

SUMMARY REPORT
101 BYPASS
REHABILITATION UNIT 87-1

Resources Management Division
Redwood National Park

by
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TABLE OF CONTENTS

	Page
INTRODUCTION	1
EROSION AND LAND USE HISTORY	4
EROSION CONTROL REHABILITATION WORK	8
Introduction	8
Objectives	8
Evaluation Phase	9
Heavy Equipment Phase	9
Cost Summary	9
Heavy Equipment	9
Heavy Equipment Costs	11
Heavy Equipment Evaluation	20
Labor Intensive Phase	20
REFERENCES	22
APPENDIX	
Soils of the May Creek Headwaters, Unit 87-1	
Photo Points and Description	

ILLUSTRATIONS

	Figures	Page
Figure 1. Location Map		2
Figure 2. Roads, Drainages, and Worksite Map		3
Figure 3. Erosion and Land Use History Map		7

Tables

Table 1. Summary Costs of Erosion Control Rehabilitation Work	10
Table 2. Heavy Equipment Sequencing	11
Table 3. Summary of Average Costs of Heavy Equipment Control Treatment	12
Table 4. Haul Road Stream Crossing Excavation	13
Table 5. Exported (Blade Endhaunched) Outsloping Summary	15
Table 6. Outsloping (No Endhaul) Summary	16
Table 7. Skid Trail Stream Crossing Excavation	17
Table 8. Deep Dish Excavation Summary	18
Table 9. Miscellaneous Heavy Equipment Rehabilitation Costs	19
Table 10. Straw Mulch Summary	21

INTRODUCTION

Rehabilitation Unit 87-1 is located about 2 miles due east of the intersection of May Creek with U.S. Highway 101. This intersection is about 5 miles north of Orick, California (see figure 1). The southern portion of the U.S. Highway 101 Bypass right-of-way borders Unit 87-1 and is currently under construction. When completed the new highway will have cut off access to the rehabilitation sites in the area. Beginning with Unit 87-1 and continuing through the next few years, Redwood National Park resources management staff will continue to address restoration in this area.

Unit 87-1 consists of the headwater regions of the May Creek drainage, and portions of the Boyes Creek and the Larry Dam Creek drainages. May Creek, Boyes Creek and Larry Dam Creek are tributaries to Prairie Creek. Prairie Creek intern is one of the major anadromous fish habitats in the area. Unit 87-1 contains 306 acres with 115 acres in the May Creek drainage and 76 and 115 acres in the Boyes Creek and Larry Dam Creek drainages respectively. There are 1140 feet of relief from the lowest elevation to the highest elevation. About 50% of this unit was logged in the early 1950's. The remainder was logged during the early to middle 1960's. As a result revegetation is heavy, with dense stands of fir and redwood second growth. Diameters of these second growth trees average from 1-2 feet (ft).

The bedrock in the area of unit 87-1 consists of the Cretaceous Franciscan assemblage and the Plio-Pleistocene sediments of the Prairie Creek Group (Kelsey and Cashman, 1983). Here the rocks of the Franciscan are "predominantly ... coherent sandstone and interbedded sandstone and mudstone" (Harden and others, 1981) and is found on the steep middle slopes from 35-70 percent. The Prairie Creek Group contains "unconsolidated to weakly consolidated silts, sands, and gravels" (Harden and others, 1981). The sands are more prevalent than the gravels in the observed exposures of the Prairie Creek Group in unit 87-1. The Prairie Creek Group is found on the ridge tops and is associated with gentle slopes of 10-40 percent. The soils derived from these two different rock types vary widely. The Franciscan derived soils are similar to the soils found in the Redwood Creek basin and include, "Coppercreek, Ahpah, Slidecreek, Tectah, Atwell and Lacks creek" (Popenoe and Sturhan, 1987). The Prairie Creek derived soils have been temporarily classified in the "Empire family of the Coppercreek series" (Popenoe and Sturhan, 1987). The appendix contains the complete soils report by Popenoe and Sturhan.

Unit 87-1 contained four major haul roads, the Upper May Creek Road, the Middle Road, the Access Road and the Spur Road, all of which were removed (see figure 2). The lower boundary of the unit begins at the junction of the Upper May Creek Road with the Upper Boyes Creek Road (hereafter refereed to as the junction). The Upper Boyes Creek Road is not in unit 87-1; the Upper May Creek Road is. From the junction the Upper May Creek Road is rehabilitated to a point 0.13 miles beyond the Larry Dam Creek stream crossing. The total treatment of the Upper May Creek Road is 1.14 miles. The Middle Road separates from the Upper May Creek Road at 0.68 miles from the junction and continues for another 0.70 miles. The Access Road separates from the Upper May Creek Road at 0.76 miles

