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Summary Report of Work
Performed on Rehab. Unit 83-3,
Bridge Creek

by
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INTRODUCTION

The M-3/M-4 Rehabilitation Unit, 83-3, is located on the west side of Redwood Creek, roughly 15 miles upstream from Orick. The unit encompasses 490 acres of the eastern headwaters of Bridge Creek (refer to Map A). It is bordered to the east by the east fork of Bridge Creek, to the south by the M-3-1 Road, and to the west by a major divide.

Relief on this unit is 1,350 feet. Elevations range from 800 to 2,150 feet. Hillslope steepness varies considerably, averaging 45 percent and ranging from 0 percent to 120 percent. In both the northeast and southwest portions of the unit, hillslopes along ridgelines change dramatically in steepness. Northwest aspects dip gently at approximately 10 percent, while northeast aspects exceed 55 percent. In general, hillslope profiles between drainages are convex, and become concave within the drainages. Amphitheaters with hummocky and/or tread and riser topography are common throughout the unit.

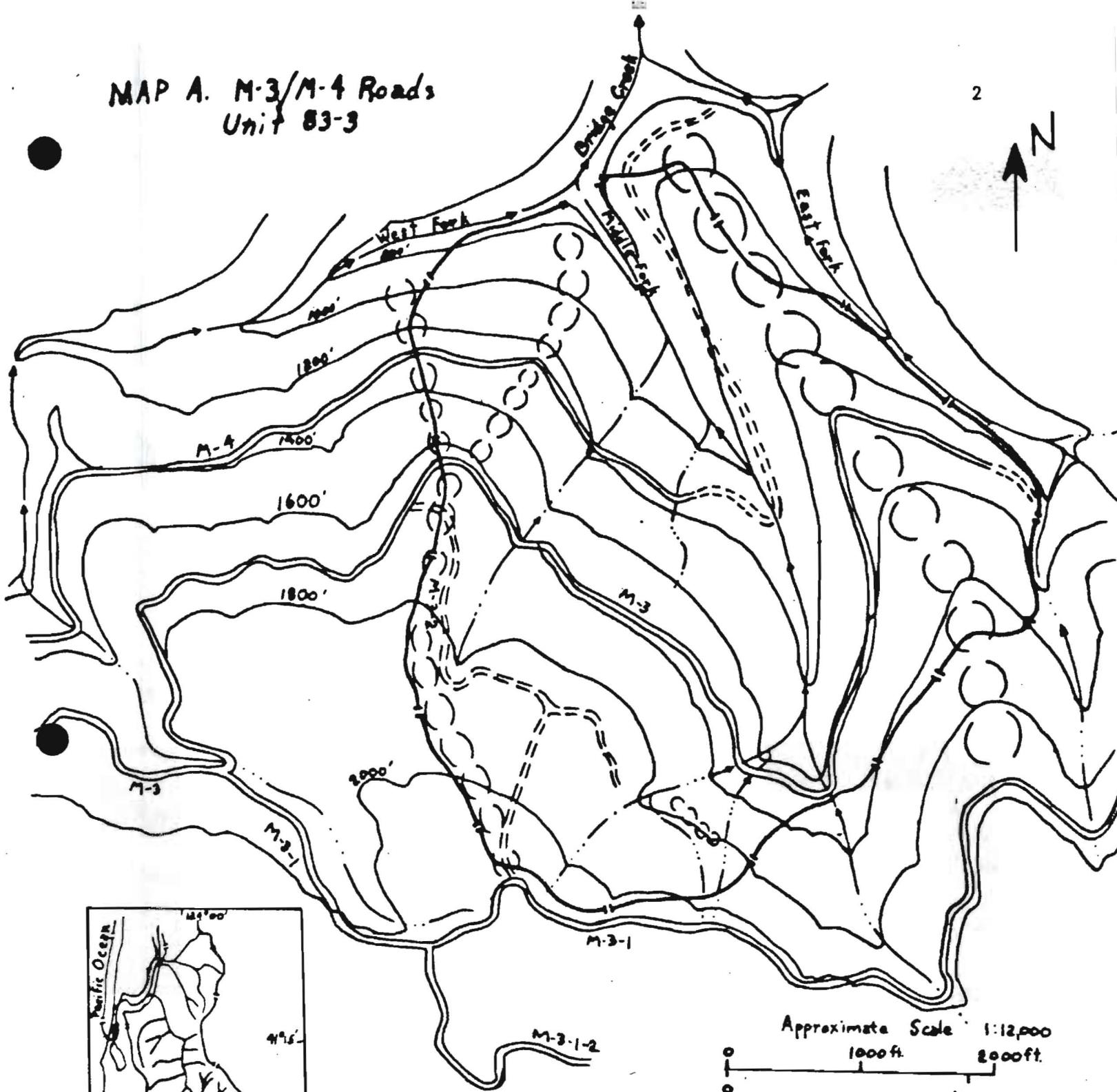
The middle fork of Bridge Creek is a third-order, perennial stream and the major drainage on this unit. It is fed by two first-order and two second-order intermittent streams. The lower-order streams contain steep profiles, are shallow to moderately incised, and are controlled by organic debris. Larger-order streams contain shallow profiles, are deeply incised within intergorges, and are bedrock controlled (boulder beds).

