Trinity Drinking Water Source
Sediment Reduction Project
06-142-551-2
Final Report – September 2010

Watershed: Trinity River, upper middle

Project Type: Implementation, Integrated Watershed Management Program, Prop 40

Funding Sources:

- Integrated Watershed Management Program, Prop 40 (State Water Resources Control Board)
- Trinity River Restoration Program Fish & Wildlife Basin Grant Program (Bureau of Reclamation)
- Partners for Fish and Wildlife Program (US Fish & Wildlife Service)
- CA Adaptive Watershed Improvement (Pacific States Marine Fisheries Commission & CDFG)
- Partners for Fish & Wildlife Program (USFWS)
- Trinity County
- CA Dept Fish & Game Fisheries Restoration Grant Program (FY05)

Total Cost: $650,426

Outsloping: Before (on left) and After (on right) on Lewiston Turnpike Road.

Prepared by:
Trinity County Planning Department
&
5 Counties Salmonid Conservation Program

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I Executive Summary

The Trinity Drinking Water Source Sediment Reduction Project addressed treatment of high priority sources of potential sediment delivery from county roads that are adjacent to community drinking water sources. The purpose of the project was to: improve drinking water quality by addressing sediment TMDL targets for road related sediment; and enhance anadromous fish habitat quality through the reduction of potential sediment sources. Existing data on potential sediment sources on county roads assembled by the 5 Counties Salmonid Conservation Program (5C) were evaluated to identify high priority sites. Roads located upstream of community drinking water intakes were identified and priority sites with cost effective treatments were targeted for restoration. Road segments included in this project were: Lewiston Turnpike Road, Trinity Dam Boulevard, China Gulch Road, Roundy Road, North Roundy Road, and Browns Mountain Road. The project is within the Trinity River watershed with the following subwatersheds:

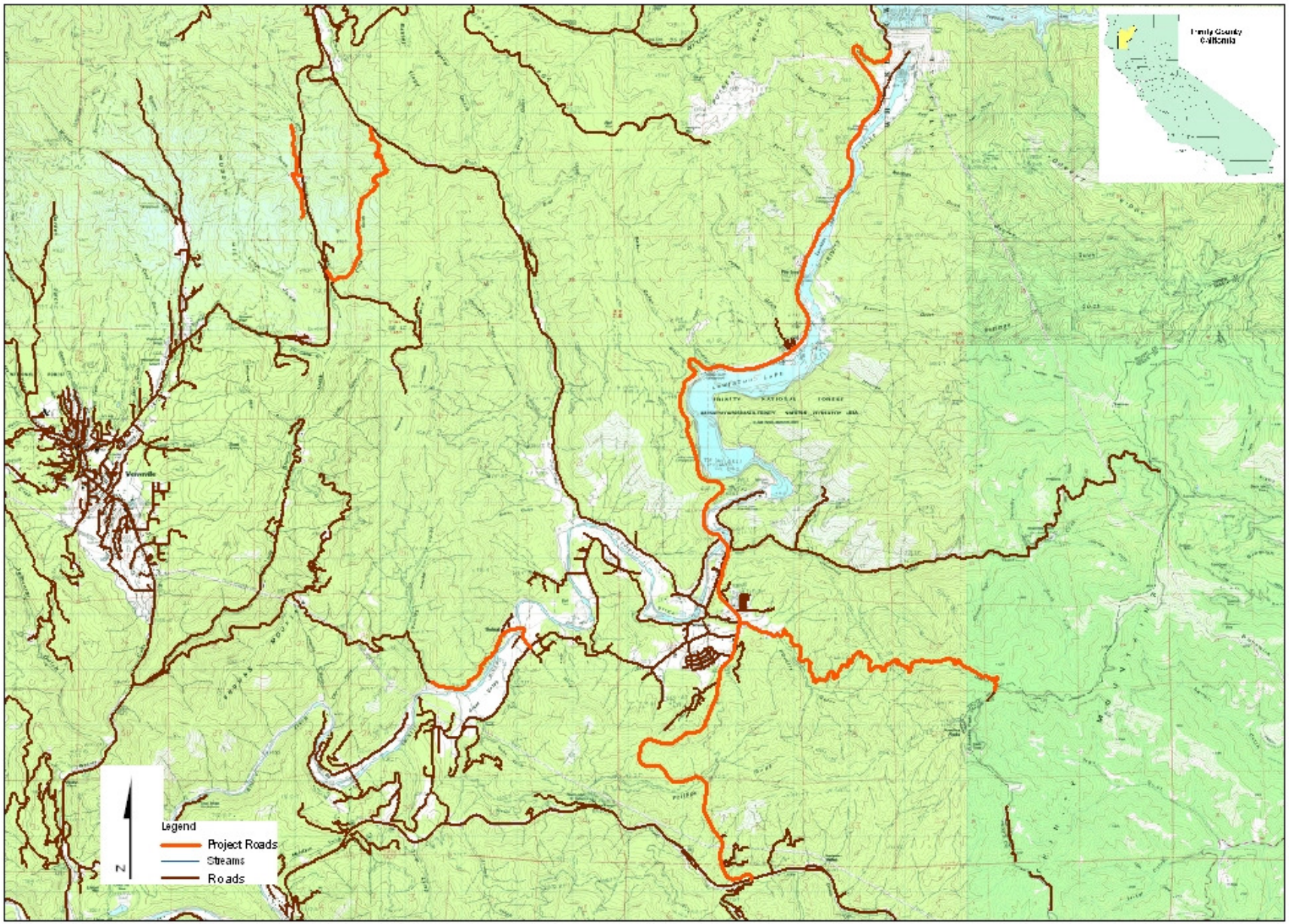
- Alder Gulch
- Hoadley Gulch
- Little Browns Creek, tributary to Weaver Creek
- Phillips Gulch
- Rush Creek