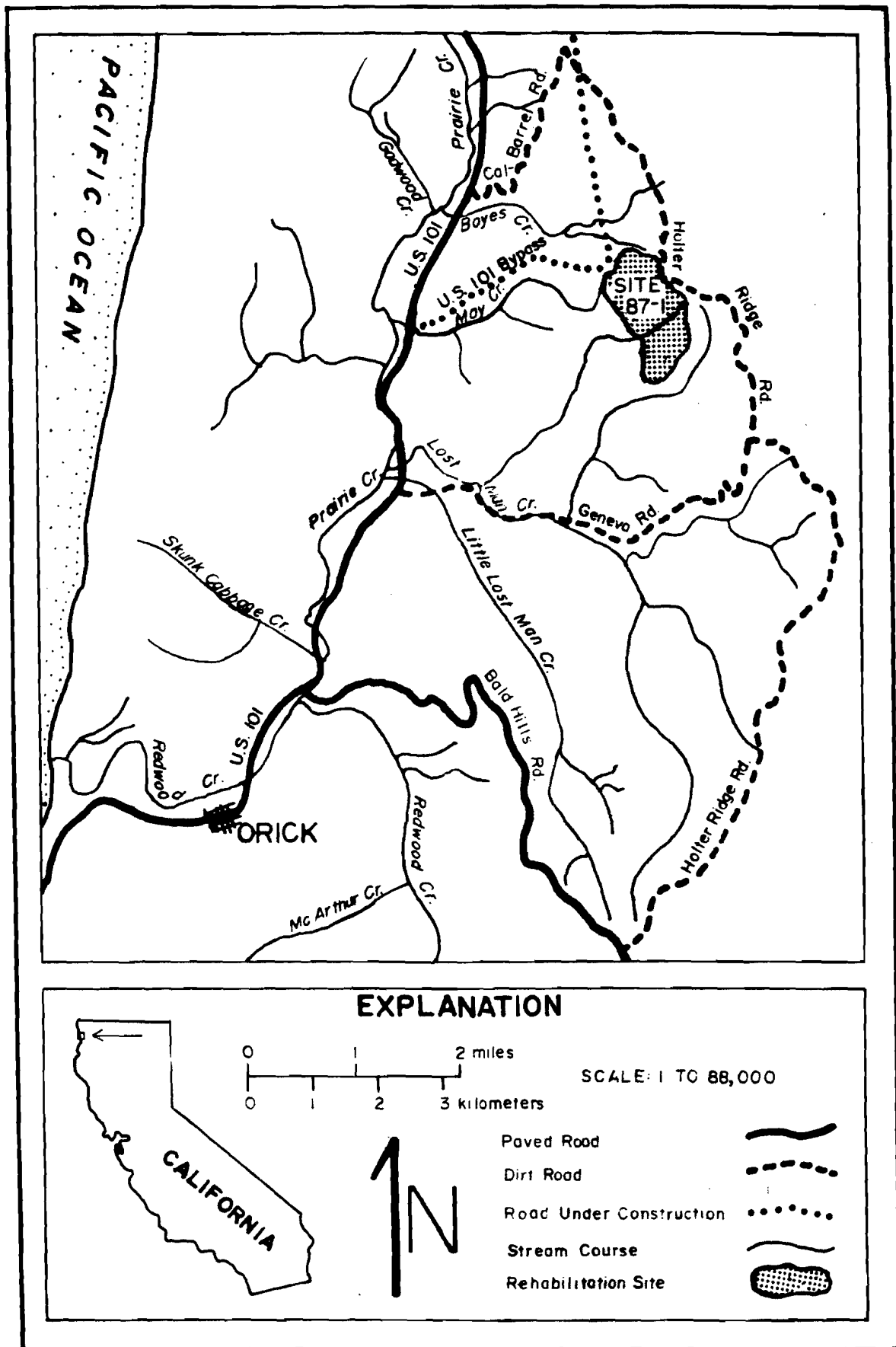


Figure 1
Location Map of Unit 87-1. Redwood National Park, (Bartolino, 1987).

