

Lower Boyes Creek Roads
Rehabilitation Project

Unit 89-6

Louise E. Johnson

January 1990

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REHABILITATION UNIT 89-6 LOWER BOYES CREEK ROADS AND SLOPES

INTRODUCTION

Public Law 95-250 (March 27, 1987) directed that a rehabilitation program be developed for some 48,000 acres in the Redwood Creek basin of Redwood National Park. Before these lands were added to the park in 1978, timber harvesting and related road construction had adversely influenced erosion rates, sediment deposition, and water quality within the entire basin. It is these problems that are being addressed in the rehabilitation program. The purpose of the rehabilitation program is to minimize man-induced erosion within Redwood National Park and to encourage the return of a natural pattern of vegetation. Ultimately the efforts should result in the restoration of natural ecosystems to a condition similar to what would have existed without disturbance by man. (Redwood National Park, Watershed Rehabilitation Plan, April 1981.)

Watershed rehabilitation work related to the construction of the 101 Bypass, was completed for Caltrans under a Memorandum of Agreement by Redwood National Park Rehabilitation Staff and National Park hourly heavy equipment contracts. All prior existing roads which were reopened and used for construction activities were rehabilitated using Caltrans funding. Prior existing roads which were not reopened by Caltrans or the contractor, and that would become isolated when reopened access roads were removed, were rehabilitated using National Park Service funding.

Lower Boyes Creek rehabilitation project encompasses approximately 450 acres in the Boyes Creek drainage, a major tributary to Prairie Creek. Approximately 2.7 miles of haul road was restored (outsloped) for a total cost of \$86,234.94 (heavy equipment costs only). Twenty-four haul road stream crossings were excavated totalling 27,500 yd³ of material removed, 1.4 mile of haul road was outsloped involving the excavation of 12,770 yd³, and one rock pit was recontoured back to natural hillslope topography. Total rehabilitation project cost was \$109,632.00, of which \$73,658.00 was Caltrans funded and the remaining \$35,974.00 was National Park Service funded (refer to Tables 1, 1A and 1B).

REHABILITATION UNIT 89-6 SUMMARY**UNIT NAME:** Lower Boyes Creek Roads**PROJECT LEADER:** Louise Johnson

LOCATION DESCRIPTION: T11N, T12N, R1E, R2E, S1,6,12 on the Holter Ridge, CA, 7.5 minute topographic series map. Located in the Boyes Creek drainage, a major tributary to Prairie Creek, approximately 6 miles north from Orick, CA. (Map A, pg 6; Map B, pg 7)

TOTAL UNIT ACREAGE: 450**MILES OF ROAD TREATED:** 2.7**TOTAL REHABILITATION PROJECT COST:** \$109,631.97 (Table 1, pg 3)

Geology, geomorphic, soils, land use/logging history and erosion features descriptions refer to Unit 89-1 Report by G. Bundros, incl. Map C.

REHABILITATION WORK SUMMARY¹(pg 8):**HOURLY CONTRACT Project**

- I. Total Heavy Equipment Cost: \$86,234.97 (Table 2, pg 14)
(Refer to Table 1A & 1B for Caltrans and In-House Funded Work Summaries, Map D, pg 24.)

Heavy Equipment Used:

- 1) Caterpillar D8H winch bulldozer @ \$99.47/hour (Twin Parks)
- 2) Kobelco K909 excavator @ \$123.00/hour (E.P.Johnson)
- 3) Caterpillar D8H ripper bulldozer @ \$143.00/hour (E.P.Johnson)

<u>Types of Treatment</u>	<u>Total Cost</u>	<u>Quantity</u>	<u>Unit Cost</u>	<u>Rate</u>
Stream Crossings	\$46,984.14	27,500yd ³	\$1.71/yd ³	64yd ³ /PH
Slope Worksites	2,601.45	1,885yd ³	1.38/yd ³	85yd ³ /PH
Export Outsloping	2,237.28	1,965yd ³	1.14/yd ³	92yd ³ /PH
Outsloping-roads	8,900.94	7,510yd ³	1.19/yd ³	99yd ³ /PH
Outsloping-decks	7,969.89	5,260yd ³	1.52/yd ³	72yd ³ /PH
Cross Road Drains(D)	543.07	6D/315ft	1.72/ft	66 ft/PH
Ripping	1,287.00	9,600ft	.13/ft	1067ft/PH
Other Expenses	10,351.20	--	--	--
Move In & Out	5,360.00	--	--	--

- II. Total Labor Intensive Cost: \$7,793.00 (Table 9, pg 23)

Labor Intensive Work Summary:

Straw Mùlch: Number of Bales = 725
Total Acreage Covered = 13
Total Unit Cost = \$7,706.00
Unit Cost = \$10.63/bale

Other: Log cable cutting at Rx3, 7 RNP person hours, \$87.00.

DISCUSSION¹: Refer to text, page 12.

¹ Detailed in report text.

Table 1

REHABILITATION WORK COST SUMMARY
Unit 89-6: Lower Boyes Creek Roads

<u>Treatment</u>	<u>Worksite Quantity</u>	<u>Total Cost</u>	<u>Average Unit Cost Per Quantity</u>	<u>Average Rate: Quantity Per Piece Hour</u>
HEAVY EQUIPMENT WORK:				
<u>Primary Treatments</u>				
Stream Crossings	27,500 yd ³	\$46,984.14	\$1.71/yd ³	64yd ³ /PH
Slopework (sx,os)	1,885 yd ³	2,601.45	1.38/yd ³	85yd ³ /PH
Export Outsloping	1,965 yd ³	2,237.28	1.14/yd ³	92yd ³ /PH
Road Outsloping	7,510 yd ³	8,900.94	1.19/yd ³	99yd ³ /PH
Deck Outsloping	5,260 yd ³	6,679.45	1.27/yd ³	86yd ³ /PH
Rock Pit Outslope	--	1,290.44	--	--
Cross Road Drains	315 ft.	543.07	1.72/ft.	66ft./PH
Ripping	9,600 ft.	1,287.00	.13/ft.	1067ft./PH
<u>Miscellaneous (Table 8)</u>		<u>15,711.20</u>	--	--
Total Heavy Equipment Cost = \$86,234.97				
LABOR INTENSIVE WORK:				
<u>Secondary Treatments</u>				<u>Person Hours</u>
Straw	725 Bales	\$7,706.00	\$10.63/bale	485
<u>Miscellaneous</u>				
Cable Cutting	--	<u>87.00</u>	--	7
Total Labor Intensive Cost = \$7,793.00				
TECHNICAL WORK:				
<u>Evaluation</u>				<u>Person Hours</u>
Mapping		\$ 497.00		34
Prescriptions		1,267.00		87
Surveying		1,471.00		117
Contract Preparation		722.00		50
<u>Supervision of Work</u>				
Heavy Equipment		9,656.00		576
<u>Documentation</u>				
Photo Points		493.00		44
Cost Analysis and Report		1,498.00		115
Total Technical Work Cost = \$15,604.00				
GRAND TOTAL COST = \$109,631.97				

