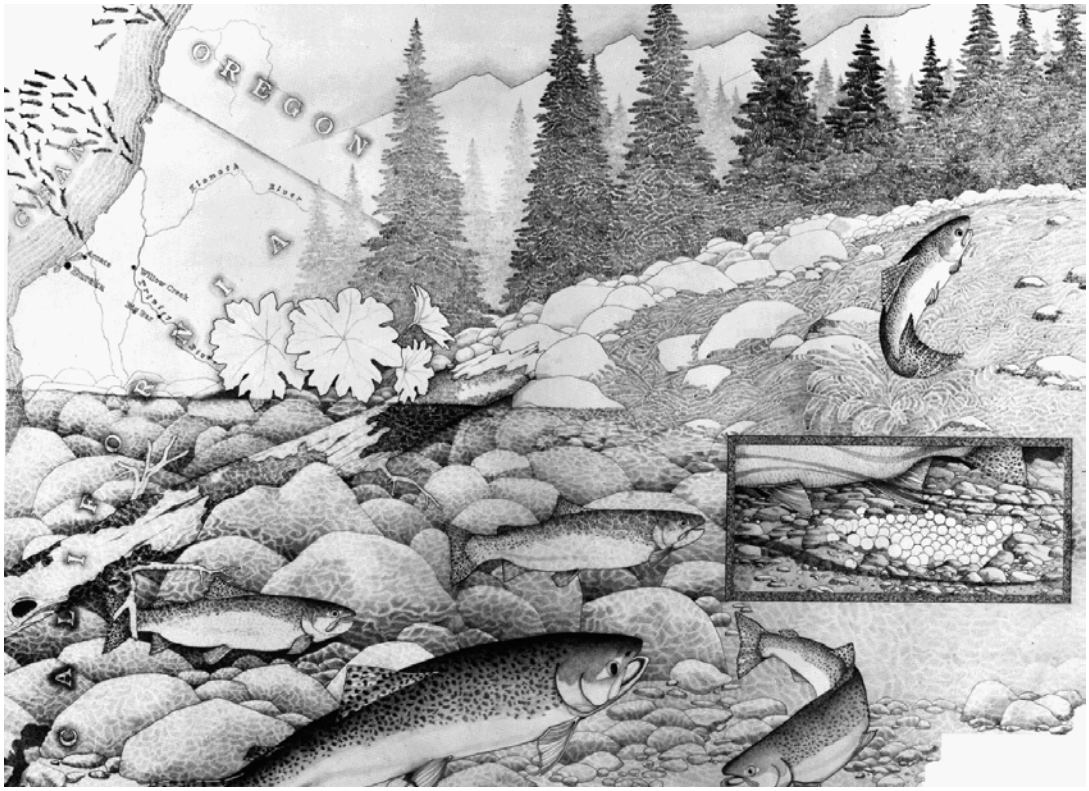
Five Counties Road Erosion Inventory

Final Report

For CA Department of Fish and Game
SB271 Program



Contract# 9985013
And
Contract# 9985149

Prepared By:

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Summary

In 1999, the California Department of Fish and Game awarded Trinity County two S.B. 271 contracts to conduct a County Roads Erosion Inventory in the counties of Del Norte, Humboldt, Mendocino, Siskiyou and Trinity. The sites inventoried were those with 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 through the Five Counties Salmonid Conservation Program.

Initially, the Counties considered the protocols for forest and ranch road inventories set forth by Pacific Watershed Associates and then modified them to reflect the differences between private and public roads. The final 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 stages of development 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. 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. For this project, the collection of data at an ecosystem (or Evolutionarily Significant Unit - ESU) level provides responsible agencies, the public, and funding managers with a valuable mechanism with which to quantify and reconcile multiple physical-factors.