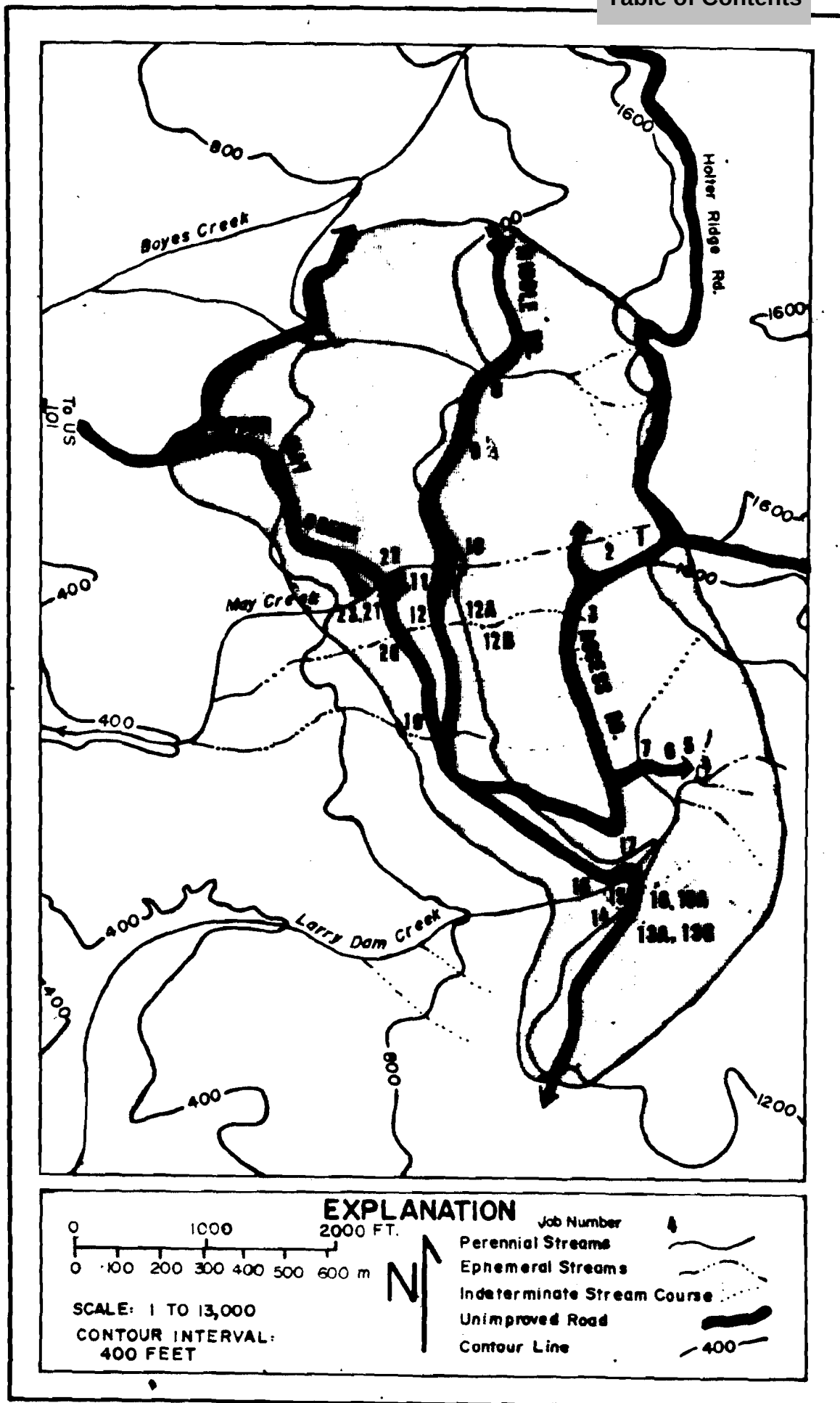


Figure 2
Roads, Drainages, and Work Site Map of Unit 87-1. Redwood National Park, (Bartolino, 1987).

from the junction and continues to Holter Ridge for a distance of 0.70 miles. Separating from the Access Road at 1.03 miles from the junction is the Spur Road. The rehabilitated section continues from this point along the spur for approximately 0.20 miles. The total rehabilitated Road network is 2.74 miles.

EROSION AND LAND USE HISTORY

The erosion and land use history section of this report were taken from the 1954, 1962, 1966, 1968, 1978, and 1984 aerial photos. Photo number and dates will be listed followed by a brief discussion of the observed land use history and/or erosion. Figure 3 (Erosion and Land Use History Map) accompanies this discussion.

1954 Aerial Photos:

CVL-14N-56 09-11-54

CVL-14N-57 09-11-54

Road Systems: The Upper Boyes Creek Road has not been constructed. The Upper May Creek Road appears constructed to the intersection of the Access Road with the Upper May Creek Road.

Logging History: There are cut trees observable on the slopes waiting to be yarded or skid. There seems to be an apparent recent yarder set up in the vicinity of the intersection of the Middle Road with the Upper May Creek Road.

Erosion: No observable road or slope erosion.

1962 Aerial Photos:

HCN-2 19A-81 1962

HCN-2 19A-82 1962

Road Systems: The Middle Road appears constructed and completed. The Upper May Creek Road is constructed to point "D", which is a landing between Larry Dam Creek and the junction of the Access Road with the Upper May Creek Road. The Access Road is constructed from the Upper May Creek Road to the Holter Ridge Road. The Spur Road has not been started.

Logging History: Most of the area between the Upper May Creek Road and the Access Road appears to have been skid logged.

Erosion: There seems to be no observable erosion or failures due to haul Road construction. There is no apparent water flowing over Road surfaces. There are however, several slope failures apparent. At point "A", which is a landing, there appears to be a debris torrent that initiated at the out board edge of the landing. This failure was caused by a skid trail diversion above the landing, causing water to flow across the landing and off of the outboard edge. At point "B" the slopes appear heavily disturbed, from the outboard edge of the Upper May Creek Road to the Middle Road, with cuts and fill. The fill on the outboard edge of the Upper May Creek Road appears wet. At point "C" there is a recent small landslide apparent.

1966 Aerial Photos:

AV-775-06-07 12-21-66
AV-775-06-08 12-21-66

Road Systems: The Upper May Creek Road is constructed from location "D" to the other side of Larry Dam Creek and connects with Geneva Road.

Logging History: All recent (since 1962) logging appears to have been tractor logged.