Table 1A

**CALTRANS FUNDED REHABILITATION WORK COST SUMMARY
UNIT 89-6: LOWER BOYES CREEK ROAD AND NALLY'S CUTOFF ROAD**

Treatment	Hours			Total Cost	Total Volume
HEAVY EQUIPMENT WORK:					
	D8W	Exc	D8R		
18 Haul Road Stream Crossings	172.75	76.00	9.50	\$27,890.00	17,345 yd³
2 Export Outslope Road Sections	7.50	4.75	--	1,330.00	1,175 yd³
4 Slope Worksites (under the bridge)	5.75	13.75	--	2,263.00	1,685 yd³
7 Outslope Road Sections	50.75	59.50	--	12,367.00	9,220 yd³
4 Cross Road Drains	1.75	1.00	--	297.00	235 ft of drain
Ripping	--	--	9.00	1,287.00	9,600 ft of road
Other Rehabilitation Expenses	44.50	14.25	2.75	6,572.00	--
Move In & Out	--	--	--	5,360.00	--
Total Hours =	283.00	169.25	21.25		
Total Heavy Equipment Cost =				\$57,366.00	

LABOR INTENSIVE WORK:					
Secondary Treatments: RNP Laborers 407 hrs Straw Mulch				\$6,485.00	610 Bales
Total Labor Intensive Cost =				\$6,485.00	

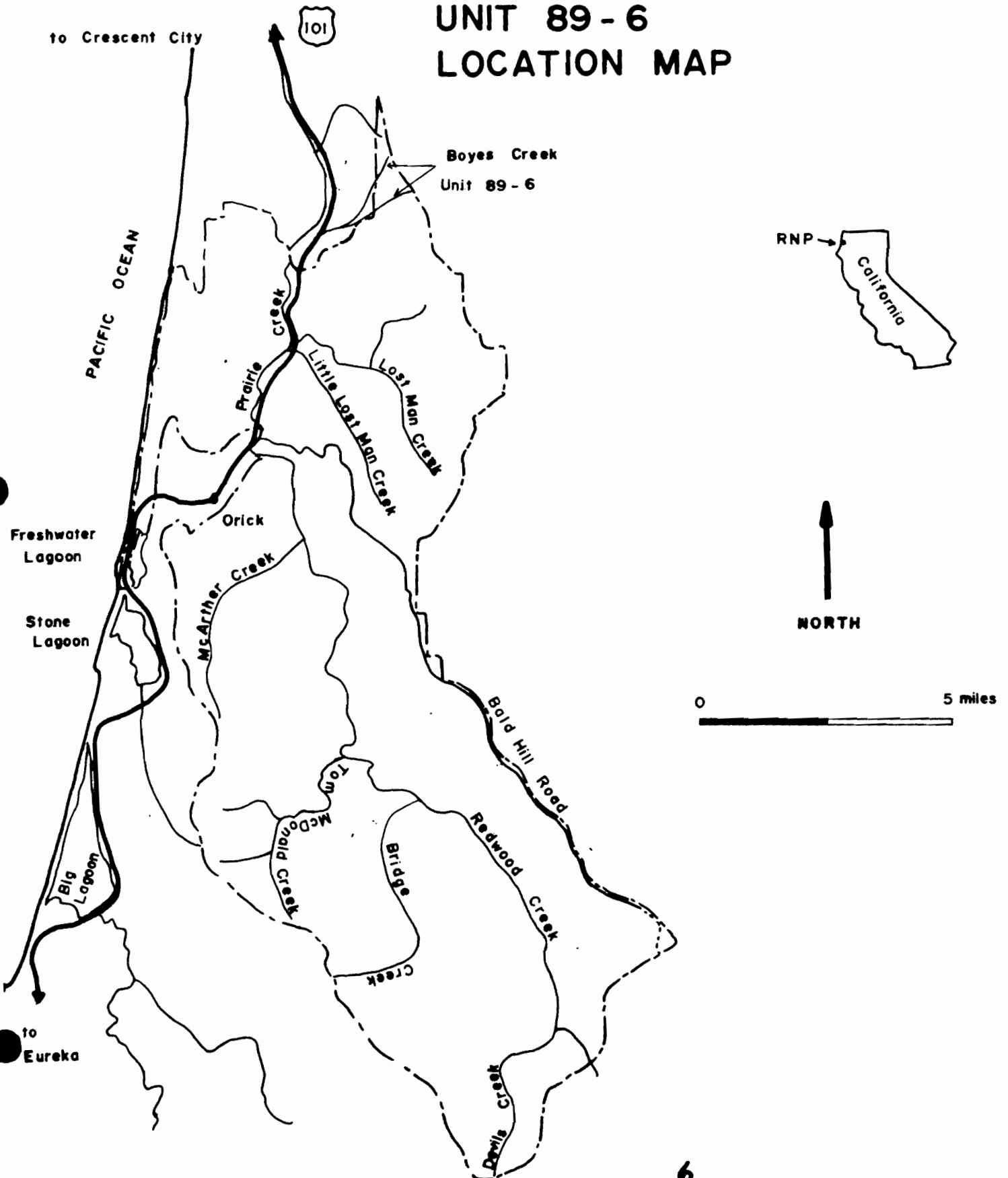
TECHNICAL WORK:					
	RNP Staff:				
Mapping	34 hrs			\$ 497.00	
Prescriptions	58 hrs			849.00	
Surveying	78 hrs			986.00	
Heavy Equipment Supervision	386 hrs			6,470.00	
Cost Analysis Documentation	77 hrs			<u>1,004.00</u>	
Total Technical Work Cost =				\$9,806.00	
GRAND TOTAL COST =				\$ 73,658.00	

