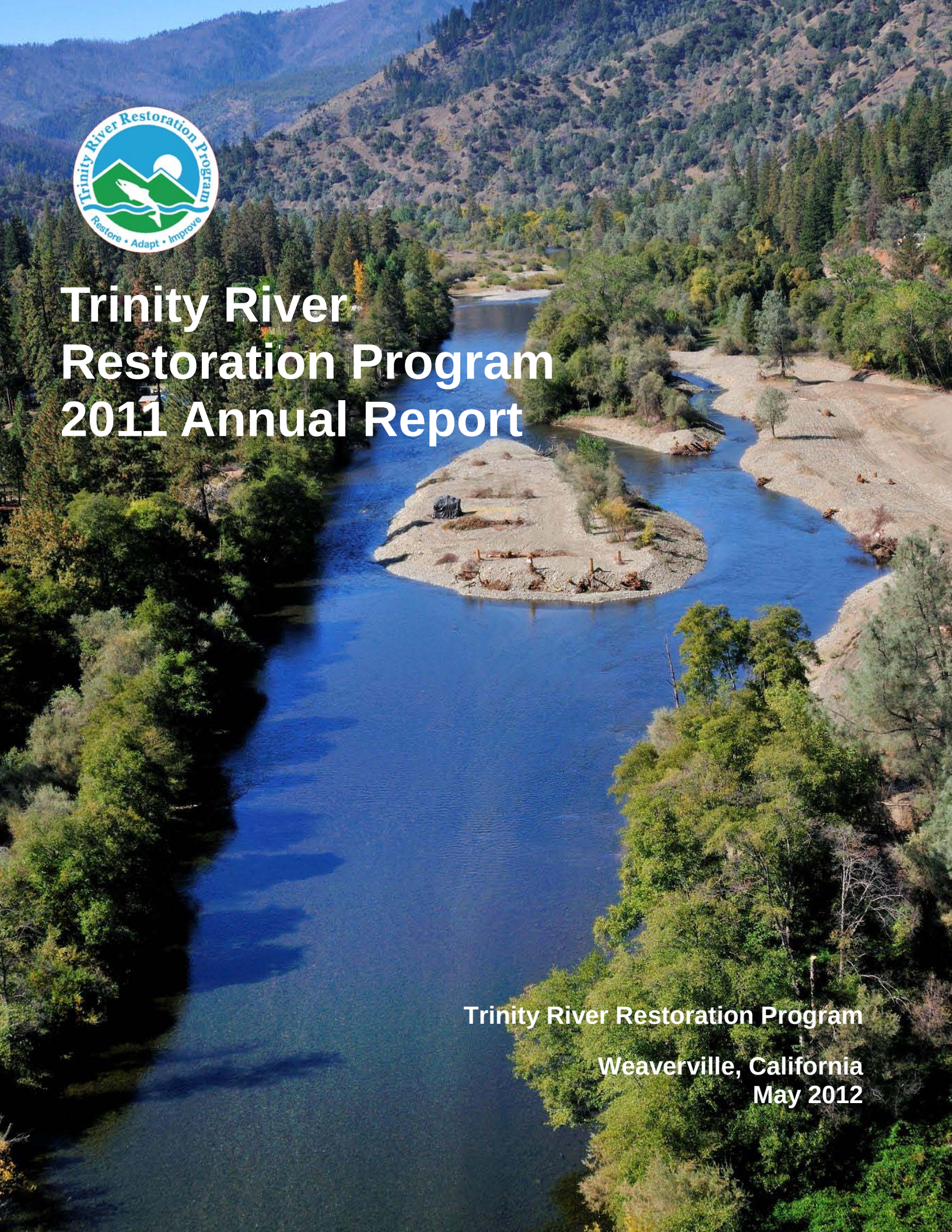

Trinity River Restoration Program 2011 Annual Report

Trinity River Restoration Program

Weaverville, California
May 2012

Trinity River Restoration Program

Thank You

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

ON COVER: Aerial view looking downstream at Wheel Gulch post-construction showing island and side channel.

ABOVE: Looking upriver toward Lewiston Dam, with streamflow at 450 cfs. The gravel in the foreground is heavily used for spawning.

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Figure 1. Geographic overview of the Trinity River between Lewiston Dam and the North Fork (approximately 40 river miles), located within the Klamath watershed in northern California.

Introduction

Background

The Trinity River Restoration Program (TRRP or the Program) is a 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 collaborates with other Federal, State, and local entities to develop projects beneficial to the river, watershed, and fisheries. TRRP was founded in 2000, based on three comprehensive foundational documents: 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); the Trinity River Environmental Impact Statement (TREIS/R; U.S. Fish and Wildlife Service et al. 2000); and the Record of Decision (ROD; U.S. Department of the Interior 2000).

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), and it describes the permanent flow allocation for the Trinity River based on five different water-year types, varying from critically dry to extremely wet years. The ROD also established the Trinity Management Council (TMC) 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.

The Program is administered by the Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (USFWS) — both bureaus of the U.S. Department of the Interior — as co-leads. Other partner agencies share in the decision making process of the TMC: the Hoopa Valley Tribe (HVT), the Yurok Tribe (YT), Trinity County, the California Resources Agency (consisting of California's Department of Water Resources (CDWR) and the Department of Fish and Game (CDFG)), the U.S. Forest Service (USFS), and the National Marine Fisheries Service (NMFS).

Other interested stakeholders provide advice and recommendations to the TMC through a federally appointed

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.

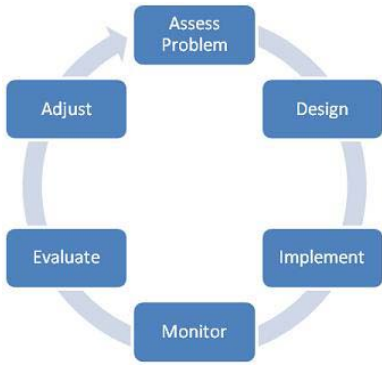


Diagram illustrating the steps of the adaptive management process.

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

advisory committee known as the Trinity Adaptive Management Working Group (TAMWG) http://www.fws.gov/arcata/fisheries/tamwg.html. The TAMWG is part of the AEAM component of the TRRP. Members represent interest groups of local citizens, landowners, recreation, water users, environmental organizations, agriculture, utilities, business, and other agencies.

The Program has a main office located in Weaverville, California, staffed by physical, environmental, and biological scientists, technicians, and administrative specialists drawn from the Program's partner agencies and organizations. 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 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 goals to restore the Trinity River to a healthy alluvial river and to benefit anadromous fisheries are articulated in the founding documents and supported by TRRP actions. Implementation activities are the physical restoration efforts on the river, such as the Wheel Gulch Restoration Project completed in 2011. Environmental assessment and monitoring activities provide periodic scientific evaluations of the success of the Program in meeting habitat and fishery restoration goals. Partner and collaborating natural resource management agencies work together to implement river and watershed projects to improve management of the river. These agencies include HVT, YT, USFWS, NMFS, CDFG and CDWR, Trinity County, Bureau of Land Management, and the National 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 2011

In 2011 the Program passed the milestone of completing half of the projects described in the Flow Evaluation Study. The program employed all of the techniques as outlined in the foundational documents. TRRP broke ground on its first project in 2005, and in the past six 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 2) that are known to enhance habitat for anadromous fish species.

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

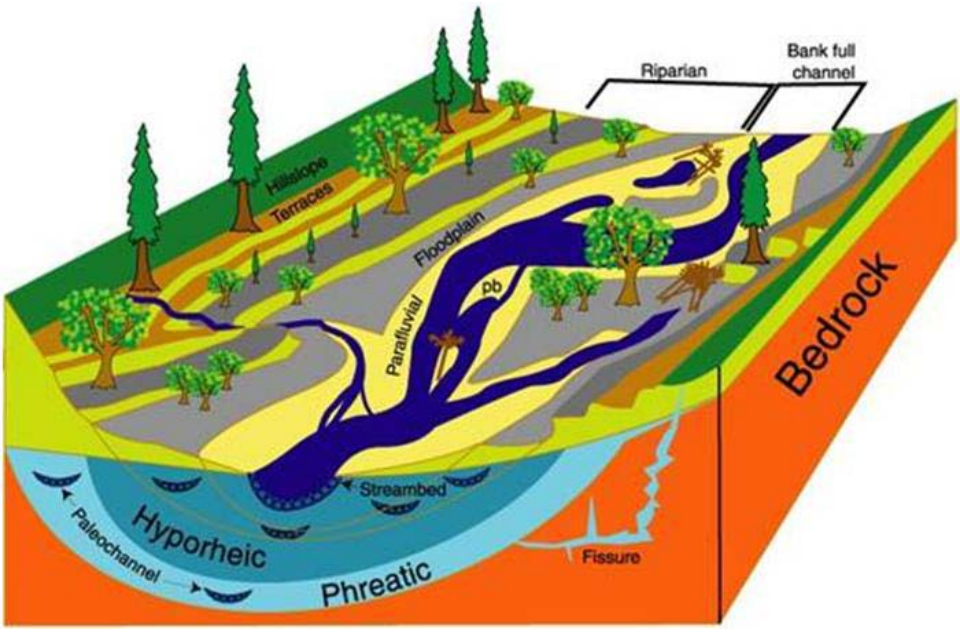


Figure 2. Conceptual view of an alluvial river (a river with bed and banks made up of mobile materials). Alluvial rivers are shaped by the magnitude and frequency of the flows and floods, and the ability of these floods to erode, deposit, and transport sediment. Alluvial rivers can assume a number of forms based on the properties of their banks, the flows they experience, the local riparian ecology, and the amount, size, and type of sediment that they carry. (Source: Stanford and Lorang 2005, used by permission.)

A Phase I review of completed projects, as 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. This evaluation will be ongoing, beginning with the first projects constructed in 2005. Future construction activities will be guided by the results of the review, and some ensuing projects may be need to be redesigned before construction begins on the remaining sites. Additional projects will be constructed after the Phase I review using the adaptive management principles in the AEAM component of the Program. The review will be completed during the summer of 2012.

The 2011 annual report describes activities to restore river function and anadromous fisheries through a suite of activities, as prescribed by the ROD, including a variety of physical rehabilitation techniques that were incorporated into the 2011 Wheel Gulch project. The most significant event of 2011, classified as a wet water year, was the opportunity for the highest restoration release since the Program was founded in 2000 — 11,000 cubic feet per second (cfs) — the highest achievable under the ROD, although well below historic spring flows. Intensive assessments of the physical responses of the river to this significant restoration release began in 2011 and will be completed in 2012. Another effort begun in 2011 was a comprehensive geomorphic assessment of the 40-mile restoration reach.

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.

Funding and Expenditures

Program funding has mostly varied between $10 million and $16.66 million per year since 2002. In 2011 the Program received a total of $14.93 million, as shown in the table at right.

Fiscal Year 2011 Funding (in millions of dollars)	
BUREAU OF RECLAMATION	
Water & Water-Related Fund	11.82
CVPIA* Restoration Fund	1.00
U.S. FISH & WILDLIFE SERVICE	
FY 2011 Appropriations	2.11
TOTAL	14.93

*Central Valley Project Improvement Act

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 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, $6.3 million, and $5.7 million, respectively.

Activities and Accomplishments

Flow Management

Restoration flows are intended to:

- Clean spawning gravels
- Build gravel/cobble bars
- Scour sand out of pools
- Provide adequate temperature and habitat conditions for fish and wildlife at different life stages
- Control riparian vegetation
- Perform many other ecological functions

11,000-cfs release from Lewiston Dam to the Trinity River, May 2011. *Photo by Ken DeCamp*.

In order to mimic some of the inter-annual variation that is naturally found within the Trinity Basin (Figure 3), the ROD defines five water-year types along with the minimum volume of water to be released into the Trinity River for each (Table 1). An annual flow release recommendation is developed through a collaborative process. The TMC makes the final flow recommendation, which is then forwarded to the Bureau of Reclamation, Central Valley Operations office.

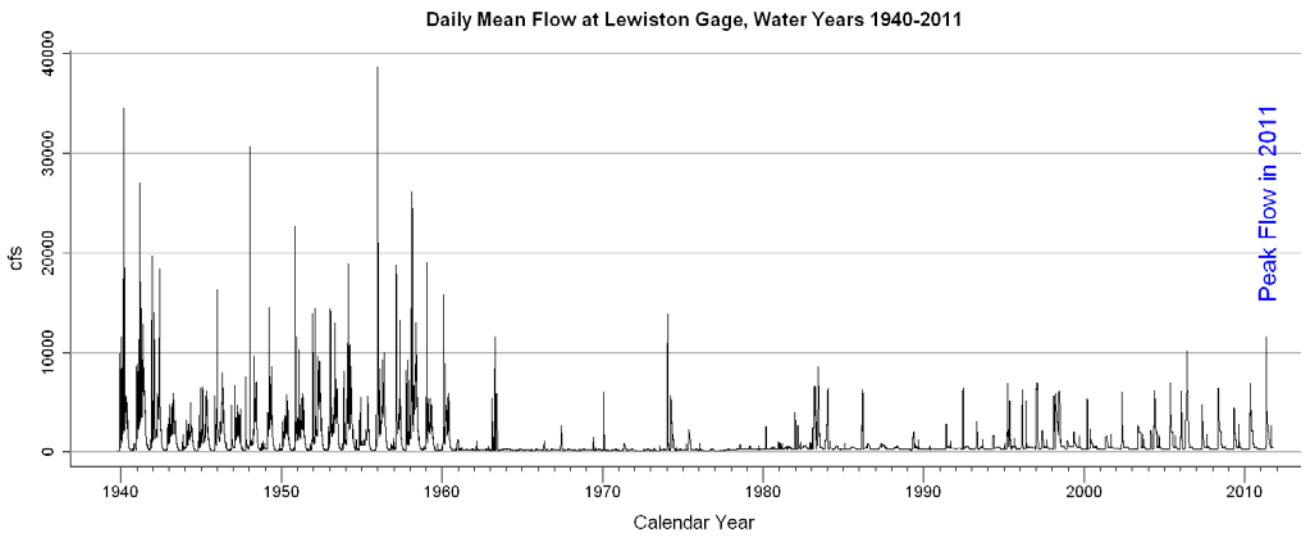


Figure 3. Average daily flows in cfs, as measured by the U.S. Geological Survey's Lewiston gage, for water years 1940 through 2011. Flow regulation becomes apparent early in 1961, before the dams were fully operational. The restoration flow in 2011 included the highest flow release rate since a safety-of-dams release in 1974.