Erosion: Water appears to be running on the road surface (gullying?) from points "E-F", "D-F", "G-H", "K-L" and at point "M". There are not any new road or slope failures observable.

1968 Aerial Photos:

AV 840-05-04 03-30-68
AV 840-05-05 03-30-68

Road Systems: No new roads.

Logging History: No new logging activity present in this unit, although roads still appear to be used.

Erosion: All former road water paths still functioning with new water observed crossing the Road at point "I" and moving along the Road from point "J-I". New slope erosion not apparent.

1978 Aerial Photos:

RNP-78 07-05-78 19-15
RNP-78 07-05-78 19-16
RNP-78 07-05-78 19-17
RNP-78 07-05-78 21-14

Road Systems: No new Roads.

Logging History: No new logging activity.

Erosion: New road water not apparent. New road associated failures or slope failures not apparent. Ponded water observed at points "I" and "N".

1984 Aerial Photos:

RNP-84 07-02-84 18-24

RNP-84 07-02-84 18-25

Road Systems: No new roads.

Logging History: No new logging activity.

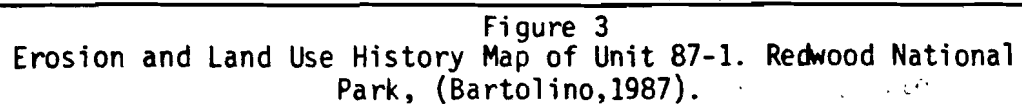
Erosion: Large debris torrent observed at point "O".

Post 1984:

Road Systems: No new roads.

Logging History: No new logging activity.

Erosion: Landslide at point "P", caused by a road diversion which occurred in the 1960's.



EROSION CONTROL REHABILITATION WORK

Introduction

The erosion control rehabilitation work at Redwood National Park consists of four different phases of work. These phases in order are: initial evaluation, heavy equipment, labor intensive, and final evaluation.

The evaluation phase begins with the geologist defining and quantifying drainage areas, documenting visible erosion problems associated with roads, skid trails and slopes, and documenting the logging activities which have occurred in the area. The initial assessment is done by aerial photographic reconnaissance. After the initial reconnaissance, the targeted areas along with the stream channels are field checked and mapped for geomorphology and erosion. During the field mapping, site specific erosion and potential erosion is documented.

As sites are visited they are also considered for erosion treatment. The factors to cogitate when considering a site for erosion treatment are: past erosion, current erosion, potential erosion, volume of material saved by rehabilitation or lost by non-action, accessibility of equipment to a site (is more damage being done by disturbing the forest and associated sediments through equipment entry than would happen by non-action), and the heavy equipment costs. After a site has been chosen for rehabilitation work it is then prescribed. This involves reviewing the prospective sites and recommending corrective or restorative procedures. Anticipating heavy equipment needs is an important part of this phase. It is by anticipating heavy equipment needs that time-space-equipment requirements and site costs are developed.

After a site is evaluated, and has been allotted time and money, the heavy equipment phase begins. During this phase of the project heavy equipment is brought in and the prescribed restoration work is accomplished. The heavy equipment usually consists of a hydraulic excavator, a bulldozer with a winch and/or a bulldozer with a ripper, and dump trucks. The type and number of pieces of equipment usually depends on the size of the project. If the project is smaller and the push distances are kept at a minimum then only a hydraulic excavator and a winch cat are needed. However if the site is large and the soil needs to be moved further then more equipment will be needed.

The labor intensive phase follows the heavy equipment phase. It is during this phase that straw mulch is applied to protect the barren soils. The bales of straw are usually distributed to the sites after the prescription phase and before the heavy equipment phase. After the heavy equipment work is completed at a particular site then labor crews come in and spread the straw.

Objectives

Logging activities increase erosion on forested lands. Unit 87-1 is not an exception. Aggraded stream channels, gullies in Roads and on slopes, and mass wasting of road fill and slopes have all occurred as a result of early logging activities in this unit. The objectives for rehabilitation in this unit were to identify all sources of erosion and minimize the existing erosion or the

potential erosion. This was accomplished. All of the 11 haul road crossings were removed completely or the total amount of fill was significantly reduced. Of the 37 skid trail stream crossings that were mapped in unit 87-1, 7 were found to have high to moderate diversion potentials. These were removed or corrected. The remaining 30 skid trail stream crossings had either failed at an earlier date or did not contain enough material in the crossing to warrant opening up skid trails to get equipment in. There were several mass wasting features which were mapped in unit 87-1 (these are noted in the Erosion and Land Use History Section of this report). The ones that were a direct result of stream diversions were corrected. The others were large enough that any impact which rehabilitation could have would be minimal. For this reason the larger ones were left untreated.

Evaluation Phase

The evaluation of Unit 87-1 took place between April and June of 1987. Table lists the total costs of the evaluation phase.

The mapping of unit 87-1 was done by R. Kahler, J. Hoffard and G. Bundros. Project supervisors during heavy equipment work were R. Kahler, J. Hoffard, and J. Bartolino.