The SB 271 grants were proposed to inventory 1,491 miles within the Five Counties, however, time and other constraints prevented completion of all work. The portions of the contract inventory areas in Trinity and Siskiyou Counties were not started. However, under these grants, 6,086 sites were inventoried on over 1,207 miles of county roads in Del Norte, Humboldt and Mendocino Counties for potential sediment delivery to streams, spoil disposal areas, and possible salmonid migration barriers. 5,205 of these sites were identified as potential erosion sites, and 274 spoils disposal sites were located. The remaining sites were classified as non-treatment sites or as delivering less than 20 yd^3 of sediment to a stream. The sites inventoried in DIRT could theoretically yield over 1.52 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:

Potential Sediment Yield (yd^3)				
	Stream Crossing	Landslide [1]	Chronic Surface[2]	Total
Del Norte	46,949	4,462	9,654	61,065
Humboldt	520,250	12,733	157,221	732,266
Humboldt v 1.3	48,003	9,143	6,772	63,918
Mendocino	420,558	6,261	238,895	665,714
Total	1,035,760	32,599	412,542	1,522,963

1-Does not include complex landslides requiring engineer review.
2- Decadal chronic road surface erosion.

Total Number of Sites By Treatment Immediacy						
	High	High/Mod	Mod	Mod/Low	Low	Total
Del Norte	15	74	91	46	39	265
Humboldt	149	634	617	181	88	1669
Humboldt v1.3	57	110	76	53	18	310
Mendocino	1326	826	445	316	48	2961
Total	**1547**	**1644**	**1229**	**596**	**193**	**5205**

Potential sediment yield estimates do not take into account the effects of individual county road maintenance practices. County road maintenance programs help to prevent and treat those conditions that would contribute to sediment delivery to a stream. For example, 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 all sites is estimated at approximately $24.6 million with an average cost of $16.88*[1]/$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 $100 million of 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 a decade or more, declining

1 *Cost estimates do not include Humboldt v1.3 data. Please refer to Appendix I2.

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.

Preface: All work completed under the SB 271 program 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.

26% of all county roads were inventoried under the SB 271 contracts. An additional 12% of county roads were inventoried under a simultaneous Proposition 204 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 grants 9958013 and 9958149 are combined in this report 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 Dennis Slota, Polly Chapman, Carolyn Rourke, Ole Wik, Earl Brown, 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: Dennis Slota, Mendocino Water Agency; Carolyn Rourke, Sandra Pérez and Janet Clements, Trinity County Planning Department-Natural Resources Division; 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.

Mark Lancaster
Contract Manager

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I. INTRODUCTION

In 1999, the California Department of Fish and Game awarded Trinity County two SB 271 grants for the inventory of 1,491 miles of County roads in Del Norte, Humboldt, Mendocino, Siskiyou and Trinity. 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 1,207 miles of roads inventoried under these SB 271 grants, 550 miles of County roads were inventoried in the Trinity River watershed (Humboldt and Trinity Counties) as part of a Proposition 204 grant.

The watersheds within these counties, encompassing approximately 11.6 million acres, contain some of the most significant anadromous salmonid habitat in California. In addition, the North Coast region is one of the last areas with large amounts of salmonid refugia. Its watersheds hold the greatest potential for the restoration of salmonid populations stocks and 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. The intricate network of County, state, federal and private road systems within the Five Counties significantly contributes to water quality and habitat degradation. Roads modify natural hillslope drainage networks and accelerate erosion processes, 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.

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. Within the Five Counties, there are 4,790 miles of County roads and approximately 16,600 culverts (Tables 1 and 2).

There are 100 known complete, or partial, migration barrier stream crossings on county roads within the contract watersheds inventoried and 208 identified within the Five Counties. Twelve of the barriers within these watersheds were removed in 2000-01 in order to allow fish passage. A complete inventory of county road migration barriers in all five counties was completed by consulting biologists Ross Taylor and Associates (refer to Appendix B). The location of these county road migration barriers was provided to Julie Brown of CDF&G Native Anadromous Fisheries Division for inclusion in CDF&G's GIS database.