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

Water Year Type	Restoration Water Allocation[1]	Annual Basin Runoff Above Lewiston Gage[1]	Probability of Occurrence[2]
Extremely Wet	815	>2,000	12 years out of 100
Wet	701	1,350 to 2,000	28 years out of 100
Normal	647	1,025 to 1,350	20 years out of 100
Dry	453	650 to 1,025	28 years out of 100
Critically Dry	369	<650	12 years out of 100
Average (weighted by probability of occurrence)	594.6		

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

The 2011 water year was classified as a "wet" water-year type. The corresponding water allocation for restoration releases is 701,000 acre-feet. The actual flow releases from Lewiston Dam for the 2011 water year are shown in Figure 4.

The summer base flow was 450 cfs (12.7 m^3/s),[1] and the winter base flow was 300 cfs (8.5 m^3/s). The spring high-flow releases are timed to correspond with the natural snowmelt runoff. Releases above 2,500 cfs are intended to reconfigure the channel, scour riparian vegetation, build gravel bars, and flush sand. Releases below 2,500 cfs (70.8 m^3/s) are intended to control water temperatures and promote riparian growth on floodplain surfaces. Taken as a whole, these actions should improve habitat abundance and quality. A non-restoration-related pulse flow of 2,650 cfs was conducted for ceremonial purposes in late August 2011.

The first-time implementation of an 11,000-cfs peak magnitude release in May 2011 represents a historic event for the TRRP. The 11,000-cfs peak magnitude release is the maximum authorized for restoration purposes, the largest release in 37 years, and the third largest release since flow regulation began in 1961 (Figure 3). The 2000 ROD required infrastructure improvements be completed to allow implementation of an 11,000-cfs release. These improvements were completed in 2007 at a cost of over $12 million.

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 at Lewiston stream gage (USGS stream gage #11525500) 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).

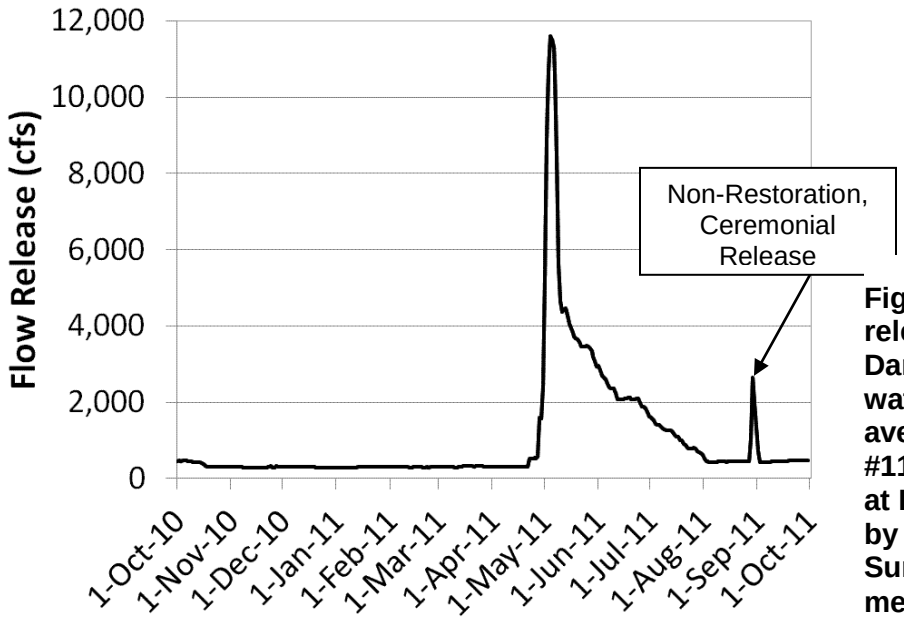


Figure 4. Actual flow releases from Lewiston Dam to the Trinity River for water year 2011. Daily average data from gage #11525500 – Trinity River at Lewiston, CA, operated by the U.S. Geological Survey. Flow measurement error is ±8 percent.

[1] Metric conversions in this document are rounded to avoid implying a greater degree of precision than the original measurement supports. For instance, although 12.742 m^3/s would be a more accurate equivalent of 450 cfs, that would imply precision to within a thousandth of a cubic meter, which is not supported by the original measurement.

Mechanical Channel Rehabilitation

Looking downstream toward the mid-channel island – split flow complex at the Wheel Gulch Channel Rehabilitation Project Site.

The second element of the Program's restoration strategy directs the creation of a dynamic alluvial channel exhibiting all the characteristics of the pre-dam river, within the geomorphic bounds of the river and limited flow releases. Finished projects are intended to work in conjunction with restoration flows, which are expected to:

- Promote alternate bar sequences and low velocity habitat for salmonid fry,
- Increase habitat complexity to provide life history habitats for anadromous fishes, and
- Allow the river to maintain itself as an alluvial system in both treated and untreated areas.

The ROD calls for 47 channel rehabilitation projects in the upper 40 miles (64 km) of river below Lewiston Dam. Through adaptive management and monitoring, projects now include construction of natural riverine features such as floodplains, point bars, forced meanders, mid-channel islands, side channels, alcoves, and other features of natural alluvial systems.

In 2011, the first Phase II project was completed with the implementation of the Wheel Gulch Channel Rehabilitation site. The Wheel Gulch project is located approximately 3 miles downstream from Junction City and sits adjacent to highway 299. The work at this site took an innovative approach in the mainstem with the construction of a split-flow complex dividing the Trinity River flow approximately 60/40 on either side of a new mid-channel island. The work also introduced low-velocity side channel and alcove habitat, and restored the historic tributary connection of Wheel Gulch Creek back to the Trinity River mainstem. The project included the treatment of more than 7 acres of floodplain area and created approximately 1,700 feet (520 m) of new low-flow channel length. The work generated approximately 48,000 cubic yards (36,700 m^3) of excavated earthen materials, which were sorted and redistributed within the site to build floodplain features. Additional processing of the raw excavated material produced more than 7,800 cubic yards (5,960 m^3) of clean in-channel course sediment, which was used to construct the mid-channel island/split flow complex. The island, built in part from the former river bank, retains some trees and other large vegetation. The project also included the installation of several large wood structures to create hydraulic diversity and

complexity and to promote geomorphic processes and aquatic habitat development.

In addition to the Wheel Gulch project site construction, an extensive amount of revegetation was initiated at several past Phase I project sites and at Wheel Gulch. Through an extensive partnership with several organizations, including the local Trinity County Resource Conservation District (TCRCD), over 7,900 plant material cuttings were harvested and installed at Lowden Ranch, Trinity House Gulch, Reading Creek, and Wheel Gulch. A total of 14 acres were revegetated within the Trinity River riparian corridor. Revegetation was completed shortly after the end of the calendar year.

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.

Coarse Sediment

Coarse sediment augmentation is intended to replace the loss of gravel behind the dams and 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. Progress toward these goals is assessed by measuring coarse sediment transport, by estimating sediment fluxes, and by a variety of geomorphic mapping and surveying activities.

A total of 5,320 cubic yards (4,067 m^3) of coarse sediment — almost half the ROD-recommended volume — was injected into the river at two locations near Lewiston during the 2011 spring high-flow release. More than half of that total was injected at the Lowden Ranch rehabilitation site, where the design included a plan to build a mid-channel bar by allowing high flows to distribute the injected gravel downstream. This innovative construction strategy, which was planned using morphodynamic modeling methods, was successful in creating a bar in the anticipated location. Overall, current recommendations for gravel additions suggest that

The rehabilitation design for the Lowden Ranch Rehabilitation site included this mid-channel bar, which was constructed by injecting gravel upstream during the 2011 spring high flow release.

programmatic objectives can be attained by adding about 7,000 cubic yards of course sediment to the upper river per year (Gaeuman 2008). The Program monitors the effects of gravel augmentation on scour and deposition in the river channel and on water-surface elevations near the gravel augmentation sites and in sensitive areas downstream.

Fine Sediment

The Program teamed with the TCRCD and local stakeholders to initiate six priority watershed projects using $492,700 from the Program and $627,000 in matching funds. These projects were designed to reduce fine sediment inputs to the Trinity River by preventing sediment production and delivery to tributary streams and to the mainstem. Project work funded in 2011 for implementation during the summer of 2012 include 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 road segments throughout the middle Trinity River area.

The TRRP has a Potable Water and Sewage Disposal System Assistance Program to benefit landowners whose domestic water or septic systems are affected by restoration flows.

Infrastructure Modification and Improvements

The fifth element of the restoration strategy is to upgrade bridges and other public and privately owned structures to withstand higher ROD flows. In 2011, prior to and immediately after the 11,000-cfs flow release, on-site inspections were performed throughout the 40 mile system to assess critical public and private infrastructure systems. Several key areas of concern were identified and the TRRP has begun to address those areas for potential improvement and modification.

In the fall of 2011, the TRRP re-initiated the Well Grant program. The program opened, on a limited basis, to provide eligible landowners with financial assistance to relocate, replace, upgrade, or otherwise improve private potable water and sewage disposal systems that have been or may be adversely affected by the TRRP's fishery restoration flows. This program is limited to systems within the Trinity River floodplain between Lewiston Dam and the confluence with the North Fork Trinity River: systems within the Maximum Fisheries Flow (MFF) floodplain.

The Well Grant program is administered by the TRRP office on a first-come, first-served basis, and annual funding is limited; however, a waiting list will be available. Landowners who are determined eligible and qualified, and who comply with all legal requirements of the program, will be reimbursed a maximum of $10,000 per each improved parcel for potable water systems and $5,000 per each improved parcel for sewage disposal systems. Applicants may receive financial assistance only one time per system for capital improvements.

Physical and Biological Responses to Restoration Flows

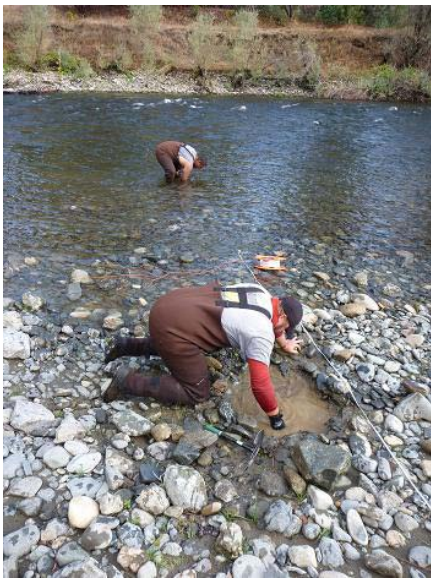
The Trinity River, like other alluvial river systems, is complex and dynamic. Our understanding of the Trinity River and how it will respond to restoration actions is continually improving. AEAM, the sixth element of the Trinity River restoration strategy, is a systematic approach for improving future management decisions by learning from outcomes of past actions. This section includes monitoring data and assessments that will be used in the AEAM approach during the Phase I review of channel rehabilitation projects constructed between 2005 and 2010.

Sediment Transport Monitoring

Once again, sediment transport was measured at four locations along the mainstem Trinity River during the 2011 peak-flow release. Such measurements have now been collected for 8 consecutive years under this ongoing monitoring program, making this one of the most comprehensive datasets of its kind in existence. Sediment transport information is used to guide many aspects of river management, including coarse sediment augmentation, fine sediment source control, and flow scheduling. Results of sediment monitoring demonstrate that the Program is meeting its stated objective of increasing coarse sediment storage and decreasing the amount of fine sediment to promote channel complexity and habitat. Recent studies indicate that the quantity of gravel stored in the Lewiston area continues to increase (Wilcock 2010; Gaeuman 2011). As of the end of 2011, coarse sediment storage throughout most of the river downstream from Lewiston Dam had attained a storage level similar to or greater than at the time of dam closure. Although load calculations for the 2011 flow release have not yet been finalized, initial indications are that the quantity of coarse sediment stored in the first 15 miles

Topography survey at river kilometer (Rkm) 141.15 — equal to river mile (RM) 87.71.

downstream from Lewiston Dam increased slightly. Meanwhile, storage of fine bed sediments, (i.e., the sand and very fine gravels that can clog spawning beds and fill pools) continues to decrease in the upper river. Initial calculations suggest that about 14,000 tons of fine bed material was flushed from the river upstream from Douglas City in 2011. This would be in addition to the 25,000 tons that Gaeuman (2011) had estimated for the decrease in fine bed material storage from 2004 through 2010.



Scour chain recovery effort at Rkm 123.72 (RM 76.88).