An overall project location map is shown in Figure 1 below. More detailed road specific maps are found in project Progress Reports. Treatments were implemented to improve drainage and other conditions in order to reduce the sediment delivery potential of each sediment source. The proposed work was identified as a priority project of the North Coast Integrated Regional Water Management Plan (NCIRWMP) within rural Trinity County. This report describes the methodology and approach used for the project and includes a summary of work that was completed. Work done primarily or exclusively with matching sources is designated with an asterisk (*). More detailed information is available in the project's Progress Reports. The overall project implemented the following treatments utilizing all funding sources on all six county roads:

Table 1: Summary of Treatments
• Upgrading 15 stream crossings;
• Installation of 1 emergency overflow culvert;
• Installation of 24 critical dips;
• Installation of 83 rolling dips;
• Outsloping approximately 3.3 miles of road;
• Rocking approximately 4.4 miles of unsurfaced road;
• Removal of approximately 2.5 miles of berm;
• Installation of approximately 365 ft of pipe in ditch;
• Insloping approximately 360 ft of road and re-establishing the ditch;
• Insloping approximately 125 ft of road;
• Rock lining approximately 46,447 ft^2 of ditch; Installation of approximately 365 ft of pipe in a ditch to facilitate drainage without undercutting decomposed granite cutbank;
• Installation of approximately 365 ft of pipe in a ditch to facilitate drainage without undercutting decomposed granite cutbank;
• Installation of 6 ditch relief culverts;
• Installation of 8 drop inlets;
• Installation of approximately 0.1 miles of downspout;
• Cleaning 8 culverts;
• Rock armoring approximately 4,392 ft^2 of fill face; and
• Several other less common treatments as detailed below in the Project Description. For example, this included landslide stabilization and a stream cleanup.

Site layout and preparation work for this project began in June 2006 with matching funds. This contract was effective from Dec 29, 2006 to Sep 30, 2010. Treatments began to be implemented in July 2006 with matching funds. Construction work continued in subsequent construction seasons through September 2010 using a combination of contract and matching funds. It is important to note that this contract was frozen due to the state bond funding crisis between December 18, 2008 and November 4, 2009. However, work continued with contract and matching sources. Construction work was done by a combination of Trinity County Department of Transportation road crews and contractors. Pre- and post-project monitoring photos are included in Attachment A. The project is estimated to have treated over 67,500 yd^3 (see V.A Conclusions below) of potential sediment delivery to anadromous streams from county roads through drainage improvements and upgraded stream crossings designed to meet 100 year stormflows.

Figure 1: Project Location Map



II Background & Project Goals

This project targets sediment sources on county roads within the Upper Middle reach of the Trinity River watershed. The larger mainstem of the Trinity River has a TMDL allocation for sediment, which recognizes roads as the biggest managed sediment source in all of the targeted watersheds (within Upper Middle Assessment Area). Specifically, the TMDL sediment watershed indicators describe the impacts of road related sediment and include targets for: 1) decreasing the number of stream crossings likely to fail during the 100 year storm; 2) decreasing the total road length that is hydrologically connected to streams; and 3) increasing the amounts of outsloping and hard surfacing on roads. The project is estimated to have treated over 67,500 yd^3 (see V.A Conclusions below) of potential sediment delivery to anadromous streams from county roads through drainage improvements and upgraded stream crossings designed to meet 100 year stormflows. Typical treatments include upgrading stream crossings, road outsloping and rolling dip installation where safe and suitable, installing ditch relief culverts, and rocking native roads. All of the proposed work was designed to meet four of the six Watershed Indicators of the TMDL as identified in Table 3.3 Sediment Indicators and Targets.

The project watersheds support many beneficial uses, which may be adversely impacted by excessive sediment:

- Municipal and Domestic Supply (MUN) (Drinking water):
  Project sites are located upstream of major Trinity County community water intakes, which serve over 4,000 people. Additionally, some individual water users obtain water directly from targeted water bodies. The project is also consistent with the State Water Board's Nonpoint Source Management Plan as Tier One voluntary implementation as well as with the Sources of Drinking Water Policy (Resolution No. 88-63).

- Water Contact Recreation (REC-1), Non-Contact Water Recreation (REC-2), and Commercial and Sport Fishing (COMM):
  The affected waterbodies are used for rafting, kayaking, swimming, fishing, and other recreational activities. Many community members and visitors hike and sightsee in the project areas. Trinity County and local towns profit from natural resources dependent tourism.

- Rare, Threatened, or Endangered Species (RARE), Migration of Aquatic Organisms (MIGR), Spawning, Reproduction, and/or Early Development (SPWN), and Cold Freshwater Habitat (COLD) :
  The affected waterbodies host anadromous fish including state and federally listed Coho salmon that are adversely affected by excessive sediment. The project would help to implement many of the range-wide and watershed specific recommendations of the CA Coho Recovery Strategy, thus contributing to the recovery of anadromous fish populations and enhancement of aquatic wildlife habitat (Task TR_HU_01.c at level E for sediment management and reduction; Task TR_DC-04 at the 5D level for sediment reduction plans).

