQA)
EIS	Environmental Impact Statement (required under NEPA)
EO	Executive Order
°F	degrees Fahrenheit
FNU	formazin nephelometric turbidity units
GRTS	generalized random-tessellation stratified (sampling design) (Stevens and Olsen, 2004)
HVT	Hoopa Valley Tribe
KBO	Klamath Bird Observatory
km	kilometer(s)
LIDAR	light detection and ranging
m	meter(s)
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NFH	North Fork Trinity near Helena (water sampling site)
NMFS	National Marine Fisheries Service
ODP	online data portal
Rkm	river kilometer
RM	river mile
ROD	Record of Decision
SAB	Scientific Advisory Board
TAMWG	Trinity Adaptive Management Working Group
TCRCD	Trinity County Resource Conservation District
THG	Trinity House Gulch (water sampling site)
TLK	Trinity River at Limekiln Gulch (water sampling site)
TMC	Trinity Management Council
TREIS/R	Trinity River Environmental Impact Statement
TRFES	Trinity River Flow Evaluation Final Report
TRRP	Trinity River Restoration Program (also “the Program”)

USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WT	Trinity River at Weitchpec (water sampling site)
WY	water year (October through September)
yd^3	cubic yards
YT	Yurok Tribe

On Back Cover:

Aerial view of the Upper Junction City rehabilitation site, constructed in the summer of 2012.

Restoration approaches include revegetation of rehabilitation project sites. Individual plantings are clearly visible. The photograph also shows legacy tailing piles along the river bank.


Tailings