This rehabilitation unit lies within the schist unit of Redwood Creek. The schist displays intense shearing, and complex folding and faulting. The most common rock type is metamorphosed mudstone with a mineral assemblage of quartz-albite white mica-chlorite. Soil types and depths vary considerably within the unit. Copper Creek soils are commonly found on ridgelines; Lacks and Devils Creek on dry to wet hillslopes, respectively. Entisols are located in wet areas along the lower hillslopes of the middle fork, along most stream channels, and on active mass movement features. In all probability, the Bridge Creek lineament influences hillslope stability in this area. In contrast to other schist bodies found on this unit, the lineament trace is pervasively sheared and appears to follow the middle fork.

In summary, the total rehabilitation cost for this unit was \$93,241. Of this total, heavy equipment and labor intensive costs accounted for 90 percent and 2 percent, respectively. Primary treatments accounted for 74 percent of the total cost, while secondary treatments accounted for less than 1 percent of the total cost of rehabilitation (Table 1). A total of 2.1 miles of haul roads were removed; 1.6 miles of the M-3 Road and 0.5 mile of the M-4 Road. A total of 10,680 yd³ were excavated from six haul road stream crossings; 130 yd³ from three skid trail crossings. A log bridge constructed at RX1, M-3 Road was also dismantled.

MAP A. M-3/M-4 Roads Unit 83-3

2



Approximate Scale 1:12,000
1000 ft. 2000 ft.
1/4 mi

LEGEND

- | | | | |
|-----------|---------------------|-----------|-----------------|
| → | Perennial Stream | == | Major Haul Road |
| - - - - - | Intermittent Stream | - - - - - | Abandoned Road |
| () | Ridge | - + - + - | Unit Boundary |

Table 1. SUMMARY COSTS OF EROSION-CONTROL REHABILITATION WORK: UNIT 83-3

Phase	Task	--RNP Employees--		Heavy Equipment Rental	YCC	Total Task Costs	% Total Cost	Phase Totals	Phase %
		Geologist & P.S. Tech.	Laborers						
Evaluation Phase	Mapping	\$4,482✓	--	--	--	\$4,482	5	\$8,011✓	8
	Prescriptions, Planning & Documentation	3,529✓	--	--	--	3,529	4		
Heavy Equipment Phase	Primary Treatments	4,906✓	--	\$62,482✓	--	67,388	73	83,774✓	90
	Secondary Treatments	--	--	--	--	--	-		
	Access Cost	--	--	3,900✓	--	3,900	4		
	Miscellaneous Costs	--	--	12,486✓	--	12,486	13		
Labor Intensive Phase	Primary Treatments	163✓	\$402	--	--	565	< 1	1,456✓	2
	Secondary Treatments	61✓	570	--	\$109	740	< 1		
	Travel Time	--	--	--	--	--	-		
	Miscellaneous	--	151	--	--	151	< 1		
		\$13,141	\$1,123	\$78,868	\$109				

GRAND TOTAL = \$93,241✓

Land Use History

Based on early aerial photographs, this headwater region of Bridge Creek remained undisturbed up until 1954. By 1960, the M-4 Road had been constructed across the lower portion of the hillslope. An unrocked road, the M-4 extended from the M-Line to the middle fork of Bridge Creek. Once across the middle fork, it crossed low on the hillslope, extending to the easternmost fork of Bridge Creek. This later portion of the M-4 appeared to be a major skid road rather than a fully developed haul road. Hillslopes above the M-4 and west of the middle fork were harvested by seed-tree-leave methods and tractor yarded. This cut extended up the hillside to the future location of the M-3 Road (refer to Map B). During this same period, a 40-acre unit located immediately upstream and east from the middle fork crossing was also harvested and tractor yarded. The middle fork crossing served as a log landing for this timber unit.

The M-3 Road had been constructed by 1966. It was initially constructed to the middle fork and pioneered approximately 500 feet beyond the crossing. At this time, the upper middle fork crossing was only a tractor crossing. A drainage device had not been installed. The M-3 Road provided access to the hillslopes above the road, and timber was harvested with seed-tree-leave, tractor yarding methods. Typical to this era of timber harvest, stream protection was not considered. Streams were crossed numerous times; earth and organic debris were sidecast into channels.

