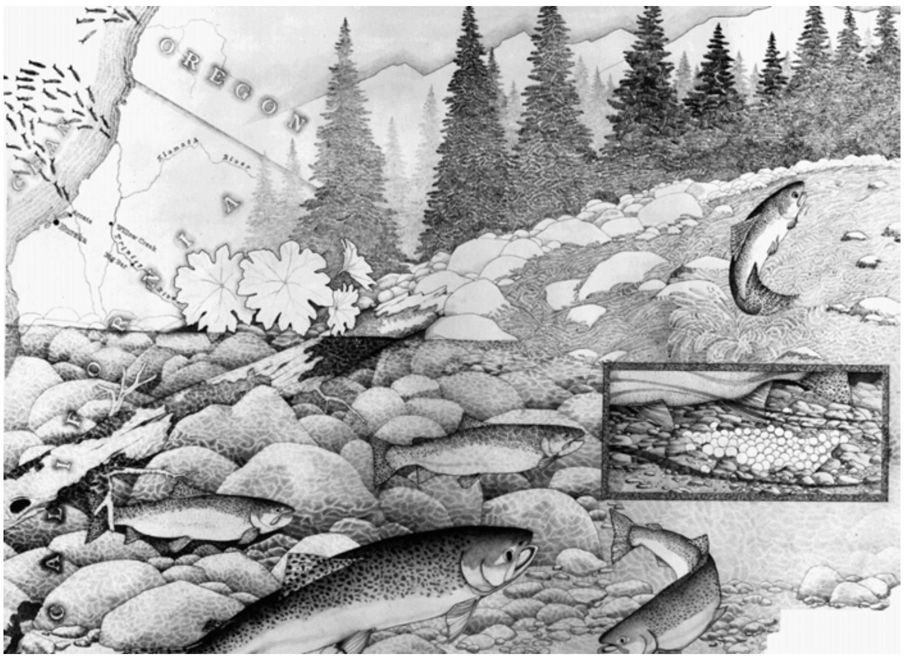
TRINITY RIVER WATERSHED
Five Counties Road Erosion Inventory

Final Report

For State Water Resources Control Board
Proposition 204 Program



Contract #9-164-250-0

Prepared By
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Summary

In 2000, the State Water Resources Control Board awarded Trinity County a Proposition 204 contract to conduct a road sediment source and migration barrier inventory of and implement several restoration projects on County Roads within the Trinity River watershed.

The county road sites inventoried have the potential to deliver sediment to streams, resulting in damage to fisheries resources and/or water quality. The inventory is one part of a comprehensive effort towards the restoration of anadromous fisheries and water quality by the Five Counties Salmonid Conservation Program. Additional inventories were completed in Del Norte, Humboldt, and Mendocino Counties under separate California Department of Fish and Game (CDFG) SB 271 grants Copies of all Final Reports are available upon request. All GIS data for those contracts has been submitted to CDF&G for incorporation into a state-wide GIS database. All GIS data from this contract will also be submitted to CDF&G for database incorporation.

The inventory method used in all three contracts was based on the protocols for forest and ranch road inventories set forth by Pacific Watershed Associates (PWA) and then modified to reflect the differences between private and public roads. The final county roads inventory protocol, known as the Direct Inventory of Roads and Treatments (DIRT), was then converted to a Microsoft Access database that was used in the field to directly input site data. During the early development stages of DIRT, three "beta" versions were tested and the results included in a file set referred to as Version 1.3. The sites in this version do not contain all of the chronic erosion sources of the later data sets and underestimate sediment yield from cutbank, road surface and other minor sediment input sources. For this reason, the results for this data set are shown as a separate summary report. All inventory sites were also located using map coordinates and GPS points to allow them to be loaded into an ArcView GIS platform (that requires Spatial Analyst to operate). For this project, the collection of data at the watershed (Trinity River) level provides responsible agencies, the public, and funding managers with a valuable mechanism with which to quantify and reconcile multiple physical-factors.

Under this Prop 204 grant, 2,653 sites were inventoried on approximately 539 miles of county roads for potential sediment delivery to streams, spoil disposal areas, and possible salmonid migration barriers. 2,089 of these sites were identified as treatable potential erosion sites, and 201 potential spoils disposal sites were located. A number of potential disposal sites could be either modified or eliminated based on subsequent environmental review. During this review process, additional sites could be identified. The remaining DIRT sites were classified as non-treatment sites. The sites inventoried in DIRT could theoretically yield over 1.04 million cubic yards of sediment to streams over the next ten years and/or in a large storm event (greater than a 10 year storm). The following tables summarize the treatment sites and their potential sediment yield:

Within decomposed granite soils, road drainage related potential sediment delivery is greater than in any other soil type within the inventory areas. Two County roads, Trinity Dam Boulevard and East Side Road, account for __% of the stream crossing related amount of potential sediment delivery. This potential volume is the result of these roads being built in highly erodible decomposed granitic soils and constructed to federal highway standards for design speeds, curve radii, width, and grade.

As a result, the roads contain throughcuts of 50-100' vertical height and fill slopes 100-200' deep that are necessary to meet acceptable highway road gradient standards. Many of the large fill slopes on these roads cross small drainages where undersized pipes were installed during the 1950's construction. The highly erodible soils have helped bury many watercourse crossing inlets and stand pipes. In these instances, the runoff typically either saturates the decomposed granitic soils and permeates across the road fills or is diverted at the toe of the fill to an alternate culvert crossing. In heavy flows, water can pond or pool on the upslope side of the roads without risk of overtopping the roads.

Under the DIRT inventory, any stream crossing without a culvert or an undersized culvert is calculated to fail at some point. Along these two roads, single crossings can have fill volumes of 20,000 yd^3 or more (refer to Table 8 for a list of the ten highest crossing volumesWhile it is possible that these fills could catastrophically fail (Refer to Photos 1 and 2).

For many of these crossings the installation of an overflow culvert placed high in the fill and the placement of a downspout down the length of the fill slope, or the placement of culverts to prevent ponding of water should prevent the potential for catastrophic failure of the fill crossings.

Significant amounts of sediment from cutslope erosion and unpaved surfaces are transported to road ditches where ditch downcutting contributes to additional sediment. These areas have a high potential for sediment delivery to a stream (photos 3 and 4). Where the fill slope leads straight to a stream crossing, sediment delivery potential is relatively high.

Potential Sediment Yield (yd^3)

	Stream Crossing	Landslide[1]	Chronic Surface[2]	Total
Trinity	708,583	15,234	290,576	1,014,393
Trinity v1.3	22,326	241	369	22,936
Total	**730,909**	**15,475**	**290,945**	**1,037,329**

1-Does not include complex landslides requiring engineer review. Including these sites would result in higher sediment volumes.

2- Decadal chronic road surface erosion.

 

Photos 1 and 2. Trinity Alps Road fill failure in May 2003. The combination of decomposed granitic soils, improper road drainange and saturated fill resulted in the fill failure at this Class III stream crossing.

Total Number of Sites by Treatment Immediacy

	High	High/Moderate	Moderate	Moderate/Low	Low	Total
Trinity	198	438	656	361	391	2,044
Trinity v1.3	3	7	10	20	5	45
Total	201	445	666	381	396	2,089

Potential sediment yield estimates do not take into account the effects of individual county road maintenance practices that help to prevent sediment delivery to a stream. Routine maintenance activities, including the cleaning of culverts and ditches, can help prevent many potential problems documented in this report from occurring.

The treatment cost of sites is estimated at approximately $9,839,379 million with an average cost of $12.37*1/yd^3. It is not economically feasible to treat all sites, and therefore, the cost-benefit ratio for all sites must be considered in implementing this program. A ranking model was developed to prioritize the data generated from these inventories, so that the most urgent sites with the best overall cost-benefit ratio are targeted for treatment.

Based on the inventory and cost analysis presented in this report, it is reasonable to predict that all County roads in the five northwestern California counties could have more than $150 million of

1 *Cost estimates do not include Trinity v1.3 data, sites that yield less than 5 yd^3 erosion, or sites for which cost cannot be estimated. Please refer to Appendix D.

restoration funding needs for water quality and associated salmonid habitat concerns. Although the total costs and value of restoration treatments may not be realized for decades, declining salmonid populations in some of the river systems create an immediate need to improve habitat and water quality at critical problem sites. Inventories on both a large and a small scale improve the public's confidence that proposed projects are resulting in the greatest cost-benefit ratio for the resources at risk.

Two sediment reduction road projects, Dutch Creek and China Gulch Roads, were completed in 2001-03. The projects will prevent __ yd3 of sediment from delivering to a stream (refer to Photos 2-5). Four additional projects are planned for construction in the summer of 2003.

Preface

All work completed under the Prop 204 grant was done as part of a larger conservation strategy developed in response to the 1997 listing of the coho salmon as a federal Threatened species by the Boards of Supervisors of Del Norte, Humboldt, Mendocino, Siskiyou and Trinity Counties. These Counties formed a salmonid conservation program based on the boundaries of the coho evolutionarily significant units (ESU) that encompass them. This effort, known as the Five Counties Salmonid Conservation Program, includes multiple program elements for the restoration of salmonid habitat (refer to Appendix A of this report). This effort represents the first time that multiple County governments have formed a watershed-based conservation strategy to address the biological, watershed, political, social and economic effects of declining salmonid populations.

12% of all county roads in the Five Counties and 99% of all County Roads in the Trinity River Watershed were inventoried under the Prop 204 contracts. An additional 26% of the Five Counties road systems were inventoried under a simultaneous CDFG SB 271 grant. The same survey designs, quality control, data management, and prioritization standards were utilized for the work done under both contracts.

The products of work completed under this contract and summarized in this report will be combined with the results of the SB 271 inventories to assist in data integration and consistency with all other work done as part of the overall Five Counties Conservation strategy.

Acknowledgements: The field work for this grant was accomplished by dedicated field staff including Polly Chapman, Carolyn Rourke, Dawn Petersen, Gary Friedrickson, Tom Leroy, Danny Hagans, and others.

The inventory work summary and data analysis presented in this report was made possible by the dedicated efforts of the following people: Carolyn Rourke, Sandra Pérez, and Janet Clements, Trinity County Planning Department Natural Resources Division; Dennis Slota, Mendocino County Water Agency; Sef Murguia, Humboldt County Public Works; and Eileen Weppner, Tom Leroy and others at Pacific Watershed Associates. In all cases, this group of people worked above and beyond the call of duty, and their dedication to finding workable solutions for restoring salmonid populations is to be commended.

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Contract Manager

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I. INTRODUCTION

In 2000, the State Water Resources Control Board awarded Trinity County a Prop 204 contract to conduct a Roads Erosion Inventory of 600 miles of County roads. This inventory is one part of a larger effort towards the restoration of salmonid fisheries and water quality known as the Five Counties Salmonid Conservation Program (refer to Appendix A for a summary of the Five Counties work plan). In addition to the 539 miles of roads actually inventoried under this grant, 1,027 miles of County roads were concurrently inventoried in Del Norte, Humboldt, and Mendocino Counties under CDFG SB 271 grants and in-kind matches from the counties.

The Five Counties area encompasses 11.6 million acres, 16 percent of which is the Trinity River watershed. This area contains some of the most significant anadromous salmonid habitat in California and is integral to southern Oregon fish stocks. The North Coast region is one of the last areas in the state with large amounts of salmonid refugia. Its watersheds hold the greatest potential for the restoration of salmonid populations and stocks and for the re-establishment of a commercial fishery off the coast of California.

It is commonly recognized that erosion and migration barrier problems associated with road systems represent a threat to salmonid population recovery (TCPD, 2002; EPA 1998 and 2000; Man-Tech, 1996). The intricate network of County, state, federal and private road systems within the Five Counties contributes to water quality and habitat degradation. Roads modify natural hillslope drainage networks and accelerate erosion, altering physical processes and leading to changes in stream flow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition, and stability of slopes adjacent to streams. These changes can have biological consequences that affect virtually all components of stream ecosystems (Furniss et al. 1991)*. However, road systems are one of the most easily controlled sources of sediment production and delivery to stream channels.

Within the Five Counties, there are 4,790 miles of County roads and approximately 16,600 culverts (Tables 1 and 2). The Five Counties have committed to a long-term, systematic, prioritization-based, sediment reduction and migration barrier removal program on County roads to improve water quality and facilitate salmonid recovery. This Prop. 204 inventory is part of that systematic effort.

An inventory of county road migration barriers in the Trinity River was completed by consulting biologists Ross Taylor and Associates. There are 52 known complete, or partial, migration barrier stream crossings on Trinity County Roads and 207 identified barriers within the Five Counties. Thirty barriers on County roads within the Five Counties have been removed between 1998 and 2002(refer to attached photos) and five are under construction in 2003 The location of these county road migration barriers was provided to the following: Julie Brown of CDF&G Native Anadromous Fisheries Division for inclusion in CDF&G's GIS database; Chris Lee, DWR; and Matthew Goslin, NMFS Research Center.