The project goals were:

- Short-term: 1) modify the shape of the roads to as hydrologically neutral a state as is practical and economical; and 2) upgrade the targeted stream crossings to accommodate the 100 year storm.
- Long-term: keep storm runoff in its natural drainage with the implemented treatments and to reduce maintenance needs.

In addition to improving water quality and anadromous habitat, the project work has other benefits. The natural environment and fisheries are of significant cultural value to local tribes and cultures. Treatments are designed to make the roads more hydrologically neutral, which will improve their resiliency in response to major storms. This will result in reduced road maintenance needs and costs for the Trinity County Department of Transportation (TCDoT). The portions of the project that called for rocking unsurfaced roads are likely to result in less dust produced during the seasonal dry periods, enhancing air quality. The goals of the County's General Plan and local Community Plans, which call for conserving streams and preserving water quality, are also addressed by the project.

This project was identified as a priority project of the North Coast Integrated Regional Water Management Plan (NCIRWMP) within rural Trinity County. It also helps to implement the 5 Counties Salmonid Conservation Program's (5C) goal to protect economic and social resources of Northwestern California by developing and implementing effective salmonid and water quality conservation programs. Furthermore, work under this contract addresses "Watershed restoration efforts, addressing negative impacts which have resulted from land use practices in the Basin" contained in the Restoration and Perpetual Maintenance Component of the US Department of Interior's Record of Decision for the Main Stem Trinity River Fisheries EIS/EIR (December, 2000, p.3)

III Project Description

A. Project Type:
Implementation, Integrated Watershed Management Program, Prop 40

B. Project Tasks

Site layout and preparation work for this project began in June 2006 with matching funds. This contract was effective from Dec 29, 2006 to Sep 30, 2010. Treatments began to be implemented in July 2006 with matching funds. Construction work continued in subsequent construction seasons through September 2010 using a combination of contract and matching funds. It is important to note that this contract was frozen due to the state bond funding crisis between December 18, 2008 and November 4, 2009. However, work continued with contract and matching sources. Construction work was done by a combination of Trinity County Department of Transportation road crews and contractors. Pre- and post-project monitoring photos are included in Attachment A. The project is estimated to have treated over 67,500 yd^3 (see Section III.G below) of potential sediment

delivery to anadromous streams from county roads through drainage improvements and upgraded stream crossings designed to meet 100 year stormflows.

The following items were submitted with progress reports:

- Item A.2 Project Assessment and Evaluation Plan (PAEP)
- Monitoring Plan
- Subcontract with Steelhead Constructors, Inc.
- Streambed Alteration Agreement for Lewiston Turnpike Road and Roundy Road
- Site Visit Report
- Streambed Alteration Agreement for Browns Mountain Road
- Site Visit Report for work on Lewiston Turnpike Road
- GPS Information for Project Site and Monitoring Locations on Trinity Dam Boulevard
- Site Identification List for Browns Mountain Road
- Map & GPS information for additional sites on Trinity Dam Blvd
- Site Identification List for China Gulch Road
- Site Visit Report for Lewiston Turnpike Road, Trinity Dam Boulevard, and Browns Mountain Road
- Site Visit Report for Trinity Dam Boulevard
- Channel Profile for Finley Gulch on Roundy Road
- Permits for Finley Gulch stream crossing upgrade
- Fish Relocation report for Finley Gulch stream crossing upgrade
- Site Visit Reports for Roundy Rd work and the Finley Gulch stream crossing upgrade
- Pre-project hardcopy photo log forms for China Gulch and Roundy Roads
- Invoice for reporting period
- List of treatments for supplemental work on Browns Mountain Road
- Map of Browns Mountain Road project sites
- Permits for China Gulch and Browns Mountain Roads work
- List of treatments for China Gulch Road
- Map of China Gulch Road project sites
- Site Visit Report for China Gulch Road
- Pre-project photo monitoring log for supplemental work on Browns Mountain Road
- Invoice for a portion of the current reporting period
- Site Visit Report for China Gulch and Browns Mountain Roads –
- Post-project photo monitoring logs for China Gulch Road and Trinity Dam Boulevard
- Final Invoice through the end of the current reporting period & end of contract

Table 2: List of Items			
Work Item	**Items for Review #**	**% Of Work Complete**	**Date Submitted**
EXHIBIT A	**PLANS AND COMPLIANCE REQUIREMENTS**		
1.	GPS Information for Project Site and Monitoring Locations	100%	α
2.	Project Assessment and Evaluation Plan (PAEP)	100%	6/20/07
3.	Monitoring Plan (MP)	100%	8/20/07
	Monitoring Reports		α
4.	Quality Assurance Project Plan (QAPP)	n/a	n/a
5.	Copy of final CEQA/NEPA Documentation	100%	12/14/06
6.	Land Owner Agreement(s)	n/a	n/a
7.	Applicable Permits	100%	α
B.	**WORK TO BE PERFORMED BY GRANTEE**		
1.1	Final Site Treatment Design	100%	α
1.2	Site Identification List	100%	12/16/2008 with revisions α
1.3	Priority List and Rankings, Location Maps	100%	α
2.	Implementation*	100%	α
2.4	Site Visit Reports (during construction)	n/a	α
3.	Project Monitoring	100%	α
3.2.	Photo Documentation; Prior To, During And Post Construction	100%	Final Report 10/31/10
EXHIBIT B	**INVOICING, BUDGET DETAIL, AND REPORTING**		
A.	Invoicing	100%	α
1.	Grant Summary Form	100%	12/4/06
2.	Progress Reports by the twentieth (20^{th}) of the month	100%	Quarterly

α: Submitted throughout the contract period with progress reports.
* See "Table 3: Quantified Implementation Treatments in Scope of Work" and subsequent discussion

100% of work on road segments treated in the project were achieved. However, as compared to the treatments quantified in the implementation section of the grant scope of work, some individual treatments exceeded 100% completion while others were less than 100% completion, as shown in Table 3 below.