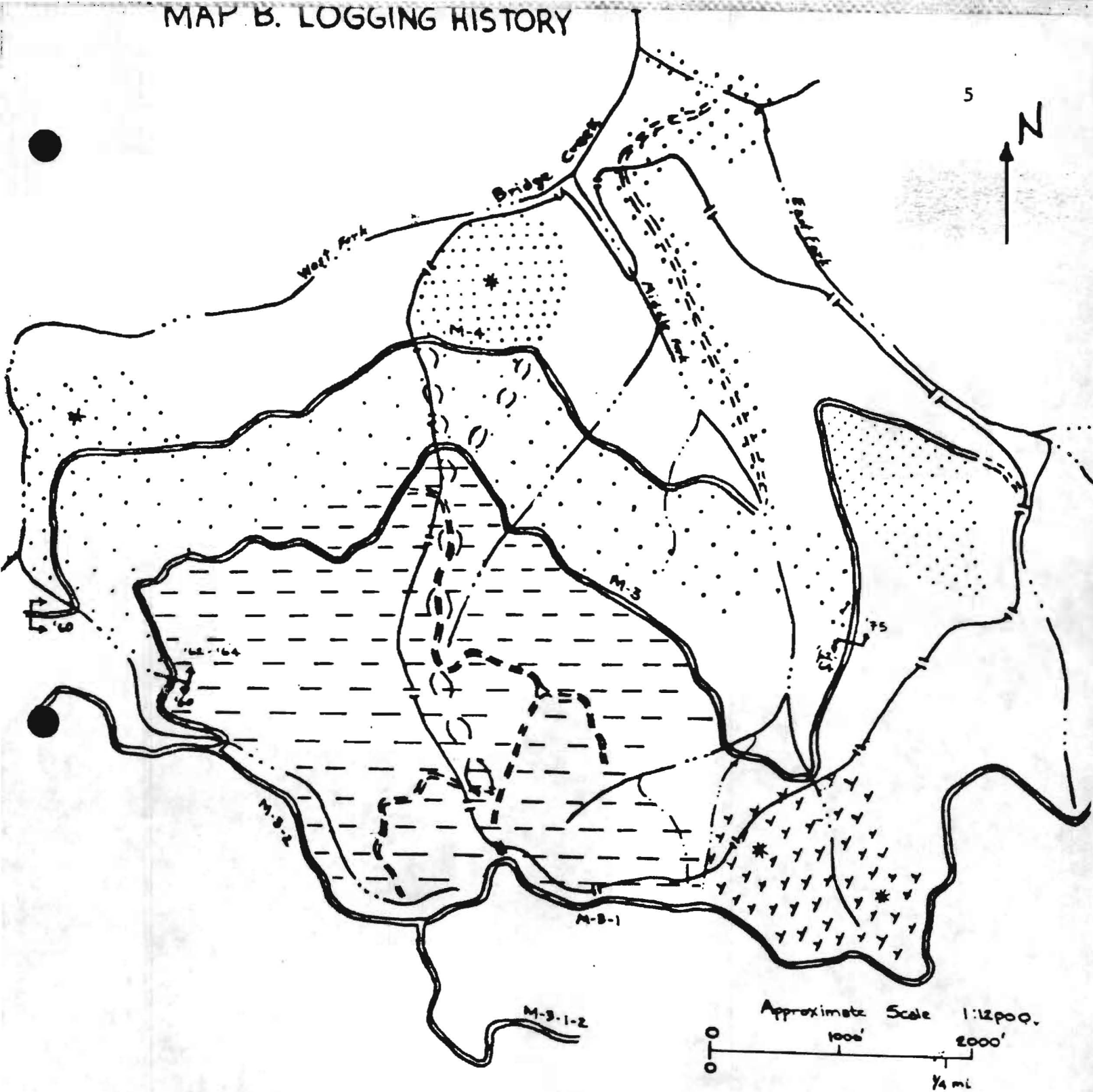
A quiescent period followed until 1973. At this time, the hillslopes between the M-3 and M-4 were relogged, removing the seed trees left during earlier timber harvest. In 1975, road crews upgraded the M-4 Road just beyond the westernmost boundary of this rehabilitation unit, and extended the M-3 an additional 0.8 mile. A cable unit below the M-4, along with a tractor unit above the M-3 were clearcut in 1976. The Water Quality Control Board of California halted further construction of the M-3 Road in 1977.