Table 1B

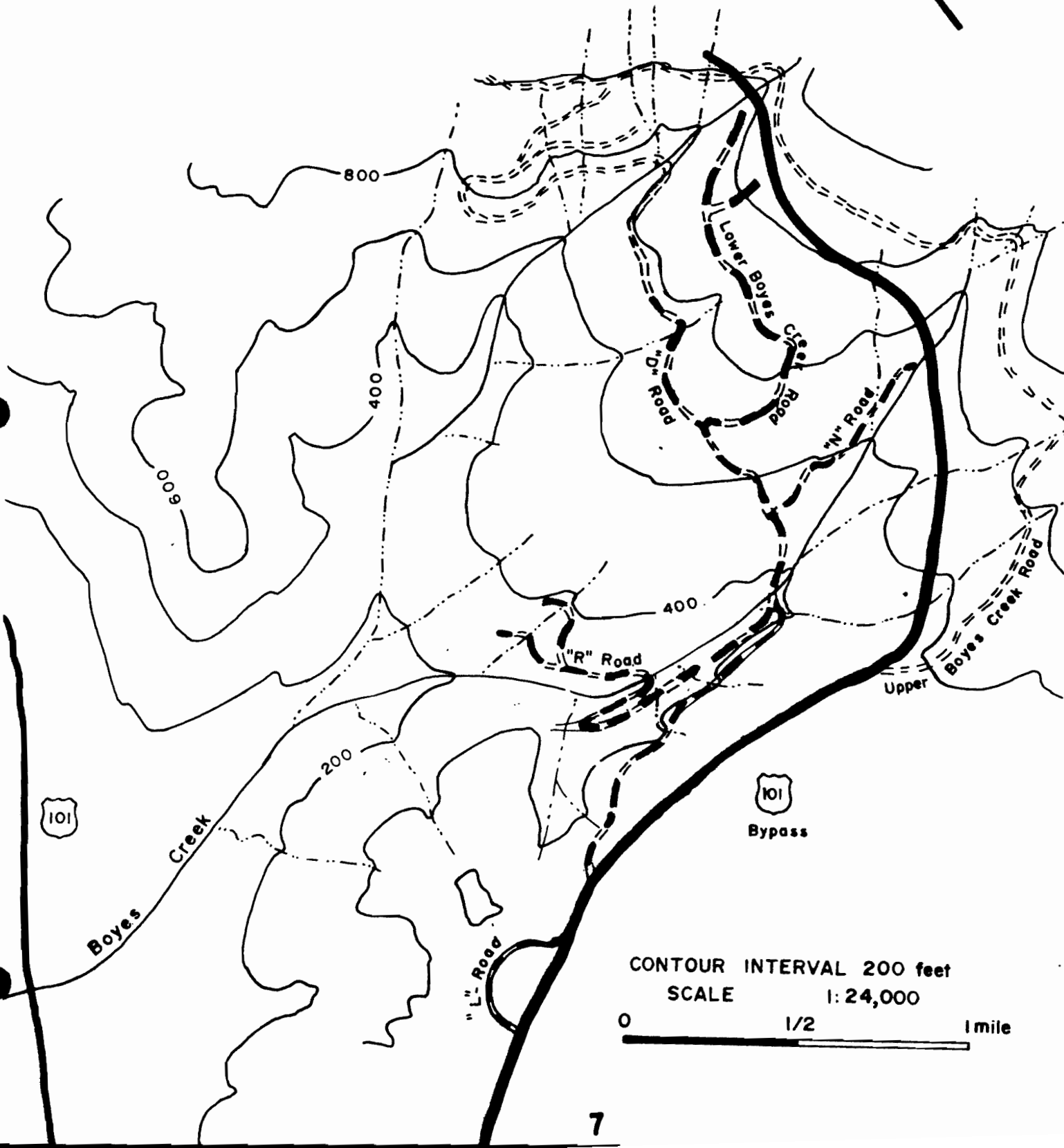
IN-HOUSE (REDW) FUNDED REHABILITATION WORK COST SUMMARY
Unit 89-6: "D" Road and "R" Road

Treatment	Hours		Total Cost	Total Volume
HEAVY EQUIPMENT WORK:				
	D8W	Exc		
6 Haul Road Stream Crossings	102.00	72.75	\$19,094.00	10,155 yd³
2 Export Outslope Road Sections	8.50	.50	907.00	790 yd³
1 Slope Worksite	--	2.75	338.00	200 yd³
5 Outslope Road Sections	13.75	25.50	4,504.00	3,550 yd³
2 Cross Road Drains	--	2.00	246.00	80 ft of drain
Other Rehabilitation Expenses	19.75	14.75	3,779.00	--
Total Hours =	144.00	118.25		
Total Heavy Equipment Cost =			\$28,868.00	
LABOR INTENSIVE WORK:				
Secondary Treatments: Straw Mulch	RNP Laborers 78 hrs		\$ 1,221.00	115 Bales
Miscellaneous: Cable Cutting	RNP Laborers 7 hrs		87.00	--
Total Labor Intensive Cost =			\$ 1,308.00	
TECHNICAL WORK:				
	RNP Staff			
Prescriptions	29 hrs		\$ 418.00	
Surveying	39 hrs		485.00	
Contract Preparation	50 hrs		722.00	
Heavy Equipment Supervision	190 hrs		3,186.00	
Photo Points	44 hrs		493.00	
Cost Analysis Documentation	38 hrs		494.00	
Total Technical Work Cost =			\$5,798.00	
GRAND TOTAL COST =			\$35,974.00	

MAP A WATERSHED RESTORATION UNIT 89 - 6 LOCATION MAP



MAP B WATERSHED RESTORATION UNIT 89-6 TOPOGRAPHIC MAP



REHABILITATION WORK

Primary erosion control rehabilitation treatments concentrated on features capable of delivering sediment directly into the main tributary streams and the main stem of Boyes Creek. These features were haul road and skid trail stream crossings, and unstable road reaches adjacent to streams. The remaining sections of road were outsloped to help accelerate revegetation thus leading to the restoration of the ecosystem and the partial elimination of man's impact upon the land (unfortunately the stumps and skid trails are beyond total visual obliteration). Table 2 summarizes average unit costs and excavation rates for all types of treatments completed on unit 89-6. Map D shows all worksites completed on unit 89-6. Worksite numbers may have letters (e.g., N, R, D, L) inbetween the treatment designation (e.g., OS, EOS, Rx, ST, Sx) and the worksite number, this letter refers to the spur road inwhich that worksite is located on. If no letter is between the treatment designation and worksite number, that worksite is located on Lower Boyes Creek Road.

As stated in the Introduction, the rehabilitation work on unit 89-6 was completed under two different funding sources, Caltrans and National Park Service, depending upon which road system the work was completed on. Only Tables 1A and 1B separate the cost summaries for the rehabilitation work completed under each funding source. For simplicity the following discussion about each type of rehabilitation treatment completed on the unit, and cost summary tables 2 through 9, are combined covering all work completed on the unit without regard to the funding source. All worksite costs on all five road networks are categorically combined and summarized together.

Redwood National Park's watershed rehabilitation and erosion control program is divided into four work phases: 1) Evaluation, 2) heavy equipment, 3) labor intensive, and 4) documentation.