2* i. Furniss et al. 1991. In Forest Ecosystem Management: An Ecological, Economic, and Social Assessment, Report of the Forest Ecosystem Management Assessment Team, 1993, p. V-16 - V-19.

County roads, cut banks and fill slopes comprise approximately 30,000 acres of the 11.6 million acres of watersheds within the Five Counties and approximately 4,300 acres in Trinity County. Many of Trinity County's roads were constructed starting in the 1850s and are located in the bottom of stream canyons. County roads located low in drainages contribute a greater percentage of road-related sediment to streams than do roads located higher in the watersheds, closer to ridges and away from drainages. In many cases, stream crossings on County roads low in watersheds cannot adequately handle ten-year or larger storm flow events without the ongoing storm maintenance and debris removal programs in each county. In addition, numerous County road culverts installed following the 1964 flood are nearing the end of their effective lives and will need to be replaced or fixed over the next 5-10 years.

Table 1: Estimated Miles of County Maintained Roads

County	Miles of Surfaced County Roads	Miles of Unsurfaced County Roads	Total County Road Miles
Del Norte	302	199	501
Humboldt	907	300	1,207
Mendocino	706	312	1,018
Siskiyou	808	556	1,364
Trinity	455	245	700
Total	**3,178 (66%)**	**1,612 (34%)**	**4,790**

Table 2: Estimated County Maintained Culverts & Stream Crossings

County	Culverts	Bridges	Low Water Crossings
Del Norte	~2000	32	0
Humboldt	~3000	162	3
Mendocino	~3500	157	19
Siskiyou	~4000	175	0
Trinity	~4100	93	9
Total	**16,600**	**619**	**31**

II. GOALS AND OBJECTIVES

A. Road Erosion Inventory Project Goals and Objectives

The goals of the Five Counties' road erosion inventory are to identify specific sites along county roads and facilities that are contributing sediment to waterways and to prioritize implementation treatments to assure economic, biological, management and physical effectiveness. The primary objectives of the program are to:

- Conserve and restore salmonid habitat by implementing cost-effective erosion control and prevention work on high priority sites.
- Maintain public safety and open roads at all times.
- Prevent or minimize delivery of sediment to streams.
- Minimize the diversion of water from one watershed to another via road ditches where practical and feasible.
- Protect aquatic and riparian habitat.
- Restore access for fish passage at stream crossings.

B. Five Counties Salmonid Conservation Program Goals and Objectives

In 1997, the Board of Supervisors adopted Resolutions establishing an overall goal and program of objectives for the Five Counties Salmonid Conservation Program. The overall goal is:

> ***To strive to protect the economic and social resources of Northwestern California by providing for the conservation and restoration of salmonid populations to healthy and sustainable levels and to base decisions on watershed rather than County boundaries.***

The overall objectives to meet this goal are as follow:

> "*Include sediment inventory and reduction planning requirements of the Clean Water Act Section 303d as part of the "Five County Salmon Conservation Plan."*
>
> *Implement cost-effective conservation and habitat restoration activities based on:*
> - *Watershed Based Planning and Actions*
> - *Biological Prioritization*
> - *Immediate Results and Long-Term Solutions*
> - *Targeting Significant Sites & Immediate Habitat Restoration*
> - *Utilizing Available Grant Funding Whenever Possible*
> - *Focusing on Politically Achievable Programs and Projects*
> - *Private Land Programs based on Incentive and Education, while using New Regulation as a last resort*

Figure 1: ***[LOCATION MAP see file]***

III. PROJECT DESCRIPTION

The watersheds inventoried under the Five Counties effort were based on a 1998 collaborative prioritization effort for all migration barriers completed through a series of meetings of federal, state, university, private industry and consultant fisheries biologists who work in Northwestern California. That effort had two objectives: to guide the counties in developing migration barrier inventory grants and to delineate watershed assessment priorities based on the overall value of salmon refugia. The migration barrier grants were based on the biologists' empirical knowledge of northwestern California fish populations and habitat utilization. The watershed delineations were used to focus the 2000 road erosion inventory grants on watersheds with the greatest need and potential for restoration. Once the watersheds were chosen, the inventory design was established to include the following elements:

- Inventory and assessment of road related erosion sources using the Pacific Watershed Associates (PWA) protocol modified for use on county roads.
- Identification of county road stream crossings that are physical barriers for salmonid migration. This work was coordinated with the culvert assessment work conducted by Ross Taylor and Associates.* Refer to Appendix B for a prioritized barrier list.
- Location of suitable spoil disposal areas to store material generated from county road maintenance activities.
- Utilization of GPS location and GIS data management of all identified erosion, spoil disposal, and migration barrier sites.
- Prioritization of inventoried sites by treatment immediacy and other criteria (refer to Section VIII: Treatment Prioritization).

The PWA protocols for forest and ranch road inventories were used to develop the base model for inventorying County roads. The model was then modified to reflect the differences between private forest and ranch roads and public roads. The differences between the two road system types include:

County Roads	Private Forest and Ranch Roads
Public safety and access are the highest priority. *Work is based on the greatest population/safety needs.*	**Resource access is often the priority.** *Road closure typically does not impact public access or safety.*
Provide primary access to nearly all other roads *(i.e. driveways/private roads timber roads, highways, etc.). This means constant maintenance costs for all roads.*	**Roads primarily have limited uses.** *Maintenance can be done 'as needed' and grading, patching, etc. may not be needed as often.*
Must meet minimum design speed and *provide safe travel for the 'average' skilled motorist based on that design speed.*	**Speed & Skill not a mandatory design** *criteria and treatments do not have to meet specific design speed for the 'average' skilled motorists.*
Must be open in all weather.	**Often closed to winter or wet weather.**

* Ross Taylor and Associates, SB 271 Final Grant Reports on County Road Migration Barriers in Humboldt, Del Norte and Mendocino Counties. Prepared for CA Dept. of Fish and Game. (1999, 2000 and 2001)

Counties have full time staff and *equipment to treat problems during a storm event.*	**Often do not monitor winter storm** *effects but assess road conditions in the spring or under favorable circumstances.*
Financial accountability to the public: *Requires Gas Tax funds be used for safety, CIP and maintenance. Maintenance costs are based on use (not on a cost/benefit ratio).*	**Financial accountability to resource** *costs and benefits only: Can remove or not repair a road if costs exceed benefits.*
Inventory tens of thousands of sites: *This effort encompasses hundreds of watersheds and multiple counties.*	**Inventory hundreds of sites:** *Typical inventory may reach 200-300 sites in a single watershed for a single ownership.*
Treatment designs must be done *or approved by a Registered Engineer.*	**Implementation work can often be done** *by landowner without formal engineer review.*

Based on these factors the PWA protocol was modified as follows:

<u>Inventory Methods:</u>

- Stream crossing surveys were modified to use a single profile of the crossing and road cross section measurements. Based on the type of crossing, appropriate trigonometric and volumetric calculations were done in the inventory software. Site data using this method was compared to similar crossing types and volume measured using original, unmodified PWA protocols. The results were significantly similar (±95%). At all county sites with significant fill depth or complexity, a detailed survey with elevation controls will be completed by engineering staff as part of the treatment implementation project design.
- The 100 year flood flow calculation was done automatically in the Access field data sheet for watersheds of less than 100 acres. This allowed for immediate estimation of flow capacity at the culvert and the volume of water that would be displaced (diverted) if the crossing were undersized.

<u>Treatment Options:</u>

- Inventory crews were instructed to use treatment protocols such as outsloping roads and installing rolling and critical dips where they could be safely applied under the worst weather conditions (typically snow or ice) and based on the posted speed limit for the road. Where there are no posted speed limits on native or rock surfaced roads, the design speed was 25 miles per hour. These safety considerations limited the use of certain treatments that would be appropriate for private ranch and forest roads.
- Inventory crews were instructed to consider use of treatment protocols such as cross drains, ditch relief culverts and other drainage treatments (which return water to Class III drainages of origin) only where downslope landowner permission was anticipated. In many areas the original watercourses have been eliminated with urban development where reintroduction of water would cause flood damage. For most forest and ranch road inventories the primary landowner owns the downslope drainages, which can often accommodate the natural storm flows.

Treatment Costs:

- Standard costs were applied to each treatment based on county costs and mandatory wage requirements for contract labor. Counties maintain equipment yards and storage facilities and can purchase materials in bulk. This results in a standardization of costs to some degree.

PWA, in cooperation with county representatives, developed the Microsoft Access field software, DIRT, based on the modified protocols discussed above.

Two crews, consisting of two members each, completed all field inventory work under this grant. In Trinity County, the work was completed by a crew employed by Trinity County Department of Transportation. Inventory work in the Trinity River watershed in Humboldt County was done by the Humboldt County Public Works Department. All work was coordinated with Sef Murguia of the Humboldt County Public Works Department and Mark Lancaster of the Trinity County Planning Department, Natural Resources Division.

For each identified existing or potential erosion source with potential delivery to a stream, a database form was filled out. The database contained questions regarding the site location, the nature and magnitude of existing and potential erosion problems, the likelihood of erosion or slope failure and recommended treatments to eliminate the site as a significant future source of sediment delivery (refer to Appendix C for a copy of the database form). Sites, as defined in this assessment, include locations where there is direct evidence that future erosion or mass wasting would likely deliver sediment to a stream channel in amounts greater than 20 yd^3. Past erosion sites and sites that were not expected to deliver sediment to a stream channel were not included in the inventory. All culvert crossings were inventoried regardless of the 20 yd^3 inventory standard. Inventoried sites generally consist of stream crossings, potential and existing road related landslides, ditch relief culverts and long sections of uncontrolled road and ditch surface runoff which discharge to the stream system.

Major factors considered in the field based prioritization process include treatment immediacy, erosion activity, total potential sediment yield, complexity, and controllability. All sites were assigned a treatment priority, based on their potential to deliver deleterious quantities of sediment to stream channels in the watershed. The erosion activity was estimated for each major existing or potential problem site. Estimates of future expected volume of sediment delivered to streams were calculated for each site. The data provides quantitative estimates of how much material could be eroded and delivered if no erosion control or prevention work is performed. Potential sediment yield estimates are a function of both episodic and chronic decadal sediment delivery. Episodic estimates apply where a landslide or stream crossing has been identified as a potential problem site. Chronic decadal erosion is the amount of sediment otherwise regularly produced over a ten-year period. In a number of locations, especially at stream diversion sites, actual sediment loss could easily exceed field predictions.

On virtually all stream crossings, tape and/or electronic distance measuring devices and clinometer longitudinal profile surveys were completed. The surveyors generated the fill volume of crossings in the field for immediate review. This survey allows for an accurate and repeatable quantification of future erosion volumes (assuming the stream crossing was to washout during a future storm) and of excavation volumes that would be required to complete a variety of road upgrading and erosion prevention treatments (culvert installation or replacement, complete excavation, etc.).

The 100-year storm flow was calculated in the Access data sheet for crossings where the upstream watershed area was less than 100 acres in size. The Rational Method formula, Q=CIA, was used in these small watersheds. Once the flow was known, culvert diameter capable of passing the 100-year flow through the crossing was included in the treatment recommendation portion of the data sheet. For larger watersheds, the surveyor recommended that the replacement culvert size be calculated by a Registered Engineer.

All inventory sites were located using map coordinates and GPS points to allow them to be loaded into an ArcView GIS platform. All field data was directly entered into the DIRT database and regularly down loaded into Trinity County's GIS program. PWA completed an intensive field-training program for all crew members and was responsible for quality assurance and control (QA/QC) of inventory crews, assessments, and data collection.

IV. TRINITY RIVER WATERSHED AND REGULATORY FACTORS RELATED TO EROSION INVENTORY

A. Background

The 1.9 million acre Trinity River watershed is the largest tributary to the Klamath River. The Trinity is composed of two major sub-watersheds: the Main Stem (68% of watershed area) and the South Fork (32%). Elevations range from 9,000+ feet above sea level in the Trinity Alps and Mount Eddy headwater areas to less than 300 feet at the confluence with the Klamath River.

Precipitation is highly seasonal with 90% falling between October and April. A portion of the annual precipitation falls as snow at the higher elevations (generally higher than about 2,000 ft). Annual precipitation ranges from about 35 inches to over 80 inches (west of South Fork Mountain).

Approximately 95% of the watershed area is forested (Shih, 2002). Predominant conifer habitat types are Douglas-fir, Klamath Mixed Conifer, and Ponderosa Pine 3. Other wildlife habitat types include White Fir, Red Fir, Subalpine Conifer, Jeffery Pine, Montane Hardwood-Conifer, Montane Hardwood, Montane Riparian, Montane Chaparral, Wet Meadow, and minor components of other types.