Erosion Features

Mass movement processes were the most common erosion features found on this rehabilitation unit. Mass movement processes included shallow translational slides of road fill (R9, R10, and many hillslope locations), deep seated rotational slides (R15, R16), and complex landslides, a combination of rotational and earthflow processes (R1 and south of RX5). As can be seen from Map C, scarp systems extended throughout this unit. Streambank slides were numerous.

Aerial photographs taken in 1954 revealed a closed canopy on hillslopes and along streams. There were no obvious signs of active mass movement processes in this undisturbed headwater region of Bridge Creek. 1966 photographs, however, revealed a different story. Major landsliding had occurred in response to the 1964 storm event and timber harvest activities. Significant portions of the M-4 Road as it approaches and leaves the middle fork had been obliterated by landslides. A 20-acre landslide occurred immediately upslope of the middle fork. Its boundaries coincided with the boundaries of the tractor unit, clearcut between 1954 and 1960. Its lateral scarps extended well above the future location of the M-3 Road. Numerous slides occurred on the M-3 Road but appeared to involve smaller volumes of material.

MAP B. LOGGING HISTORY



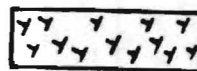
LEGEND



logged 1954-60
seed-tree leave



logged 1962-64; Re-logged 1962-73
seed-tree leave



logged 1975
clearcut



logged 1976
clearcut

* cable yarded, otherwise, tractor yarded



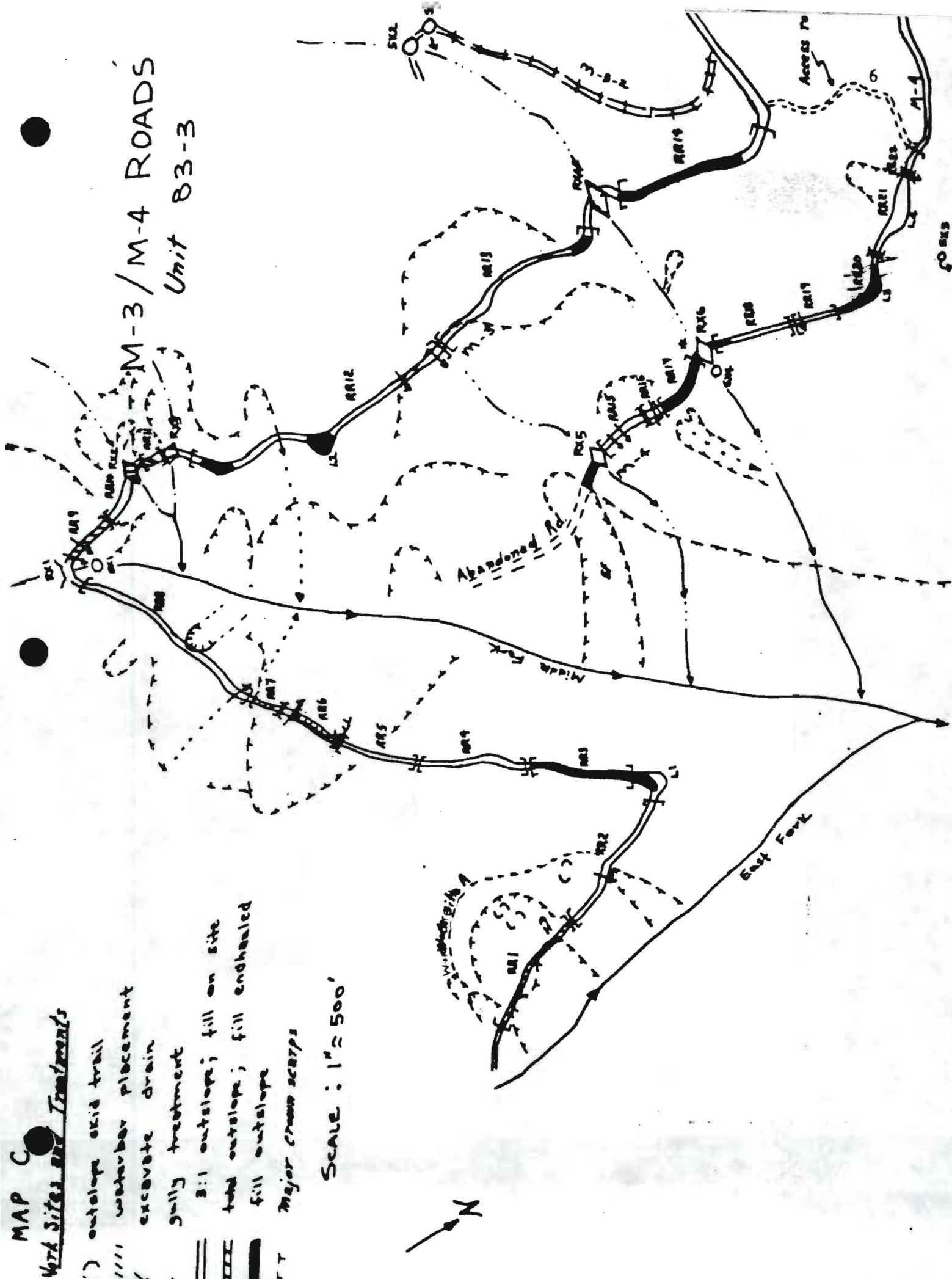
Unit Boundary

MAP C

Work Sites and Treatments

- () outslope acid trail
- ||||| waterbar placement
- () excavate drain
- gully treatment
- 3:1 outslope; fill on site
- 4:1 outslope; fill endhailed
- fill outslope
- Major cross scarps

Scale: 1" = 500'



M-3/M-4 ROADS

Unit 83-3

At the time of mapping, mass movement features capable of delivering sediment directly to streams included R1 (worksite A), R9, R10, and earthflow, gully, and landslide features below RX5 and RX6. R1 and adjacent hillslopes contained a recent debris torrent which originated from a network of skid trails above the M-3. Its potential for continued erosion remained high, by virtue of steep hillslopes, dense skid trail networks, and disrupted surface drainage. Below the M-3 and immediately above the east fork, the uncut hillslope displayed active, complex landslide characteristics.

R9 and R10 were unstable road segments located immediately above a second-order, perennial stream. Translational slides had already occurred in R9 (and remained active); R10 displayed similar potential. R8 contained a rotational landslide in an uncut forest. Its movement initiated in 1978, and advanced significantly in 1982-1983.

Numerous gully systems, mostly discontinuous, had eroded on the hillslopes due to uncontrolled road runoff and culvert discharge onto steep hillslopes and/or unprotected skid trails. At the time of mapping, most gullies had stabilized. In many cases, however, gully discharge appeared to contribute to numerous slump and/or translational slides along streambanks. The most active gully entered this unit from the hillslopes above R9. Caused by a misplaced culvert and diverted stream on the M-3-1 Road, gully flow plugged the inboard ditch and splayed across the road, causing the road prism to fail.