Evaluation Phase

The evaluation phase for unit 89-6 included geomorphic mapping, prescribing rehabilitation treatments, completing volumetric surveys and compiling the new hourly format contract package. The geomorphic mapping for both Upper and Lower Boyes Creek Rehabilitation Units was completed by a hand full of park geologists and these hours are summarized in G. Bundros' in-house report for Unit 89-1. Mapping costs included in this report are only for L. Johnson. Prescriptions and surveys were completed between April 1989 and July 1989, and involved 15 person days to complete. Contract preparation involved 5 person days to complete in March 1989.

Heavy Equipment Phase

The heavy equipment rehabilitation work on unit 89-6 was done under the new hourly heavy equipment contract format developed this year. Two bulldozers and one excavator was utilized on the unit. One of the bulldozers was a Caterpillar D8H with a "U"-blade and winch which was awarded to Twin Parks Lumber Company

(CX #8000-9-0008) with an hourly rate of \$99.47 (Jay Franke, operator). The other bulldozer and the excavator were awarded to E. P. Johnson Construction Company (Kennewick, Washington), CX #8000-9-0007. The second bulldozer was a Caterpillar D8H with a "U"-blade and rippers (\$143.00 per hour), operated by John Jackson (sub-contractor with E.P. Johnson). The excavator was a Kobelco K909LC Mark II with a 1.36 yd³ bucket (SAE heaped capacity) at \$123.00 per hour, operated by Bill Reese and Jim Harrison.

The D8 winch bulldozer and Kobelco excavator worked together throughout the entire project, and the D8 ripper bulldozer was used only to rip the rock surfaced roads, and to assist in the excavation of one very large stream crossing (Rx8). The D8 winch bulldozer and Kobelco excavator were not matched in production rates which made for an inefficient combination of equipment. But due to a contract error, the bid had to go to the low bid excavator even though it was not the most cost effective piece of equipment to use with a D8-sized bulldozer. This equipment mismatch is discussed in further detail in the next section.

Heavy equipment work began on August 10, 1989, and took 42 days to complete (totalling 735.75 hours of combined heavy equipment time). Work was completed on September 30 at sunset! And Louise packed her truck and went on vacation on October 1st!

Haul Road Stream Crossings

Twenty-four haul road stream crossing excavations were completed on unit 89-6. Table 3 details the excavation costs, unit costs and excavation rates for each haul road stream crossing. The total cost for 24 crossings was \$46,984.14, with a unit cost of \$1.71 per cubic yard and an overall excavation rate of 64 cubic yards per hour per piece of equipment. A total of 27,500 cubic yards of fill material was excavated from the 24 crossings. All worksites are located on Map D.

These haul road stream crossings were excavated to prevent erosion due to road fill failures and/or stream diversions resulting from potential culvert/humboldt fill constructed failures. Excavations were designed to tie into stable base levels at, or near, the original channel bed level, and with sideslopes of 30-45 percent. Most of the crossings had an average push distance to a fillsite of 200 feet or less. Though nine crossings had a push distance of 300-500 feet. These are listed on page 2 of Table 3.

Unfortunately due to a contracting error the most cost effective combination of equipment was not obtainable the way the contract was written. Therefore an unmatched dozer-excavator combination (based on individual production rate capabilities) had to be used on unit 89-6. This posed a difficult dilemma for maintaining high production rates on very large and difficult stream crossing excavations. The excavator was much smaller (1+ cubic yard bucket size) than what has been proven to be the most cost effective sized excavator (2.5-3.0 cubic yard bucket) on past rehabilitation projects (in FY87 and FY88). The D8 bulldozer could easily bury this excavator or have very long coffee breaks inbetween pushes. To avoid either of these problems, the bulldozer was used for more hours to prep large stream crossings, while the excavator worked

independently on road outslope and hillslope worksites. Stream crossings could then be ditched down to a point where the channel was ready to be defined by the excavator. Also a major draw back of the little "itsybitsy" excavator was its inability to move large old growth logs and rootwads. Therefore, more time was consumed in winching than is normal when using a large 3 cubic yard excavator which has plenty of horse power to lift old growth rootwads from the bottom of a stream crossing excavation. Several times I thought the "little scooper" was going to have a hernia trying to lift a saturated rootwad from a crossing!

The heavy equipment excavation method was similar for almost all the crossings. The excavation method of using the bulldozer independently first then having the excavator finish defining the stream channel worked well on most of the crossings except those which turned to quagmires midway through the excavation and the two log bridge crossings. Rx1 was the worst excavation for wet'n muddy conditions, which required the excavator to complete the crossing independently due to the dozer's candid ability of getting stuck. The two log bridges on unit 89-6 were very large (1,830 and 2,165 cubic yards) and composed of one to two dozen 5-6 feet diameter old growth logs that were 50-60 feet in length. The first step was to blade off the fill material on top of the logs and dig out around the ends of the logs on both side banks. Then the excavator could wiggle the ends of the logs just enough to get a choker around each one, then the dozer winched each log to the fillsite. After the logs were removed the remaining muck in the channel was excavated out using the excavator and the side banks were pulled back to a stable grade.

At Rx8 on Lower Boyes Creek Road, both D8 bulldozers were used to maximize the excavation production rate since the fillsite push distance was over 300 feet away and 2,165 cubic yards needed to be excavated. Though an unforeseen problem was encountered two-thirds of the way through the excavation and it was not water'n mud, it was an extremely hard competent lens of bluegoo which was almost impossible to dig through to achieve the prescribed channel grade. Both the D8 winch bulldozer and excavator "chiselled" away at it, finally getting to grade after 15 hours of frustration. This channel should not erode!

Overall the stream crossing excavation rates on unit 89-6 were low impart due to the small excavator and to the large organic filled wet crossings encountered. Normal excavation rates on past rehabilitation units where medium to large excavators (2.0-3.0 cubic yard bucket) were used run between 75-100 cubic yards per hour per piece of equipment. Unit 89-6 had an overall excavation rate of only 64 cubic yards per hour.

Slopework

Two types of erosion control rehabilitation treatments were completed on the hillslopes adjacent to Lower Boyes Creek Road and "R" Road. These were three skid trail stream crossing excavations and two skid trail outslope sections. All worksites are located on Map D. Table 4 details the costs, unit costs and production rates for each worksite. The total cost for the five worksites was \$2,601.45, with an average unit cost of \$1.38 per cubic yard, and an average excavation rate of 85 cubic yards per hour per piece of equipment. Heavy equipment time and costs include opening skid trails and travel time to and from between the haul roads and slope worksites.