Heavy Equipment Phase

Cost Summary

Total costs for unit 87-1 are shown on table #1. These costs are separated into their different phase costs, with individual aspects of phase costs also broken out. As shown the total costs for unit 87-1 is \$58,600.91. This figure represents costs to Redwood National Park from the initial mapping of the area through the construction work to the final summary report. Included within this figure are wage plus benefit costs paid to Redwood National Park personnel who worked on this project. Of the \$58,600.91 spent on rehabilitation work, \$43,626.82 or 74 percent was spent on actual earth moving restorative costs. Evaluation and documentation costs were \$14,974.09 or 26 percent of the total costs.

Heavy Equipment

Two pieces of heavy equipment were used in the restorative work of unit 87-1; a Case 220 hydraulic excavator (excavator) and a D8 Caterpillar winch cat (D8). The excavator was equipped with a 2.75 cubic yard bucket, a digging depth of 27 feet, and an engine with 223 horse power. This piece of equipment was leased and operated by Chris Hake of Arcata, California. The D8 was equipped with a winch, a 4-way hydraulic U-blade, power-shift, 24 inch wide tracks with 2.75 inch grousers and an engine with 270 horse power. This piece of equipment was owned by Twin Parks Lumber Company and operated by Jay Franke of Arcata, California.

Table 1
SUMMARY COSTS OF EROSION CONTROL REHABILITATION WORK
Unit 87-1

	Task	RNP Employees		YCC	Redwoods United	Heavy Equipment	Materials	Total Task Cost	Phase Totals	Phase %
		Geologist & Technician	Laborers							
EVALUATION PHASE	Mapping	\$5,472.30	--	--	--	--	--	\$5,472.30		
	Prescription	3,424.37	--	--	--	--	--	3,424.37		
	Planning								\$12,140.54	21%
	Brushing (initial)	143.30	2,550.30	--	--	--	--	2,693.60		
	Straw (location)	550.27	--	--	--	--	--	550.27		
HEAVY EQUIPMENT PHASE	Primary Treatment	5,933.56	--	--	--	\$19,944.09	--	25,877.65		
	Secondary Treatment	--	--	--	--	90.97	--	90.97	38,296.58	65%
	Miscellaneous	786.50	--	--	--	11,541.46	--	12,327.96		
LABOR INTENSIVE PHASE	Straw	--	--	--	--	--	\$1,115.49	1,115.49	5,330.24	9%
	Distribution & Application	693.57	1,694.12	\$368.50	\$1,458.56	--	--	4,214.75		
DOCUMENTATION PHASE	Cost Analysis and Reports	2,833.55	--	--	--	--	--	2,833.55	2,833.55	5%
TOTALS:		\$19,837.42	\$4,244.42	\$368.50	\$1,458.56	\$31,576.52	\$1,115.49	\$58,600.91	\$58,600.91	100%
% OF TOTAL:		34%	7%	1%	2%	54%	2%			

Usually it is desirable to have the D8 work slightly ahead of the excavator. This enables the D8 to remove the brush and to cut out some of the material from a work site. In unit 87-1 the second growth was so well established that both the D8 and the excavator were needed to brush the work sites. The D8 spent 13 hours and the excavator spent 19 hrs on brushing work sites. The D8 started on unit 87-1 one day before the excavator. By doing this it was able to open some of the roads and prepare some of the sites for the excavator. During the last week of the project the D8 developed serious engine problems and had to be replaced. At this point it was necessary to place the excavator on standby. To work the excavator without the D8 for the remainder of the project would have been counterproductive. Table #2 shows the sequencing of events for the heavy equipment.

HEAVY EQUIPMENT SEQUENCING (Table 2)

<u>Week No.</u>	<u>Dates</u>	<u>Work Locations</u>	<u>Type of Equipment</u>
1	08-03 to 08-07	Open Roads (Upper May Creek, Access, Spur, Middle). Work sites 1-8.	D8 & Excavator
2	08-10 to 08-14	Work sites 9-12.	D8 & Excavator
3	08-17 to 08-21	Work sites 13-18	D8 & Excavator
4	08-24 to 08-28	Work sites 19-23	D8 & Excavator

(station numbers of work sites are located on tables 4 through 8)

Heavy Equipment Costs

Heavy equipment costs for unit 87-1 are summarized on table #3. As can be seen, excavation of the haul Road crossings account for the largest volume and largest costs of the heavy equipment phase. Approximately 14,796 cubic yards of material were excavated from haul road crossings. This represents about 68 percent of the total excavated unit yardage. The costs for excavating haul Road crossings was \$13,793.93. This is about 70 percent of the primary heavy equipment costs. The average site cost for haul road crossings was \$1,254.00, with an average per yard cost of \$1.42.

Two haul road stream crossings stand out as having the highest unit costs and the lowest excavation rates (table #4). The first highest unit cost crossing is at station UM 25+00 (ws #19) on the Upper May Creek Road. This is the intersection of the Upper May Creek Road with the Middle Road. 850 cubic yards of material were removed from this dry excavation. This crossing was not expensive because of the difficulty of the work. The difficulty experienced here was with the equipment. The excavator was broken down twice at this crossing with broken hydraulic hoses. The D8 broke down on a Friday with engine problems and was repaired over the weekend. On the following Monday the D8's engine became totally non-functional. The final unit cost for this site is \$1.94 per cubic yard with an excavation rate of 46 cubic yards per piece-hour.