County roads span approximately 30,000 acres of the 11.6 million acres of watersheds within the five counties. Many of these roads, which were constructed starting in the 1850s, are located in the bottom of stream canyons. County roads located low in drainages contribute a greater percent of road-related sediment to streams than roads located higher in the watersheds, closer to ridges and

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22* 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.

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
Totals	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
Totals	**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.

- Prevent or minimize the amount of normal runoff into streams.
- 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 follows:

> "***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***

LOCATION MAP

III. PROJECT DESCRIPTION

The watersheds inventoried using SB 271 funds were selected 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 watersheds based on their overall value as 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 1999 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 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 and migration barrier sites.
- Prioritization of inventoried sites by treatment immediacy and other criteria (refer to Section VII: Treatment Prioritization).

The Pacific Watershed Associates 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.) means constant maintenance costs for all roads*	**Roads primarily are for 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 have equipment to treat inventories problems during a storm event*	**Often do not monitor winter storm effects** *but conduct road condition in the spring or in favorable conditions*
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 10,000s of sites: *This effort encompasses vast sites across 100s of watersheds and multiple counties*	**Inventory 100's of sites:** *Typical inventory may reach 200-300 sites in a single watershed for a single ownership*
Treatment designs must be done by, 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:

Inventory Methods:

- 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 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.

Treatment Options:

- 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 and 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.

Pacific Watershed Associates (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 Mendocino County, work was completed by a crew employed by Mendocino County Department of Transportation. Inventory work was done by the Humboldt Co. Public Works Department in Humboldt and Del Norte Counties. All work was coordinated with Dennis Slota of the Mendocino County Water Agency (MWA), Sef Murguia of the Humboldt County Public Works Department, Art Reeve, Del Norte County Community Development Department and Mark Lancaster of Trinity County 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 could be expected to 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.

Tape and/or electronic distance measuring devices and clinometer longitudinal profile surveys were completed on virtually all stream crossings. The surveyors generated the fill volume in 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), including 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 recommended replacement culvert was identified as requiring an engineer check on the data sheet and will be calculated by a Registered Engineer.

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. All inventory sites were located using map coordinates and GPS points to allow them to be loaded into an ArcView GIS platform. PWA staff supervised the county inventory crews in both site review and data quality.

IV. INVENTORY RESULTS

Under these grants, 6,086 sites were inventoried on county roads in Del Norte, Humboldt and Mendocino for potential sediment delivery to streams, spoil disposal areas, and possible salmonid migration barriers. 5,205 of these sites were identified as potential erosion sites, and 274 spoils disposal sites were located. The remaining sites were classified as non-treatment sites or as having no potential to deliver over 20 yd^3 of sediment to a stream. The sites inventoried in DIRT could theoretically yield over 1.52 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).

During the inventory effort, it became clear that there were more miles of County roads within these watersheds than originally identified in the grant application. As a result, the target mileage of grant #9958013 was exceeded by 13%. However, a combination of factors, including delayed contract initiation and contract time limitations, resulted in only 62% of the total miles targeted under grant #9958149 being completed (refer to Table 3 below). In all, 1,207 miles of the 1,491 miles originally identified in these contracts were completed (81% of targeted miles) within the contract deadline. The Mendocino County Department of Transportation, however, has committed staff and funding to complete the inventory of their county roads originally encompassed by this project. The inventory Siskiyou County roads has not yet started and the Trinity County inventory, although complete, is not covered under this grant contract.