Table 3: Quantified Implementation Treatments in Scope of Work						
Task	**Treatment**	**Quantity Proposed**	**Unit**	**Quantity Implemented**	**% of Target**	**Quantity Remaining to Meet Scope of Work***
2.2 a	outslope approximately miles of road	2.6	mi	**3.3**	126%	(0.7)
2.2 b	install approximately rolling dips	85	ea	**83.0**	98%	2.0
2.2 c	install approximately critical dips	21	ea	**24.0**	114%	(3)
2.2 d	remove approximately miles of berm	2.5	mi	**2.5**	100%	(0.0)
2.2 e	rock approximately miles of unsurfaced roads	4.5	mi	**4.4**	97%	0.1
2.2 f	rock line ditch approximately area (sq ft)	1300	ft^2	**46,447.0**	3,573%	(45,147)
2.2 g	inslope approximately rd & re-establish ditch (ft)	360	ft	**360.0**	100%	0
2.2 h	inslope rd approximately (ft)	125	ft	**125.0**	100%	0
2.3 a	Upgrade approximately stream crossings	13	ea	**15.0**	115%	(2)
2.3 b	Install approximately emergency overflow culverts	1	ea	**1.0**	100%	0
2.3 c	Install approximately pipe in ditch (ft)	325	ft	**365.0**	112%	(40)
2.3 d	Install approximately drop inlets	8	ea	**8.0**	100%	0
2.3 e	Install approximately ditch relief culverts	6	ea	**6.0**	100%	0
2.3 f	Clean nine (9) culverts	9	ea	**8.0**	89%	1
2.3 g	Install at least miles of downspout	0.1	mi	**0.1**	76%	0.0
2.4	Armor approximately square feet of fill face	5,500	ft^2	**4,392.0**	80%	1,108
2.5	Excavate approximately yd^3 material	1400	yd^3	**882.6**	63%	517

* Numbers in red/parentheses indicate additional quantities (in excess of those in the grant scope of work) were completed.

It is evident that while there were 2 less rolling dips, 0.1 miles less of unsurfaced road rocked, 1 less culvert cleaned, 1,108 ft^2 less of fill face armored, and 517 yd^3 less of material excavated than called for in the scope of work, there were 3 additional critical dips, 0.7 additional miles of road outsloped, 45,147 additional ft^2 of ditch rock lined, 2 additional stream crossing upgrades, and 40 additional ft of pipe installed in ditch. Also, 0.15 miles of road was surfaced with asphalt grindings, which is nearly equivalent to being chip sealed, as a special treatment. Furthermore, many additional treatments were implemented that were not included in the scope of work. Sometimes work done to address sediment sources for any given site is modified such that different treatments are employed but the same objectives are achieved. Additional work done as part of this project consists of:

- 0.15 miles of the outsloped road were surfaced with asphalt grindings;
- 200 yd^3 of landslide excavated for stabilization and shaped with 900 ft^2 of 1.5 ton RSP placed along toe and lower third revegetated with native brush and trees;
- 1430 ft^2 of a cutbank slide's toe rock armored;
- 1 downspout repaired;
- 45,000 ft^2 of runoff surface regraded;
- 300 ft of stream channel restored, which included removal of 1,400 yd^3 of stored sediments;
- Trash and debris cleanup above fish bearing stream crossing; and
- Emergency overflow culvert inlet repaired;

The quantities and completion amounts between such different treatments may not be reconciled numerically. However, project managers feel that the additional work and extra treatments completed more than make up for the few implementation items that were not done to 100% of the quantities in the scope of work. They are confident that treatments implemented targeted the sediment sources and project objectives.

C. Project Methodology & Construction/Implementation

Methodology

From 2001 to 2002, Trinity County roads were inventoried to identify and assess potential sources of sediment delivery to streams by the Five Counties Salmonid Conservation Program (5C) through the Direct Inventory of Roads and Treatments (DIRT). DIRT inventories include: ratings on erosion potential; estimated potential sediment delivery volumes; recommended treatments designed to improve site conditions; immediacy of proposed treatments; and other ratings on which prioritizations are based. The DIRT methodology is based on Pacific Watershed Associates' (PWA) techniques adapted by PWA and the 5C Program for use on county roads. Treatment prescriptions focus on returning the road to as hydrologically neutral a state as is practical and reducing the sediment delivery potential of each site. This is typically achieved by reducing runoff collection and diversion down road surfaces through removal of road ditches and berms, outsloping the road, the installation of ditch relief culverts and rolling dips where safe and suitable, and rocking unsurfaced road segments. Stream crossings are upgraded by installing culverts designed to accommodate 100 year storm flows. Outboard fill erosion is eliminated with the placement of downspouts and/or energy dissipating rock.