Scour chain recovered over 0.3 m (1.0 ft) below current fall 2011 ground surface at Rkm 123.72 (RM 76.88).

Bed Mobility and Scour Monitoring

Bed scour and bed mobility were monitored using a combination of painted tracer rocks, scour chains, and topographic surveys at 24 sites during the May 2011, 11,000-cfs spring ROD release. This monitoring was performed as a part of the 2011 Interdisciplinary Habitat Assessment Project, and was conducted first in spring 2010 following winter storms and again in summer 2011 after the spring ROD release. While 2011 was classified as a wet water year, the spring ROD peak magnitude was raised to 11,000 cfs for three days, which is similar in magnitude to what would occur during an extremely wet water year.

Monitoring was cross-section-based at each site. (Each site had two cross sections.) Preliminary results from the spring ROD release include the following:

- Bed mobility monitoring showed full mobilization of most bar surfaces monitored, meeting the extremely wet water year objective.
- Bed scour monitoring showed variable scour patterns occurred across monitored surfaces, but most sites had scour depths that exceeded 2.0 D_{84} diameters (D_{84} = particle diameter at which 84 percent of sample was smaller), particularly within the “riparian encroachment risk zone” (450 to 2,000 cfs). These results show that the spring release largely met the extremely wet water year scour objective. Measured deposition also commonly exceeded 2.0 D_{84} diameters, but areas of greatest scour did not always coincide with areas of greatest deposition.
- Net topographic changes along surveyed cross sections include bed elevation changes up to 3 feet (1 m) (both bed raising and lowering), lateral thalweg shifts up to 65 feet (19.8 m), and bank erosion up to 30 feet (9.1 m).

Systemically, the WY 2011 restoration flow release was largely successful in meeting TRFE bed mobility and bed scour management objectives for an extremely wet water year.

Riparian Vegetation

Prior to construction of Trinity and Lewiston Dams, large floods on the Trinity River constrained encroaching riparian vegetation. Since flow regulation began, undesirable vegetation has encroached upon and stabilized the river channel, reducing channel complexity and restricting riverine ecological processes. However, abundant and diverse riparian vegetation is known to be good for salmonids, birds and other wildlife. This contrast is at the heart of the Program's complex management of vegetation. The goal of the Program's revegetation is no net loss of riparian cover within 10 years, and riparian cover placed more appropriately for the development of a healthy functioning riparian community structure.

Riparian vegetation monitoring, a component of the Integrated Habitat Assessment Program, included vegetation mapping at 24 sites. Monitoring was conducted in the fall 2010 before winter storms and fall 2011 after the 11,000 cfs spring ROD releases. While 2011 was a wet water year class, the spring ROD peak magnitude was raised to 11,000 cfs for three days which is similar in magnitude to an extremely wet year class. During the spring ROD releases, streamflow recession was managed to promote the regrowth of riparian vegetation on higher ground surfaces above the 2,000-cfs water-surface level and on constructed floodplains.

Band transect sampling was conducted along one cross section at each of the 24 sites. Vegetation measures included: structural complexity, extent, species richness, age diversity, and riparian woody regeneration within different inundation zones. Riparian vegetation monitoring in 2011 followed the strategy identified in the Integrated Assessment Plan (TRRP and ESSA 2009). The data was used to evaluate whether TRFES riparian regeneration objectives for wet and extremely wet water year classes were being met. The 2011 peak flows and the prolonged flow recession to lower levels:

- Increased seedling species diversity of regenerating riparian woody plants.

- Promoted riparian woody plant seed germination and growth (i.e., regeneration) over a wider elevation range above the 2,000-cfs water-surface elevation than has been previously documented.
- Scoured many 2009 and 2010 riparian woody plants and effectively inhibited woody plant densities from crossing detrimental encroachment thresholds within the 300 to 2,000 cfs inundation zones.
- Facilitated fine sediment deposition around stems re-growing from roots remaining after construction (i.e., regrowth) at channel rehabilitation sites below Canyon Creek, although at elevations higher than would have occurred under the pre-ROD flow regime.

Seedling frame with primarily narrowleaf willow (*Salix exidua*) plants in sand-gravel substrate at Rkm 118.73 (RM 73.77).

Water year 2011 flows facilitated widespread fine sediment deposition above the mainstem channel. More fine sediment (<8 millimeters) was observed to be deposited across gravel bars and upper (floodplain) surfaces in 2011 than had been previously observed. In addition to fine sand deposits, the amount of fine sand in the interstitial spaces between the gravels and cobbles on exposed bars also seemed to increase after the spring 2011 ROD release. Higher numbers of woody plant seedlings were documented to be regenerating after the 2011 high flows began to recede than documented in 2009 or 2010. The higher number of seedlings documented in 2011 was likely a result of a combination of increased fine sediment availability both in interstitial spaces and surface deposits across exposed bars and floodplain surfaces. More fine sediment may have led to higher soil moisture for longer in growing season because fine sediments stayed wetter longer due to the slower recession limb.

Riparian woody plant species diversity increased systemically resulting from spring 2011 ROD releases. Narrowleaf willow was the still most frequently sampled woody plant regenerating within the 300 to 2,000 cfs inundation zones. However, cottonwoods, shiny willow, and red willow successfully regenerated in higher numbers than previously documented above 2,000 cfs on naturally formed bars and some constructed floodplain surfaces as a result of the recommended changes in the rate of recession in the 2011 ROD release. Current trends in seedling establishment suggest that managed spring ROD releases are inhibiting woody plant seedling densities from crossing detrimental encroachment thresholds within the 300 to 2,000 cfs inundation zones.

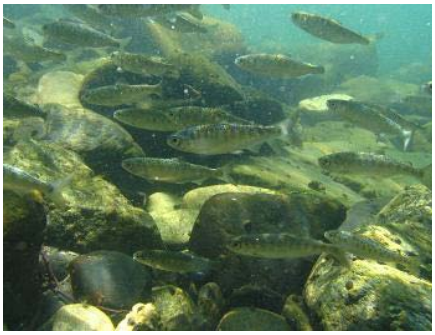
Peak flows of 11,000 flows appear to be insufficient at removing "riparian woody plant regrowth" within channel rehabilitation sites lacking a bedrock outcrop, gravel bar, or large wood that confines the channel. Riparian woody plant regrowth results from vegetation that was intended to be completely removed during construction, but grew back from remnant roots. If flows of 11,000 cfs cannot scour away woody plant regrowth, then it is unlikely that ROD peak streamflows will be able to scour regrowth from along the summer base-flow water edge. Ultimately, because woody stems from regrowth are larger than seedlings of a similar age, they may exert more of a geomorphic influence in their potential to detrimentally encroach the summer base-flow channel in a shorter timeframe after construction. In 2011, fine sediment collected in regrowth areas and was re-forming a berm at some channel rehabilitation sites downstream of Canyon Creek. At these sites, the berm is re-forming above the 2,000-cfs water surface level. The re-forming berm may still have the potential to induce channel simplification, but it has not done so yet. Therefore, it is important to continue to monitor areas of woody plant regrowth and channel geometry to determine whether the sediment berms that are re-forming will subsequently simplify the channel.

Fisheries

Juvenile Salmonid Outmigrant Abundance

To estimate 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 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 is employed with USFWS conducting the fish marking and CDFG providing fish from Trinity River Hatchery.

From January through August, 2011, abundance estimates of natural age-0 Chinook Salmon were: 2,008,653 (±194,751) at the upriver site and 3,047,673 (±162,607) at the lower river site. The mean migration rate between the two sites was 10.4 miles (16.8 km) per day (±5.7 miles or 9.3 km per day). The 80-percent population outmigration date for juvenile Chinook



Juvenile Chinook and Steelhead.

Outmigration Timing

The timing of outmigration varies with species. Yearling Coho and Steelhead Salmon out-migrate in March and April. Spring and fall run Chinook fingerlings generally out-migrate over a longer period with 90 percent of outmigration occurring in early July in most years.

Fisheries terms

Anadromous - Fish that spend most of their lives at sea and migrate to freshwater to spawn.

Escapement - The number of fish that return to spawning grounds or to the hatcheries to spawn.

Harvest - The commercial, recreational, and tribal catch of fish.

Fish Diseases

Ich (*Ichthyophthirius mulitifilis*) is a large protozoan that infects fish and other species, including salmon, trout, and frogs, commonly under warm-water conditions. The parasite burrows into the skin, leaving grainy, salt-like lumps that are visible to the naked eye.

Columnaris is an external disease that can be chronic or progress to acute symptoms, including advanced skin and gill necrosis. The disease, caused by *Flavobacterium columnare* bacteria, is associated with mortality in freshwater fishes in high (warm) water temperatures and crowded conditions.

Salmon at the lower river site was July 23, which missed 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 2011. 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 April 15 through August 19, 2011, 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 5,338 juvenile Chinook Salmon including 54 coded-wire-tagged (i.e., hatchery-raised) Chinook for laboratory analysis. Lab analysis detected *Ceratomyxa shasta* in 7.0 percent (2/28) and *Parvicapsula minibicornis* in 17.0 percent (2/12) of Trinity River origin juvenile Chinook Salmon tested. (See Figure 5.) Detection of pathogenic organisms does not necessarily mean the fish will succumb to the disease. See final California/Nevada Fish Health Center laboratory report on the USFWS Arcata Office web site: **http://www.fws.gov/arcata/fisheries/projectUpdates.html**.

Adult Run-Size Estimation

Run-size estimates (escapement and harvest) for Trinity River spring- and fall-run Chinook Salmon, Coho Salmon, and adult fall-run Steelhead are made annually above two mainstem Trinity River weir sites at Junction City and Willow Creek (CDFG 2011a). Preliminary adult escapement estimates (March 20, 2012**)** and TRRP escapement goals are presented in Table 2 and are subject to change.

Adult Fall Run Chinook Salmon Harvest

Estimates of fall run Chinook adult returns to Basin hatcheries and spawning grounds, as well as Basin harvest by Tribal and recreational fisheries are reported in the annual report on the Klamath River Fall Chinook Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates, 2011 Run (Klamath River Technical Team 2012; CDFG 2012).

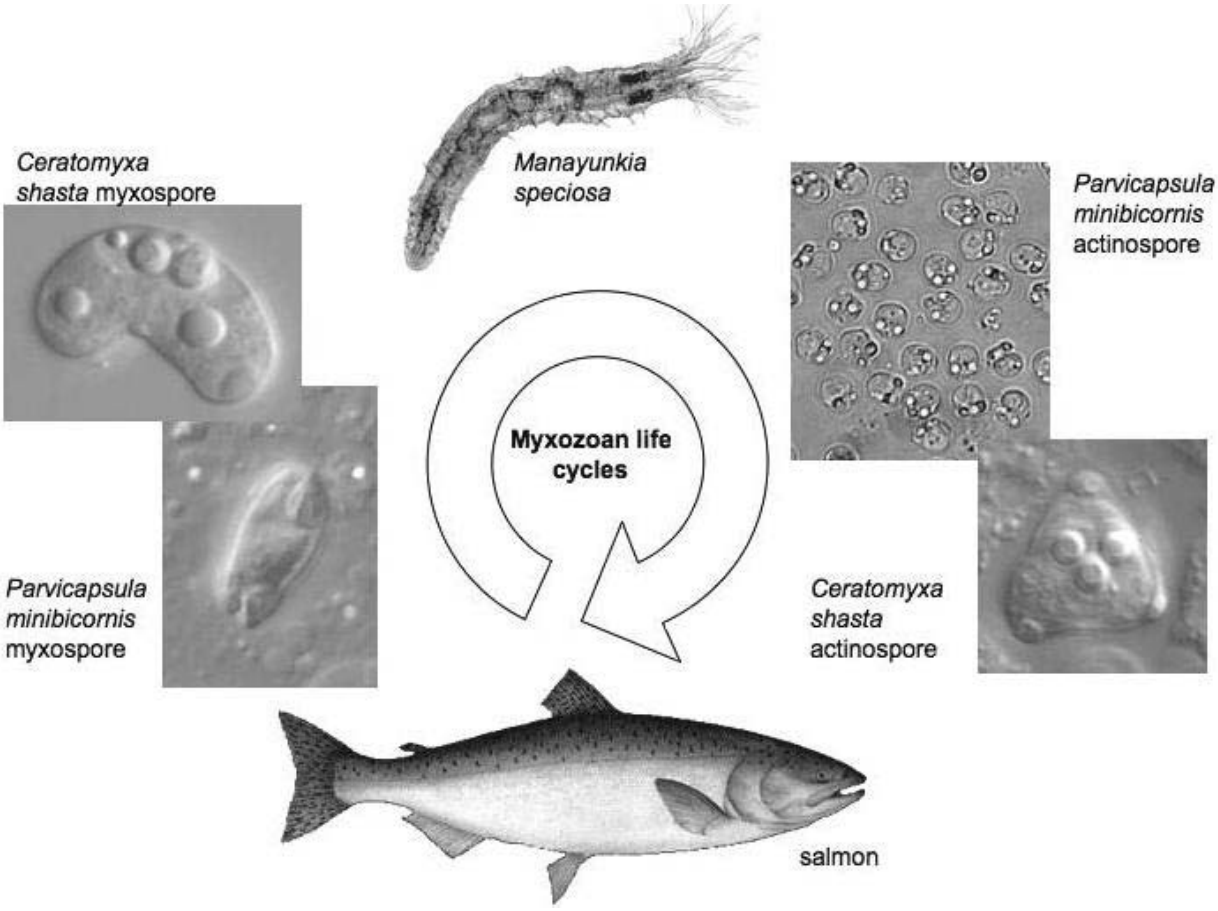


Figure 5. The life cycle of *Ceratomyxa shasta* and *Parvicapsula minibicornis*. *Manayunkia speciosa* is a freshwater polychaete worm and intermediate host of both parasites. (Graphic provided with permission from Jerri Bartholomew, Oregon State University.)