Table 3. Miles of Roads Inventoried By Watershed Under SB 271 Grant # 9958013

Hydrologic Unit/ Watershed	Miles to be Assessed (under grant)	Miles Actually Assessed	% Complete
Humboldt County:			
110.0 Eureka Slough	1.18	0.68	100%
110.0 Freshwater Creek	5.84	11.02	100%
110.0 Freshwater Slough	1.60	5.12	100%
112.3 Mattole River	99.49	107.80	100%
107.0 Redwood Creek	38.80	51.47	100%
County Total	**146.91**	**176.09**	
Mendocino County:			
112.3 Mattole River	29.90	1.12	4%
113.1 Rockport	3.00	40.69	1000%
113.2 Noyo River	37.20	66.85	100%
113.3 Big River	29.50	70.26	100%
113.4 Albion River	31.40	33.83	100%
113.7 Garcia River	46.50	65.48	100%
113.6 Pt. Arena	9.20	37.29	100%
113.8 Gualala River	14.90	29.03	100%
County Total	**201.60**	**344.5**	**100%**
Siskiyou County:			
105.20 Salmon River	17.80	0	0%
105.23 N. F. Salmon River	28.25	0	0%
105.24 E. & S. Forks Salmon	87.60	0	0%
County Total	**133.65**		
Del Norte County:			
103.0 Lower Smith R.	61.60	113.76	100%
Trinity County:			
106.12 Trinity River	13.0	0	0%
111.20 Van Duzen River	4.7	0	0%
County Total	17.7	0%	
TOTAL	**561.46**	**634.35**	**113%**

SB 271 Grant # 9958149

Hydrologic Unit	Miles to be Assessed (under grant)	Miles Actually Assessed	% Complete
Humboldt County:			
111.2 Van Duzen River	78.23	85.96	100%
111.1 Lower Eel R.	33.91	35.73	100%
111.3 South Fork Eel R.	68.09	68.09	100%
111.4 Middle Eel R.	85.71	85.71	100%
County Total	**265.94**	**275.49**	
Mendocino County:			
111.30 South Fork Eel R.	44.85		
111.40 Middle Main Eel R.	22.77		
111.50 North Fork Eel R.	6.96	6.96	100%
111.60 Upper Main Eel R.	174.97	144.00	82%
111.7O Middle Fork Eel R.	74.00	74.00	100%
113.50 Navarro River	47.90	72.58	100%
County Total	**344.70**	**297.54**	
Siskiyou County:			
105.4 Scott River	246.41	0	
Trinity County:			
111.1 Lower Eel River	67.87	0	
111.2 Van Duzen River	4.70	0	
County Total	**72.57**		
Total Miles Both Grants:	**929.62**	**573.037**	**61.7%**

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 extensive data checking and editing prior to final analysis. Future use of the software will require more and better filters being 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 (371 sites, of which 310 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 data base. This may have resulted in an under-estimation of total chronic sediment delivery from 177 sites in the Redwood Creek drainage (Titlow Hill, Bair, Stover, Chezem, Davidson, and Bald Hills Roads) as well as 133 sites on Kneeland Road. The early version of the DIRT database was refined to include all chronic sources when version 1.4 was released. 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 310 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 considered to be minor, the summary of these sites is included in Appendix D rather than in the body of this report.

Throughout the data collection process, individual management techniques resulted in differences and inconsistencies among the three data sets. The majority of these differences were reconciled in the final data analysis in order to meet the overall regional prioritization. The most significant change occurred in Mendocino County, where the Department of Transportation engineers requested that the inventory crew discontinue their estimation of culvert pipe length at ditch relief culverts, road ditches and some crossings. This was done for approximately 614 sites. The engineers preferred to determine site specific characteristics such as DRC location and DRC length. In addition, Mendocino County sites where pipe length was not included were given predominantly high/high moderate immediacy rankings to ensure their review by an engineer. However, this change was not conveyed to the project manager during that period. The failure to enter culvert length into the database prevented the completion of an accurate estimated cost analysis for these sites. In these cases, the average pipe length for all Mendocino sites (in which the installation or replacement of a culvert was recommended) was used as the estimate for new culvert lengths in order to integrate these 614 sites into the final analysis. This may result in an under, or over, estimation of site costs at any of those individual sites, but the effect is not expected to be significant. Prior to any grant proposal being submitted, all sites will be checked by the Mendocino County engineering staff and specific pipe lengths will be specified.