B. Fisheries

The Trinity River and its tributaries have historically been recognized as a major contributer to anadromous fisheries including chinook and coho salmon and steelhead trout throughout the river system as well as green sturgeon below the Burnt Ranch Gorge. The warm surface water temperatures of Trinity Lake provide habitat for sport fishery species entirely different then those found in the cold waters draining off the Trinity Alps snow pack. Rainbow trout, kokanee salmon, large and small mouth bass and other sport fish species are found upstream of Lewiston Dam. Planted trout species such as German brown and rainbow are common in many streams throughout the river system. The upper 20% of the Main Stem Trinity River has been impounded behind Lewiston and Trinity Dams, cutting off anadromous fish rearing and spawning habitat in the upper 109 miles of the river and in many more miles of tributary.

C. General Ownership and Land Use Patterns

Approximately 1.58 million acres of the watershed (83% of area) is under Tribal, local, state or federal ownership/management. The Six Rivers, Shasta-Trinity and Mendocino National Forests, and the Bureau of Land Management account for the vast majority of public land management. Almost half of the public lands, ±700,000 acres (37% of the watershed area), is within Federally designated Wilderness areas or inventoried roadless areas. Additional public lands are within the Wild and Scenic River corridor and/or designated Late Seral Reserves with limited road management or development activities. A National Recreation Area managed by the Shasta-Trinity National Forests was established around Lewiston and Trinity Lakes.

The remaining ±320,000 acres in the watershed is privately owned and generally managed for timber and other forest products, ranching, limited farming, mining, and residential/urban

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3 Kenneth E. Mayer and William F. Laudenslayer. A Guide to Wildlife Habitats of California. (1988)

development. Sierra Pacific Industries owns approximately ±180,000 acres (60% of the private lands) in the watershed. Other industrial owners (Simpson Natural Resources Company, Timber Products, Roseburg Resources, Michigan-California Lumber) manage another ±70,000 acres.

D. Geology[4]

The Trinity River watershed consists of complex geology and is underlain by two major geologic provinces: the Coastal and Klamath Mountain Ranges. (Refer to Appendix M for a more detailed description of the geologic units and roads within these units.) These ranges differ significantly not only in age but in lithology (layering), structure, and metamorphism. The South Fork basin straddles the boundary between the Coast Ranges and the Klamath Mountains geologic provinces. The Klamath Mountain Range, which makes up ±98% of the Main Stem Trinity River and ±80% of the South Fork watershed, is underlain by metamorphic rock units that dip to the east with the older (eastern) rock units overlying the younger (western) units (refer to map in Appendix M). Plutonic rock units, such as granite peaks and ridges, are intruded throughout the Klamath range. The Coast Ranges are underlain by the Franciscan Assemblage, a highly deformed, faulted, and sheared complex of partly metamorphosed marine sedimentary and volcanic rocks.

The South Fork Trinity River drains an area containing steep, unstable slopes adjacent to some of the most rapidly eroding terrain in the United States. Rivers to the south and west, such as the Eel, have some of the highest recorded suspended sediment loads in the world (Judson and Ritter, 1964).

E. North Coast Regional Water Quality Control Board's Basin Plan - Trinity River Designated Beneficial Uses of Water

The Trinity River's mix of high elevation snow-fed streams, lakes, and reservoirs combined with the complex geology create numerous beneficial uses of its waters. The diversion of much of the Main Stems' flow from the upper basin into the Sacramento River extends the beneficial uses well beyond the watershed itself. The water diversion to the Sacramento River allows hydroelectric power generation at Trinity, Whiskeytown, and Keswick power plants. Trinity River water also contributes to meeting water quality objectives for the endangered Sacramento River chinook salmon and the San Francisco Bay-Delta temperature and salinity objectives. It also helps to facilitate federal water delivery contracts from the Sacramento River to agricultural water districts in the Sacramento-San Joaquin Valleys.

In some instances, beneficial uses of Trinity River water can conflict or impact each other. For example, diverting flows for hydroelectric power generation, water delivery contracts, and water quality objectives of the Bay-Delta is to the detriment of downstream migration, spawning, reproduction and/or early development of anadromous fisheries in the Trinity River watershed.

The beneficial uses for the Trinity River, contained in the *Water Quality Control Plan for the North Coast Region* (Basin Plan) as amended in 1996 (Regional Water Board 1996) are:

- Municipal and Domestic Supply
- Agricultural Supply

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4 Geology summarized from CA Department of Water Resources - Main Stem Trinity River and South Fork Watershed Erosion Investigation (1980 and 1997 respectively).

- Industrial Service Supply
- Industrial Process Supply
- Groundwater Recharge
- Freshwater Replenishment
- Hydropower Generation
- Water Contact Recreation
- Non-contact Water Recreation
- Commercial and Sport Fishing
- Warm Freshwater Habitat
- Cold Freshwater Habitat
- Wildlife Habitat
- Migration of Aquatic Organisms
- Spawning, Reproduction and/or Early Development of fish
- Aquaculture

F. North Coast Basin Plan Water Quality Objectives

The Regional Water Board's North Coast Basin Plan (1996) contains narrative water quality objectives with some numeric targets for the Trinity River as follows:

1) Suspended Material: Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
2) Settleable Material: Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affects beneficial uses.
3) Sediment: The suspended sediment load and discharge rate of surface water shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
4) Turbidity: Turbidity shall not be increased more than 20% above naturally occurring background levels. Allowable zones of dilution in which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.

Road construction, reconstruction, and maintenance have all been documented at one time or another as contributing factors when basin plan water quality objectives are not met (NCRWCB, 1998, EPA, 2000, Man-Tech, 1996, Furniss et al 1991).

G. Federal Endangered Species Act

The Trinity River is included within the federally designated Southern Oregon/Northern California Evolutionarily Significant Unit (ESU) for coho salmon, which was listed as Threatened under the federal Endangered Species Act (ESA) in 1997. This ESU extends from the Mattole River watershed in California north to the Elk and Rogue River watersheds in Oregon. (Refer to map in Appendix A.)

The federal listing prevents the direct take or incidental take of a listed species, except as permitted under Sections 4(d), 7, or 10 of the act. Accelerated erosion from land management, past mining, roads, and altered flows all affect migration, spawning, reproduction, and early development of cold water fish such as coho and chinook salmon and steelhead trout in the river.

Neither Trinity County Department of Transportation nor Humboldt County Public Works Department has a Section 10 Habitat Conservation Plan for management activities that could take, or indirectly take, coho salmon. There are no Section 4(d) take limits established for routine road maintenance activities or capital improvement projects within this ESU. Most road projects and management activities that may affect coho salmon are currently addressed under Section 7 of the ESA either through the Federal Highway Administration, Federal Aviation Administration, U.S. Forest Service, Bureau of Land Management, or the U.S. Army Corp of Engineers.

H. California Endangered Species Act

In August 2002 the California Fish and Game Commission indicated that it would designate the coho salmon north of Punta Gorda as a state Threatened species.

I. Section 303(d) of the Federal Clean Water Act[5]

In 1994, the Trinity River was listed under the Clean Water Act (CWA) Section 303(d) as water quality impaired due to sediment. Sediment levels were determined to be in excess of the Water Quality Standards (WQS) necessary to protect the beneficial uses of the basin – particularly cold water fishery.

Assessments of watershed conditions and sediment source inventories were completed for the South Fork Trinity River in 1998 and for the Main Stem in 2000. Completed TMDLs can be reviewed at http://www.epa.gov/region09/water/tmdl/final.html.

The Trinity TMDLs included analyses of the rivers by sub-watershed units, targeting sediment sources and effects to salmonids within each reach. Of particular concern for road managers are those portions of the TMDL where a reasonable link can be found between the identified sediment sources and county road management. Relevant portions of the TMDL assessments are summarized as follows:

1. **Upper Trinity Assessment Area (Upstream of Lewiston Dam):** Several tributaries to Trinity and Lewiston Reservoirs are currently exhibiting low watershed condition geomorphic and biotic integrity relative to their natural potential condition – specifically, portions of the upper Trinity River mainstem and East Fork and Eastside tributaries to the Trinity reservoir (De la Fuente et al. 2000). The upper Trinity mainstem and the East Fork each received values indicating an “at risk” condition.

   The DIRT inventory done under this grant confirmed that County roads in East Fork and Eastside tributaries are a major potential sediment source. Eastside Road and Trinity Dam Boulevard theoretically have a combined potential volume of 490,000 cubic yards or 46% of the total volume from all County roads. Actual potential delivery volume from these roads is estimated to be substantially less than the estimated volume in a 50 year + storm event.

2. **Upper Middle Reach (Lewiston Dam to North Fork Trinity River):** The condition of aquatic habitat in the Upper Middle Reach was identified as being of particular importance

5 From Trinity River and South Fork Trinity River TMDLs (EPA, 2001 and 1998)

in the mainstem TMDL for two reasons: (1) biologically, it is utilized more extensively for anadromous fish spawning and rearing than are other basins, and (2) the tributaries and mainstem of this basin have been subjected to a high level of habitat modification, due to the Central Valley Project (CVP) Trinity River Diversion, land management in the tributaries, and natural slope processes.

The TMDL identifies several flow and geomorphic effects that result in mainstem impairment. Each of these factors is associated with the operation of the CVP as well as with other upslope activities. Instream impairment factors within the upper half of the Middle Reach are:

A) **Reduced Coarse Sediment Supply From the Upper Basin:** Below the confluence with Rush Creek, the annual coarse sediment supply from tributaries has continued at rates equal to or slightly higher than before the CVP Trinity River Diversion, resulting in lower instream flows that reduce mainstem transport capacity (US FWS and HVT 1999). Inadequate bedload mobility results in a decrease in substrate complexity thereby reducing macroinvertebrate production and reducing the pool depths needed for adult fish cover and rest. GMA (2001b) identified a 12 foot increase in channel bed elevation at a cross-section just below the confluence of Indian Creek.

B) **Limited Sediment Mobilization Below Lewiston Dam:** The mainstem channel bed, since the completion of the CVP Trinity River Diversion, has not been adequately mobilized, increasing sediment accumulation at the deltas of tributaries and resulting in loss-of-habitat characteristics associated with alternate bar sequence. The gravels delivered by the mainstem tributaries below the dam have also not been effectively mobilized and dispersed due to inadequate flood flows.

C) **Reduced Main Stem Pool Depth:** After access to the upper basin was eliminated due to dam construction, spring chinook had to “summer-over” in any available deep pools below the dam until spawning began in Fall. Fine sediment has reduced the mainstem pool depths, affecting the amount of deep pool habitat important for adult salmonids holding over in the summer. Since many of these pools were historically occupied by summer-run steelhead, chinook were forced to compete for pool habitat below the dam.

D) **Excessive Levels of Fine Sediment:** The reduction of dam controlled scouring flows in the mainstem has contributed to fine sediment infiltration into spawning gravels. This impact is greatest just below the confluence of Grass Valley Creek. Deposition of sediment on exposed cobble bars and lack of flushing flows has created “fossilized” berms or sediment accumulation around riparian vegetation. This contributes to loss of open, shallow, low-velocity gravel bar habitats for rearing salmonid fry.

   Numerous studies have identified and evaluated decomposed granite sediment sources and delivery from Grass Valley Creek. This creek has been determined to be the largest source of decomposed granite sediment in the reach. However there are few County roads within this drainage. Portions of Trinity Dam Boulevard, Lewiston Turnpike, Old Lewiston and other roads in the Lewiston area cross through decomposed granite soils and represent both actual and potential sediment sources.

De la Fuente et al. (2000) determined that Weaver and Rush Creeks are impaired based on an analysis of the stream and watershed condition indicators. Because of their water quality and channel conditions, Weaver and Rush Creeks were rated as functioning at risk and as having a high watershed hazard condition. The same assessment determined that Brown's Creek was in a moderate condition. In other words, physical and biological conditions suggest that aquatic and riparian systems are at risk of being unable to support dependent species and retain beneficial uses of water.

3. **Lower Middle Reach Assessment Area:** The lower middle reach assessment area generally consists of relatively steep gradient (i.e., high sediment transport) stream reaches and rugged terrain, much of which lies within the Trinity Wilderness area. Land management disturbance is minimized in much of the area due to the Wilderness designation.

   Canyon Creek, according to De la Fuente et al. (2000), is at risk with regard to several aquatic habitat indicators including water quality, stream vegetation, channel stability, and aquatic integrity. The presently unstable channel conditions in Canyon Creek largely result from intensive historic mining activity and other land use activities for several miles along the lower mainstem that are easily accessible via a primary road (pers. comm. Loren Everest). Conversely, other tributaries in the lower-middle area are relatively difficult to access and have not experienced the same level of disturbance.

4. **Lower Trinity Assessment Area:** The Lower Assessment Area includes the portions of the Trinity River below the confluence of the South Fork, except for streams within the Hoopa Reservation. There are a limited number of county roads within the assessment area. No inventories were done within the Hoopa Reservation.

J. Trinity River TMDL Watershed Indicators Related to Road Management

The South Fork and Main Stem TMDLs included a series of watershed indicators that could be evaluated or measured to assess the progress of meeting the recovery goals established by each TMDL. Watershed indicators that directly relate to road management are:

1. **Stream Crossings with Diversion Potential or Significant Failure Potential:** One of the TMDLs' targets is to have less than one percent of all stream crossings divert or fail as a result of a 100-year or smaller flood. The TMDLs purported that potential to deliver sediment to streams can be eliminated from almost all stream crossings by eliminating inboard ditches, outsloping roads, or installing rolling dips (US EPA 1998).