Table 2. Preliminary 2011 adult escapement estimates for Trinity River salmonids (CDFG 2012)

Spring Chinook Salmon are estimated above Junction City weir (Rkm 133); Coho Salmon and fall run Steelhead are estimated above Willow Creek weir (Rkm 37); and fall Chinook Salmon are a total basin estimate.

Species	Natural Escapement		Hatchery Escapement	
	2011 Run	Program Goal	2011 Run	Program Goal
Spring Chinook Salmon	6,926	6,000	3,579	3,000
Fall Chinook Salmon	18,853	62,000	27,710	9,000
Coho Salmon	4,222	1,400	1,923	2,100
Fall Steelhead adults	7,920	40,000	16,692	10,000

Marking adult salmon at Willow Creek Weir.

The harvest in the Yurok Tribal fishery and the lower Klamath recreational fishery is composed of naturally produced Chinook Salmon from both the Klamath and Trinity Rivers, as well as the major tributaries to both rivers and Chinook Salmon produced at Trinity River Hatchery and Iron Gate Hatchery on the Klamath River. The harvest in the Hoopa Tribal fishery is composed of fall run Trinity River Chinook.

YT harvest of 2011 adult fall run Chinook Salmon was 21,490. The HVT harvest of 2011 adult fall run Chinook Salmon was 4,881. The Lower Trinity total sport harvest estimate of 2011 adult fall run Chinook Salmon below Willow Creek Weir was 1,145.

Redd Distribution and Abundance

The mainstem Trinity River is surveyed each fall to determine the geographic distribution of spawning salmon. It is expected that the improved fry-rearing habitat created through Program activities will lead to changes in both the distribution of spawning by natural-origin Chinook Salmon and the relative run size of natural versus Trinity River Hatchery origin fish. A total of 6,510 redds (Chinook and Coho Salmon) were mapped from September 14 to December 21, 2011, from Lewiston Dam to Weitchpec (excluding Cedar Flat to Hawkins Bar). Using the distribution of 4,619 spawned female carcasses recovered over the same survey, we estimate 5,020 of these redds were constructed by natural-origin Chinook Salmon females and 1,449 were constructed by hatchery-origin Chinook Salmon females (Figure 6).

Adult Fall Chinook Salmon Disease Monitoring

Monitoring of ich and columnaris levels began in response to the 2002 Klamath River fish die off, in which 33,000 to 67,000 adult Chinook Salmon in the lower river died during an epizootic outbreak of these diseases. In general, healthy fish are resistant to columnaris. Columnaris is observed among adult Chinook Salmon in the Klamath River every year to some extent, whereas the outbreak of ich in the Lower Klamath River during 2002 was unprecedented. A total of 122 adult Chinook Salmon were sampled in 2011 with only 17 confirmed cases of columnaris observed and not a single incidence of ich.

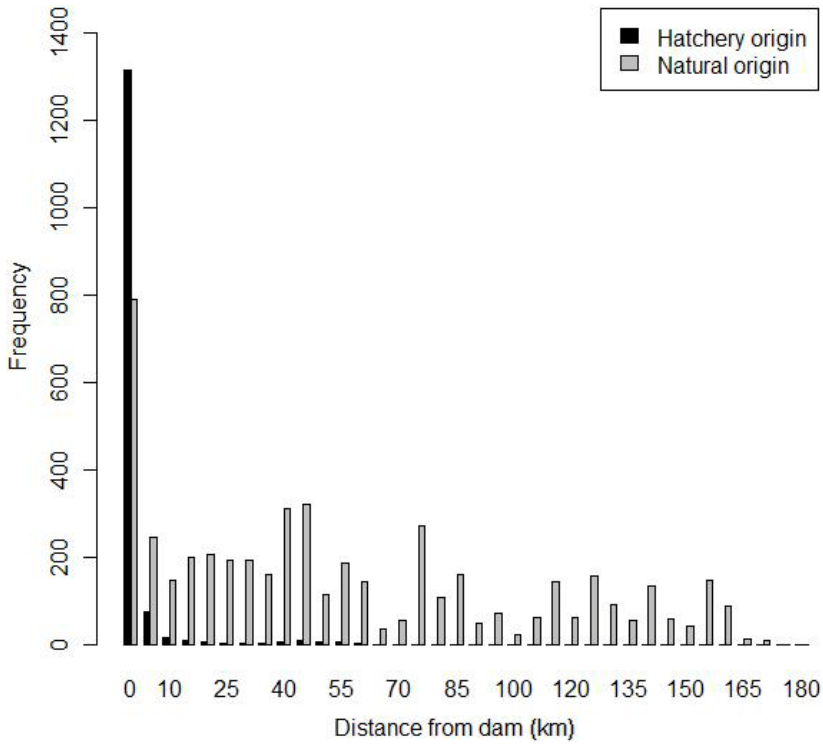


Figure 6. Spatial distributions, starting at Lewiston Dam, of mainstem Trinity River redds constructed by natural-origin and hatchery-origin Chinook salmon females, fall 2011.

Pre-Spawn Mortality of Trinity River Salmonids

Estimates of fall run Chinook female pre-spawning mortality is reported for the Trinity River mainstem above Weitchpec (Figure 7; CDFG 2011b). Forty (8.62 percent) of the 464 female spring Chinook carcasses evaluated were determined to be pre-spawn mortalities. Seventy (5.57 percent) of the 1,256 adult female fall Chinook carcasses examined were determined to be pre-spawn mortalities. Trinity River Chinook Salmon pre-spawn mortalities for years when more than 100 females were examined have ranged from 1.0 to 63 percent for spring Chinook, and 0.7 to 43.7 percent for fall Chinook (CDFG 2011b). Twenty two (12.50 percent) of 176 female Coho Salmon carcasses examined were determined to be pre-spawn mortalities. Pre-spawn mortality rates for Coho have ranged from 8.5 to 15.9 percent in past years.

Fish Habitat Assessment

Channel Rehabilitation Site Assessment—
The post-construction habitat was assessed at the Lowden Meadows and Reading Creek Rehabilitation Sites at five flows ranging from 300 to 2,000 cfs and at the Trinity House Gulch

Rehabilitation Site at a single flow of 450 cfs. Sites were evaluated by mapping the boundaries of habitat using the numeric criteria for water depth, velocity, and presence of cover. After construction, total fry and presmolt winter base flow rearing habitat increased at all sites (Table 3), ranging from 25 and 27 percent, respectively, at Reading Creek, up to 141 and 121 percent, respectively, at Lowden Meadows. Optimal habitat increased 65 and 76 percent for fry and presmolt, respectively, across the entire Lowden Meadows site. (See Figure 8.) There was a positive change to the shape of the flow-habitat curve at the Lowden Meadows site. Generally, optimal habitat increases with increasing flows.

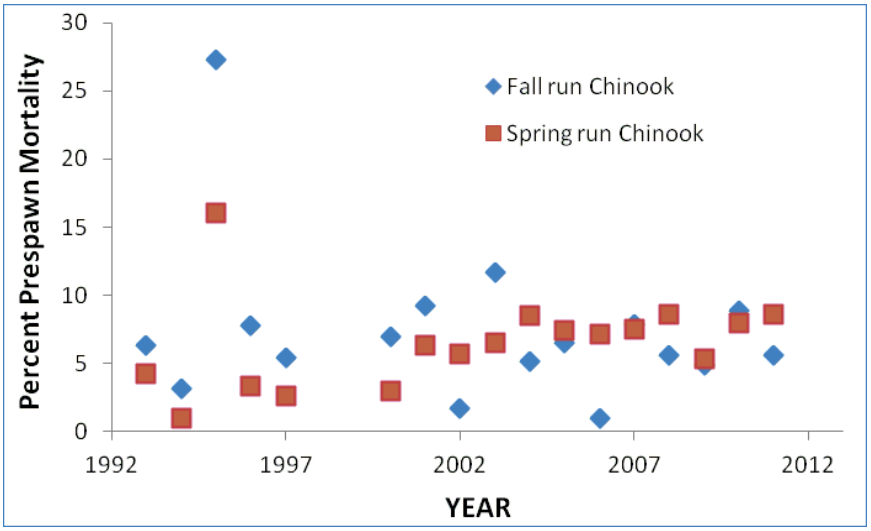


Figure 7. Prespawn mortality (displayed here as percent of total carcasses examined) for spring- and fall-run Chinook has been low in recent years. In 2011 the rates were well within normal for the Trinity River.

Table 3. 2011 Post-Construction Habitat Densities (Area of Habitat per Length of Channel) at Winter Base Flow (~300 cfs or 8.5 m^3/s) at the 2010 Rehabilitation Sites

Habitat type	Life stage	Lowden Meadows		Trinity House Gulch		Reading Creek	
		ft^2/ft	m^2/m	ft^2/ft	m^2/m	ft^2/ft	m^2/m
Optimal	Fry	8.1	2.5	2.0	0.6	2.4	0.7
	Presmolt	15.5	4.7	3.0	0.9	3.3	1.0
Total	Fry	34.1	10.4	18.0	5.5	18.6	5.7
	Presmolt	46.0	14.0	23.3	7.1	25.5	7.8

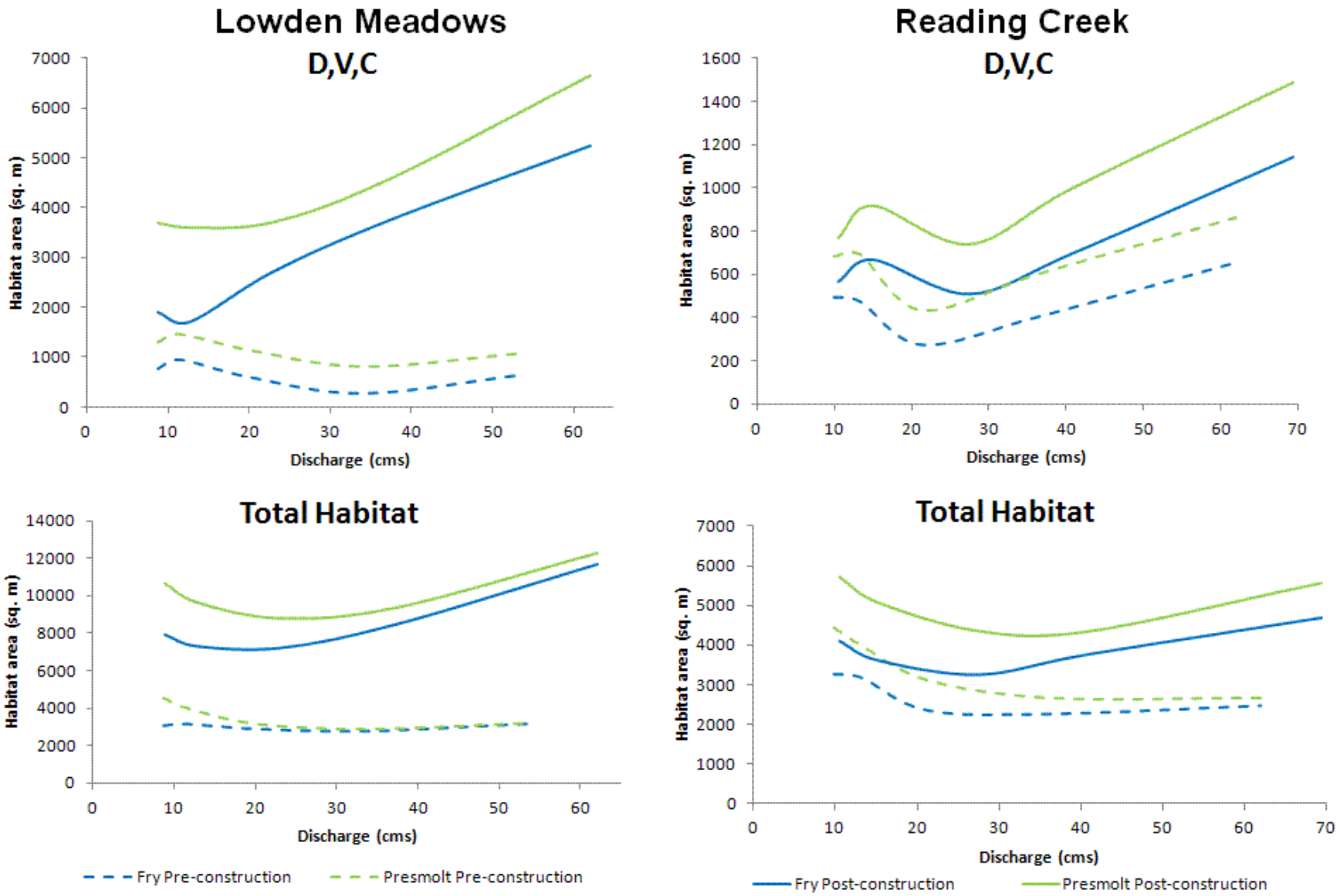


Figure 8. Post-construction fry and presmolt habitat assessments at the Lowden Meadows and Reading Creek Rehabilitation Sites, based on water depth, velocity and presence of cover (D,V,C) and on total habitat.