B. Overall Summary Of Inventory Sites

Table 4: Potential Sediment Yield for all Treatment Sites

	Potential Sediment Yield (yd^3)			
	Stream Crossing	Landslide[1]	Chronic Surface[2]	Total
Del Norte	46,949	4,462	9,654	61,065
Humboldt v 1.4 & 1.5	520,250	12,733	157,221	732,266
Humboldt v 1.3*	47,992	9,143	6,772	63,907
Mendocino	420,558	6,261	238,895	665,714
Total	1,035,749	32,599	412,542	1,522,952

1-Does not include complex landslides requiring engineer review
2-Decadal chronic road surface erosion
* For Humboldt v1.3, chronic surface erosion was not specifically calculated but was instead included in one estimate for total future erosion. However, the total estimated chronic surface erosion for was based on sites that were not landslides or stream crossings.

Table 5: Treatment Immediacy Summary

	Total Number of Sites By Treatment Immediacy					
	High	High/Mod	Mod	Mod/Low	Low	Total
Del Norte	15	74	91	46	39	265
Humboldt	149	634	617	181	88	1669
Humboldt v1.3	57	110	76	53	18	310
Mendocino	1326	826	445	316	48	2961
Total	**1547**	**1644**	**1229**	**596**	**193**	**5205**

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 27% 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 each county. For a more complete breakdown of sites please refer to Appendix G.

Summary of Problem Types

Problem Types for all counties and treatment immediacy for all counties

Table 6: Summary of Recommended Treatments by County*:

Treatment	Del Norte	Humboldt	Mendocino	All	Units
	% Total	%Total	%Total	Total	
Site #	5.41	34.10	60.49	4895	#
Possible fish barrier	6.15	20.00	73.85	65	#
Engineering check	3.32	18.01	78.67	211	#
Install Culvert	3.84	30.91	65.25	990	# sites
New Culvert Length	5.44	39.62	54.94	27.35	mi
Replace Culvert at Crossing	8.50	51.12	40.38	1647	# sites
Repair culvert	0	22.22	77.78	36	# sites
Clean culvert	4.48	32.84	62.69	67	# sites
Clean Ditch	0.04	11.59	88.37	9.47	mi
Outslope and Retain Ditch Length	0	0	100	7.40	mi
Outslope and Remove Ditch Length	0	0	100	28.98	mi
Inslope Length	0	0	100	0.43	mi
Remove Berm Length	0	1.28	98.72	78.35	mi
Remove Ditch Length	26.00	30.23	43.78	0.33	mi
Rock Road Length	0	66.67	33.33	1.7E-01	mi
Pave Road Length	0	0	100	1.8E-01	mi
Rock or Pave Surface Area	0	29.67	70.33	1.5E-03	mi^2
Install DR-CMP	7.30	31.35	61.35	3384	#
New DR-CMP Length	8.38	29.41	62.21	25.55	mi
Replace DR-CMP Length	1.02	16.86	82.12	6.15	mi
Install Cross Road Drain	83.33	16.67	0	12	#
Install Downspout	1.40	48.60	50.00	930	#
New Downspout Length	0.90	36.80	62.30	6.52	mi
Install Crossing Downspout	2.21	29.23	68.57	1088	#
New Crossing Downspout Length	2.56	26.26	71.18	6.65	mi
Install Flare Inlet Diameter	5.77	86.54	7.69	52	#
Install Wet Crossing	0	0	0	0	# sites
Install Ford	0	0	0	0	# sites
Armor Fill	33.33	66.67	0	3	# sites
Fill Height	71.43	28.57	0	5.3E-03	mi
Fill Width	6.25	93.75	0	3.0E-03	mi
Excavate Soil	0	25.49	74.51	51	# sites
Critical Dip	15.38	23.08	61.54	13	# sites
Install Rolling dip	0	0	100	1	#
New Emergency Overflow Length	9.83	29.85	60.32	1.56	mi
Install natural bottom	5.88	41.18	52.94	17	# sites
Fill Face Area	4.95	18.38	76.67	8.6E-04	mi^2
Reconstruct Fill	4.55	10.61	84.85	66	# sites
Other treatment needed	4.20	42.15	53.65	1191	# sites
Total Erosion	4.19	50.19	45.63	1459044.78	yd^3

*Note: does not include Humboldt v1.3 data.