For this project, high priority sediment source sites along roads located upstream of community drinking water sources. Sources of potential sediment delivery were targeted and prioritized based on their likelihood to deliver sediment, total potential delivery volume, and cost effectiveness of treatments. Each site was re-assessed to evaluate current conditions and proposed treatments. Some treatments were modified to better meet current site conditions and needs. Due to the large scope and more complex nature of this project, work was implemented through individual projects on each road over the course of the contract period.

Construction work was performed according to "A Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern CA Watersheds" (5C Program Road Manual available at http://www.5counties.org/Projects/FinalGeneralProjectPages/RoadsManual800.htm) Best Management Practices (BMPs) and Low Impact to Hydrology Guidelines (LITH). The Road Manual BMPs are designed to protect local water quality and stream habitat while maintaining county roads and

maintenance facilities. Various agencies including the CDFG, North Coast Regional Water Quality Control Board, US Army Corps of Engineers, and NOAA Fisheries were involved in the development of the manual. Many of these agencies recommendations were incorporated into the manual. It was recently included for incidental take coverage under NOAA Fisheries ESA 4(d) rule. The LITH road standard is an alternative design for public agency approved roads developed by the 5C and utilized in many projects. It outlines standards for outsloping and rolling and critical dips designed to improve road drainage. The LITH standard conforms to the American Association of State Highway Transportation Officials: Guidelines for Geometric Design of Very Low Volume Local Roads criteria.

Construction

Generally work consisted of: upgrading stream crossings to accommodate 100 year storm flows and ensure that culverts were placed at grade; installation of critical dips to prevent diversion of streams out of the channel during storm events; road surface drainage improvements such as outsloping and the installation of rolling dips to catch and disperse runoff; rock armoring fill faces or culvert inlets and outlets to prevent erosion; rocking unsurfaced road segments to prevent road surface erosion; stabilization of landslides to prevent erosion; and cleaning culverts to prevent plugging and increased likelihood of diversion and/or failure. The more notable 5C Roads Manual BMPs used in every project include:

- Aligning new culverts with the stream channel and placing them at the same grade as the stream channel;
- Rock armoring the outlet and inlets of newly installed culverts to minimize and prevent erosion;
- Incorporating disturbed materials into drainage upgrades (such as road outsloping) or properly removing them off-site to a suitable spoils disposal site; and
- Disturbed areas were re-seeded and mulched upon project completion or the end of a construction season.

Specific treatments are listed below for each road. More unusual treatments are described.

<u>Browns Mountain Road</u>

The Trinity County Department of Transportation (TCDoT) performed the following on the Trinity River watershed portion of the road with grant contract and matching funds:

- Upgrading 4 stream crossings;
- Installation of 7 critical dips;
- Installation of 42 armored rolling dips;
- Outsloping approximately 2.44 miles of road;
- Rocking approximately 3.79 miles of road;
- Removal of approximately 2.18 miles of berm;
- Cleaning 1 stream crossing and 1 ditch relief culvert;
- Excavation of ~105 yd^3 of slide material; and

- Rock armoring the toe of a cutbank slide (approximately 1,430 ft^2) with ¼ to 1 ton rock slope protection.

The Trinity County Department of Transportation (TCDoT) performed the following on the Little Browns Creek watershed portion of the road*:

- Upgrading 2 stream crossings;
- Installation of 2 critical dips;
- Outsloping approximately 0.15 miles of road and applying asphalt grindings to the road surface;
- Rocking approximately 0.43 miles of road;
- Installation of approximately 10 ft of downspout to a stream crossing;
- Repairing an emergency overflow culvert inlet;
- Excavation of approximately 39 yd^3 of material from upgraded stream crossing channels; and
- Rock armoring approximately 550 ft^2 of upgraded stream crossing channels.

Lewiston Turnpike Road

Steelhead Constructors, Inc was contracted to complete the following with grant contract and matching funds:

- Upgrading 3 stream crossings;*
- Installation of 12 critical dips;
- Installation of 33 armored rolling dips;
- Outsloping approximately 0.10 miles of road;
- Rocking approximately 0.04 miles of road;
- Removal of approximately 0.32 miles of berm;
- Insloping approximately 360 ft of road and re-establishing the ditch;
- Insloping approximately 125 ft of road;
- Rock lining approximately 620 ft^2 of ditch;*
- Installation of 1 ditch relief culvert;
- Installation of 1 drop inlet with grate lid;
- Installation of approximately 60ft of downspout;
- Repairing 1 downspout;
- Repositioning 4 existing downspouts to more effectively catch runoff;
- Cleaning 6 culverts;* and
- Rock armoring approximately 411 ft^2 of fill face.

Trinity Dam Boulevard

Eagle Rock, Inc. was contracted to complete the following:

- Regrading and rock lining approximately 45,000 ft^2 of inboard area to direct inboard ditch delivery to a drop inlet;
- Rock lining approximately 90 ft^2 of ditch;
- Installation of approximately 365 ft of pipe in a ditch to facilitate drainage without undercutting decomposed granite cutbank;
- Installation of 1 ditch relief culvert;
- Installation of 1 emergency overflow culvert;
- Installation of 7 drop inlets;
- Installation of approximately 0.06 miles of downspout;
- Rock armoring approximately 400 ft^2 of fill face; and

- Excavation of approximately 346 yd^3 of material from existing sediment basins and from outboard fill faces.

North Roundy Road*
- Outsloping and rock lining approximately 0.10 miles of road.