Primary heavy equipment method was to use the excavator independently on all slope worksites since fillsite locations are usually within reach of the excavator requiring no bulldozer push time. This allowed the bulldozer time to prep haul road stream crossings. On Sx2 the bulldozer dished down the crossing then the excavator finished it, and on STOS2 the bulldozer completed the finish outslope work after the excavator roughed out the outslope.

Haul Road Treatments

There were four types of erosion control rehabilitation road treatments completed on this unit: Export (blade endhaunched) outsloping, outsloping, cross road drains and ripping. All worksites are located on Map D. Four export outslope road sections were completed for a total cost of \$2,237.28, with an average unit cost of \$1.14 per cubic yard and an average excavation rate of 92 cubic yards per hour per piece of equipment. Table 5 details the costs, unit costs and production rates for each worksite. The primary heavy equipment method was to use the bulldozer to remove 80-100 percent of the volume. Only on steep export outslope sections (EOSN1) did the excavator need to pull up the outboard edge material. All export outslope worksites had an average fillsite push distance of 200 feet or less.

One and four-tenths of a mile (7,506 feet) of haul roads was outsloped, with a total of 12,770 cubic yards of fill material moved. Total cost for all outsloping was \$16,870.83, with an average unit cost of \$1.32 per cubic yard and an average excavation rate of 85 cubic yards per hour per piece of equipment. These costs are detailed for each outslope reach in Table 6, which also includes average cubic yard per linear foot of road. This table also sub-divides deck outsloping and the recontouring of a rock pit from general road outsloping.

Primary heavy equipment excavation method for outsloping was to use the excavator to pull up all outboard edge of road material and "rough-out" this fill material against the cutbank. Then the bulldozer smoothed and contoured this fill into the finished outslope. This is a very efficient method which allows the bulldozer to work on export outslope and/or stream crossing worksites while the excavator is outsloping independently. All of the outsloping completed on this unit was a mild partial to complete recontouring of the road prism. In most cases the cutbank fill height did not exceed ten feet. One outsloping experiment was implemented on this site. This was an attempt to outslope a section of road which went up the spine of a ridge. Here the excavator was able to retrieve fill material from both sides of the road digging around and between stumps and mounding this fill material on the center line of the road thus resulting in a mid-road convex outslope. This section of road is just upslope of "N" road on Lower Boyes Creek Road.

Four decks were mildly outsloped using the excavator to pull up the outboard edge fill material while the bulldozer pushed this material against the cutbanks creating a mild 10-25 percent outslope. One rock pit was recontoured on Lower Boyes Creek Road near Rx6. The majority of the rehabilitation work was completed by the bulldozer, though several hundred cubic yards were retrieved (outsloped) from the edge of the rock pit by the excavator.

Six cross road drains were constructed on unit 89-6 for a total cost of \$543.07, with an average unit cost of \$1.72 per linear foot of drain. Also 1.8 mile of road was ripped for a total cost of \$1,287.00 and an average unit cost of \$.13 per linear foot of road. These costs are detailed in Table 7. Not all roads were ripped on the unit. Only Lower Boyes Creek Road and "L" road were ripped by the D8 ripper bulldozer. These roads were heavily rocked, whereas the other roads were unsurfaced dirt roads.

Other Rehabilitation Work Costs For Heavy Equipment

Table 8 details all other rehabilitation work costs for heavy equipment which were incurred on unit 89-6 totalling \$10,351.20. These include road opening ("R" and "D" roads), brushing worksites, paid breaks, general discussions, travel between roads, paid down time not in excess of one quarter hour, stuck in the mud times and helping, fueling and moving straw bales. Move in and out cost for all three pieces of heavy equipment totalled \$5,360.00.

Labor Intensive Phase

The labor intensive phase involved the application of straw mulch to prevent surface erosion and aid revegetation on the freshly disturbed ground on all rehabilitation worksites completed on unit 89-6. The total area disturbed by rehabilitation efforts and treated with straw mulch was 13 acres, and a 4000lbs/acre application rate was used. The total number of straw bales used on the unit was 725 bales, costing \$2,466.00. The straw bales were distributed and spread by Redwood National Park (RNP) labor crews, totalling 485 person hours and costing \$5,240.00. The total unit cost for straw mulch on unit 89-6 was \$7,706.00, with an overall unit cost of \$10.63 per bale (Table 9).

One miscellaneous task was completed on the unit and this was the cutting of a long high lead logging cable at Rx3 on Lower Boyes Creek Road. The cable ran parallel to the road on the fillslope of the stream crossing. To prevent the equipment from becoming tangled in the cable during excavation work, the cable was cut (torched) into 5-foot pieces which could be disposed of in the fillsite without threat of entanglement. Total cost of this work was \$87.00 completed by a RNP laborer.

Documentation Phase

Following completion of the erosion control and rehabilitation heavy equipment work, the worksites were surveyed where needed, photo points were retaken, cost data was compiled, and the annual report was prepared. Total cost of this phase was \$1,991.00, involving 16 person days to complete. Work was done by L. Johnson, J. Wood, and T. Hardt, and was completed by January 1990!

DISCUSSION

The quality of the rehabilitation work completed on unit 89-6 by the heavy equipment operators and labor intensive crews was excellent. Due to the contract error that precluded the ability to choose a larger excavator, the excavation rates were lower than they have been on past rehabilitation sites of similar intensity. Unfortunately the error made in the contract equipment requirements was meant not to limit bids due to a select size class on the excavator, but to allow all sizes of medium to large excavators to bid, then we hoped to be able to choose the most cost effective one based on its hourly bid price and its hourly excavation production rate average. This was later determined not feasible due to a contract law that states ALL contracts must be awarded to the lowest bidder, as long as they meet or exceed the minimum requirements. Therefore in the future the new hourly contracts should specify exactly the size piece of equipment needed: Example = a D8-sized bulldozer and a 3 cubic yard (bucket size) excavator. This will hopefully eliminate any more booboos in the future. Otherwise the new hourly contract format works well and still allows the project supervisor to control the work sequence and application of equipment on worksites.

Once again I felt it was very important to completely restore the Lower Boyes Creek Rehabilitation unit as cost effectively as possible and to restore the land to a condition similar to what would have existed without disturbance by man (which is the Congressional mandate set forth in Public Law 95-250). When prescribing rehabilitation treatments, management needs to consider the future use and needs of the park and in particular the importance of mature stands of second growth forest in Northern California. This park may seem like it receives few visitors especially in the "backcountry", but we must remember that in 50-100 years from now the visitor pressure on the resources here will be tremendous, due to the ever increasing population in California and the country. People will be hiking in the Redwood Creek basin and they will be offended if old rocked road prisms are still visible in forested areas and on the prairies. And they'll ask the questions "where was that \$33 million spent; and why are there roads still in the park where none should exist?" It is our responsibility as land managers to protect and preserve the resources for today's and future generations to enjoy. So no matter how far out in the basin or removed from a public road a rehabilitation site is, it will be visited in the future and therefore should be restored as best as possible to a condition similar to what would have existed without disturbance by man! So OUTSLOPE!