Table 7: Summary of Treatments in All Counties by Immediacy*:

	%H	%HM	%M	%ML	%L	Totals	Units
Site #	30.44	31.34	23.55	11.09	3.58	4895	#
Engineering check	56.87	25.12	11.85	5.21	0.95	211	#
Install Culvert	39.90	29.29	19.70	8.28	2.83	990	y
New Culvert Length	30.53	30.93	25.52	9.69	3.33	27.35	mi
Replace Culvert at Crossing	22.65	32.85	29.08	11.29	4.13	1647	y
Repair culvert	44.44	25.00	19.44	5.56	5.56	36	y
Clean culvert	35.82	32.84	17.91	7.46	5.97	67	y
Clean Ditch	30.42	31.83	24.01	12.82	0.91	9.47	mi
Outslope & Retain Ditch	49.37	30.35	14.26	6.02	0	7.40	mi
Outslope & Remove Ditch	61.92	28.63	6.29	2.79	0.37	28.98	mi
Inslope Length	31.23	0	11.81	56.96	0	0.43	mi
Remove Berm	46.91	28.69	11.80	11.38	1.22	78.35	mi
Remove Ditch	11.79	72.04	15.22	0.32	0.63	0.33	mi
Rock Road	33.33	0	0	66.67	0	0.17	mi
Pave Road	45.95	54.05	0	0	0	0.18	mi
Rock or Pave Surface Area	27.24	32.71	0	40.05	0	1.5E-03	mi^2
Install DR-CMP	30.91	31.32	22.28	12.68	2.81	3384	#
New DR-CMP Length	27.25	34.01	24.64	9.57	4.53	25.55	mi
Replace DR-CMP Length	47.36	29.77	15.97	6.31	0.59	6.15	mi
Install Cross Road Drain	0	16.67	83.33	0	0	12	#
Install Downspout (DS)	29.46	37.63	25.59	6.02	1.29	930	#
New DS Length	26.68	35.87	29.71	6.34	1.40	6.52	mi
Install Crossing DS	45.31	30.42	16.73	5.79	1.75	1088	#
New Crossing DS Length	46.75	29.47	16.00	6.25	1.53	6.65	mi
Install Flare Inlet	15.38	51.92	25.00	5.77	1.92	52	#
Install Wet Crossing	0	0	0	0	0	0	y
Install Ford	0	0	0	0	0	0	y
Armor Fill	0	33.33	33.33	0	33.33	3.00	y
Fill Height	0	3.57	71.43	0	25	5.3E-03	mi
Fill Width	0	50	6.25	0	43.75	3.0E-03	mi
Excavate Soil	47.06	37.25	15.69	0	0	51	#
Critical Dip	7.69	38.46	38.46	15.38	0	13	y
Install Rolling dip	0	0	100	0	0	1	#
Install Emergency Overflow	39.18	33.33	14.53	11.99	0.97	1.56	mi
Install natural bottom	17.65	29.41	35.29	11.76	5.88	17	y
Armor Fill Face Area	82.99	9.07	4.79	2.44	0.72	8.6E-04	mi^2
Reconstruct Fill	69.70	13.64	13.64	3.03	0	66	y
Other Treatment needed	29.39	34.26	22.08	12.09	2.18	1191	#
Total Erosion	30.61	26.81	24.60	15.79	2.20	1459044.78	yd^3

*Note: does not include Humboldt v1.3 data.