Roundy Road
TCDoT completed work at the Finley Gulch stream crossing on Roundy Road, which is an anadromous fish bearing stream. Finley Gulch is the only site in the entire project that bears fish and does not typically run dry in the summer season. The pre-project crossing was a barrier to fish migration. For this reason, more extensive design and site preparation were performed and a higher level of permitting was secured. Work was done using both grant contract and matching funds and consisted of:
- Replacement of an undersized and perched 42-inch diameter, 30-foot long corrugated metal culvert with an embedded 84-inch diameter, 34-foot long corrugated metal culvert. The project increased the crossing's capacity to convey the estimated 100-year flows for the watershed, resulting in sediment savings from potential failure of the crossing. The jump height into the culvert was reduced from 1.8 feet to 0.45 feet and provides for a natural stream bed through the crossing.
- Metal, plastic and other debris from past mining activity at the site was also removed from the upstream and downstream riparian areas.*

Concrete Aggregate Products, Inc. performed work on the remainder of Roundy Road as follows with both grant contract and matching funds:
- Upgrading 1 stream crossing;
- Rock lining approximately 717 ft^2 of ditch;
- Installation of 1 ditch relief culvert;
- Rock armoring approximately 381 ft^2 of fill face.

China Gulch Road
TCDoT performed work on China Gulch Road treatments using both grant contract and matching funds. The following treatments were implemented:
- Upgrading 4 stream crossings;
- Installation of 3 critical dips;
- Installation of 8 armored rolling dips;
- Outsloping approximately 0.47 miles of road;
- Rock lining approximately 20 ft^2 of ditch;
- Installation of 2 ditch relief culverts;
- Rock armoring approximately 1,050 ft^2 of fill face and 30ft2 of downstream channel; and
- Stabilizing 2 landslide areas with rock armored toes and seeding and mulching.

Implemented work will be maintained long term by the TCDoT, whom manages the entire county road system. It will continue maintaining the

treated county road segments as part of its overall obligation to upkeep the county road system.

Prior to the beginning of each project's implementation phase and after construction, project photo monitoring pictures were taken. Following the project completion, approximately 20% of the treated road segments were re-inventoried using the current DIRT methodology.

D. Existing data and/or Before Photos

Numerous pre-project photos like the one shown above were taken and are found in Attachment A. This one is of a crossing on China Gulch Road.

E. New data (graphs & tables) and/or After Photos

Numerous post-project photos like the one shown above were taken and are found in Attachment A. This one is an "After" photo of the same China Gulch

site shown in the previous photo that has been upgraded crossing with a critical dip.

F. Monitoring Results: Data Evaluation/Pollutant Reduction

Photo monitoring was a component of the overall monitoring plan. Before and after photo logs for each road are included as Attachment A. Hard copies of the field photo logs that contain photopoint GPS coordinates, photo descriptions, and other information were submitted regularly with project Progress Reports.

Effectiveness monitoring included a quantification of treatments. This is shown in Table 1: Summary of Treatments above. During and after construction, project managers conducted site visits (as described in the project Progress Reports) to ensure treatments were implemented according to design. Occasionally, work was modified by the contractor or TCDoT at the project managers' requests in order to meet specifications.

DIRT re-inventories of 20% of the treated road segments were performed upon project completion based upon random selection. There are some noteworthy differences between the DIRT methodology used to obtain pre-project data and the more refined current DIRT methodology. The latter captures sources of chronic erosion, such as cutbanks, road surface, ditches, more thoroughly than the original version. However, some most of the basic principles remain the same:

- A site is defined as a road-related source of sediment that has the potential to deliver at least 20 yd3 over a period of ten years to a stream. Although inventory crews make take note of a site and log it into the DIRT database, it may not necessarily be considered an actual DIRT sediment site unless the assessment reveals that the 'site' criteria has been met.
- A site is a point of potential sediment delivery on a road and includes all sources of potential sediment that it receives including ditch and road surface runoff, stream crossing fill, cutbank material, landslides, etc. Therefore, although a site is recorded at a discrete location, it may encompass a long segment of road.
- Not all identified DIRT sites are recommended for treatment. For example, a stream crossing located downstream of a poorly constructed or maintained private driveway may be considered a DIRT site due to the potential for road related sediment delivery. However, if the main source of the sediment may not be treated by the landowner, then it could be considered a "non-treatment" site. Another example is a location where physical site constraints or conditions make it difficult to literally or effectively implement a treatment. Examples of this are steep roads located in decomposed granite.

The post project DIRT re-inventory DIRT results of 20% of the treated road sections indicate that there are only 3 sites identified and recommended for

treatment. Those 3 sites have a combined total volume of 1,391 yd^3 of potential sediment delivery over a ten year period. They are summarized below:

Table 4: Post-project DIRT results

Site #	Distance	Potential Volume yd3	Road Name	Surface	Site Type	Water-shed	Control-lability	Generalized Treatment
1195P	0.61	560	Browns Mountain Road	native	Stream crossing	Little Browns Creek	H	Outslope ~1270' road, where safe and suitable and remove berm. Install 3 rolling dips every 300', where suitable.
1540P	4.55	231	Lewiston Turnpike Road	rocked	Ditch relief culvert	Hoadley Gulch	HM	Clean off drop inlet (DI) lid; clean DI and make sure the culvert is open. If not clean. Install a rolling dip. Rock armor the outboard fill face of the dip.
1650P	0.337	600	Roundy Road	paved	Ditch relief culvert	Little Browns Creek	HM	Many constraints to access: Little Brown Creek is at the toe of the outlet erosion. Private land on the outboard. Trees and power line on the inboard. Armor boulders.