Haul road and skid trail stream crossings had eroded to different degrees since construction. Channel fill eroded from the crossings when culverts plugged or the crossing initiated fluvial and/or mass movement process elsewhere by diverting streamflow out of its drainage.

Aerial photographs taken in 1966 recorded stream crossing failures resulting from the 1964 storm event. RX2 had diverted down the M-3 to RX1, significantly gullying the road and road prism. Culverts (?) at RX3 and RX4 plugged, sending streamflow over the road and scouring the crossing fill. Streamflow at RX5 and RX6 diverted down the M-4 causing severe hillslope erosion. The diversion at RX5 either initiated or re-activated a large earthflow feature that extended to the middle fork. As a result of that event, two hundred feet of road disappeared entirely from the hillslope. The diversion from RX6 created a gully/landslide feature measuring 80 feet across, 150 feet long, and 20 feet deep. Downstream impacts to the middle fork were severe.

EROSION CONTROL REHABILITATION WORK

Field mapping began in February and continued through April, requiring 49 person-days to map 490 acres. Treatment prescription, planning and documentation was performed from April 21 to June 15. During this period the entire unit was assessed, sediment sources prioritized, peak discharges computed, treatments prescribed, and equipment scheduled. Pre-treatment work site conditions were photographed, and all road segment and road stream crossing volumes were surveyed. This phase required 37 person-days to complete. Heavy equipment work began July 14 and ended September 12.

Objectives, Methods and Summary Costs

The objectives of rehabilitation were to eliminate active and potential sediment sources to stream channels, and to encourage vegetation as the ultimate form of erosion control. Erosion features which would store their eroded material as slope deposits were not a concern. The reader is referred to Map C which locates all work sites on this unit.

The erosion control prescriptions for this rehabilitation unit addressed three main categories of erosion processes. They included: 1) mass movement features or "systems" capable of delivering sediment directly to stream channels, 2) gully systems delivering sediment to streams and contributing to incipient hillslope failures, and 3) erosion resulting from the failure of haul road and skid trail stream crossings.

Work site A, R7-R10 fell under the first category of processes. A total outslope was prescribed for these road segments as well as the skid trails crossing the upper hillslope of work site A. The goals of these treatments were to remove as much of the potential sediment source as possible and to improve surface drainage on these hillslope areas.

The second category of prescriptions addressed the gully systems. Whether an enlarging gully system or a stable flowcourse, many gully systems appeared to be contributing to incipient hillslope failures, which sometimes discharged sediments directly into streams. A general treatment to mildly outslope the entire length of the M-3 and M-4 roads was prescribed to disperse hillslope drainage and to eliminate road generated runoff, thereby eliminating or reducing the amount of gully and stream discharge.