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 in 2009, 2010, and 2011 as part of a multiyear study. Total area of rearing habitat within the restoration reach in 2011 was about 3.52 million square feet (326,700 m^2) for fry, and 4.57 million square feet (424,300 m^2) for presmolt (Figure 9). A significant increase in total fry and presmolt habitat was detected between 2010 and 2011. However no significant differences were detected between 2011 and 2009.

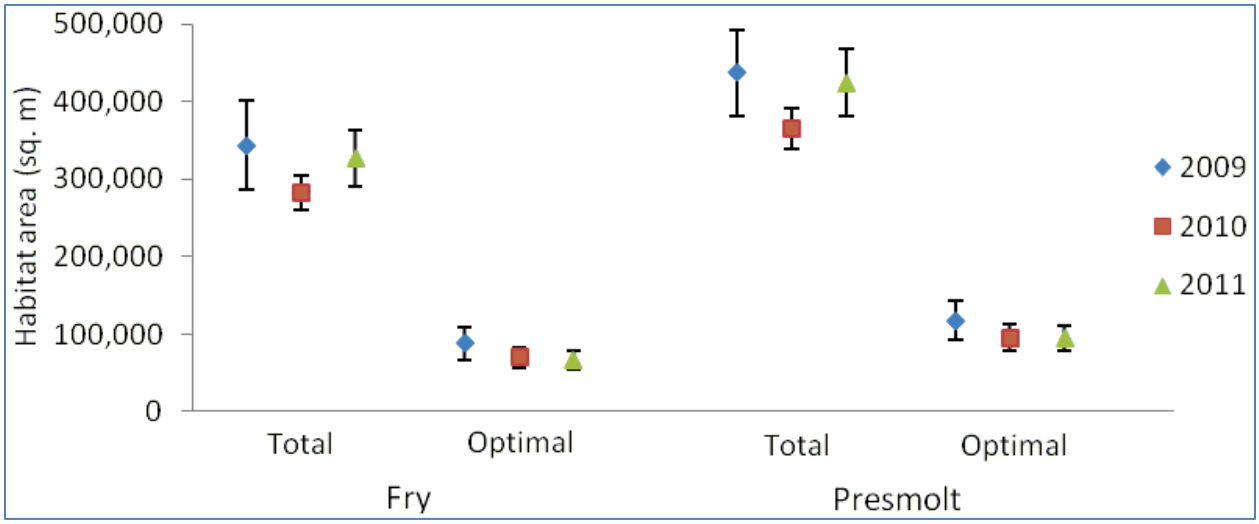


Figure 9. Total and optimal fry and pre-smolt rearing habitat available in 2009, 2010, and 2011. Error bars indicate a 95-percent confidence interval.

Data Management

The ultimate products of the Program will be twofold: a more functional river and the information we gather about it. As evidenced by the diversity of data presented in the AEAM section, data management in TRRP and its use for conducting adaptive management is complex, making coordination and data sharing of great importance. A data team brought together across the partnership has developed the TRRP Data Management and Utility Plan, which establishes procedures for the development and dissemination of data packages to promote collaboration and efficient adaptive management. This draft plan is already being implemented at several levels.

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 has robust functionality for storing and searching data packages as well as reports and other documents. 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. By the end of the fiscal year, the ODP contained 475 documents, an initial set of 6 data packages, and 3,592,647 time series data points (includes stream gage, water temperature, reservoir operations, and other measures). Future ODP enhancement will include a complete revision of the interactive map.

Aerial Photography

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. Aerial photography showing the as-built condition of the Lowden Ranch and Trinity House Gulch rehabilitation sites was collected with an unmanned aerial vehicle in April 2011 prior to the release of restoration flows. New reach-wide orthorectified aerial photography was collected after the river returned to its summer base flow on August 16, 2011.

To supplement the Program's aerial photography records from recent years, georectification was applied to previously unrectified aerial photography obtained in 2005, 2006, and 2008. The program now has orthorectified aerial photography datasets for every year starting in 2005. These imagery sets, together with previously orthorectified historic aerials, provide context for recent and current river restoration challenges, and enable change analyses of the effects of restoration actions (Figure 10).

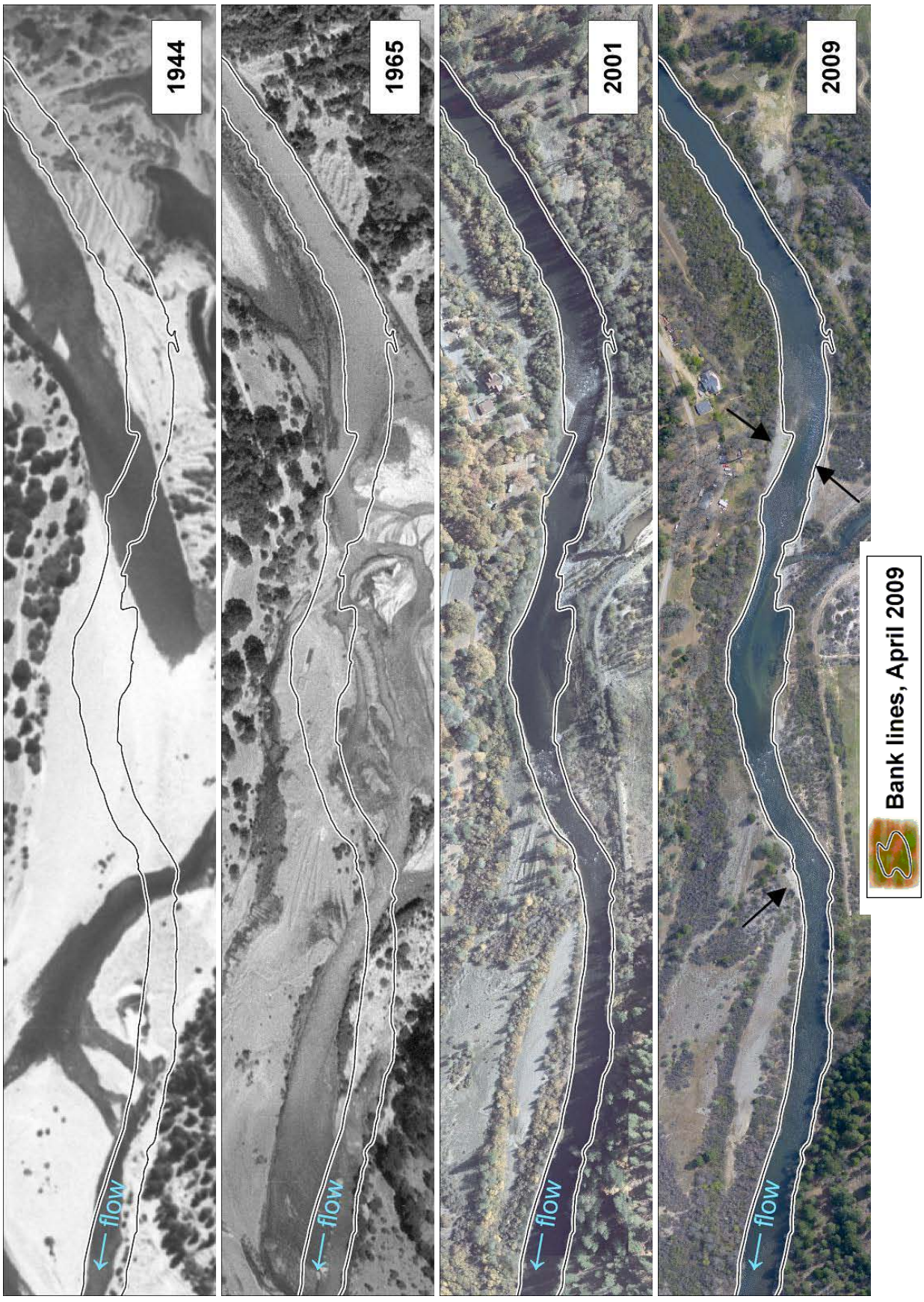
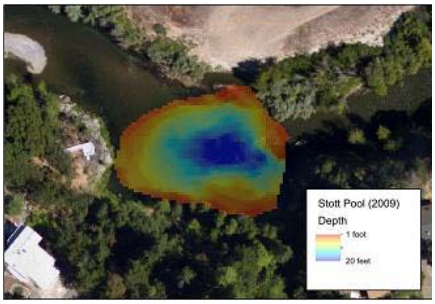

1944
1965
2001
2009
flow
flow
flow
flow
Bank lines, April 2009

Figure 10. Comparative aerial photographs of the Lowden Ranch and Trinity House Gulch reach of the Trinity River with 2009 bank lines for reference. The 1944 and 1965 photos show a river bed heavily modified by mining, but with diverse and dynamic geomorphology; the 2001 photo demonstrates how continuous low flow simplified the channel and encouraged growth of a uniform bank of riparian vegetation; the 2009 photo demonstrates that a few years of restoration flows can begin to rework bars (arrows), but that progress is slow; the 2010 photo shows bank rehabilitation in progress; the 2011a photo shows the as-built condition of the 2010 bank rehabilitation work; the 2011b photo shows the change brought to the river as a combination of bank rehabilitation plus an 11,000-cfs dam release, resulting in more variable geomorphology than the reach has had in decades.



Pool depth and geometry are being monitored at numerous locations along the Trinity River to assess the impact of TRRP management actions on scour and deposition affecting pools.

Implementation Monitoring and Analysis

Implementation monitoring informs a range of implementation actions, including rehabilitation site design and gravel augmentation. In 2011, implementation monitoring focused on assessing the transport characteristics of added coarse sediment and its potential impacts on downstream pools. Boat-mounted sonar was used to conduct extensive bathymetric surveys of approximately 45 pools that were identified by local stakeholders as being important habitats for adult fish. These data have recently become available for analysis and are currently being compared with bathymetric data obtained in 2009 to determine if, where, and how pools have been affected by TRRP management actions. Bathymetric data collected in 2011 is also a key component of a separate analysis currently underway to assess the mechanisms of topographic changes associated with the 2011 high-flow coarse sediment injection at the Lowden Ranch Rehabilitation site.

Environmental Compliance and Mitigation

The seventh element of the restoration strategy involves activities that require Program compliance with various environmental laws. (See sidebar, page 26.)

Projects performed on public lands managed by the U.S. Forest Service or the Bureau of Land Management must also meet guidelines of the Northwest Forest Plan and the Aquatic Conservation Strategy.

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 2010 and 2011, this programmatic EIR streamlined the CEQA, NEPA, and permitting requirements (e.g., USACE, NMFS, CDFG, NCRWQCB, and Trinity County).

In 2011 a separate Environmental Assessment/Initial Study, which worked off the 2009 Master EIR, was completed for the first Phase II project, Wheel Gulch. Implementation of the envisioned channel rehabilitation component of the ROD — a total of 47 rehabilitation projects — is now halfway to completion. However, as the extent of Trinity River restoration has increased, so has the need to ensure that

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

program objectives and environmental compliance goals are being satisfied.

The Master EIR was developed to ensure that CEQA requirements are met. The EIR mitigation and monitoring program requires that negative impacts to fish and wildlife be mitigated during construction and subsequent TRRP management actions. TRRP monitoring of sensitive State and federally listed species ensures that these species' conservation and restoration needs are met. These combined program requirements ensure that mitigation is completed for any cumulative negative impacts from ROD implementation. Consequently, the Program must replace the riparian vegetation which it lawfully removes during project implementation, and must monitor/evaluate the success of replanted riparian vegetation, which many migratory birds rely on for shelter, food, and nesting. The birds that use riparian vegetation are monitored to ensure that project implementation is not causing a decline in key species throughout the program restoration reach.

The results of 2002–09 riparian bird monitoring along the 40-mile restoration reach found trends of increasing abundance in four of five targeted riparian bird species (black-headed grosbeak, song sparrow, tree swallow, yellow-breasted chat, and yellow warbler). However, different river reaches varied considerably from each other, with some trending up and some level or trending down. This information may be used to examine the relationship between site-scale restoration actions and the broader programmatic scale. Results also indicated that abundances of several species, including yellow warbler, yellow-breasted chat, and song sparrow, are higher in areas with large amounts of riparian habitat such as willows, alders, or herbaceous vegetation.

In 2011, the Klamath Bird Observatory (KBO) monitored riparian birds through the 40-mile reach and at select rehabilitation sites. They then created an enhanced monitoring strategy designed to establish links between bird abundance and distribution and habitat development at restoration sites. In 2012, KBO will implement this enhanced strategy, focusing on how restoration-associated changes in riparian habitat complexity (e.g., how riparian planting patches are configured, types of species planted, horizontal and vertical structure, etc.) affect target bird species distribution and use of habitats. In addition, KBO is analyzing previously collected data to provide rehabilitation site-specific habitat associations and

Brian O'Donnell (Klamath Bird Observatory) conducts area Search for riparian birds along Trinity River in summer 2010

Two photos above: Hatchling Western Pond Turtle caught in a pond along Browns Creek in August, 2011

Western Pond Turtle basking in shallow water at Union Hill Pond in August, 2011.

evaluate the performance of existing floodplain features constructed by the program.

Humboldt State University and USFWS researchers have been monitoring western pond turtles at the Lowden Ranch rehabilitation site since before the project was constructed in 2010. At Lowden Ranch, where turtles live in a series of permanent ponds along the river, researchers examined the turtle habitat use, movement patterns, and population structure. They tracked turtles using radio telemetry to observe movement patterns and determine how quickly turtles move into new wetland habitat created during the 2010 restoration project. The longest terrestrial journey measured was 615 meters. Although turtle movements between ponds were infrequent, the majority of the turtles made terrestrial journeys between different ponds, both in 2010 and 2011 (65 and 70 percent, respectively). This highlights the importance of protecting upland habitat and maintaining connectivity between different wetland habitats. Two turtles that had radio transmitters were found using one of the newly created wetlands and two other turtles were observed basking on logs in this new wetland, indicating that new wetlands created by the Program are providing additional western pond turtle habitat.