Table 3.
SUMMARY OF AVERAGE COSTS OF HEAVY EQUIPMENT EROSION CONTROL TREATMENTS
Unit 87-1

Totals:				Averages:				
Treatment	Number of Worksites	Total Quantity	Total Cost	Cost Per Worksite	Unit Cost Per Quantity	Range: Cost Per Quantity (yd ³)	Rate: Quantity Per Hour (yd ³)	Rate Range: Quantity Per Hour (yd ³)
Haul Road Stream Crossings	11	9,745 yd ³	\$13,793.93	\$1,253.99	\$1.42/yd ³	1.01-1.94	64	46-90
Skid Trail Worksites	7	760 yd ³	1,750.18	250.00	2.52/yd ³	1.53-3.87	41	23-60
Exported Outslope	1 200 LF	1,900 yd ³	806.64	4.03/LF	0.42/yd ³	0.42	211	211
Outslope	4 700 LF	2,000 yd ³	2,135.36	3.05/LF	0.91/yd ³	0.38-1.75	131	52-229
Drains(D)		47	1,109.78		23.61/drain			
Deep Dish	4	390 yd ³	348.20	87.05	1.04/yd ³	0.73-1.43	97	67-125
Miscellaneous	See Table 9		11,541.46					
TOTALS -		14,795 yd³	\$31,485.55					

Table 4
HAUL ROAD STREAM CROSSING EXCAVATION
Unit 87-1

Worksite#	Station	Excavation Volume Yd ³	Total Cost	Unit Cost \$/yd ³	Equipment Hours:		Excavation Rate yd ³ /pc-hr
					W	X	
3 A	11+88	450	\$492.28	\$1.09	3.75	1.75	82
4 Sp	00+25	250	270.90	1.08	1.75	1.25	83
7 Sp	09+75	450	723.73	1.61	4.50	3.50	56
8 M	07+10	1,200	1,518.71	1.27	9.00	7.75	72
9 M	15+40	2,800	2,824.10	1.01	15.00	16.00	90
10 M	26+00	350	541.79	1.55	3.50	2.50	58
12 M	33+30	475	788.94	1.66	5.25	3.50	54
17 UM	05+80	1,300	2,503.26	1.93	16.50	11.25	47
19 UM	25+00	850	1,648.69	1.94	13.50	5.00	46
20 UM	31+85	895	1,378.23	1.54	8.75	6.50	59
21 UM	38+00	725	1,103.30	1.52	7.50	4.75	59
TOTAL		9,745	\$13,793.93		89.00	63.75	
or							
AVERAGE		886	\$1,253.99	\$1.42	8.09	5.80	64

A: Access Road

Sp: Spur Road

M: Middle Road

UM: Upper May Creek Road

W: \$86.94 per hour: Caterpillar bulldozer, D8H-46A with winch, U-blade, and 24 inch tracks.

X: \$95.00 per hour: Case 220 Hydraulic excavator with 2.75 yd³ bucket.

Excavation rate is volume excavated divided by the total combined number of equipment hours.

The second highest unit cost crossing is the Larry Dam Creek crossing at station UM 05+80 (ws #17) on the Upper May Creek Road. At this crossing Larry Dam Creek is a third order stream with an approximate flow of 0.2 cubic feet per second (flow estimated during June, 1987). This crossing did not have a culvert or apparent visible humboldt logs. As a result of this, the total stream flow was across the crossing. Remarkably this crossing was mostly intact with some gullying occurring along the outboard edge. This crossing was constructed with a high degree of rocky material. A pond (with dimensions 80 feet by 30 feet) had developed on the upstream side of this crossing, and had filled in with loose silt sized sediments. The pond was drained approximately two months before actual excavation. This was done to minimize the anticipated difficulty of the excavation due to mud. Although the mud surrounding the pond did not dry completely through draining, it helped. Still a large portion of this excavation was soupy mud. As can be imagined, this proved to be quite a mess. The designated fill sight would not contain the fill because it would not pile. Even pushing the material with the D8 was challenging as mud would flow out on either side of the blade. In the end about 50 percent of this fill had to be pushed 300 feet further than prescribed. However, due to the experience of the operators no equipment became stuck, and we were able to excavate a difficult crossing. The unit cost for this crossing was \$1.93 per cubic yard with an excavation rate of 47 cubic yards per piece-hour.

The haul road crossing with the lowest unit cost was at station 15+40 on the Middle Road. 2800 cubic yards of material was removed from this crossing. This crossing had a high debris torrent potential. Because of this, a high volume of material needed to be moved. The unit cost for this crossing is \$1.01 per cubic yard, with an excavation rate of 90 cubic yards per piece-hour. The low costs for this crossing are a result of both pieces of equipment being able to work independently of each other during the majority of the excavation.