The third category of prescriptions addressed active and potential erosion from haul road and skid trail stream crossings. Complete excavation of channel fill was prescribed for all haul road crossings and four skid trail crossings. The intent of this treatment was to prevent channel fill from eroding, prevent stream diversions, and correct diversions which had already taken place.

The total cost of rehabilitation, including supervision was \$93,241. Of this total, heavy equipment and labor costs accounted for 90 percent and 2 percent, respectively. Evaluation costs accounted for the remaining 8 percent (refer to Table 1). Heavy equipment performed only primary treatments. Labor crews performed both primary and secondary treatments. Primary treatments accounted for 73 percent and secondary treatments accounted for 1 percent of the total cost of erosion control rehabilitation work.

Heavy Equipment Phase

Heavy equipment work began on July 14 and ended September 12, 1983. Work began on the M-3 Road and progressed to the M-4 Road. In total, eight pieces of equipment were employed. Two tractors and a hydraulic excavator formed the core of the equipment package. They performed a variety of tasks and worked the entire duration of this project. In contrast, three dump

trucks, a wheel loader and self-loading log truck were utilized for a brief period during the early stages of the project. Table 2 lists the equipment owners, operators, and describes the equipment used.

The D7 was the first piece of equipment to begin work. It reconstructed short road reaches across two landslides and upgraded the entire M-3 Road for dump truck traffic. This completed the preliminary work on the M-3.

Three dump trucks and the hydraulic excavator were delivered next. Their first job involved the removal of slide debris between RX2 and RX3 (R11) to provide clear working space during these road crossing excavations. Next, they performed preliminary excavations along road reaches prescribed as total outslope areas. Preliminary excavations were performed along R5, R7, R9, and R10, utilizing the excavator to load directly into the dump trucks. The excavator removed as much fill as possible from along these road segments, leaving intact a vertical-faced, narrow road for access. Since stable fillsites located near these work sites were uncommon, dump trucks endhailed the material to R3, which had been designated as the primary fillsite on the M-3 Road. When needed, the D7 would level the fillpiles to provide more room, and smooth the road surface to expedite truck traffic. When not required at the fillsite, the D7 reconstructed 500 feet of failed road (R1) for tractor access only and upgraded another 600 feet (R2) for dump truck traffic. During this time, the D7 also initiated the outsloping of landing #1 (L1).

Table 2. EQUIPMENT AND OPERATORS

Owner	Operator	Equipment	Rate
Wendell Larkin	same	D7E Cat w/rippers	\$78.50
Paul Johnson	same	D8 Cat w/winch	\$75.00
Whitey Brown	Ellis Campbell	Case 980B hydraulic excavator	\$85.00
Keith Parker	same	10yd ³ dump trucks	\$32.95
Diamond R. Logging	Tim Renner	Cat 950 wheel loader	\$51.00
Woodland Access	--	Self-loading short logger	\$65.00

The D8 and wheel loader were delivered next and marked the beginning of the road removal phase. A total outslope was performed on R1 using the two tractors to excavate and push (average distance = 300 ft) road material to a loading site, where the loader filled dump trucks. Once again, fill material was endhailed to R3. During this time, the excavator assisted the tractors when needed, but spent most of its time outsloping skid trails on the hillslope and outsloping L1. The dump trucks and loader were terminated following the completion of R1.

From this point to the completion of the project, the two tractors and hydraulic excavator worked together as a team, completing the road removal treatments on the M-3 and M-4 roads. When performing a regular outslope, the tractors removed roughly 95 percent of the volume. The hydraulic

excavator assisted the tractors by outslowing discrete swaths through the road prism, enabling the tractors to back down and behind the road fill. This expedited the tractor's work where fillslopes were excessively steep and where stumps and trees were encountered along the road. Whenever the crown region of a landslide was encountered, the excavator performed the majority of the excavation, passing the fill to a tractor which push-endhauled (100-200 ft.) the material to the closest fillsite. This method was used at R6, R8 and R15.

A total of six road crossings were excavated from the M-3 and M-4 roads. The method of excavation varied according to work site conditions. Rx1 was a log bridge and was atypical of haul road crossings. Assisted by the excavator, the D8 dismantled the log bridge and skidded the logs to L2. A self-loading log truck transported these logs to the Y-Line rock pit. RX2 and RX3 had been constructed across deep, steep, and narrow channels. The road surfaces were narrow (approx. 12 ft.) and fill prisms exceed 80 feet in length. To complicate the excavations further, both streams were flowing at the time of excavation. Because of these site conditions, the tractors were extremely limited when performing preliminary excavations. Sideslope steepness at RX2 prevented the tractors from removing more than 50 percent of the channel fill. At RX3, the culvert had been placed close to the road surface preventing the tractors from removing more than 35 percent of the channel fill. Both crossings required extensive use of the hydraulic excavator and push-endhaul distances average 250 feet.