Table 2

SUMMARY OF AVERAGE COSTS OF HEAVY EQUIPMENT EROSION CONTROL TREATMENTS
Unit 89-6: Lower Boyes Creek Roads

Treatment	Hours		D8R	Total Cost	Total Quantity	Unit Cost per Quantity	Rate: Quantity Per Hour	Linear Feet of Road	Percent of Total
	D8W	Exc							
Haul Road Stream Crossings	274.75	148.75	9.50	\$46,984.14	27,500yd ³	\$1.71/yd ³	64yd ³ /Hr	2,558	54%
Skid Trail Worksites	5.75	16.50	--	2,601.45	1,885yd ³	1.38/yd ³	85yd ³ /Hr	--	3%
Exported Outslope	16.00	5.25	--	2,237.28	1,965yd ³	1.14/yd ³	92yd ³ /Hr	450	3%
Outslope (roads)	19.00	57.00	--	8,900.94	7,510yd ³	1.19/yd ³	99yd ³ /Hr	6,481	10%
Outslope (decks)	45.50	28.00	--	7,969.89	5,260yd ³	1.52/yd ³	72yd ³ /Hr	1,025	9%
Drains(D)	1.75	3.00	--	543.07	6D/315Ft	1.72/Ft	66Ft/Hr	550	1%
Ripping	--	--	9.00	1,287.00	9,600 Ft of road	.13/Ft of road	1067 Ft of road per hour	9,600	2%
Other Expenses	64.25	29.00	2.75	10,351.20	--	--	--	--	12%
Move In & Out	--	--	--	5,360.00	--	--	--	--	6%
TOTALS =	427.00	287.50	21.25	\$86,234.97	44,120 yd³				

Table 3

HAUL ROAD STREAM CROSSING EXCAVATION COSTS
Unit 89-6: Lower Boyes Creek Roads

Worksite	Hours ¹			Total Cost	Volume: ² Cubic Yards	Unit Cost/ Yard	Rate: ³ Cubic Yards/ Hour	Linear Feet of Road
	D8W	Exc	D8R					
Rx1	13.25	8.50	--	\$2,363.48	1,100	\$2.15 ⁵	51	120
Rx2	4.50	2.00	--	693.62	650	1.07	100	70
Rx3	5.50	4.50	--	1,100.59	660	1.67	66	95
Rx4	3.00	1.00	--	421.41	300	1.40	75	70
Rx5	10.50	.75	--	1,136.69	600s	1.89	53	112
Rx6	14.50	15.25	--	3,318.07	1,830s	1.81 ⁴	62	90
Rx7	15.75	.25	--	2,212.40	1,480s	1.50	70	84
Rx8	36.75	15.00	9.50	6,859.02	2,440s	2.81 ⁶	40	115
Rx9	2.75	--	--	273.54	360	.76	131	75
Rx10	5.75	--	--	571.95	430	1.33	75	65
Rx11	3.25	--	--	323.28	240	1.35	74	53
Rx12	3.75	--	--	373.01	450	.83	120	82
RxD1	35.00	22.50	--	6,248.95	3,320s	1.88	58	245
RxN1	12.00	11.50	--	2,608.14	2,460s	1.06	105	142
RxN2	10.75	10.25	--	2,330.05	1,775s	1.31	85	105
RxN3	4.75	2.00	--	718.48	670s	1.07	99	85
RxR5/6	14.75	11.25	--	2,850.93	1,865s	1.53	72	200
RxR7	12.75	4.00	--	1,760.24	1,120s	1.57	67	100
RxR8	23.50	22.75	--	5,135.80	2,165s	2.37 ⁴	47	150
RxR9	12.75	7.75	--	2,221.49	1,330s	1.67	65	100
RxR10	3.25	4.50	--	876.77	355s	2.47	46	70
RxL1	7.25	--	--	721.16	650	1.11	90	100
RxL2	5.25	--	--	522.22	450	1.16	86	80
RxL3	13.50	--	--	1,342.85	800	1.68	59	150

TOTALS =

24	274.75	148.75	9.50	<u>\$46,984.14</u>	27,500	1.17	64	2,558 Ft
crossings					cubic	(ave)	(ave)	.5 mile
					yards			

Footnotes continued on the next page...

Table 3, page 2

HAUL ROAD STREAM CROSSING EXCAVATION COSTS
Unit 89-6: Lower Boyes Creek RoadsFootnotes:

¹ D8W @ \$99.47/hour, Exc @ \$123.00/hour, D8R @ \$143.00/hour.

Primary heavy equipment method used was to utilize the bulldozer as much as possible to dish down the stream crossings prior to the excavator's arrival. Crossings which were done this way usually have the highest production rates and lowest unit costs, otherwise the material is handled twice. On wet, muddy crossings the excavation method relies heavily on the use of the excavator due to their ability to "walk" on water'n mud.

² All worksites were surveyed prior to heavy equipment work using the HP survey programs. Volumes with "s" next to them were surveyed post heavy equipment work. Worksites not surveyed post heavy equipment had little change from the pre-volume surveys.

³ All haul road crossings had a push distance to a fillsite of 200 feet or less, except those listed here: Rx1, Rx2, Rx5, Rx6, Rx7, Rx8, RxD1, RxR5/6, and RxR8. These nine crossings each had an average push distance of 300 to 500 feet.

⁴ Rx6 and RxR8 were large log bridge crossings requiring hours of winching 4-5 foot diameter old growth logs (50-60 feet long), and cleaning out the mud and debris that accumulated under each bridge, an extremely slow process. Both crossings had fillsites over 400 feet distant.

⁵ Rx1 was an extremely wet muddy excavation which limited the use of the D8W bulldozer about two-thirds of the way through the excavation. The remaining volume had to be bailed out by the excavator 2-3 times before the muddy material was in the fillsite location.

⁶ Rx8 had a fillsite push distance of over 300 feet. It also has a very competent lens of fine-grained blue-goo which was extremely hard to dig channel grade through, making the excavation of the final channel grade a slow tedious process.