Table 8: Summary of total pipes that need to be replaced or installed*:

	Del Norte	Humboldt v1.4 & 1.5	Mendocino	Humboldt v1.3	All Counties
# of Sites requiring new pipe	364	2357	4193	590	7504
# of New Pipes	485	3148	5227	829	9689
Total Pipe Length (mi)	4.07	24.00	45.71	41,215	41,289

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

C. Total Potential Erosion Volumes

A general summary of sediment sources indicates that an average of 4.3 potential erosion sites occur per mile of County road with each site representing a potential delivery of 290 yd^3 of sediment to a stream. In actuality, the volume potential 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.

Fig 4a-c Tot Eros Vol

Fig 4d Tot Eros Vol for all counties

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.

While crossing and landslide volumes are typically episodic in nature (i.e. strongly associated with storm intensity) chronic erosion occurs annually with the passing of even minor storms. This inventory estimates that at least 412,542 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 3,418 stream crossing sites were inventoried and recommended for treatment prioritization. The stream crossings inventoried could potentially generate a total of approximately 1,259,566 yd^3 of future road related sediment. However, not all crossings are expected to wash out.

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 replacing or fixing over the next 5-10 years. For example, in December 2001, a 12' CMP crossing of McNutt Gulch on Mattole River Road plugged and failed due to a deteriorated bottom. The crossing washed out yielding approximately 30,000 yards of sediment to the stream. This inventory will help to prevent similar events from occurring in the future. The following table summarizes the number of stream crossings by immediacy for each county.

Table 9 Summry Stream Xgs & Fig 5 Summry Strm Xgs by Tx Immed

Fig 6 DRC chart by Immed

F. Landslides

The most common forms of landslides on County roads are related to cut bank and fill slope failures. There were 46 cutbank and fill slope 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 eliminated through standard disposal procedure. However, future cut and fill slope landslides have the potential to deliver nearly10,635 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, cut and fill failures tend to fail in the same places and are rapidly removed by road maintenance crews.

In addition to cutbank and fillslope landslides, 14 hillslope landslide sites were identified in the inventory. 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 caused by undercutting of the toe slopes by streams. Others are the result of road construction or road drainage that have 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. The hillslope 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 number of sites, the unstable features were either stabilized or removed entirely before they could fail. These areas were not inventoried.

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

Fig 7 Summry Road related landslides

V. SPOILS INVENTORY

274 spoils disposal sites (both existing and potential) were identified and mapped through the inventory process. These sites were then analyzed for suitability and assurance that slide related debris, ditch spoils, and other sediment could be safely stored and treated on site to prevent deposition to a stream. Further determination and analysis of suitable sites included an evaluation of resources at risk such as Threatened or Endangered species, archaeological sites, unstable areas, and wetlands. Refer to Appendix

Table 10: Summary of Spoils Sites

County	Number of Spoils Sites	Total Capacity (yd^3)
Del Norte	3	58,500
Humboldt v1.4 & 1.5	29	1,150,963
Humboldt v1.3	29	1,210,573
Mendocino	207	98,701
Total	**268**	**2,518,737**

VI. TREATMENT COSTS

The total treatment cost for all sites amounts to over $24,000,000, averaging $16.88* per cubic yard of sediment. Approximately 837,000 yd^3 of the total inventory potential future yield (449 sites) can be treated for under $10/$yd^3$ (refer to Table 11). Individual site cost estimates were generated based on the treatment recommendations entered during data collection (refer to Appendix I). 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 J).

*Average cost per cubic yard of sediment does not include estimates from Humboldt v3. For a summary of treatment costs for the v3 Humboldt sites, refer to Appendix I2.