Because of limited work space and wet soil conditions, the hydraulic excavator performed nearly the entire excavation at RX5. Once the road prism had been removed by tractors, the excavator constructed a 160 foot-long channel below the road crossing. In this case, tractors were used more to push-endhaul material than to excavate it. A more efficient approach to road crossing excavations was applied at RX4 and RX6. Both crossings contained large volumes (3,300-4,800 yd³) of fill, and had ample work space and dry soil conditions. Tractors performed the preliminary excavations at both crossings, removing 65-70 percent of the channel fill.

Less frequent equipment tasks consisted of outslowing skid trails above R1, outslowing landings along both roads and excavating skid trail crossings on the hillslopes. All tasks were performed sequentially, as encountered during the road removal process. The D7 and hydraulic excavator worked together to outslope skid trails. The excavator performed the outslowing while the D7 disposed of the fill material. On landings, tractors performed the majority of the excavation, with minor assistance from the excavator. Finally, skid trail crossings were excavated by either the D7 or the hydraulic excavator.

The total cost of heavy equipment (less supervision) was \$78,868 or 85 percent of the total rehabilitation cost. Heavy equipment performed only primary treatments and accounted for 79 percent of the total equipment costs. Miscellaneous and access costs accounted for 16 percent and 5 percent, respectively (refer to Table 1).

Average heavy equipment costs are summarized in Table 3. A summary of equipment costs, providing an hourly breakdown for each piece of equipment and for all tasks performed is included in Appendix A. Miscellaneous costs include the costs to open roads, salvage logs, and remove slide debris from R11. Also included in miscellaneous costs are administrative time, paid standby and breaks. Administrative time is that time spent discussing work, schedules, and safety.

The average cost to excavate six road crossings on this rehabilitation unit was \$2.56/yd³. As can be seen from Table 4, costs varied from \$1.83/yd³ to \$4.45/yd³. The lower unit costs associated with Rx4 and Rx6 reflect good work conditions; i.e., wide road surfaces, broad stream valleys, and dry fill.

Not including fill-outslope areas, a total of 1.1 miles of road were outsloped on the M-3 and M-4 roads at an average cost of \$2.02/yd³. The outslope techniques varied according to site conditions, available fill-sites, and the degree of outslope. Table 5 summarizes the outslope methods and costs. As can be seen, a regular outslope (fill remains on site) performed largely by tractors averaged \$0.96/yd³. This represented the simplest outslope method. In contrast, total road outslope (no fill remains on site) required the hydraulic excavator to perform the preliminary excavations, loading directly into dump trucks, and tractors to complete the treatment when the road was no longer needed. Total outslope treatments ranged from \$1.81/yd³ (tractor endhaul) to \$3.57/yd³ (dump truck endhaul). The most extreme case - tractor and dump truck endhaul - performed on R1, cost \$4.55/yd³.

Evaluation of Equipment Phase

All equipment hired for this rehabilitation unit were well suited for the work. Once familiar with our goals and techniques, the operators utilized their equipment effectively and efficiently. All work was well within the capabilities of the equipment.

The D7 proved to be an extremely versatile piece of equipment. Considerably lighter and smaller in overall dimensions than a D8, this tractor could maneuver into small areas and work closely with the hydraulic excavator. The D7 also continued to work well in wet soil conditions. In general, both tractors complemented each other, and proved to be an effective team.

Though not absolutely necessary, the hydraulic excavator worked with the tractors to outslope roads. In most cases, it stayed just ahead of the tractors, excavating narrow swaths through the road prism so that tractors could back down and behind the road fill. As can be seen from Table 5, the average excavation rate per piece of equipment fell slightly when the excavator was added to the outslope team. It was, however, encouraging to note that a hydraulic excavator can work along with tractors to outslope a road and not appreciably effect overall cost.