Table 4

SKID TRAIL STREAM CROSSING AND OUTSLOPE EXCAVATION COSTS
Unit 89-6: Lower Boyes Creek Roads

Worksite	Hours ¹		Total Cost	Volume: ² Cubic Yards	Unit Cost per Cubic Yard	Rate: ³ Cubic Yards Per Hour
	D8W	Exc				
Sx1	--	3.00	\$ 369.00	300	\$ 1.23	100
Sx2	2.75	3.00	642.54	550	1.17	97
SxR1	--	2.75	338.25	200	1.69	73
STOS1	--	2.50	307.50	170s	1.81	68
STOS2	3.00	5.25	944.16	665s	1.42	81
TOTALS =						
5 worksites	5.75	16.50	<u>\$ 2,601.45</u>	1,885 cubic yards	1.38 (ave)	85 (ave)

¹ D8W @ \$99.47/hour, Exc @ \$123.00/hour.

Primary heavy equipment method is to use the excavator on slope worksites which have close fillsites. This frees up the bulldozer to prep (dish down) haul road stream crossings prior to the excavator's arrival.

² All worksites were surveyed prior to heavy equipment work using the HP survey programs. Volumes with "s" next to them were surveyed post heavy equipment work because the excavations changed in design from the pre-surveys, thus the volumes were different.

³ All worksites had a fillsite push distance of 200 feet or less.

Table 5

EXPORTED (BLADE ENDHAULED) OUTSLOPE ROAD EXCAVATION COSTS
Unit 89-6: Lower Boyes Creek Roads

Worksite	Hours ¹		Total Cost	Volume: ² Cubic Yards	Unit Cost/ Cubic Yards	Rate: ³ Cubic Yds Per hour	Linear Ft. of Road	Cubic Yards/ Ft. of Road
	D8W	Exc						
EOS1	2.25	--	\$ 223.81	250s	\$.90	111	100	2.50
EOSN1	5.25	4.75	1,106.47	925s	1.20	93	150	6.17
EOSR1	7.00	.50	757.79	615s	1.23	82	100	6.15
EOSR2	1.50	--	149.21	175	.85	117	100	1.75
TOTALS =								
4 worksites	16.00	5.25	<u>\$2,237.28</u>	1,965 cubic yards	\$1.14 (ave)	92 (ave)	450 feet of road	4.37 (ave)

¹ D8W @ \$99.47/hour, Exc @ \$123.00/hour.

Primary heavy equipment method was to use the bulldozer to remove 80-100% of the volume. Only steep export outslopes (EOSN1) required the use of the excavator to pull the outboard edge material.

² All worksites were surveyed prior to heavy equipment work using the HP survey programs. Volumes with the "s" next to them were surveyed post heavy equipment work because the excavations changed in design from the pre-surveys, thus the volumes were different.

³ All worksites had a fillsite push distance of 200 feet or less.

Table 6

OUTSLOPE ROAD EXCAVATION COSTS
Unit 89-6: Lower Boyes Creek Roads

Worksite	Hours ¹		Total Cost	Volume: ² Cubic Yards	Unit Cost/ Cubic Yards	Rate: Cubic Yds/ Per Hour	Linear Ft.of Road	Cubic Yards/ Ft.of Road
	D8W	Exc						
Road								
Reaches:								
OS1	--	1.25	\$ 153.75	135s	\$1.14	108	150	.90
OS2-Rd	.50	6.25	818.49	695s	1.18	103	1,150	.60
OS3-Rd	5.75	15.75	2,509.20	2,245s	1.12	104	2,571	.87
OS4-Rd	6.00	11.50	2,011.32	1,855s	1.08	106	1,335	1.39
OS5	2.25	5.75	931.06	735s	1.27	92	400	1.84
OS6	.75	--	74.60	80e	.93	107	75	1.07
OSN1	.50	2.00	295.74	300s	.99	120	150	2.00
OSR2	1.00	2.25	376.22	255s	1.48	78	125	2.04
OSR3	1.00	6.50	898.97	575s	1.56	77	250	2.30
OSR4	.50	3.50	480.24	345s	1.39	86	200	1.73
OSR5	.75	2.25	351.35	290s	1.21	97	75	3.87
ST=	19.00	57.00	8,900.94	7,510	1.19	99	6,481	1.16
Decks: ³								
OS2-Dk	9.75	8.00	1,953.83	1,150s	1.70	65	250	4.60
OS3-Dk	11.75	3.50	1,599.27	1,400s	1.14	92	275	5.09
OS4-Dk	3.00	3.50	728.91	625s	1.17	96	200	3.13
OSR1	10.50	11.00	2,397.44	2,085s	1.15	97	300	6.95
ST=	35.00	26.00	6,679.45	5,260	1.27	86	1,025	5.13
Rock Pit: ⁴								
OS4-RP	10.50	2.00	1,290.44	--	--	--	--	--
TOTALS =								
16 worksites	64.50	85.00	<u>\$16,870.83</u>	12,770 cubic yards	\$1.32 (ave)	85 (ave)	7,506 1.4 mile	--

Footnotes continued on next page...

Table 6, page 2

OUTSLOPE ROAD EXCAVATION COSTS
Unit 89-6: Lower Boyes Creek RoadsFootnotes:

¹ D8W @ \$99.47/hour, Exc @ \$123.00/hour.

Primary heavy equipment method for outsloping is to use the excavator to pull up all outslope material and "rough-out" the material against the cutbank. Then the bulldozer smoothed and contoured the fill material into the finished outslope. Using the excavator to outslope frees up the bulldozer to allow it to work on stream crossings where fill needs to be pushed a distance to a fillsite.

² All worksites were surveyed prior to heavy equipment work using the HP survey programs. Volumes were unchanged post heavy equipment work = "s". The "e" means the volume was estimated (eyeballed).

³ Decks (DK) were mildly outsloped using the excavator to pull the outboard edge fill material up to the road while the bulldozer pushed this material up against the cutbanks creating a mild 10-25% outslope. there are duplicate worksite numbers (OS2, OS3, and OS4) which shows that a deck was outsloped within this long road section.

⁴ One rock pit was recontoured on Lower Boyes Creek Road near Rx6. The majority of the work was completed by the bulldozer, though several hundred cubic yards were retrieved (outsloped) from the edge of the rock pit by the excavator.

Table 7

HAUL ROAD RIPPING AND DRAIN CONTRUCTION COSTS
Unit 89-6: Lower Boyes Creek Roads

Category	Hours ¹			Cost	Quantity	Quantity	Per Hour
	D8W	Exc	D8R				
Ripping	--	--	9.00	\$1,287.00	9,600ft.	\$.13/ft.	1,067'/hr
Drains-D	1.75	3.00	--	543.07	6D/315ft.	1.72/ft.	66ft./hr
TOTALS =	1.75	3.00	9.00	<u>\$1,830.07</u>	--	--	--

¹ D8W @ \$99.47/hour, Exc @ \$123.00/hour, D8R @ \$143.00/hour.