   The TMDLs both reported that "less than 1% of stream crossings have conditions where modification is inappropriate because it would endanger travelers or where modification is impractical because of physical constraints." This conclusion does not appear to have considered County roads and state highways, and may have been based on private and resource management roads. (Refer to Section III for a discussion on the differences between public and private road design and management constraints.) Direct observations made as part of this contract and in consultation with Registered Engineers in the Trinity County Department of Transportation indicate that crossing designs are constrained by site or safety factors and can not be accurately estimated until design speed and site specific conditions are evaluated. While the overall percentage of crossings, where modification is impractical because of physical constraints, is not expected to be significant, even one percent may not be realistic.

The DIRT inventory did identify all crossings with diversion potential or significant failure potential and developed a ranking matrix that allows for targeting high priority sites (refer to Section VIII).

2. **Hydrologic Connectivity:** A TMDL target was established to decrease the amount of inboard ditch length. A road is hydrologically connected to a stream when the road drains water directly to the stream. A hydrologically connected road increases the intensity, frequency, and magnitude of flood flows and suspended sediment loads in the adjacent stream, which can result in destabilization of the stream channel.

   The DIRT inventory determined that there are 24 miles of inboard ditch in the inventory area with the potential to yield 35,700 cubic yards of sediment to streams. A few significant ditch sediment reduction projects have been funded and treated under this grant or as part of routine road maintenance projects. Refer to Section IX, Project Implementation and Tables 15-20 for additional information.

3. **Annual Road Inspection and Correction:** A qualitative target was developed to decrease the amount of road length next to streams, increasing the proportion of outsloped or hard surfaced roads. EPA's analysis indicates that in watersheds with road networks that have not experienced excessive road-related sedimentation, roads are either (1) regularly inspected and maintained; (2) hydrologically maintenance free (i.e., they do not alter the natural hydrology of the stream); or (3) decommissioned or hydrologically closed (i.e., fills and culverts have been removed and the natural hydrology of the hillslope has been largely restored).

4. **Road Location, Surfacing, Sidecast:** A qualitative target was established to address the highest risk sediment delivery from roads not covered in other indicators. This includes hardening road surfaces where there is potential for road surface pulverization, wear, and maintenance practices will result in sediment delivery to streams. Trinity County Department of Transportation has begun a program of surfacing native roads. It has also participated in the development of a maintenance manual for water quality objectives that specifies: practices to prevent side casting into streams; development of spoils disposal sites (refer to Section VI); and other practices that will contribute to maintaining or enhancing water quality.

Figure 2: Road Eros Inv area map

V. TRINITY RIVER WATERSHED ROAD INVENTORY RESULTS

Under this Prop 204 grant, 2,653 sites were inventoried on approximately 539 miles of county roads for potential sediment delivery to streams, spoil disposal areas, and possible salmonid migration barriers. 2,089 of these sites were identified as treatable potential erosion sites and 201 potential spoils disposal sites were located. The remaining sites were classified as non-treatment sites. The sites inventoried in DIRT could theoretically yield over 1.04 million cubic yards of sediment to streams over the next ten years and/or in a large storm event (greater than a 10 year storm).

The results of this inventory will be combined with previous inventories completed under the CDFG SB 271 program. Funding to complete the remaining portions of the Five Counties is currently being pursued.

A. Data Management

Significant data management lessons were learned as a result of the development and implementation of such a large and complex data set. The data set was periodically analyzed at a macroscopic level to check for data errors or field omissions but the analysis was not adequate to detect misspelled words and incomplete data entry in “non-calculated” fields. This resulted in somewhat extensive data checking and editing prior to final analysis. Future use of the software will require more and better filters be built into the data check routines to avoid extensive data clean-up.

In addition, a few data management problems were realized in the final analysis process. In the initial version of the DIRT database, version 1.3, used by the Humboldt County crew (49 sites, of which 45 were identified as treatment sites), some chronic surface erosion sources (cutbank and fillslope erosion, road surface lowering, and other minor sources) were not adequately accounted for in the database. This may have resulted in an under-estimation of total chronic sediment delivery from 45 sites in the portion of the Trinity River drainage that lies in Humboldt County. The next version of the DIRT database (v1.4) was refined to include all chronic sources. The data forms for the latest DIRT version, 1.5, are included in Appendix C.

The impacts on total sediment yield from the omission of portions of the chronic yield sources for these 45 sites is expected to be minor because the inventory included the major erosion sources at each site and the proposed treatments addressed these problems. While the effect is not considered to be significant, the summary of these sites is included in Appendix D rather than in the body of this report. The data gathered for spoils disposal sites surveyed using DIRT v1.3 were the same as those in current database. Only one spoil site was surveyed in v1.3. Therefore, the v1.3 spoil site has been combined with the remaining dataset in this report.

B. Overall Summary of Inventory Sites

Table 3: Potential Sediment Yield for all Treatment Sites

	Potential Sediment Yield (yd^3)			
	Stream Crossing	**Landslide[1]**	**Chronic Surface[2]**	**Total**
Trinity	708,583	15,234	290,576	1,014,393
Trinity v1.3	22,326	241	369	22,936
Total	**730,909**	**15,475**	**290,945**	**1,037,329**

1-Does not include complex landslides requiring engineer review
2-Decadal chronic road surface erosion
* Although for Trinity v1.3 sites chronic surface erosion was not specifically calculated, the total estimated chronic surface erosion was based on sites that were not landslides or stream crossings and tend to have chronic surface erosion as their major source of sediment production.

Table 4: Summary of Sites by Treatment Immediacy

	Total Number of Sites by Treatment Immediacy					
	High	**High/Mod**	**Mod**	**Mod/Low**	**Low**	**Total**
Trinity	198	438	656	361	391	2,044
Trinity v 1.3	3	7	10	20	5	45
Total	**201**	**445**	**666**	**381**	**396**	**2,089**

Based on the inventory results, virtually all future road-related erosion and sediment yield is expected to come from three sources: 1) the failure of road cuts and fills (landslides), 2) erosion at or associated with stream crossings (from several possible causes), and 3) road surface and ditch erosion. The greatest potential sediment sources identified include plugged culverts, washed out stream crossings, and stream crossing diversions. Approximately 30% of the stream crossings inventoried in the assessment area have a "high or high/moderate" plugging potential. The following tables summarize problem types and treatment recommendations. For a more complete breakdown of sites please refer to Appendix G.