In 2010 researchers found that the population of turtles is adult biased at Lowden Ranch (i.e., very few young turtles were found). Since this is a serious concern for population survival, the Program wanted to determine if other ponds along the Trinity River also had adult biased western pond turtle populations. In 2011 researchers sampled ponds along the Trinity River from Lewiston to Junction City, as well as a few ponds on Trinity River tributaries (Browns Creek and Little Browns Creek). All ponds along the Trinity River had adult biased populations, with less than 25 percent of the turtles being under 10 years old (Figure 11). However, the turtles in ponds along Trinity River tributaries had high numbers of young turtles (over 40 percent of the population was less than 10 years old). The primary difference between the two was that bullfrogs were observed in the Trinity River ponds but not in the tributary ponds Bullfrogs are an invasive species that will eat hatchling western pond turtles. It is likely that bullfrogs are the cause of the adult-biased populations along the Trinity River. Consequently, to the extent possible, Program conservation efforts will focus on eliminating bullfrogs and creating ephemeral ponds that dry in late summer

or early fall; turtles and native amphibians do not require permanent water, but bullfrogs require two years of continual moisture to reach adulthood. When the Program constructs seasonal wetland ponds for future projects, we will endeavor to pick locations not adjacent to areas where bullfrogs have been found.

The non-native bullfrog (*Lithobatees catesbeianus*) is likely one of the reasons that Trinity River western pond turtle populations are adult biased with few young turtles.

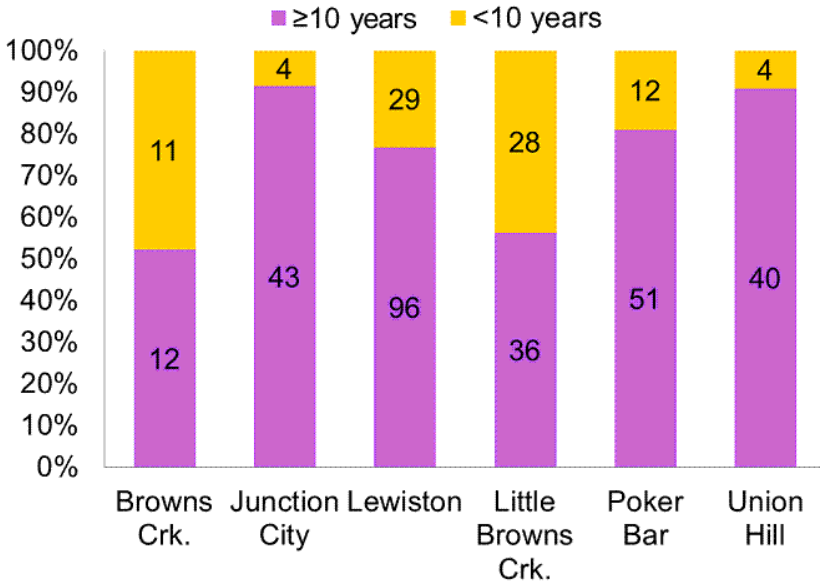


Figure 11. Percent of young (<10 years) and old (≥10 years) turtles in ponds along the Trinity River. Sample sizes indicated within each column.

Replanting Assessments and Wetland Mitigation

As part of its environmental mitigation requirements, the Program has been charged with ensuring a 1:1 replacement of riparian vegetation areas that are disturbed during channel rehabilitation site construction. To ensure revegetation success on the often hot and dry Trinity River floodplain, the Program has been updating its techniques since first planting in 2006. During fall 2011, the Program returned to all previously planted channel rehabilitation sites to evaluate the success of plantings, to determine the species that have colonized the areas, and to examine the relative contribution of planted versus volunteer riparian plants within these areas. This is important because the intent of the Program is to revegetate with a diverse assemblage of riparian plants, as well as to create self-maintaining conditions where functioning floodplains will be naturally seeded with a diverse mix of native riparian species. Functioning floodplains provide the species and various age classes of vegetation, and the structural diversity necessary to support historic species along the river.

Native willow pole collection in Trinity River drainage for use at mainstem revegetation sites.

Revegetation at Lowden Ranch. Locally harvested cuttings were planted in groups of six to a depth of 9-10 feet in order to reach the water table below.

Early data from the fall 2011 survey indicates that survival of more recent plantings, starting in 2009 at the Sawmill site, exceeds that achieved in earlier planting efforts. Increases are attributable to the care that the pole cutting received prior to planting. Since 2009, all cuttings have been soaked for two weeks prior to planting. Additionally, increased care is taken to ensure that ground water is reached whenever cuttings are planted. Watering and soil placement at the time of planting (muddying in) is also utilized to increase soil to cutting contact during planting, and to ultimately increase the rate of plant survival. The collected data from the Sawmill site is being evaluated to establish the relative cost/benefit effectiveness of using weed mats to reduce competition for riparian pole cuttings, and fertilizer tablets, to increase planting growth and survival.

As part of the Program's effort to speed recovery of impacted riparian vegetation, the TRRP planted approximately 14 acres of riparian cuttings (about 8,000 pole cuttings total) in fall 2011/winter 2012. The plantings included cottonwood (*Populous balsamifera* ssp. *trichocarpa* and *P. fremontii*) and native willows. Willows included: arroyo (*Salix lasiolepis*), red *(S. laevigata*) and shiny (*S. lucida*) species. Where possible, these species were planted to the ground water table at Lowden Ranch, Trinity House Gulch, Reading Creek, the Indian Creek boat ramp area, and Wheel Gulch rehabilitation sites. At Indian Creek boat ramp, boulders and a wooden fence were also installed to protect the revegetation from vehicles.

In an outreach effort with the TCRCD, the Shasta Trinity Fly Fishers Association, the California Conservation Corps, the AmeriCorps Watershed Stewards Project, and the Program, three dozen volunteers planted sedges, rushes, and about 200 rooted trees (vs. pole cuttings) through about 0.5 acre of riparian corridor along one of the Lowden Ranch constructed side channels. The plant materials were purchased by the Program and the Fly Fishers and planted during a wet rainy March day. The May high flows did not scour these rooted plants, but rather watered them, so the plants now stabilize the side channel banks.

During monitoring of the Lowden Ranch constructed wetlands it was found that one of the seasonal wetlands was actually holding water year round. Building on a recommendation from Humboldt State University that the Program create only seasonal wetlands in which non-native bullfrog tadpoles cannot overwinter, additional sediment was added to this wetland in

Chorus frog eggs present in Lowden's constructed wetlands in the spring of 2012

December 2011. The pond's performance will be evaluated in the heat of summer 2012. During a recent visit to evaluate the planted riparian vegetation at this wetland, native chorus frog eggs were visible in this pond as well as in all the other ponds constructed in summer 2010.

Beginning with the 2010 work at Reading Creek and Lowden rehabilitation sites, the Program has increased its efforts to revegetate upland areas where excavated floodplain materials are placed. At these sites we specifically placed "better" soils, with more organic material, in configurations that could be planted with trees. Walk-through surveys of the created upland terraces in 2011 indicated that most of the conifers planted at both sites survived the summer and that native grasses were also abundant. In 2011 we continued this effort at the Wheel Gulch channel rehabilitation site, where we seeded the upland terrace with native grasses and planted over 200 ponderosa pines and 20 black oaks (Figure 12).

Figure 12. Ponderosa pine and black oak seedlings planted at Wheel Gulch.

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 and 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 during the first reverse flows through the rehabilitation sites, especially in areas close to the dam where mainstem water clarity has not been degraded by tributary input. Such an effect was noted in 2011. The 2010 channel rehabilitation projects at Lowden Ranch and Trinity House Gulch are located downstream of Rush Creek and upstream of all other major Trinity River tributaries within the 40 mile reach. Consequently, in 2011 the Program deployed a self-contained turbidity probe just downstream of Trinity House Gulch to measure turbidity as high flows washed over both sites.

Trinity House Gulch water quality probe removed for maintenance after high spring 2011 flows

Turbidity monitoring during 2011 high flows substantiated that the river can move a lot of sediment. Spikes in turbidity at Trinity House Gulch, and downstream (at NFH — the U.S. Geological Survey gage upstream of the North Fork Trinity near Helena) were generally seen with each increase in flow. However, these peaks were short in duration and represent fine sediment that was being washed from the floodplain and moved into the water column (Figure 13). This fine sediment may move quickly downriver or settle on floodplains where it could support the development of riparian vegetation

In 2011 the Program continued to increase its capability to control turbidity during channel rehabilitation construction activities. Construction of the 2011 Wheel Gulch channel rehabilitation site included creation of an island, split river conditions, a side channel, and placement of large wood habitat features. Despite the large amount of in-river work the Program was able to isolate summer low-flow channel construction areas from the river and to wash those areas prior to reconnecting them to the mainstem river. 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 formazin nephelometric turbidity units (FNUs) at 500 feet (150 m) downstream. Some isolated spikes above the permit value were of short duration. Monitoring data from summer 2011 construction is included in Figure 14, which displays both contractor values and data collected by a Program-deployed probe, used for quality assurance/control. The highest peaks in turbidity released during construction correlate to opening of isolated construction areas to the river and/or to increased flows washing over freshly constructed areas. In all cases these turbidity releases were brief (several hours).

Turbidity control during construction of Island at Wheel Gulch

In 2011 the Program used many of the same techniques as in earlier years to control turbidity (Figure 15). These included isolation and pumping techniques and the slowing of equipment work during periods of increased turbidity. In addition, this year the contractor used some innovative techniques to control the inflow of river water through newly opened channel rehabilitation features (e.g., the new river channel created at Wheel Gulch). The contractor used cement k-rails to limit water flowing through the new split-flow feature and, accordingly, metered the turbidity which reached the mainstem over a longer period than otherwise would have been necessary. In addition, the contractor washed the banks of newly constructed and isolated channels with hoses and then pumped turbid water into upslope detention ponds for clarification. Concurrently, laborers literally removed buckets of fine muck from the bottom of the isolated off channel areas (e.g., the new split flow area and side channel) and placed the materials above the ordinary high water line. The Program was able to meet water quality requirements for this project by using these labor-intensive techniques.

Water Temperatures and Compliance

2011 was a wet water year (TRFES, Sections 7.1.1 and 8.1). The water year began Oct 1, 2010 with Trinity Reservoir holding a total volume of 1,553,642 acre feet (1.916 km^3), roughly 63.5 percent capacity. The water year ended on September 30, 2011 with Trinity Reservoir holding a total volume of 2,166,835 acre feet (2.673 km^3), roughly 89.5 percent capacity.

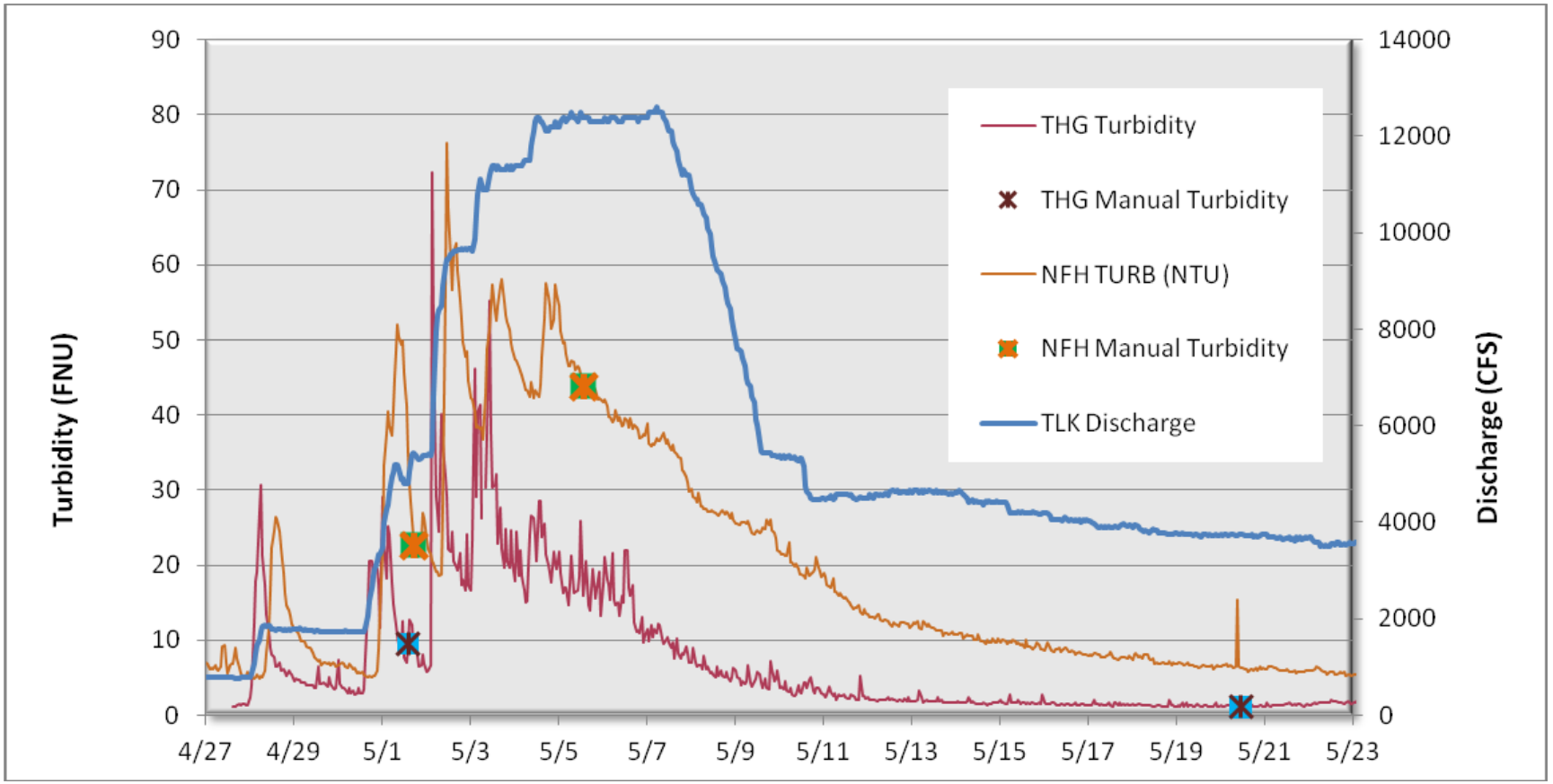


Figure 13. Turbidity measured during 2011 at monitoring sites downstream of Trinity House Gulch (THG) and just upstream of the North Fork Trinity tributary (NFH = North Fork near Helena). River flow (discharge in cfs) was measured on the Trinity at Limekiln Gulch (TLK) near Douglas City. Manual readings were used to ensure that deployed units were reading correctly and had not fouled in the field. Turbidity from unpublished data collected by the TRRP Weaverville office.