They all have a "low" immediacy for treatment and "moderate-low" potential for erosion. It should be noted that because of the steepness of Browns Mountain Road at the first site, the TCDoT was reluctant to install rolling dips and outslope the road. There were additional locations recorded during the re-inventory but were not recommended for treatment. The overall reduction in treatment sites indicates that this project was successful in reducing the amount of notable road related sediment sources along the treated road segments.

G. Project Performance: Evaluation & Effectiveness – Results of PAEP

The project goals and desired outcomes were to: 1) upgrade the targeted stream crossings to accommodate the 100 year storm; 2) modify the shape of the roads to as hydrologically neutral a state as is practical and economical to reduce likelihood of erosion and sediment delivery to streams; and 3) to reduce sediment delivery from the road surface. Additional, anticipated benefits of the project (with an uncertain timeframe) are a reduction in maintenance needs and a reduction of the sediment load from the county road system with the potential to enter a stream.

The Project Performance Measures of the project are listed in Table 5 (on a subsequent page). All treatments were inspected to assure conformance with design standards. When possible, their function and performance were also observed during subsequent winter seasons. In fact, some treatments and/or modifications were added on Browns Mountain Road based on these performance observations. The installation of overall treatments relate to the Project Assessment and Evaluation Plan (PAEP) measures as follows:

1. To address the first goal, all of the stream crossings upgraded were sized to accommodate the 100-year stormflow and placed at grade with the stream channel. Many of these were accompanied by critical dips where suitable to prevent diversion.

2. The road shape and drainage pattern of much of the treated road sections were modified by outsloping, installing rolling dips, removing berm, installing ditch relief culverts. This addressed the second project goal by helping to reconnect hydrologic patterns and minimize the concentration of runoff on the road surface and in ditches.
3. Some segments of previously unsurfaced roads were also rocked as were some ditch segments and road fill face. These treatments were designed to reduce erosion and sedimentation from the road and other surfaces per the third project goal.

DIRT re-inventories of 20% of the treated road segments yielded favorable results. Generally, there were fewer DIRT "sites" identified while other "sites" were designated as "No treatment needed." The reduction in total potential sediment volume for the 20% treated road segments proportionally represents a 91% decrease in volume (using 20% of the original 74,490 yd3 project total as a reference, or 14,898). Using this approach, the project may be estimated to have treated approximately 67,500 yd^3 (~91%) of potential sediment delivery to anadromous streams from county roads through drainage improvements and upgraded stream crossings designed to meet 100 year stormflows. This meets PAEP targets for 75% to 90% decreases in estimated volumes per the first project goal. The quantities of treatments implemented such as road surface and fill face armoring generally met or exceeded original targets. The amount of outsloping (3.3 miles) completed exceeded original targets by approximately 25%. Because there was very little outsloping on the treated road segments prior to the project, this treatment amount translates to a significant change in the nature of the project areas. Therefore, the road surfacing and drainage improvement targets set in the PAEP appear to have been satisfied.

Table 5: Project Performance Measures					
Project Goals	**Desired Outcomes**	**Output Indicators**	**Outcome Indicators**	**Measurement Tools and Methods**	**Targets**
1. Upgrade the targeted stream crossings to accommodate the 100 year storm.	Proper functioning of stream crossings through the road prism at 100 year storm flow, which consists of : stream crossing upgrades (replacing existing culverts and/or installation of emergency overflow culverts)to ensure correct pipe size and proper placement to accommodate the 100 year storm flow; and/or installation of critical dips to ensure streams are retained within their drainage and do not divert off-site.	Quantification of stream crossing treatments (e.g., number of stream crossings upgraded, number of emergency overflow culverts and critical dips installed). The treatment types are listed in project activity 2.3.	Visual observations of pre- and post- project upgraded stream crossings that are documented through project activity 3.2 will be used to observe pre- and post culvert conditions. Upon completion of all proposed treatments, 20% of the total treated road segments will be inventoried using the methodology originally used to identify sites and prescribe treatments (DIRT) as described in project activity 3.3.	5C Program Direct Inventory of Roads and Treatments (DIRT) methodology and database. Note that the underlying methods for sizing stream crossing culverts are based on watershed size and the following universally used calculation methods: 1) Rational method for watersheds of < 100 acres; 2) Waananen and Crippen method for watersheds ≥ 100 acres. Also, photo documentation of pre and post project conditions.	1. Reduction of the number of stream crossing sites (those estimated to have the potential to deliver at least 20 cyd of road-related sediment to a stream(s) and are improperly sized to accommodate the 100 year storm flow of its watershed) identified through the DIRT re-inventory 2. By the end of the project, a reduction in at least 75% of total cyd of sediment that the treated road segments were estimated to have the potential to deliver to a stream(s) at the start of the project.
2. Modify the shape of the roads to as hydrologically neutral a state as is practical and economical to reduce likelihood of erosion and sediment delivery to streams	Through the proposed activities, the drainage of the targeted road segments will be improved by reshaping the road surface as well as upgrading the stream crossings. The specific treatments are listed in section I above under project activities 2.2, 2.3, and 2.4. These improvements are designed to maximize the retention of streams and runoff in their natural drainage. (Treated road segments disconnected from stream hydrology).	Quantification of treatments implemented (e.g., number of rolling dips and ditch relief culverts installed). This information will be gathered for each road segment as it is completed. The list of treatment types are listed in project activities 2.2, 2.3, and 2.4.	Visual observations of pre- and post- project road segments that are documented through project activity 3.2 will be used to observe erosion processes and road conditions on treated road segments. Upon completion of all proposed treatments, 20% of the total treated road segments will be inventoried using the methodology originally used to identify sites and prescribe treatments (DIRT) as described in project activity 3.3.	5C Program Direct Inventory of Roads and Treatments (DIRT) methodology and database. Also, photo documentation of pre and post project conditions.	1. At least an 80% reduction in the number of treatments sites (those estimated to have the potential to deliver at least 20 cyd of road-related sediment to a stream(s)) present within a treated road segment identified through the DIRT re-inventory by the end of the project. 2. By the end of the project, a reduction in at least 75% of total cyd of sediment that the treated road segments were estimated to have the potential to deliver to a stream(s) at the start of the project.
3. Decrease sediment delivery from the road surface.	Increased length of outsloped road and increased amount of rocked surfaced areas. Treated road surfaces may deliver only negligible amounts of sediment to streams.	Quantification of the length of road outsloped, the amount of surface area rocked, and area of fill face armored.	Visual documentation of outsloped road conditions and rocking on road and fill face surfaces as compared to pre-project road conditions.	Photo documentation of pre and post project conditions. 5C Program Direct Inventory of Roads and Treatments (DIRT) methodology and database.	1. Increase in the amount of surfaced road and fill face areas by at least 33% compared to the total amount present before the project. At least a 33% increase in the length of outsloped road compared to the total amount present before the project.