Table 8

OTHER REHABILITATION WORK COSTS FOR HEAVY EQUIPMENT
Unit 89-6: Lower Boyes Creek Roads

Category	Hours ¹			Total Cost
	D8W	Exc	D8R	
Road Opening ("R" and "D" roads) ²	13.75	--	--	\$ 1,367.71
Brushing Worksites (RX's) ³	10.25	5.75	--	1,726.82
Paid Breaks	19.50	13.00	1.00	3,681.67
General Discussions	8.75	4.25	.75	1,500.36
Travel Between Roads ⁴	4.00	2.75	1.00	879.13
Paid Down Time	1.25	1.25	--	278.09
Stuck and Helping	5.50	1.00	--	670.08
Fueling	1.00	.25	--	130.22
Moving Straw Bales	.25	.75	--	117.12
TOTALS =	64.25	29.00	2.75	<u>\$ 10,351.20</u>

¹ D8W @ \$99.47/hour, Exc @ \$123.00/hour, D8R @ \$143.00/hour.

² Both the "R" and "D" roads were overgrown and not driveable. In order to deliver straw bales and fuel the equipment, both roads were opened (brushed and bladed) using the D8W bulldozer.

³ Instead of brushing the haul road stream crossings with labor crews, the heavy equipment brushed the 10-15 year old alder from the crossing fillslopes prior to beginning each excavation. The excavator does a fine job along the outboard edge of crossings and fillslopes, and the bulldozer does a fine job brushing fillsites and road surfaces.

⁴ Travel between "R" road to "N" road to "D" road to the end of Lower Boyes Creek road (under the bridge) and then to the "L" road.

Table 9

LABOR INTENSIVE COSTS
Unit 89-6: Lower Boyes Creek Roads

<u>Work Types</u>	<u>Type of Laborers</u>	<u>Person¹ Hours</u>	<u>Total Cost</u>	<u>Quantity</u>	<u>Cost/Quantity</u>
Secondary Treatments:					
Straw Distribution	RNP	204	\$2,208.00	725 Bales	\$3.05/ bale
Straw Application	RNP	281	3,032.00	725 Bales	4.18/ bale
Straw Acquisition	--	--	2,466.00	725 Bales	3.40/ bale

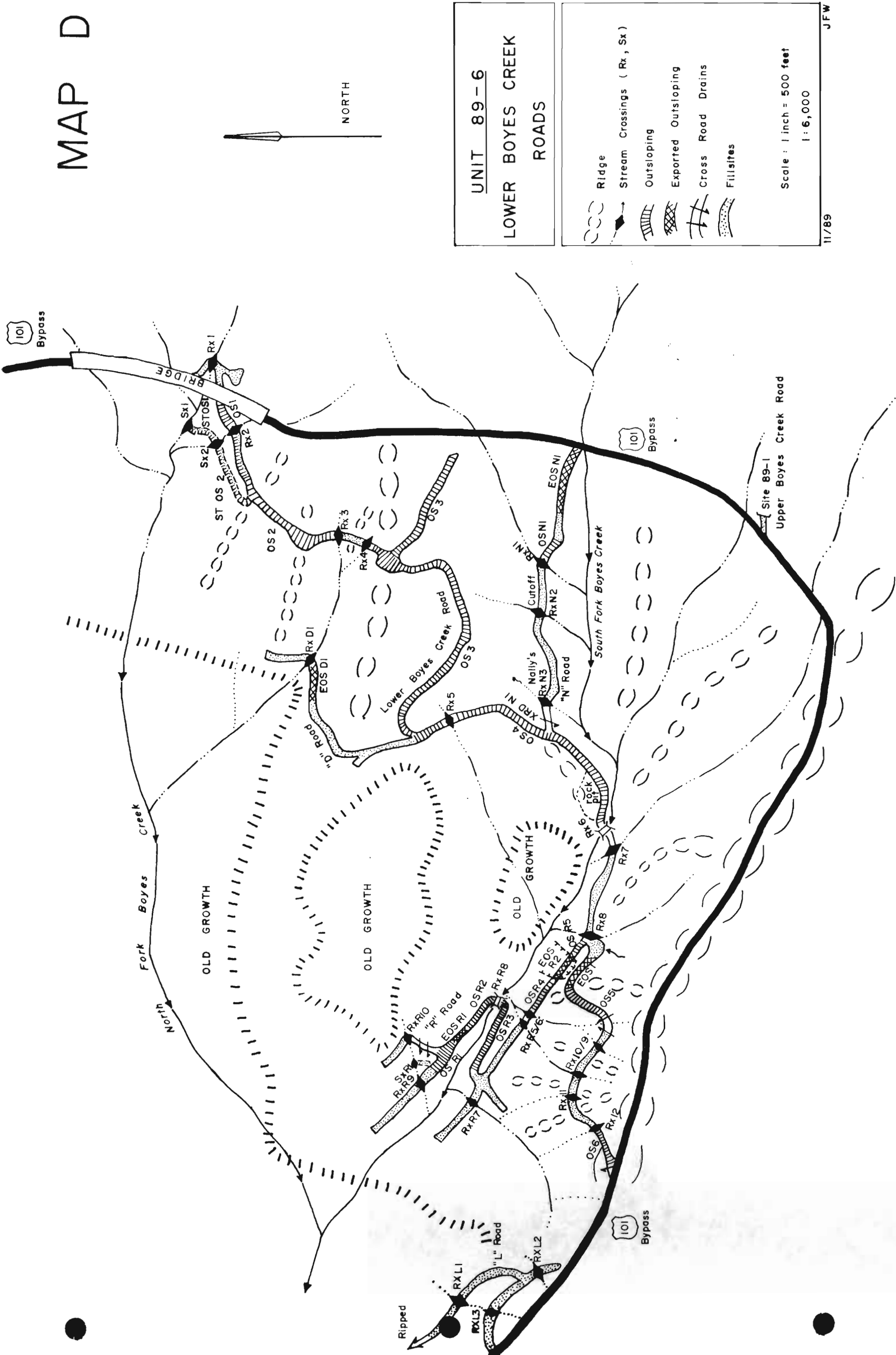
Total Secondary Treatments =			\$7,706.00	725 Bales	\$10.63/ Bale
Miscellaneous:					
Cable Cutting ²	RNP	7	87.00	--	--

Total Miscellaneous Costs =			\$ 87.00	--	--
TOTAL LABOR INTENSIVE COSTS =			<u>\$ 7,793.00</u>		

¹ Wages used to determine costs for RNP employees include benefits. All person hours and costs include round trip travel time.

² At RX3 on Lower Boyes Creek Road, an old logging yarding cable (100's of feet long) was cut (torched) into 5-10 foot sections to prevent the heavy equipment from becoming tangled up in it during the excavation of this stream crossing.

MAP D



THE END