Figure 3a: Summary of Sites by Treatment Immediacy

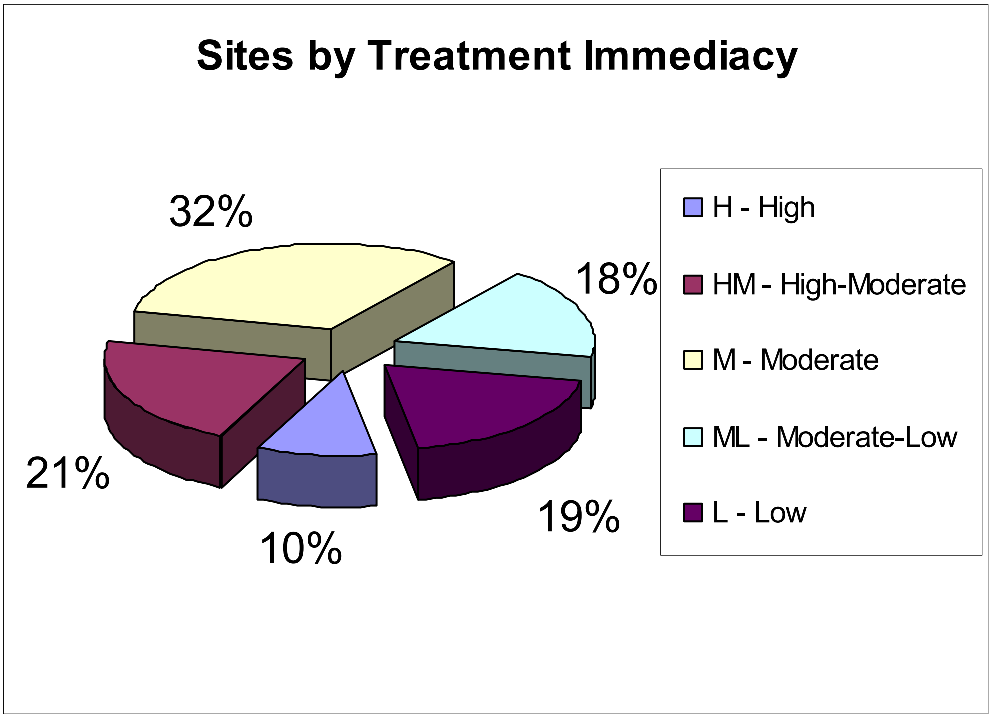


Figure 3b: Summary of Sites by Treatment Immediacy – v1.3

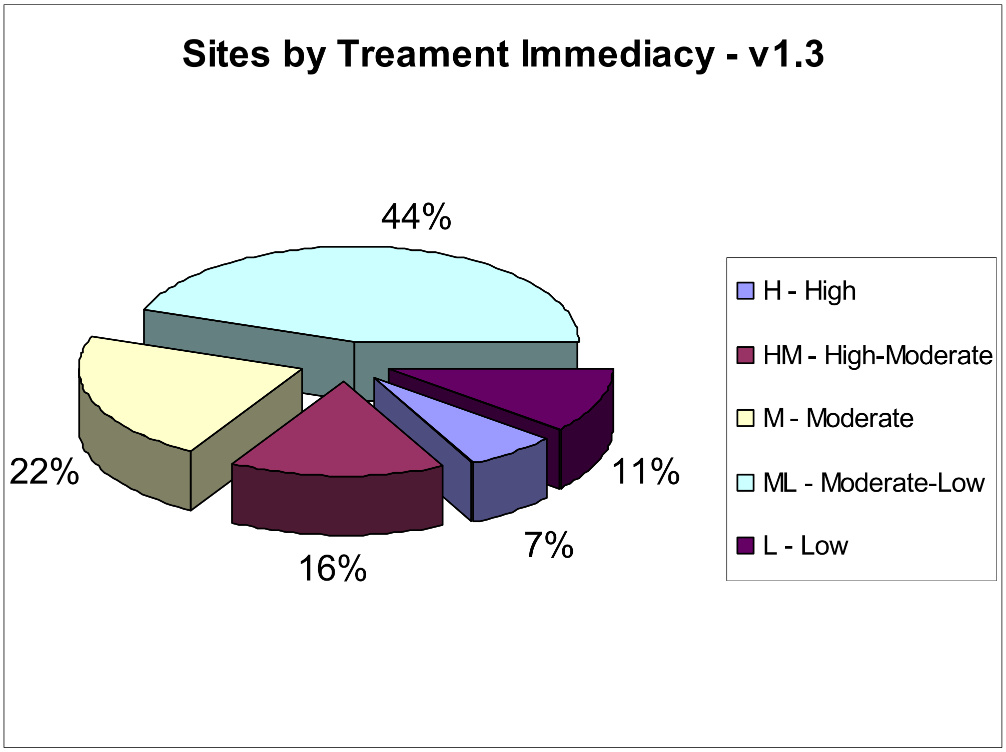


Table 5: Summary of Treatments by Immediacy*

Treatment	Units	%H	%HM	%M	%ML	%L	Total
Site #	#	9.69	21.43	32.09	17.66	19.13	2044
Possible fish barrier?	# sites	14.29	44.90	28.57	8.16	4.08	49
Immediacy Need		H	HM	M	ML	L	All
Engineer Check	# sites	21.57	29.02	28.63	13.33	7.45	255
Install Culvert	# sites	8.73	22.22	31.35	16.67	21.03	252
New Culvert Length	mi	10.45	25.33	31.99	15.92	16.31	9.53
Replace Culvert	# sites	8.50	23.64	32.54	17.40	17.93	753
Repair Culvert	# sites	8.96	20.90	35.82	16.42	17.91	67
Clean Culvert	# sites	8.80	16.20	36.11	20.37	18.52	216
Clean Ditch	mi	1.60	47.15	19.22	4.60	27.43	0.95
Outslope & Retain Ditch Length	mi	0	67.09	13.84	16.93	2.13	1.78
Outslope & Remove Ditch Length	mi	6.90	44.96	37.09	7.32	3.73	23.69
Inslope Road	mi	0	0	0	0	0	0
Remove Berm	mi	7.16	38.00	41.72	11.74	1.37	37.14
Remove Ditch	mi	27.92	35.76	36.33	0	0	2.82
Rock Road	mi	3.61	40.56	52.02	0.85	2.96	23.37
Pave Road	mi	0	8.19	88.92	0.16	2.73	0.69
Rock or Pave Road	mi^2	5.32	70.16	19.15	0.98	4.39	0.06
Install DRC	#	14.41	26.01	37.26	12.48	9.84	569
Install DRC	mi	16.59	27.04	35.22	11.17	9.97	4.91
Replace DRC	mi	13.59	22.67	24.25	18.17	21.32	2.52
Cross Road Drain	#	0	0	0	100	0	1
Install Downspout (DS)	#	15.98	24.74	41.24	11.34	6.70	194
DS Length	mi	22.55	27.91	37.65	7.65	4.23	1.86
Install Crossing DS	#	9.78	25.54	40.76	15.22	8.70	184
Crossing DS Length	mi	14.22	26.23	38.89	12.44	8.22	1.33
Install Wet Crossing	# sites	0	7.41	37.04	24.07	31.48	54
Install Ford	# sites	0	0	33.33	16.67	50.00	6
Armored Fill	# sites	0	0	20.00	20.00	60.00	5
Fill Height	mi	0	0	17.39	30.43	52.17	0.02
Fill Width	mi	0	0	25.00	75.00	0	0.02
Excavate Soil	# sites	10.64	30.85	31.91	19.15	7.45	94
Install Critical Dip	# sites	8.02	26.58	33.76	22.36	9.28	237
Install Rolling Dip	#	8.36	37.15	42.44	6.89	5.17	813
Install Emergency Overflow	mi	15.86	20.50	34.40	9.89	19.34	1.06
Install Natural Bottom	# sites	0	0	0	0	0	0
Armor Fill Face	mi^2	15.52	17.79	43.47	17.86	5.37	0
Reconstruct Fill	# sites	28.57	14.29	28.57	28.57	0	7
Other treatment	# sites	17.23	29.25	29.71	12.93	10.88	441
Episodic Erosion Volume	yd^3	25.13	22.24	29.01	11.72	11.90	723816.8
Decadal Erosion Volume	yd^3	18.75	38.25	29.23	4.10	9.67	290576.0
Total Erosion Volume	yd^3	23.31	26.82	29.07	9.54	11.26	1014392.8

*** Does not include v1.3 sites (shown in Table 6 below).**

Table 6: Summary of Treatments by Immediacy – v1.3

Treatment	units	%H	%HM	%M	%ML	%L	Total
Number of Sites	# sites	6.67	15.56	22.22	44.44	11.11	45
Possible fish barrier	# sites	0	0	0	0	0	0
Engineer Check	# sites	20.00	20.00	0	60.00	0	5
Install Culvert	# sites	0	13.64	27.27	45.45	13.64	22
New Culvert Length	ft	0	9.21	35.56	43.10	12.13	2390
Replace Culvert	# sites	0	0	42.86	42.86	14.29	7
Repair Culvert	# sites	100	0	0	0	0	1
Clean Culvert	# sites	100	0	0	0	0	1
Clean/Cut Ditch Length	ft	0	0	0	0	0	0
Outslope & Retain Ditch Length	ft	0	0	0	0	0	0
Outslope & Remove Ditch Length	ft	0	0	0	0	0	0
Inslope Road Length	ft	0	0	0	100	0	170
Remove Berm Length	ft	0	0	0	100	0	100
Remove Ditch Length	ft	0	0	0	0	0	0
Pave Road Length	ft	0	0	0	0	0	0
Rock Surface Area	ft^2	0	0	0	0	0	0
Install Ditch Relief Culvert (DRC)	# sites	9.30	23.26	30.23	32.56	4.65	43
DRC Length	ft	6.64	26.56	24.07	37.34	5.39	2410
Cross Road Drains	#	0	0	0	0	0	0
Install Downspout Length	ft	0	0	28.57	42.86	28.57	140
Install Flared Inlet	# sites	0	0	0	0	0	0
Install Wet Crossing	# sites	0	0	0	0	0	0
Fill Height	ft	0	0	0	0	0	0
Fill Width	ft	0	0	0	0	0	0
Excavate Soil	# sites	0	0	0	100	0	1
Install Critical Dip	# sites	50.00	0	0	50.00	0	2
Install Rolling Dip	#	0	0	100	0	0	1
Armor Fill Face (AFF)	# sites	0	0	0	0	0	0
AFF area	ft^2	0	0	0	0	0	0
Reconstruct Fill	# sites	0	0	0	0	0	0
Other Treatment	# sites	16.67	16.67	33.33	33.33	0	6
Future Yield	yd^3	26.57	11.90	33.63	23.60	4.31	22936

Table 7: Summary of total pipes that need to be replaced or installed*

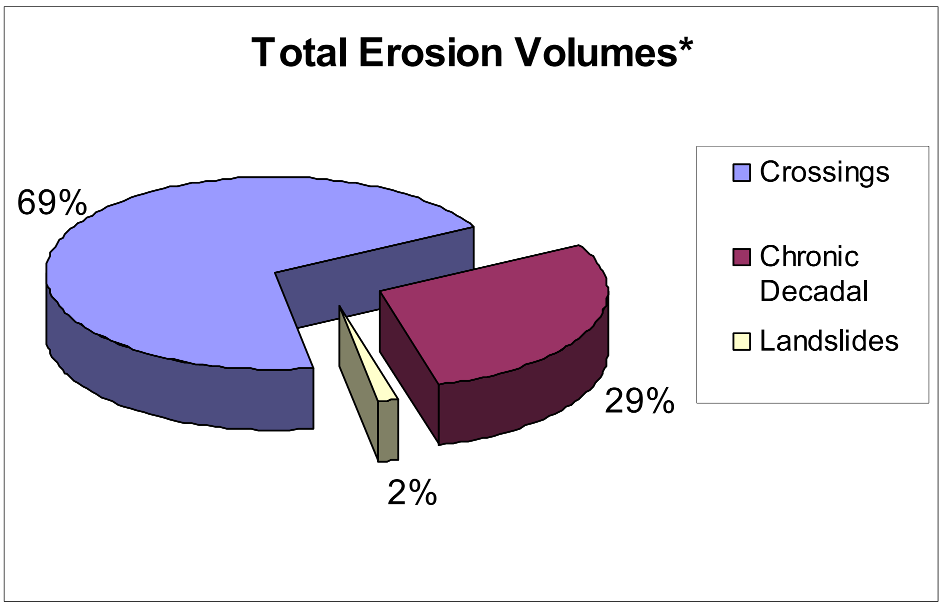
	Trinity	Trinity v1.3	Total
# of Sites requiring new pipe	1,503	42	1545
# of New Pipes	2,233	76	2,309
Total Pipe Length (mi)	21.22	0.94	22.16

*Includes the installation or replacement of culverts, downspouts, and emergency overflows.

C. Total Potential Erosion Volumes

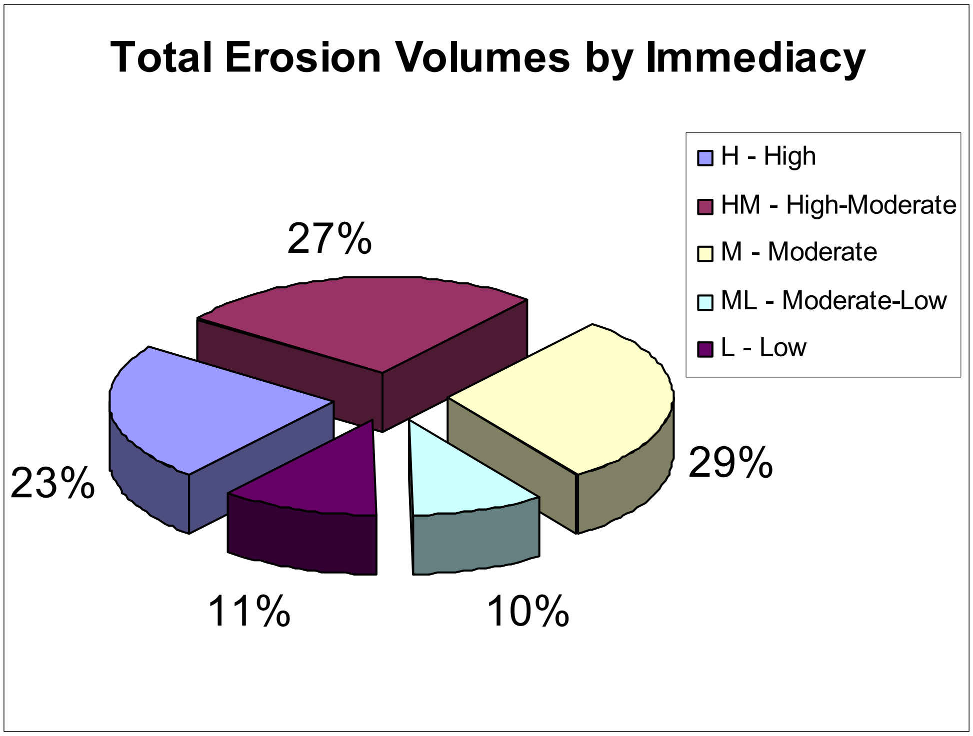
A general summary of sediment sources indicates that an average of 3.9 potential erosion sites occur per mile of County road with each site representing an average potential delivery of 497 yd^3 of sediment to a stream. In actuality, the potential volume and site locations are a factor of slope location, inherent geologic stability, soil erosion potential, the age of the road, road construction techniques, and numerous other factors.

Figure 4: Summary of Total Erosion Volumes



*** Does not include v1.3 sites**

Figure 5: Summary of Total Erosion Volumes by Immediacy*



*** Does not include v1.3 sites**

D. Chronic Surface Erosion

Chronic surface erosion is a result of a number of problem types producing an expected annual sediment yield to stream systems. The problem types within this category include ditch down-cutting/enlargement and associated cutbank landslides, diversion of ditches down roads or over hill slopes, road surface erosion (mechanical pulverizing and wearing down of the road surface), gully formation or enlargement at the outlets of ditch relief culverts, berms or other points of discharge, cutslope erosion (dry ravel, rainfall, freeze-thaw processes, brushing/grading practices, etc) and other minor sources of sediment. Chronic erosion occurs annually with the passing of even minor storms, while crossing and landslide volumes are typically episodic in nature (i.e. strongly associated with storm intensity). This inventory estimates that at least 290,945 yd^3 of sediment will be delivered to streams over a period of ten years from sources such as ditch widening, road surface lowering, cutbank erosion, etc. Please refer to Appendix F for location maps of problem sites.

E. Stream Crossings

Stream crossing failure represents the greatest potential source of sediment delivery in the watersheds inventoried. The most common causes for stream failures include undersized culverts, high plug potential, high diversion potential, and/or gully erosion at the outlet. The sediment delivery from stream crossings is always classified as 100% because sediment eroded at the site is delivered directly to the stream. Even sediment that is delivered to small ephemeral streams will eventually be delivered to downstream fish-bearing stream channels.

A total of 1,428 stream crossing sites were inventoried and recommended for treatment. They could potentially generate a total of approximately 925,764 yd^3 of future road related sediment. However, not all crossings are expected to wash out.

Two County roads, Trinity Dam Boulevard and East Side Road, account for 57.8% of the total (708,583 yd^3) stream crossing related amount of potential sediment delivery. This potential volume is the result of these roads being built in highly erodible decomposed granitic soils and constructed to federal highway standards for design speeds, curve radii, width, and grade. As a result, the broad roads contain throughcuts of 50-100' vertical height and fill slopes 100-200' deep that are necessary to meet acceptable highway road gradient standards. Many of the fill slopes on these roads intercept small drainages where undersized pipes were installed during the 1950s construction. The highly erodible soils have helped bury many watercourse crossing inlets and stand pipes. In these instances, the runoff typically either saturates the decomposed granitic soils and permeates across the road fills or is diverted at the toe of the fill to an alternate culvert crossing. In heavy flows, water can pond or pool on the upslope side of the roads and slowly drain without risk of overtopping the roads. The flattening of these watercourses upstream of the road may be occurring as sediment builds up. If that is the case, channel changes and loss of riparian habitat could occur over an extended length of time. This potential issue was not evaluated in this inventory.

Under the DIRT inventory, any stream crossing without a culvert or an undersized culvert is calculated to fail at some point. In these two particular roads, single crossings can have fill volumes of 20,000 yd^3 or more (refer to Table 8 for a list of the ten highest crossing volumes). While it is possible that these fills could catastrophically fail, the likelyhood is minimal.

Table 8 Largest Fill Crossings Within the Trinity River Watershed Inventory

Site #	Road Name	Mile Post	Crossing Volume (yd^3)	Potential Sediment Delivery (%)
667	Trinity Dam Blvd	8.13	27,867	
390	Eastside Road	11.59	24,670	
621	Trinity Dam Blvd	1.51	21,054	
373	Eastside Road	8.81	17,188	
381	Eastside Road	10.07	16,811	
741	Trinity Dam Blvd	17.47	15,448	
638	Trinity Dam Blvd	3.57	15,368	
661	Trinity Dam Blvd	7.2	14,613	
1130	Canyon Creek Road	7.54	14,533	
736	Trinity Dam Blvd	16.95	13,870	

For many of these crossings the installation of an overflow culvert placed high in the fill and the placement of a downspout down the length of the fill slope should prevent the catastrophic failure of the fill crossings.