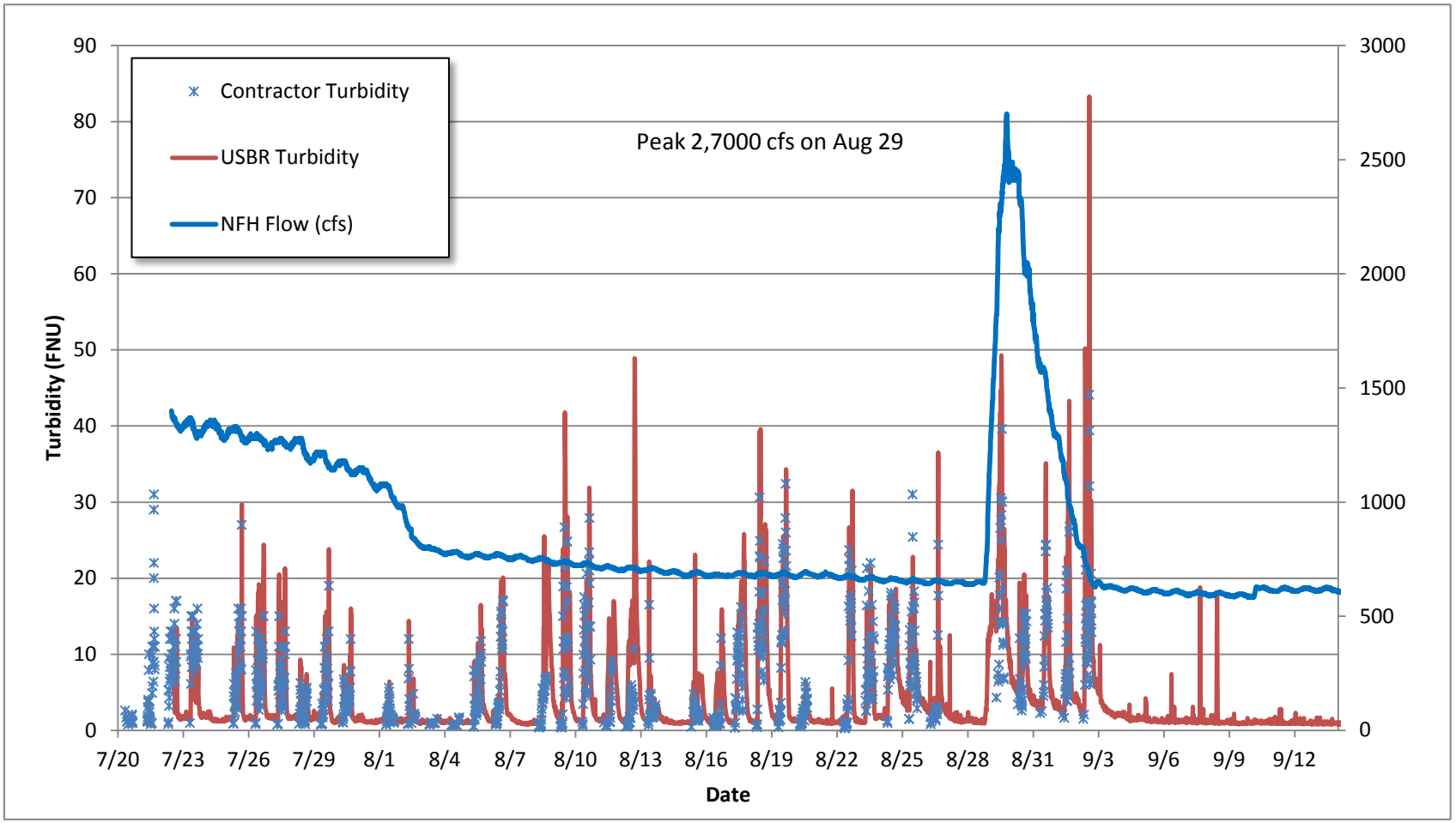


Figure 14. Turbidity measured at the Wheel Gulch channel rehabilitation site during the in-river construction period of July 15 through September 15, 2011. Trinity River flows were measured downstream of the Wheel Gulch Project at the U.S. Geological Survey gage above the North Fork Trinity near Helena (NFH). Contractor turbidy was measured with a Lamotte turbidity meter approximately 500 feet downstream of construction activities. USBR turbidity was measured with a stationary deployed probe located approximately 500 feet downstream of the most downstream construction area. Turbidity from unpublished data collected by the TRRP office in Weaverville and the construction contractor on-site.

Figure 15. Controlling flow of water through Wheel Gulch split flow channel in order to meter (reduce) delivery of turbidity to Trinity River during construction. Upstream of the bladder dam, the bottom of the new split-flow channel was vacuumed in order to reduce fines in the area and to reduce turbidity releases upon opening of the channel to the river.

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.

Table 4 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. 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).

Table 4. 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)

Water Temperature Modeling

Temperature modeling of Trinity Reservoir, Lewiston Reservoir, and the Trinity River simulated several 2011 dam release scenarios[2] and their impacts on temperature compliance in the river. The scenarios were based on the wet water year hydrograph. The summer and fall temperature predictions displayed in Figure 16 show the StreamTemp temperature model output of these release scenarios.

The springtime objectives specify the optimal smolt temperatures established in the flow study. Figure 17 shows the observed river temperatures and appropriate temperature targets between April 15 and July 9 at Weitchpec (WT). Figure 18 shows observed river temperatures between April 15 and December 31, 2011, at Douglas City, and above the North Fork. The figure includes the three Basin Plan targets (WR 90-5) listed in Table 1; Adult Holding – July 1 to Sept 15; Douglas City Spawning – Sept 15 to 30; North Fork Spawning – October 1 to December 31.

[2] See the section on 2011 Flow Scheduling for more details on 2011 flow release scenarios

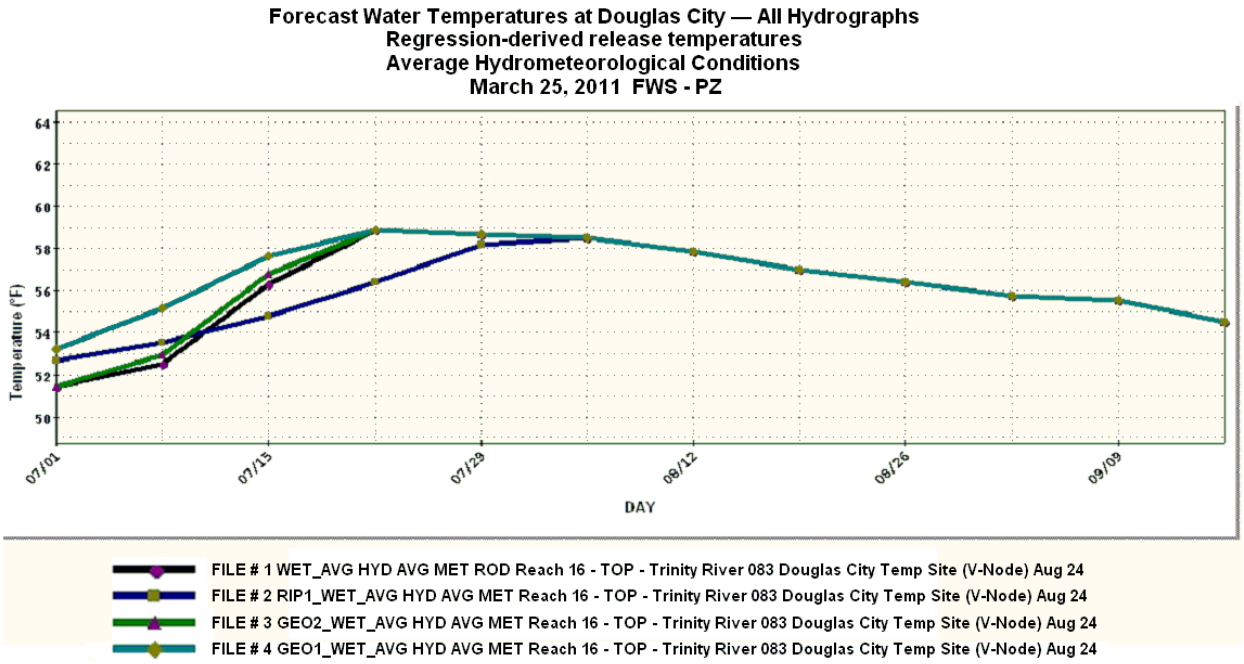


Figure 16. StreamTemp model predictions of river temperatures (ºF) at Douglas City, July through Oct 15, 2011. Model runs made in March 2011 by USFWS. Modeling conditions include the ROD wet year hydrograph, alternatives, and average meteorological conditions.

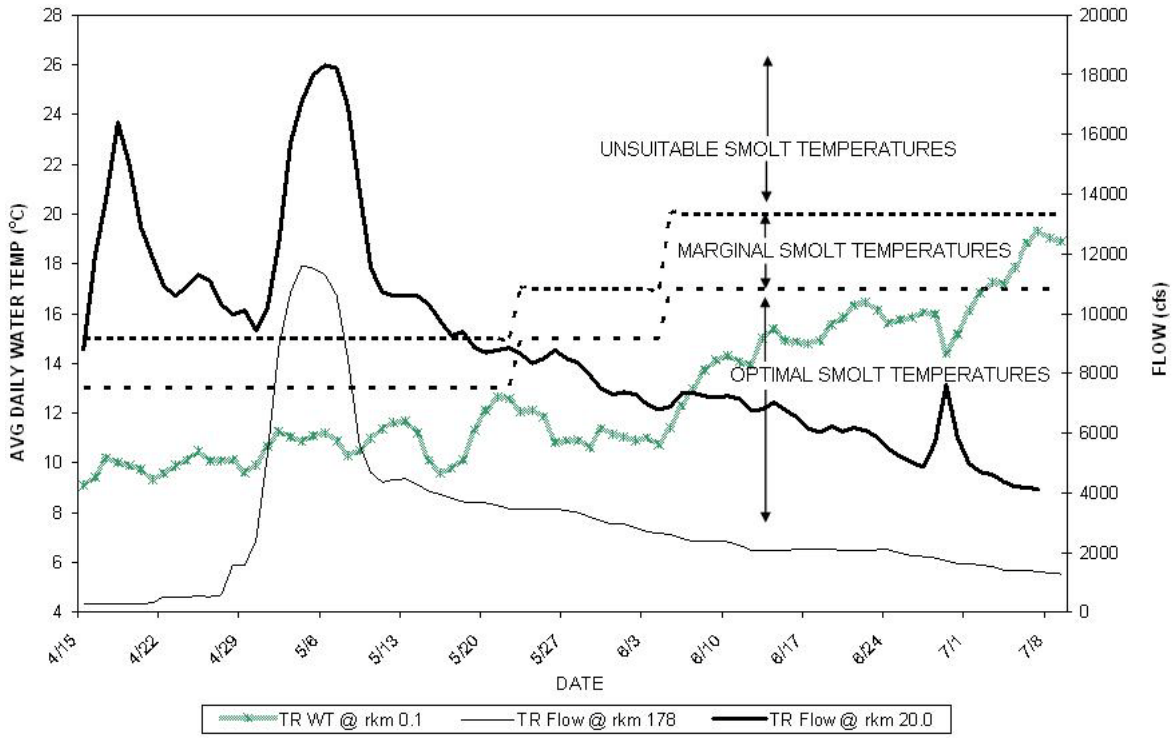


Figure 17. River temperatures (ºC) during the spring of 2011 observed at Weichpec, with flows (in cfs) at Hoopa.