IV Outreach

Because Trinity County owns the project areas and has a right-of-way on road shoulders, etc, extensive outreach was not necessary. However, for work on Roundy Road, which supports a small yet dense cluster of homes, outreach to local landowners was done in advance of the project. Adjacent landowners were generally supportive of the project.

Techniques used in this project were incorporated into training for county road crews both locally and as part of the 5C Program's multi-county roads and water quality trainings. Photographs from the project have been and will continue to be used in powerpoints, posters, and other educational outreach.

V Project Funding

Project costs totaled $650,426 from all sources including ~35% match:

Table 6: Match Sources		**Total**
Trinity River Basin Fish & Wildlife Restoration Grant Program (Bureau of Reclamation/TRRP)		$167,744
Trinity County		$15,124
CA Adaptive Watershed Improvement (Pacific States Marine Fisheries Commission & CDFG)		$25,000
CA Dept Fish & Game Fisheries Restoration Grant Program, 5C Program 10327		$183
Partners for Fish & Wildlife Program (USFWS)		$19,955
	TOTAL	$228,006

As discussed in Section III.B, Project Tasks, the project was completed to 100% implementation. However, only 83.6% of the total grant contract funds were expended for the following reasons:

- The actual grant contract expenditures are consistent with the level of expected match contribution outlined in the agreement. Spending more grant contract funds would have compromised the grantee's ability to meet the in-kind commitment;
- $32,455 of funds were for contingency needs, which did not arise in the course of the project. Factoring out this contingency amount would result in 89.3% of contract funds having been spent;
- The grant's suspension of 2008-09 limited the grantees ability to perform additional work.

Funding for the project was provided by the State Water Resources Control Board and came from Proposition 40, the California Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act of 2002.

VI Conclusions

A. Lessons Learned

One of the biggest learning lessons in the overall project was the selection of pre-project monitoring sites. Because of the nature of some of the treatments, such as rolling dips whose shape is subtle, selecting ideal photo point locations that will result in good pre- and post- project monitoring comparisons is difficult. Ideally, even more pre-project photopoints could improve results. However, the detailed process and protocols that were used/required limit the amount of resources that could be devoted to this activity. In subsequent contracts, the grantee is likely to select sites that are a bit further removed from the expected treatment location to ensure that before and after photos will easily capture the differences in site conditions.

Unfortunately, due to multiple factors – primarily a lack of wet winters following the majority of construction – thorough observations of the response of implemented treatments to significant storm activity was not possible during the contract period. However, as part of the County's ongoing maintenance review of roads and the 5C Program's commitment to track restoration projects in the long term, these sites will continue to be evaluated over time. On the other hand, despite the lack of major storms, project managers were better able to evaluate some treatments for projects that began early in the contract period. They could observe the driveability of some of the road surface drainage modifications, their response to wear and tear, and performance in smaller storm events. In some cases, such as Browns Mountain Road, additional work was prescribed to further improve drainage and enhance the overall condition of treated road segments. Project manager found this type of adaptive management helpful in improving the overall project.

B. Next Steps

As described above, these sites will be observed regularly by the TCDoT and the 5C Program for several years. Generally, sites will be observed for their long term performance in annual storm events. Current forecasts for this winter indicate that it may produce considerable storm activity. If this proves to be the case, project managers will more closely observe treated road segments this winter. In particular, Lewiston Turnpike Road will be observed for any effects to treatments that may result from current and ongoing logging operations in the area. Future treatments and timing are highly dependent on what is observed in upcoming wet seasons and available resources. Fortunately, there remains a strong interest in restoration within the Trinity River watershed, which should prove helpful in securing funds for additional work should it be needed.

Trinity County Planning Department would like to thank:

- 5 Counties Salmonid Conservation Program (5C);
- Trinity Management Council;
- North Coast Integrated Regional Water Management Group; and
- The Northwest CA Resource Conservation & Development Council.

VII Attachments

A. Project photo logs (pre- and post project pictures)