Significant amounts of sediment from cutslope erosion and unpaved surfaces are transported to road ditches where ditch downcutting contributes to additional sediment. These areas have a high potential for sediment delivery to a stream. While fill slope sediment can be significant, much of this material erodes to flats where it is less likely to be transported to a stream. Where the fill slope leads straight to a stream crossing, sediment delivery potential is relatively high.

While this report reflects the theoretical potential volumes for the crossings on these two roads, the program manager estimates the actual potential delivery volume to be less than 50% of these reported volumes.

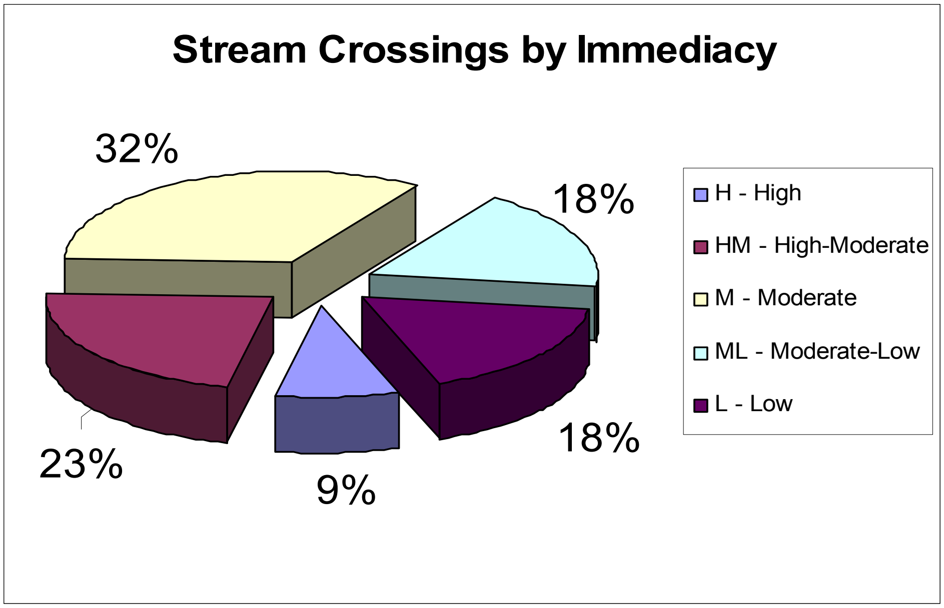
Each county has a full complement of staff and equipment that patrol County roads during storm and flood events. These crews regularly clean the culverts and remove debris during high flows. While this is an effective short-term practice, the potential of culverts plugging remains. A washed-out stream crossing not only results in adverse impacts to fish and water quality, but can preclude access to other stream crossings on roads behind the plugged culvert.

As a result of the inventory, the condition of existing culverted stream crossings was evaluated and priority problem sites located. This evaluation was particularly beneficial for the identification of culverts installed following the 1964 flood. Many of these culverts are nearing the end of their effective lives and will need replacement or repair over the next 5-10 years. This inventory will help to prevent future culvert failure. The following table summarizes the number of stream crossings by immediacy.

Table 9: Stream Crossing Sites by Immediacy

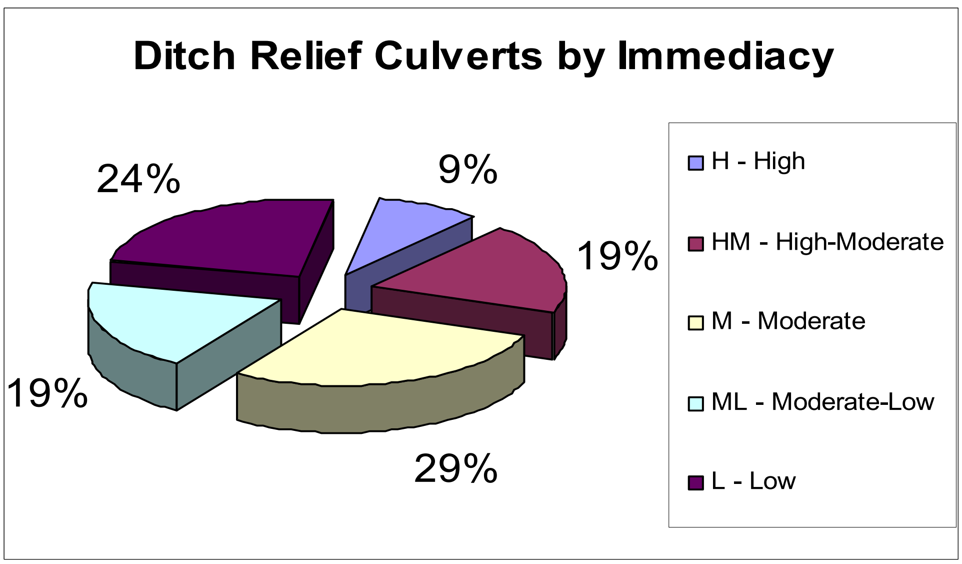
Number of Stream Crossing Sites by Immediacy			
Immediacy	Trinity	Trinity v1.3	Total
High	124	1	125
High-Moderate	314	3	317
Moderate	464	10	474
Moderate-Low	245	17	262
Low	245	5	250
Total	**1,392**	**36**	**1,428**

Figure 6: Stream Crossing Sites by Immediacy*



*** Does not include v1.3 sites**

Figure 7: Ditch Relief Culverts by Immediacy*



*** Does not include v1.3 sites**

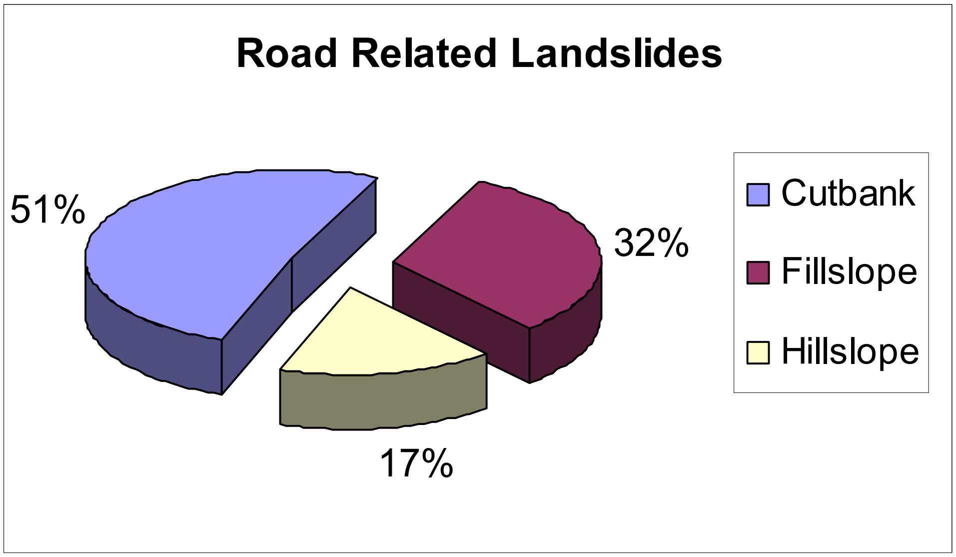
F. Landslides

The most common forms of landslides on County roads are related to cut bank and fill slope failures. There were 36 cutbank and fillslope landslides inventoried in the project area and only those landslide sites with a potential for sediment delivery to a stream channel were inventoried*. In the past some of this slide material was deposited in areas where it could reach a stream. This practice has been gradually reduced and should be eliminated through standard disposal procedures. However, future cutbank and fillslope landslides have the potential to deliver approximately 6,471 yd^3 of sediment to streams when they fail. The individual slides are generally shallow and of small volume, or located far enough away from an active stream that delivery potential is minimal. In addition, cutbank and fillslope failures tend to fail in the same places and are rapidly removed by road maintenance crews.

In addition to cutbank and fillslope landslides, 7 hillslope landslide sites were identified in the inventory with the potential to deliver approximately 8,739 yd^3 of sediment. These sites are large and complex and are typically deep-seated earthflows, debris torrents, or colluvial filled hollows that cannot be treated with a series of standardized treatments. Some of these sites are naturally unstable slopes or are caused by stream undercutting of the toe slopes. Others are the result of road construction or road drainage that has contributed to overall slope instability. Many of these features have already delivered the majority of the stored sediment in past failures and now represent chronic surface erosion sources. While theses large features represent a small number of sites, they potentially contain a significant volume of sediment. All sites were located and mapped into GIS for future assessment and analysis. At these sites, engineering and geologic designs are necessary to determine appropriate treatments. In a few instances, the unstable features were either stabilized or partially excavated before they could fail. Insert So Fk slide pix

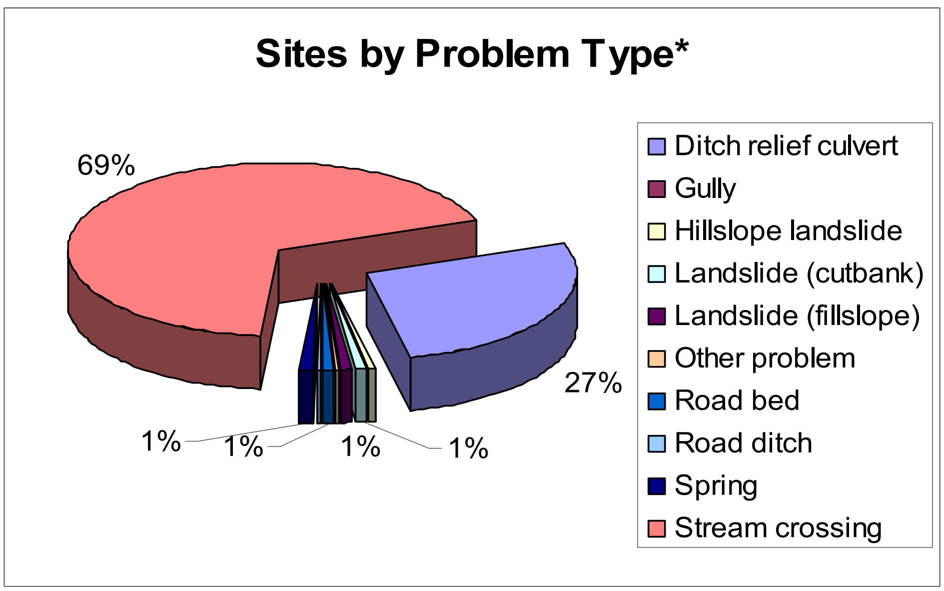
* Large, complex landlside sites were classified as requiring engineer and or geologic review to determine failure potential or treatment design.

Figure 8: Road Related Landslides*



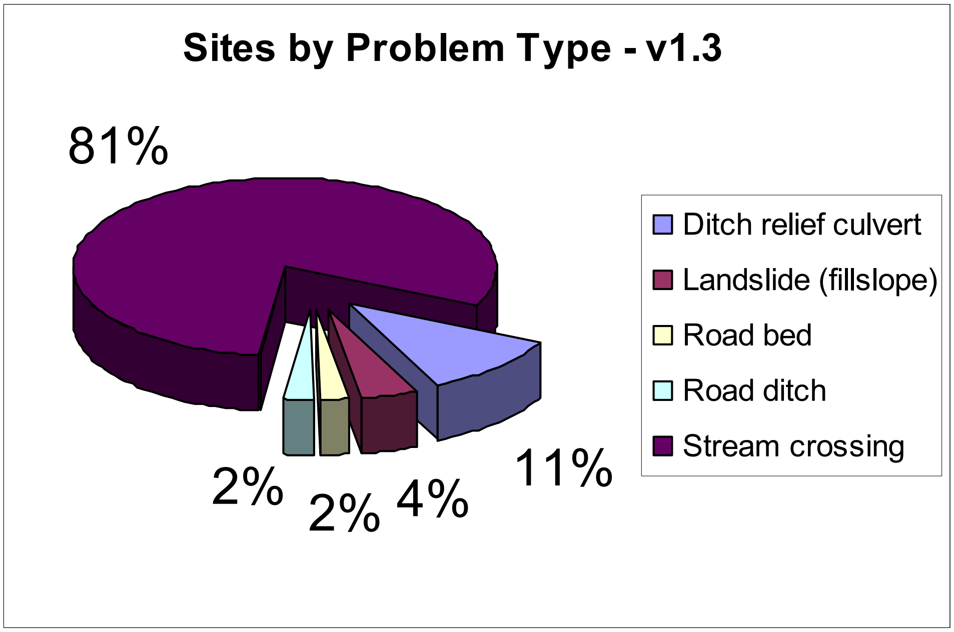
*** Does not include v1.3 sites**

Figure 9a: Sites by Problem Type*



*** Does not include v1.3 sites (shown in Figure 9b below).**

Figure 9b: Sites by Problem Type – v1.3



VI. SPOILS INVENTORY

Road spoils are generated from a variety of maintenance operations ranging from ditch and culvert cleaning to removal of debris or landslide material. During severe or wet winters, substantial amounts of landslides and slump and sheet and rill erosion must be removed quickly from county roads, in-board ditches, and other sediment sources. In 1998, an estimated 30,000 yd^3 of slide material was removed from County roads in the South Fork Trinity River and Readings Creek watersheds. During annual road maintenance, spoils are disposed by incorporating them into road base or fill slopes, drifting off the edge of the road, or end-hauling to a disposal area.