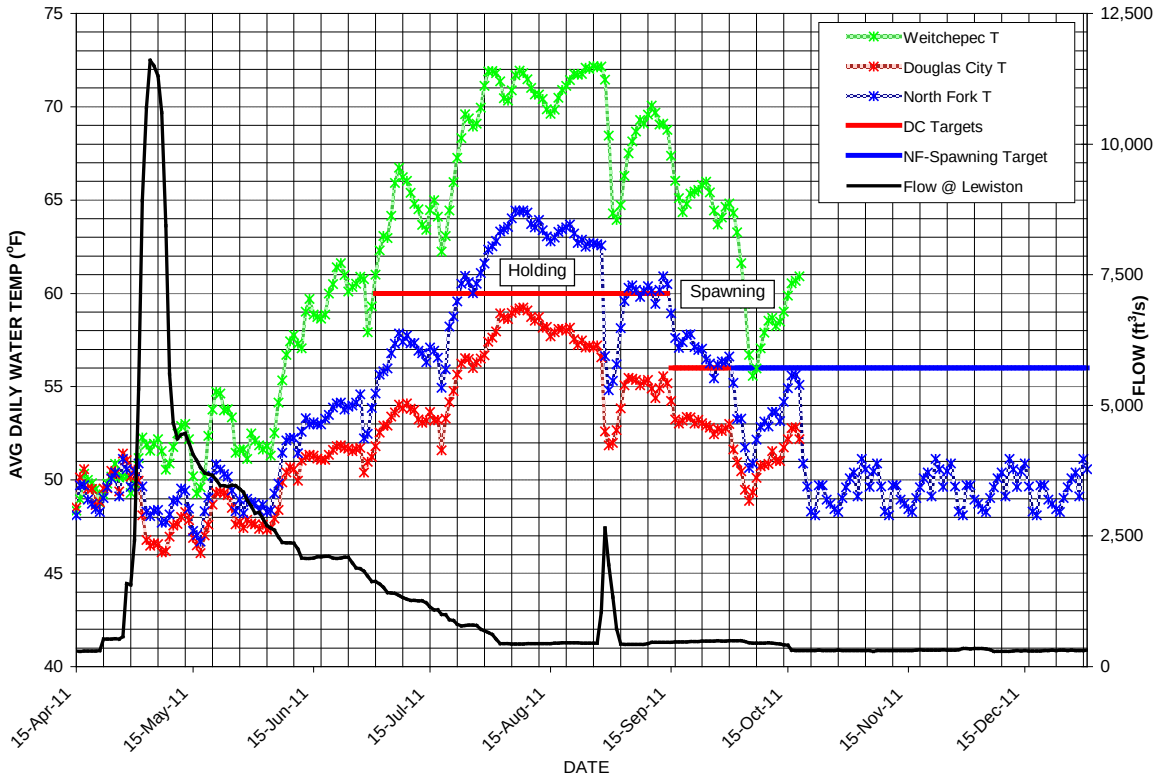


Figure 18. River temperatures (ºF) during the spring of 2011 observed at Douglas City and above the North Fork, along with flows (in cfs) at Lewiston.

Figure 19 shows temperature compliance in 2011 according to the 2011 temperature performance metric. The vertical axis has no units; it is a dimensionless measure of temperature relative to the maximum exceedances in each of the three target periods.

Major findings include:

- The North Coast Region Basin Plan (NCRWQCB 2011) Springtime Objectives for emigrating smolts focus on Trinity River temperatures at Weitchpec (Table 4). During the spring and early summer (mid-April to July 9), the water temperature regime of the lower Trinity River at Weitchpec was mostly within the optimal thermal regime, as Figure 16 illustrates, for salmonid smolts (TRFES, appendix K). Water temperatures increased to marginal from July 4 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 excursions above the optimal regime during early July may be due to warming air temperatures in the region.

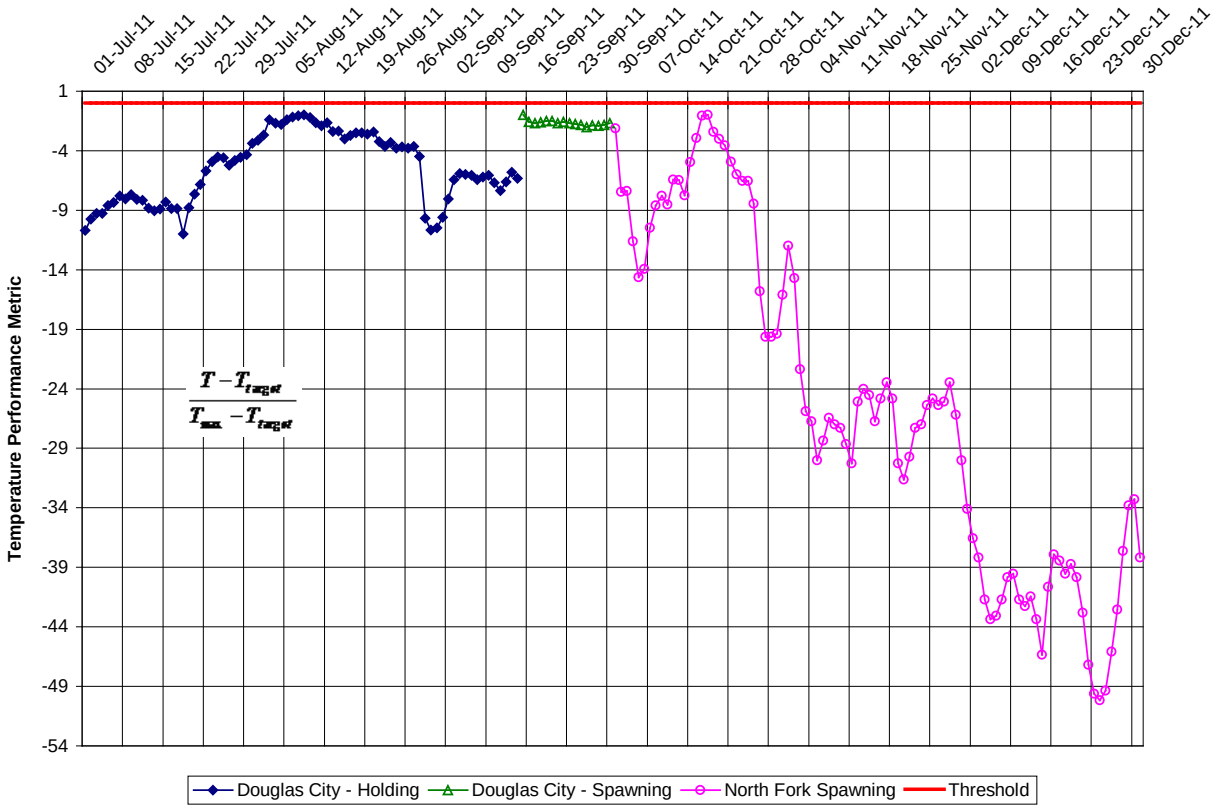


Figure 19. Temperature performance metric for 2011 at Douglas City and above the North Fork. Values above threshold of '0' indicate exceedance of the target for that period and location. Metric normalized to the maximum exceedance during each period.

- 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 18 illustrates the temperature performance during these periods.

Public Outreach in 2011

2011 was a year of increased and new outreach efforts by the Program:

- At the Weaverville TRRP office, we welcomed many walk-ins, telephone and email queries. Our public customers asked a wide range of questions, most often regarding flow release schedules, duration and maximum peak, and ramping rates.
- We held a number of public meetings and workshops to preview designs for upcoming projects, discuss project objectives and approaches, and to explain environmental impact compliance requirements for rehabilitation sites.
- One-on-one meetings with private landowners on their properties were related to rights of entry for projects, assessment of changes from the 11,000-cfs restoration flow release, and monitoring of revegetation at previous project sites.
- Participation in local recreation association meetings, face-to-face discussions about project design features, and outings to observe changes in the river, also attributed to the 11,000-cfs restoration release, increased dramatically in 2011.
- Program staff and their families participated in a tree planting organized by the Shasta-Trinity Fly Fishers and Trinity County Resource Conservation District to improve habitat along the river near a newly constructed side channel at Lowden Ranch.
- TRRP staff also volunteered at the Weaverville Salmon Festival, the Return of the Salmon Festival (Coleman National Fish Hatchery), and other county and local community events.
- TRRP also mentored a Yurok Tribe intern who participated in field studies including surveying and mapping of rehabilitation sites and fisheries field work including snorkeling with the Yurok Tribe Fisheries Department and other partner agencies (USFS).

Wheel Gulch Rehabilitation Project:
Trinity River Mile 75.8 to 76.4
Public Workshop and Review Meeting

February 15, 2011 at 6:00 PM
Junction City N. Fork Grange Hall
Red Hill Road,
Junction City, California

6:00 PM INTRODUCTION: Alex Cousins, Trinity County RCD (10 min)

Purpose of this meeting

6:10
Band

6:15

6:25
Band

Trinity River Restoration Program

Wheel Gulch Channel Rehabilitation Project to Begin in Junction City area

OPEN HOUSE July 27th at N. Fork Grange Hall

The Trinity River Restoration Program (TRRP) and the Water Quality Control Board wish to advise all locals and visitors that the Wheel Gulch Channel Rehabilitation Project, approximately 3 miles downstream of Junction City, is slated to begin by early July. An **open house to discuss Wheel Gulch construction and to present TRRP preliminary designs for future work is scheduled for July 27 at 6:00 pm at the North Fork Grange Hall, on Dutch creek RD, in Junction City, CA.**

Boaters are cautioned to be aware of construction equipment that may be working in the river between July 15 and September 15, 2011.

We also advise the public to be careful of heavy equipment along highway 299 in proximity of the project (approximately ¼ mile east of Wallow Gulch RD). We apologize for any inconvenience and appreciate your cooperation.

The project is designed to increase shallow low-velocity areas for salmonid fry rearing and to increase and maintain fish habitat complexity in the Trinity River. In-river work will be completed by September 15, 2011 while floodplain construction activities will continue through the fall. This project is being implemented under direction of the TRRP in cooperation with the Bureau of Land Management, California Department of Water Resources, and the North Coast Regional Water Quality Control Board.

If you have any questions concerning this project, public meetings, or future TRRP restoration plans, please call the TRRP office at (530) 623-1800 or visit next to the Tops Grocery in Weaverville.

To learn more about the TRRP rehabilitation projects, please visit www.trrp.net.

Sample agenda and outreach notice for a couple of TRRP's 2011 outreach activities.

Tree-planting event, Shasta-Trinity Fly Fishers

Looking Ahead: 2012 Program Activities

In 2012, the Program will continue to execute the restoration strategy 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). Activities will include the construction of two channel rehabilitation projects (Upper Junction City and Lower Steiner Flat), Water Year 2012 flow schedule planning and implementation, completion of five priority watershed projects, and continuation of monitoring and assessment projects with an emphasis on changes in channel bed morphology. Other noteworthy activities planned for 2012 include:

- **Phase I Review of the Channel Rehabilitation Projects** – The Program's Scientific Advisory Board (SAB) will complete a comprehensive evaluation of design features and performance of completed channel rehabilitation projects (Phase I). An independent expert panel will evaluate the draft Phase I review report, and the Scientific Advisory Board will provide its final report to the Program by fall 2012. The Phase I review will serve as a foundation for planning Phase II projects.
- **Adult Salmonid Monitoring Evaluation** – Dr. Mike Bradford (Fisheries and Oceans Canada and Simon Fraser University) and Dr. Dave Hankin (Humboldt State University) will complete a review of TRRP-funded adult salmonid assessments in spring 2012. Study leads and the TRRP Fish Work Group will utilize the reviewer's recommendations to strengthen component projects and the overall adult monitoring program. External reviews of all TRRP investigation plans and reports will also continue.
- **Sampling design** – Darcy Pickard (Senior Statistician, ESSA Technologies) has been contracted to evaluate and strengthen the current sampling design for system scale assessments and to develop a multidisciplinary sampling design for channel rehabilitation sites. Pickard's recommendations will be implemented to the extent possible in 2012 and to a greater degree in 2013.

- **Program Integration** – With the assistance of ESSA Technologies, Program staff will develop a short list of "Big Questions" for the Trinity River Restoration Program to improve focus and guide integration of Program efforts to bring together channel rehabilitation and ecological restoration activities in successful adaptive management. The questions will serve as a reminder of the big picture, which can often be forgotten when dealing with technical details. These unifying concepts will feature prominently in the 2012 Annual Report and other Program documents.
- **Performance measures** – An initial set of TRRP performance measures will be completed in 2012. The measures will track many aspects of the Trinity River, its ecology, and restoration efforts by reporting on various measurable responses of the river to TRRP actions. After releasing the initial set, Program staff will develop a plan to continue and enhance performance measures reporting.

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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/?page_id=74**Error! Hyperlink reference not valid.**
  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 2011 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
°C	degrees Celsius
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
EIR	Environmental Impact Report (required under CEQA)
EIS	Environmental Impact Statement (required under NEPA)
°F	degrees Fahrenheit
FNU	formazin nephelometric turbidity units
HVT	Hoopa Valley Tribe
KBO	Klamath Bird Observatory
km	kilometer(s)
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
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”)
USFWS	U.S. Fish and Wildlife Service
WT	Trinity River at Weitchpec (water sampling site)
YT	Yurok Tribe

On Back Cover:

Constructed side channel at Wheel Gulch Rehabilitation Project site just downstream of Junction City, constructed in the summer of 2011.

Side channels benefit the Trinity River by increasing the amount of juvenile and fry rearing habitat and increasing the quality of the rearing habitat. These side channels increase floodplain connectivity and trap wood and organic debris moving down the river. These side channels are attractive to both young and adult salmonids.