Table 11: Summary of Treatment Costs per yd^3 of Potentially Deliverable Sediment

Cost per yd^3	Number of Sites	Total Volume (yd^3)	Average Cost per yd^3
n/a[1]	363	118,023	n/a
n/a[2]	306	0	n/a
<$5	221	656,328	$2.42
$5-$10	228	175,745	$7.53
$10-$15	280	115,962	$12.60
$15-$20	347	76,202	$17.55
$20-$25	236	52,274	$22.45
$25-$45	879	131,032	$34.56
$45-$65	554	55,254	$54.43
$65-$85	352	27,719	$73.85
$85-$105	235	20,442	$94.04
>$105	973	29,594	$389.89
Totals	**4974**	**1,458,575**	
	Average Cost per yd3 for all sites: $16.88		

1-Treatment costs cannot be determined because recommended treatments were not entered during data collection. The majority of these sites are pending engineer review.
2-Sites with no volume indicate pending engineer checks, or crossings inventoried with no delivery.

VII. 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 K). Note that sites with High or High Moderate immediacy and $0/$yd^3$ were moved to the bottom of each section. This is because, as previously mentioned, Mendocino County sites that needed other treatments or an engineer check were often given a High or High Moderate immediacy. Therefore, the specific treatments required for these sites are not yet known and/or their price cannot be estimated. To compensate for this difference in the High and High Moderate immediacy sites between counties, 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 capitol 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 pending instability or erosion.

Erosion potential and sediment delivery play significant roles in determining the treatment priority of each inventoried site (see "treatment immediacy," 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 base 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.
- Counties do 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 staffing to the point that maintenance and public safety are compromised.

Of the 5,205 potential erosion sites, 338 were identified as maintenance sites (refer to the following chart). Each road department has been provided a summary of the maintenance sites, by treatment immediacy and potential sediment delivery volume. The road 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 12: Maintenance Activity Needs Identified During Inventory

County	# of sites	# Culverts to repair	# Culverts to clean	Ft. Ditch to Clean
Del Norte	4	0	3	20
Mendocino	85	28	42	40,754
Humboldt	252	17	25	5,958
Totals	341	45	70	46,732

A. Overall Treatment Prioritization Criterion

The 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 I). 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, capitol 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 Salmon 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 assure that the focus of restoration activities was on the highest priority sites.

3. Maintenance Plans and Capitol Improvement Criteria

Prioritization criteria are also based on the existing maintenance and capitol 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, capitol improvement and restoration actions. Other constraints must be factored in at the local level including multiple construction project schedules occurring within limited operating period restrictions, 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 SB 271 grants is $25 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 for 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, the Council recommended allocating $455,000 to National Forest roads projects and $145,000 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 Management Council Watershed 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 authorizing legislation for 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 funds projects within Shasta and Siskiyou Counties.

5. Regulatory Criteria- A significant number of regulatory factors are considered in the prioritization and implementation of sites (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 13: 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**
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, the Garcia River watershed treatment sites could be rated as a higher priority for implementation over similar sites in all other watersheds within this inventory because of the TMDL Implementation Plan for the Garcia River*.

Table 14: Federal and State Endangered Species Act- Status of ESA Listings of Salmon & Steelhead in the Five County 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
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 describe in Section VII above. To do this, a Simplified Prioritization Ranking Model has been developed as an Excel spreadsheet (refer to Appendix L for an example) that assigns a value to the criteria factors. This allows for

* 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 once a listing is established. Once the load allocation of sediment has been set for a watershed, implementation plans are to follow. Once an implementation plan is adopted, sediment reduction efforts in that watershed must be completed under a specified time frame. The only adopted implementation plan adopted to date is the Garcia plan, placing treatment in this watershed at higher priority than other watersheds.

assessment of sites based on the 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 factors of fisheries presence, 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 15: Simplified Prioritization Ranking Model

	Minimum Possible Score	Maximum Possible Score
DIRT Inventory Prioritization	0	225
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 a TMDL implementation plan 5 for a 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	
Sub-Total For Management Factors		100 points maximum

VIII. 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 then 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 $100 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 on-going 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.