A spoils disposal site assessment was done concurrent with the sediment source inventory. The spoils site inventory identified existing and potential disposal areas and then reviewed the sites for possible resource conflicts. The goal was to locate a disposal site within approximately 15 minutes of hauling time from significant road sediment sources. This translates into a 3-5 mile distance from sediment sources. Ideal sites have the following characteristics: practical, feasible and would not impact other resources. The primary effort of this task was to locate disposal in areas of high demand while minimizing the potential for sediment delivery into watercourses.

Based on the 3-5 mile distance requirement, it was anticipated that approximately 120-200 sites might be expected to be identified. As a result of the inventory, 201 spoils disposal sites (both existing and potential) were initially identified and mapped through the inventory process (Table 9). Of these sites, 24 were eliminated due to environmental constraints such as archaeological resources, proximity to sensitive plant or animal species or better adjacent spoils sites.

Table 9: Summary of Spoils Sites

County	Number of Spoils Sites	Total Capacity (yd^3)
Trinity	200	1,535,999
Trinity v1.3	1	667
Total	**201**	**1,536,666**

VII. TREATMENT COSTS

The total treatment cost for all sites amounts to over $9,839,379, averaging $12.37* per cubic yard of sediment. Approximately 615,055 yd^3 of the total inventory potential future yield (335 sites) can be treated for under $10/$yd^3$ (refer to Table 10). Individual site cost estimates were generated based on the treatment recommendations entered during data collection (refer to Appendix G). A unit cost table, produced by Mendocino County Water Agency Staff, was applied to all treatments in order to determine individual site costs (refer to Appendix I).

*Average cost per cubic yard of sediment does not include estimates from Trinity v1.3. For a summary of treatment costs for the v1.3 sites, refer to Appendix D.

Table 10: Summary of Treatment Costs/yd^3 of Potentially Deliverable Sediment

$/$yd^3$	# of Sites	Total Volume	Average $/$yd^3$	Average $/$yd^3$
n/a [1]	184	226,409	n/a	n/a
n/a [2]	201	261	n/a	n/a
<5	208	548,623	$1.92	$0.89
5 - <10	127	66,433	$7.34	$7.31
10 - <15	108	34,636	$12.36	$12.28
15 - <20	106	28,652	$17.54	$17.48
20 - <25	86	18,403	$22.33	$22.00
25 - <45	280	44,587	$34.57	$33.72
45 - <65	174	15,876	$54.35	$53.47
65 - <85	127	10,705	$74.55	$74.58
85 - <105	86	5,690	$94.80	$95.74
≥105	357	21,633	$249.31	$177.32
Total	**2,044**	**1,021,908**	**$192.20**	**$10.12**

1-Treatment costs cannot be determined because recommended treatments were not entered during data collection or there were specialized treatments for which cost could not be estimated. Many of these sites are pending engineer review.
2-Sites with no volume indicate pending engineer checks or crossings inventoried with no delivery.

VIII. TREATMENT PRIORITIZATION

The initial prioritization of treatment sites for this contract was based on Treatment Immediacy, Erosion Potential, and Total Potential Sediment Delivery at each site. However it is also necessary to consider the cost-benefit ratio of treatments. This was done by taking the total cost of the prescribed treatments for each site and dividing it by the amount of theoretical erosion the site would produce (cost/yd^3). In order to determine an initial ranking, those sites with a High or High-Moderate treatment immediacy and erosion potential were selected from the database. Those sites were then sorted by their cost/yd^3 and total erosion volume (refer to Appendix J). As previously mentioned, treatments for sites that need only an "other" treatment or an engineer check are not yet known and/or their price cannot be estimated. To compensate for this difference, sites with \$0/yd^3 were moved to the bottom of each section. This initial ranking serves as a platform for further prioritization analysis including both economic and biological factors and is intended to provide information that can be incorporated into maintenance and capital improvement planning. Prioritization may change based on criteria other than that assigned by the field technicians (refer to following discussion).

The treatment immediacy of a site is a professional evaluation of the likelihood that erosion will occur during a future storm event. Treatment need is an estimate of the potential for additional erosion, based on field observations of a number of local site conditions. Immediacy values are assigned as: High, High-Moderate, Moderate, Moderate-Low and Low. The evaluation is a subjective estimate of the probability of erosion based on the age and nature of direct physical indicators and evidence of current or pending instability or erosion.

Erosion potential and sediment delivery play significant roles in determining the treatment priority of each inventoried site (as described above). Field indicators that are evaluated in determining the potential for sediment delivery include such factors as slope steepness, slope shape, distance to the stream channel, soil moisture and evaluation of erosion processes.

While field designated treatment prioritization is the most important basis for project prioritization, each county must also consider the following constraints:

- Road funds must be allocated to provide for public safety as the first priority.
- County road managers must comply with County, State and/or Federal policies or legal obligations to maintain year round access on public roads.
- County roads are merely "ribbons" across the landscape and the County often does not own the underlying or adjacent lands and thus can have only limited effects on the landscape.

- Many County roads were the earliest constructed and located low in watersheds, often within or adjacent to stream banks with limited options to prevent sediment delivery to the stream at these locations.
- The County does not own land on which to relocate roads upslope or away from problematic sites. Even if this were not the case, many driveways and private roads have been developed off of County roads making relocation problematic.
- Sediment reduction and habitat restoration costs must fit within the financial capacity of county road programs and must not overtax staff to the point that maintenance and public safety are compromised.

Of the 2,089 potential erosion sites, 271 were identified as maintenance sites (refer to the following chart). The road department has been provided a summary of the maintenance sites, by treatment immediacy and potential sediment delivery volume. The road erosion inventory crews, in some instances, have provided maintenance crews with maintenance needs summaries simultaneously with the completion of the inventory of road segments. This has allowed the maintenance crews to treat high priority sites more immediately.

Table 11: Maintenance Activity Needs

County	# of sites	# Culverts to repair	# Culverts to clean	Ft Ditch to Clean
Trinity	270	67	216	4,995
Trinity v1.3	1	1	1	0
Totals	271	68	217	4,995

A. Overall Treatment Prioritization Criteria

The Five Counties' approach to watershed and biological restoration implementation is to apply a systematic process based on both regional ecosystem and management considerations. This has significantly reduced inter-county competition for funding sources and resulted in multi-county cooperation and the application of better biological and watershed science to funding opportunities.

Basing these programs on biological and watershed needs alone does not work in instances where engineering and other staff specialists have a large backlog of work. A good example of this is the 1998-2000 multi-county focus on funding migration barrier removal projects. In this instance, the short coastal streams of Humboldt County were identified as the highest priority salmon migration barrier removal sites. A total of 12 barrier removal projects were funded, requiring construction to be completed in a short time frame. The effect of such a large number of design, permitting, and construction demands overwhelmed the county resources, delaying implementation.

For the purposes of this contract, prioritization based on cost/yd^3 was the desired output. Cost/yd^3 was calculated for each site (refer to Appendix G). However, there are a number of factors and complexities faced by counties that must be considered throughout the prioritization process. As a result, we have developed a Ranking Model for the final prioritization of sites to include potential erosion volume and treatment immediacy, as well as biological, capitalcapital improvement, economic, and regulatory overlay criteria. The parameters for the model have been developed (refer to following discussion). however, the system has not been approved by the individual counties. The criteria have been incorporated into the model as follows:

1. **DIRT Inventory/Physical Site Prioritization and Cost/Yard Criteria**
   Physical criteria consist of the data collected in the field and prioritized by three major physical site factors: treatment immediacy, erosion potential, and potential sediment yield. Once this prioritized list was completed, the cost per cubic yard to treat the sites was added and the data re-sorted.

2. **Biological Overlay Criteria**
   Restoration of usable salmonid habitat upstream of migration barriers is a high priority of the overall Five Counties Conservation strategy. Treatment of these sites may take precedence over sediment reduction projects. Migration barrier inventories of stream crossings in all five counties were completed by Ross Taylor and Associates (RTA) under a series of SB 271 and Prop. 204 grants. In addition to identifying the sites, RTA prioritized the sites for treatment within each county. The treatment prioritization was based on biological and physical factors, including extent of barrier, quantity and quality of habitat that could be accessed, and maximum capacity of the stream crossing under existing size. Copies of these reports can be reviewed at CDF&G Native Anadromous Fisheries and Watershed Branch, Sacramento, CA or the Five Counties Salmonid Conservation Program library at the Trinity County Planning Department, Weaverville, CA. Further prioritization was completed for all migration barriers through a series of meetings of federal, state, university, private industry, and consultant fisheries biologists who work in Northwestern California. These biologists established a prioritization list across the counties to ensure that the focus of restoration activities was on the highest priority sites.

3. **Maintenance Plans and Capital Improvement Criteria**
   Prioritization criteria are also based on the existing maintenance and capital improvement plans for each county. In areas where a county has already programmed significant work, the DIRT recommendations can be considered in addition to, or regardless of, prioritized biological criteria. The economic efficiency of these opportunities may make it possible to treat sites that would not otherwise warrant priority treatment.

   Conversely, counties may not be able to accomplish work due to resource constraints. Typically County maintenance staff must shift workloads in response to natural events (flood, fire, snow, etc) that disrupt public safety and access. In these instances, the Counties often lack the resources to complete all levels of maintenance, capital improvement and restoration actions. Other constraints must be factored in at the local level including multiple construction project schedules that are restricted to limited operating periods, limited availability of specialized equipment needed at multiple job sites, detailed geo-technical or engineering designs, and other factors.

In addition, the cost-benefit ratio of treatments must be considered in project prioritization. The effects of greater biological need and regulatory requirements will lower the cost-benefit ratio factor to some degree. But in general, where the cost-benefit ratios are high, prioritization will tend to be lower.

4. Economic Overlay Criteria

It is well-known that treating all identified problem sites is cost-prohibitive. The total estimated cost to treat all sites inventoried under these Prop. 204 grants is $10,342,503.12 million (averaging $16.88*/$yd^3$ treated). In another example, the U.S. General Accounting Office has estimated that the cost to mitigate road related impacts to salmonids on National Forests in Oregon and Washington would exceed $375 million and take decades to accomplish. For this reason economic factors must be considered in the prioritization process.

In some counties unique funding sources may be available for sediment reduction and habitat restoration efforts in specific watersheds or counties. The following are examples of potential funding sources that could affect project prioritization:

- **Rural Schools and Stable Communities Act (PL 106-393. 114):** The Rural Schools and Stable Communities Act established a process where counties could recommend the allocation of a portion of federal funds to counties. In Trinity County, the County Resource Advisory Council has recommended allocating $600,000/year to roads and watershed restoration activities this fiscal year. This money is to be used on National Forest lands, but can include County roads within the land base. For FY 2002, $60,000 was allocated to specific County Road sediment reduction projects identified during the road erosion inventory for the Trinity River (funded under a Prop. 204 grant).

- **CALFED Program:** The Trinity River watershed (Trinity and Humboldt Counties) is the only potentially eligible area in which these funds could be expended. No Trinity River projects have been funded from these sources.

- **Trinity River Restoration Program:** This program was formed under the Secretary of Interior's Record of Decision for the Trinity River. The program supports watershed mitigation and restoration activities in the main stem Trinity River. The funding for the program is based on hydroelectric revenues from water exported from the Trinity River basin to the Sacramento River.

- **Klamath River Management Council:** This program supports watershed mitigation and restoration activities in the Klamath River (Siskiyou, Humboldt and Del Norte Counties). The funding for the program is distributed through the US Fish and Wildlife Service as part of 1986 legislation authorizing the Klamath Restoration Program.

- **Coastal Conservancy Funding:** Only coastal Mendocino, Humboldt, and Del Norte Counties are eligible for this funding source.

- **Coastal Assessment and Impact Program:** Only Mendocino, Humboldt, and Del Norte Counties are eligible for this funding source. This program is funded by Congress and is based on offshore oil field revenues.

- **Private Foundations:** Private foundations can be approached for project or conservation plan funding. For example, the McConnell Foundation financially supports projects within Shasta and Siskiyou Counties.