Outsloping was the next most costly treatment in unit 87-1. 3,900 cubic yards of material were excavated from five sites. This represents about 27 percent of the total excavated yardage. The costs for these treatments was \$2,942.00, which is 15 percent of the primary heavy equipment costs. The costs of moving this material ranged from \$0.38 to \$1.75 per cubic yard. The lowest per yard costs of outsloping was on the Access Road at station 04+70 (ws# 1, table #5). This material was in place outsloped with the excavator. The total amount of material moved was 400 cubic yards. The unit cost was \$0.38 per cubic yard with an excavation rate of 229 cubic yards per piece-hour. The unit cost was low at this site because the site preparation was minimal and the equipment was able to work independently of each other.

The highest per yard costs of outsloping was associated with the previously discussed muddy crossing on Larry Dam Creek (ws #17). Eight hundred cubic yards of material were outsloped at a unit cost of \$1.75 per cubic yard and an excavation rate of 52 cubic yards per piece-hour (table #5). The costs were high because this outslope reach was associated with the muddy crossing on Larry Dam Creek (ws #17) and 50 percent of this material had to be pushed for an extra 200 feet. This extra push combined with the generally muddy conditions slowed down the excavation of this crossing.

Table 5
EXPORTED (BLADE ENDHAULED) OUTSLOPING SUMMARY
Unit 87-1

Worksite	Station	Excavated Volume yd ³	Total Cost	Unit Cost \$/yd ³	<u>Equipment Hours:</u>		Linear Feet of Road	Volume Per Linear Foot of Rd. yd ³ /ft.	Mean Blade Endhaul Distance ft.	Excavation Rate yd ³ /pc-hr
					W	X				
5 Sp	02+25	1,900	\$806.64	\$0.42	6.0	3.0	200	9.5	70	211
TOTAL or AVERAGE		1,900	\$806.64	\$0.42	6.0	3.0	200	9.5	70	211

Sp: Spur Road

W: \$86.94 per hour; Caterpillar bulldozer, D8H-46A with winch, U-blade and 24 inch tracks.

X: \$95.00 per hour; Case 220 Hydraulic Excavator with 2.75 yd³ bucket.

Excavation rate is volume excavated divided by the total combined number of equipment hours.

Table 6
OUTSLOPING (NO ENDHAUL) SUMMARY
Unit 87-1

Worksite	Station	Excavated Volume yd ³	Total Cost	Unit Cost \$/yd ³	<u>Equipment Hours:</u>		Linear Feet of Road	Volume Per Linear Foot of Rd. yd ³ /ft.	Excavation Rate yd ³ /pc-hr
					W	X			
1 A	04+70	400	\$152.15	\$0.38	1.75		200	2.0	229
11 M	26+30	300	245.13	0.82	2.0	0.75	150	2.0	109
14 UM	02+00	500	336.10	0.67	2.5	1.25	100	5.0	133
18 UM	06+50	800	1,401.98	1.75	8.75	6.75	250	3.2	52
TOTAL		2,000	\$2,135.36		15.00	8.75	700		
or AVERAGE		500	\$533.84	\$0.91	3.75	2.9	175	3.1	131

A: Access Road

M: Middle Road

UM: Upper May Creek Road

W: \$86.94 per hour; Caterpillar bulldozer, D8H-46A with winch, U-blade, and 24 inch tracks.

X: \$95.00 per hour; Case 220 Hydraulic Excavator with 2.75 yd³ bucket.

Excavation rate is volume excavated divided by the total combined number of equipment hours.

Table 7
SKID TRAIL STREAM CROSSING EXCAVATION
Unit 87-1

Worksite#	Station	Excavation Volume Yd ³	Total Cost	Unit Cost \$/yd ³	Equipment Hours:		Excavation Rate yd ³ /pc-hr
					W	X	
12a M	33+20a	165	\$326.03	\$1.98	3.75	-. -	40
12b M	33+20b	150	356.25	2.38	-. -	3.75	44
13a UM	03+00a	150	237.50	1.58	-. -	2.5	60
13b UM	03+00b	125	355.82	2.85	3.0	1.0	31
16a UM	04+90	75	290.62	3.87	2.25	1.0	23
22 UM	38+00a	20	69.24	3.46	0.25	0.50	26
23 UM	38+00b	75	114.72	1.53	0.50	0.75	60
TOTAL		760	\$1,750.18		9.75	9.50	
or							
AVERAGE		108.6	\$250.03	\$2.52			41

M: Middle Road

UM: Upper May Creek Road

W: \$86.94 per hour: Caterpillar bulldozer, D8H-46A with winch, U-blade, and 24 inch tracks.

X: \$95.00 per hour: Case 220 Hydraulic excavator with 2.75 yd³ bucket.

Excavation rate is volume excavated divided by the total combined number of equipment hours.