5. **Regulatory Criteria**
A significant number of regulatory factors are considered in the prioritization and implementation of sites for each county's Department of Transportation (DoT) or Public Works (PWD) (refer to the following tables). These include:

MTBE Groundwater Detection
Covelo Maintenance Yard: MDoT
Ft. Bragg Maintenance Yard: MDoT
Hayfork Maintenance Yard: TDoT
Hyampom Maintenance Yard: TDoT
Junction City Maintenance Yard: TDoT
Lewiston Maintenance Yard: TDoT
Tule Lake Maintenance Yard: SPWD
Ukiah Maintenance Yard: MDoT

NCRWCB Possible Sediment Violations
Tomki Road, Mendocino County
China Gulch Rd., Trinity County
Mattole River Rd, Humboldt County

Table 12: Total Maximum Daily Load Allocation and/or Implementation Requirements of Section 303(d) of the Federal Clean Water Act

River Name	County Location	Listed Pollutant	Due Date
Albion River	**Mendocino**	**Sediment**	**12/01**
Big River	**Mendocino**	**Sediment**	**12/01**
Eel River – Delta	Humboldt	Sediment & Temperature	12/06
Eel R. – Middle Fork	Mendocino	Sediment & Temperature	12/03
Eel R. – Middle Main	Mendocino	Sediment & Temperature	12/05
Eel R. – North Fork.	Mendocino/Trinity	Sediment & Temperature	12/02
Eel R. – South Fork	**Mend/ Humboldt**	**Sediment & Temperature**	**12/99**
Eel R. – Upper Main	Mendocino	Sediment & Temperature	12/04
Elk River	Mendocino	Sediment	12/09
Freshwater Creek	Humboldt	Sediment	12/10
Garcia River	***Mendocino***	***Temperature / Sediment***	***12/00***
Gualala River	**Mendocino/Sonoma**	**Sediment**	**12/01**
Klamath River – all	Siskiyou /Humboldt /Del Norte	Nutrients & Temperature	4/04
Klamath - mainstem	Siskiyou /Humboldt /Del Norte	Low Dissolved Oxygen	12/04
Mad River	Humboldt / Trinity	Sediment & Turbidity	2/07
Mattole River	Mendocino/ Humboldt	Sediment & Temperature	12/02
Navarro River	**Mendocino**	**Sediment & Temperature**	**12/00**
Noyo River	**Mendocino**	**Sediment**	**12/99**

River Name	County Location	Listed Pollutant	Due Date
Redwood Creek	**Humboldt**	**Sediment**	**12/98**
Russian River	Mendocino/Sonoma	Sediment	12/11
Scott River	Siskiyou	Sediment & Temperature	4/05
Shasta River	Siskiyou	Low DO & Temperature	9/05
Ten Mile River	**Mendocino**	**Sediment**	**12/00**
Tomki Creek	Mendocino	Sediment	12/04
Trinity River	**Trinity/ Humboldt**	**Sediment**	**12/01**
Trinity R.-South Fork.	**Trinity/ Humboldt**	**Sediment**	**12/98**
Trinity R.-South Fork.	**Trinity/ Humboldt**	**Temperature**	**12/08**
Van Duzen River	**Humboldt**	**Sediment**	**12/99**

Bold indicates Allocation Plan has been complete.
Bold and Italic indicates Implementation Plan completed.

For example, in the overall Five Counties prioritization, the Garcia River watershed treatment sites could be rated as a higher priority for implementation over similar sites in all other watersheds because of the TMDL Implementation Plan for the Garcia River*.

Table 13: Federal and State Endangered Species Act- Status of Listings of Salmon & Steelhead in the Five Counties Region (Note: State listed species delineated in color)

Species / ESU	Listing Status[1]	ESU Area
Coho Salmon		
So. Oregon / No. California	Threatened / *Interim 4(d) rule*	Elk River, OR to Mattole River / Klamath & Trinity Basins
Central Calif. Coast	Threatened /4(d) rule	Punta Gorda to San Lorenzo River
Chinook Salmon		
Calif. Coastal	Threatened	Redwood Creek through Russian River basin
Upper Klamath / Trinity	Not listed	Klamath /Trinity basins, *above confluence* with Trinity River
Southern Oregon / Northern California	Not listed	Cape Blanco south *to lower Klamath R. downstream* of Trinity River
Steelhead		
Central Calif. Coast	Threatened /4(d) rule	Russian River- Mendocino County.
No. Calif. Coast	Threatened	Redwood Cr. through Gualala River
Klamath Mtn. Province	Not listed	Cape Blanco, OR to South Fork Trinity Basin
State-wide	Proposed CA Endangered/Threatened	All Areas within Five Counties

* A TMDL is the Total Maximum Daily Load defined in Section 303(d) of the Federal Clean Water Act for pollutants. All of the rivers in the Five Counties area, except the Smith, are listed as sediment impaired. A rivers' TMDL allocation is established by the North Coast Regional Water Quality Control Board or the U.S. EPA when a listing is established. Once the load allocation of sediment has been set for a watershed, implementation plans are to follow. After an implementation plan is adopted, sediment reduction efforts in that watershed must be completed under a specified time frame. The only adopted implementation plan to date is the Garcia plan, placing treatment in this watershed at higher priority than other watersheds.

Species / ESU	Listing Status[1]	ESU Area
Klamath River Lamprey,	Candidate Species	Del Norte, Humboldt and Siskiyou
Eulachon	Candidate Species	Del Norte and Humboldt Counties
GREEN STURGEON		
Klamath Mtn. Province	Petition Accepted	Klamath & Trinity Rivers

B. Simplified Prioritization Ranking Model

Considering all of the factors necessary to develop an effective restoration program for county facilities, it was necessary to develop a model that could assess not only the site features measured under these grants, but also the factors described in Section VIII above. To do this, a Simplified Prioritization Ranking Model has been developed as an Excel spreadsheet (refer to Appendix K for an example) that assigns a value to the criteria factors. This allows for assessment of sites based on that criteria. This model is a guide for comparing sites and may be modified over time to reflect additional factors.

The model incorporates the field data assessment, biological fisheries factors, water quality issues including TMDLs and possible violations of Basin Plans, local government funding levels, management complexity, permitting requirements, and other management constraints. The higher the total score, the higher is the site's treatment priority. Values for the various factors are weighted as follows:

Table 14: Simplified Prioritization Ranking Model

	Minimum Possible Score	Maximum Possible Score
DIRT Inventory Prioritization	0	150
Biological Criteria	0	70 for barrier sites; 70 for non-barrier sites
Water Quality Violation	0	50 for an existing violation
TMDL Criteria	0	10 for TMDL implementation plan; 5 for TMDL allocation plan
Sub-Total For Biological and Watershed Factors	0	280 points maximum
County Funding Match	0	50 (function of % of county match)
Management and Design Complexity	-5	10
Permits Needed	-5	10
Other Management Considerations	0	30

Sub-Total For Management Factors	100 points maximum
Total	380 points maximum

IX. PROJECT IMPLEMENTATION

Trinity County Department of Transportation began sediment reduction and migration barrier projects prior to the completion of this Trinity River DIRT Inventory. These projects, done between 1994 and 2002, will prevent more than 68,650 cubic yards of sediment delivery to streams (refer to Tables 15-18 below).

Trinity TMDL Project and Watershed Indicator Target Met By Project

Table 15: Trinity TMDL Target Watershed Indicator: Hydrologic Connectivity

Road	Watershed	Project Description	yd^3/Miles	Status
China Gulch Rd	Weaver Creek	Outslope, rolling dips & restore Class III	7,500/1.0	Completed
Dutch Creek Rd	Maple/Dutch Cks	Outslope, rolling dips & restore Class IIIs	1,111/0.6	In Progress
Deadwood Creek Rd	Deadwood Ck	Rolling dips, ditch relief culverts Down spouts & rock slope protection	8,040/1.8	2003
Lewiston Turnpike Rd	Trinity River (Middle Reach)	Rolling dips, ditch relief culverts Down spouts & rock slope protection	2,912/7.2	2003
South Fork Rd.	SF Trinity River	Rolling dips, ditch relief culverts	1,686/2.78	2004
Big Creek Rd	Hayfork Creek	Install/replace ditch relief culverts Outslope, chip seal, wire wall	2,615/3.37	2003
Lower S.F. Road	SF Trinity River Ditch relief culverts	Outslope, drainage, rolling dips,	1,100/2	2004
Total			**24,964 /18.75 mi**	

Table 16: Trinity TMDL Target Watershed Indicator: Stream Crossings with Diversion Potential or Significant Failure Potential

Road	Watershed	Project Description	Volume	Status
Oregon St.	Weaver Creek	Replace culvert/salmon barrier w/bridge	1,228	Completed
Canyon Creek Rd	Canyon Creek	Replace culvert/salmon barrier w/bridge	500	Completed
Eastside Rd	EF Trinity River	Install liner in rotten CMP	759	Completed
Eastside Rd	EF Trinity River	Pour concrete bottom in rotten CMP	4,483	Completed
Trinity Dam Blvd	Trinity Lake	Install liner in rotten CMP	3,093	Completed
Wildwood Rd	Hayfork Creek	Pour two concrete bottoms in rotten CMPs	674	Completed
Sky Ranch Rd	Oregon Gulch/ T.R. Middle Reach	Replace culvert w/bridge	730	2003
Deadwood Rd	Deadwood Creek/ T.R. Middle Reach	Modify culvert	3,459	2003
Total			**14,926 yd^3**	

Table 17: Trinity TMDL Target Watershed Indicator: Road Surfacing (rocking/paving of native/dirt roads)

Road	Watershed	Project Description	Miles Surfaced	Status
Millview Drive	Upper Trinity River	Chip Seal*	0.3	Completed
Steiner Flat Rd	Middle Trinity River	Oil seal	0.1	Completed
China Gulch Rd	Weaver Creek	Rock dirt segment	1.0	In Progress
Dutch Creek Rd	Maple/Dutch Cks	Chip Seal	2.0	Completed
Dutch Creek Rd	Maple/Dutch Cks	Rock dirt segment	0.6	In Progress
Deadwood Rd	Deadwood Creek	Chip Seal	1.6	Completed
Indian Creek Rd	Indian Creek	Chip Seal	5.2	Completed
Reading Creek Rd	Reading Creek	Chip Seal	3.7	Completed
Valdor Rd	Trinity River	Chip Seal	0.4	Completed
South Fork Rd	S.F. Trinity River	Chip Seal	3.0	Completed
Kingsbury Rd	Hayfork Creek	Chip Seal	0.5	Completed
Summit Creek Rd	Hayfork Creek	Chip Seal	1.0	Completed
Corral Bottom Rd	Price Creek	Chip Seal	3.0	Completed
Nelson Rd	Hayfork Creek	Chip Seal	0.8	Completed
Rattlesnake Creek	Hayfork Creek	Chip Seal	1.0	Completed
Total			**24.2 Miles/~2,420 yd^{3}****	

* Chip seal includes placement of asphalt-concrete grindings that are oil sealed.
** Total volume based on an estimate of 10 yd^{3}/mi/year.

Trinity County Department of Transportation's road surfacing program has resulted in the paving, chip sealing, or rocking of 10% of its' native or dirt surface roads in the Trinity River watershed since 1994.

Table 18: Trinity TMDL Target Watershed Indicator: Annual Road Inspection and Correction

Road	Watershed	Project Description	Volume	Status
Eastside Rd	EF Trinity River	Landslide material excavation	2,000	Completed
Bear Creek Loop	Upper Trinity River	Rock slope protection	unknown	Completed
Reading Creek Rd	Reading Creek	Replace shotgun CMP	unknown	Completed
Fountain Ranch Rd	Trinity River (Lower Reach)	Replace culvert, downspout	924 yd^{3}	Funded
South Fork Rd	SF Trinity River	Landslide material excavation	45,000	Completed
Hyampom Rd	Hayfork Creek	Wire wall installation at landslide	260	Completed
Total			**>48,000 yd^{3}**	

In addition to projects completed between 1998 and 2002, numerous projects have been developed and will be implemented in 2003 as follows:

X. CONCLUSION

For this project, the collection of data at an ecosystem (or ESU) level provides lead agencies, responsible agencies, the public, and funding managers with a valuable mechanism with which to quantify and reconcile multiple physical factors. This, we believe, is the most beneficial approach on which to base recovery actions and utilize future funds in the most efficient manner. The difficulties of collecting and homogenizing data from multiple agencies (Public Works and Transportation Departments) across broad landscapes and considering numerous other factors is significant and requires far greater analysis than originally anticipated. However, the time and effort required to create a working data set on an ESU level is worthwhile and necessary to achieve data consistency among otherwise disconnected agencies.

Based on the inventory and cost presented in this report, it is reasonable to anticipate that all County roads in the five northwestern California counties could have more than $150 million of restoration funding needs for water quality and associated salmonid habitat concerns.

In addition to this inventory, the Forest Service, Caltrans and some private landowners are beginning inventories for road treatments and costs. Even without results from the numerous ongoing inventories, it is commonly recognized that the potential costs of restoration activities on private, city, county, state or federal roads will exceed any reasonably foreseeable restoration funding available. The total costs and value of restoration goals may not be known for a decade or more, but the declining salmonid populations in some of the river systems create an immediate need to improve habitat and water quality at critical problem sites. Inventories on both a large and small scale improve the public's confidence that proposed projects are resulting in the greatest cost-benefit to the resources at risk.