Table 8
DEEP DISH¹ EXCAVATION SUMMARY
Unit 87-1

Worksite #	Station	Excavated Volume Yd ³	Total Cost	Unit Cost \$/yd ³	Equipment Hours:		Excavation Rate Yd ³ /pc-hr
					W	X	
2 A	05+80	40	\$47.50	\$1.19		0.50	80
6 Sp	05+40	175	138.47	0.79	0.50	1.00	117
15 UM	03+00	50	71.25	1.43		0.75	67
16 UM	04+90	125	90.98	0.73	0.50	0.50	125
TOTAL		390	\$348.20		1.00	2.75	
or AVERAGE		97.50	\$87.05	\$1.04			97

A: Access Road

Sp: Spur Road

UM: Upper May Creek Road

W: \$86.94 per hour; Caterpillar bulldozer, D8H-46A with winch, U-blade, and 24 inch tracks.

X: \$95.00 per hour; Case 220 Hydraulic Excavator with 2.75 yd³ bucket.

¹Deep dishes are generally <150 yd³ excavations designed to remove fill from zero order basin areas or headwater swales, and to improve drainage.

Table 9
MISCELLANEOUS HEAVY EQUIPMENT REHABILITATION COSTS
Unit 87-1

Task	Task Cost	Equipment Hours:			% of Total Heavy Equipment Cost
		W	B	X	
Mobilization	\$1,156.72				3%
Access	1,075.53	8.00		4.00	3%
Standby	950.00			20.00	3%
Breaks	1,364.55	7.50		7.50	4%
Discussion	3,267.29	16.00		19.75	9%
Brushing	2,935.22	13.00		19.00	8%
Paid Down	229.44	1.00		1.50	1%
Stuck Equipment	112.71	0.75		0.50	<1%
Drain Pond	450.00		10.0		1%
TOTALS	\$11,541.46	46.25	10.0	72.25	31%

W: \$86.94 per hour; Caterpillar bulldozer, D8H-46A with winch, U-blade, and 24 inch tracks.

B: \$45.00 per hour; Case Backhoe.

X: \$95.00 per hour; Case 220 Hydraulic Excavator with 2.75 yd³ bucket.

The costs for skid trail crossings, deep drains, and cross road drains was \$3,208.16. This represents 16 percent of the total primary heavy equipment costs (table #3, table #7 and table #8).

Miscellaneous heavy equipment costs total \$11,541.46 and account for 30 percent of the total heavy equipment costs (table #8). As can be seen brushing and discussion are the single largest costs on this table. Because of the extensive second growth developed in unit 87-1 the brushing of work sites and the disposal of the slash took longer than anticipated. The discussion time was higher than past years because the site geologists were in their first heavy equipment season and needed to talk methods through more thoroughly before deciding upon a course of action.

Heavy Equipment Evaluation

An experienced heavy equipment operator who is intimately familiar with the capabilities of his machine is the single most valuable asset of the heavy equipment phase of rehabilitation. The heavy equipment phase of unit 87-1 was a success because of the experienced heavy equipment operators which were on the site. Mr. Jay Franke has worked for the park for five seasons as a D8 operator and has continued to show exceptional skill and judgement. Mr. Chris Hake has worked for the park for several seasons as an excavator operator. He has also demonstrated his expertise in this type of work. Both Mr. Franke and Mr. Hake were excellent as operators and proved to be a valuable resource on the best use of their piece of equipment. Some difficulties were encountered (as in work site # 17); however, the experience of the operators made a seemingly difficult situation move along quite smoothly.

Labor Intensive Phase

The labor intensive phase of unit 87-1 was divided into two parts. Part one is distribution and part two is spreading. The Redwood National Park inhouse labor crew along with a crew supplied by Redwoods United Incorporated was responsible for the distribution of the straw. Three hundred sixty-one bales of straw were distributed to the work sites of unit 87-1. This represents 131 person hours of work and a total distribution cost of \$1263.18. Because some of the work sites were narrow and steep it was necessary to place the straw on the high cutbanks with the excavator before the heavy equipment work progressed too far along at a specific work site.

The Redwood National Park inhouse labor crew, the Redwood United Incorporated crew, and the Youth Conservation Corps all worked to spread the straw in this unit. The spreading of the straw took 320 person hours which represents \$2258.00. The initial cost of the 361 bales of straw was \$1115.49 or \$3.09 per bale. By the time the straw was distributed and spread, the cost rose to \$4,636.67 or \$12.84 per bale (table #10). The main focus of the straw mulch was at haul road crossings and on outslope reaches. The straw was spread at a rate of 5000 pounds per acre over most areas. Spreading the straw was done as soon after the heavy equipment finished a site as was practical.

Table 10
STRAW MULCH SUMMARY
Unit 87-1

	Number of Bales	RNP		RUI		YCC		TOTAL COST	COST per BALE
		Person Hours	Cost	Person Hours	Cost	Person Hours	Cost		
Materials	361							\$1,115.49	\$3.09
Distribution		65	\$780.72	66	\$482.46			1,263.18	3.50
Spreading		80	913.40	130	976.10	110	\$368.50	2,258.00	6.25
TOTAL		145	\$1,694.12	208	\$1,458.56	110	\$368.50	\$4,636.67	\$12.84

RNP: Redwood National Park, Resource Management labor crew

RUI: Redwoods United Incorporated labor crew

YCC: Youth Conservation Corps

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