Table 3. SUMMARY OF AVERAGE HEAVY EQUIPMENT COSTS: UNIT 83-3

Treatment	# of Work-sites	Total Quantity	Total Cost	Avg. Cost Worksite	Avg. Cost Quantity	Range Cost/Quantity
<u>Primary Treatments</u>						
Haul road crossings	6	10,680 yd ³	\$27,300	\$4,550	\$2.56/yd	$\frac{\$1.83-4.45}{\text{yd}^3}$
Skid trail crossings	3	130 yd ³	288	96	2.21	$\frac{\$1.70-3.92}{\text{yd}^3}$
Rip roads	M-3 Rd. only	1.3 mi	628	--	483/mi	--
Outslope roads	16	13,380 yd ³	27,214	--	2.02/yd ³	$\frac{\$0.70-4.55}{\text{yd}^3}$
Outslope skid trails	3	--	1,921	640	--	$\frac{\$21 - 960}{\text{each}}$
Waterbars & Cross Road Drains	8	--	891	111	--	$\frac{\$20 - 293}{\text{each}}$
Outslope landings	4	--	4,240	1,060	--	$\frac{\$191 - 1,629}{\text{each}}$
Total Primary Treatment =			\$62,482			
<u>Secondary Treatment</u> - None						
<u>Access Costs</u>						
Lowboy	--	9 trips	\$2,806	--	312/trip	$\frac{\$81 - 363}{\text{trips}}$
Travel	--	--	1,094	--	--	--
Total Access Cost =			\$3,900			

Table 3. - Cont'd. SUMMARY OF AVERAGE HEAVY EQUIPMENT COSTS: UNIT 83-3

Treatment	# of Work-sites	Total Quantity	Total Cost	Avg. Cost Worksite	Avg. Cost Quantity	Range Cost/Quantity
<u>Miscellaneous Costs</u>						
Open roads	--	--	\$1,270 ✓	--	--	--
Log salvage	1	47,832 bf.	827 ✓	--	\$17.29/K bf.	--
Slide debris removal, R#11	1	80 yd	551 ✓	--	6.89/yd	--
Administrative time	--	--	1,831 ✓	--	--	--
Paid standby	--	--	3,912 ✓	--	--	--
Paid breaks	--	--	4,095 ✓	--	--	--
Total Miscellaneous			\$12,486 ✓			
TOTAL HEAVY EQUIPMENT COST =			\$78,868			

Table 4. HAUL ROAD CROSSINGS: UNIT 83-3

Crossing	Equipment	Hours	Cost	Volume (yd ³)	Unit Cost (yd ³)	Average Push Distance
RX1 ¹	D7	1	\$1,147	300	\$3.82/yd	--
	D8	5 3/4				
	HE	7 1/2				
RX2	D7	17	3,973	1,120	3.55	300
	D8	14 1/2				
	HE	18 1/4				
RX3	D7	10 3/4	3,073	690	4.45	250
	D8	13				
	HE	14 3/4				
RX4	D7	46 3/4	11,346	4,800	2.36	250
	D8	50 1/2				
	HE	45 3/4				
RX5	D7	10 1/4	1,671	450	3.71	--
	D8	4 3/4				
	HE	6				
RX6	D7	20 3/4	6,090	3,320	1.83	200
	D8	27 3/4				
	HE	28				

1/ RX1 was a log bridge; costs reflect the dismantling of bridge more than the excavation of fill.

Table 5. SUMMARY OF ROAD OUTSLOPING: UNIT 83-3

Outslope method Excavation method ¹ Push distance ²	# of Sites	Average Volume Excavated	Avg. Cost yd ³	Range ³ Cost/yd ³	Average Excavation Rate, yd/hr.	Range Excavation Rate, yd/hr.
Regular outslope 100% T N.A.	2	585 yd ³	\$0.96/yd ³	\$0.76 - 1.01 yd ³	86 yd/hr.	75 - 98 yd ³ hr.
Regular outslope 90% T, 10% HE N.A.	7	850	1.07	0.70 - 1.27	82	61 - 112
Total outslope ³ 80% HE, 20% T 100-200 ft.	2	425	1.81	1.60 - 2.10	47	39 - 56
Total outslope ⁴ 100% HE Truck endhaul	1	440	3.57	--	84	--
Total outslope 80% HE, 20% T 80% Truck endhaul 20% 100-200 ft.	3	990	2.53	2.18 - 2.87	51	44 - 54
Total outslope ⁵ 90% T, 10% HE 100% T 300 ft. 100% Truck endhaul	1	1,990	4.55	--	29	--

Total Cost \$27167.6

^{1/} T = tractor (s) H.E. = hydraulic excavator^{2/} Average push distance^{3/} Hydraulic excavator and tractor (s) each handle the same volume 75% of the time.^{4/} Hydraulic excavator excavates and loads 100% of the volume.^{5/} Hydraulic excavator and tractor (s) each handle the same volume

Table 6. SUMMARY OF AVERAGE LABOR COSTS: UNIT 83-3

16

Treatment	Type of Labor	Total Person Hours	Avg. Cost Per Hour	Total Cost	Quantity	Avg. Cost Quantity
<u>Primary Treatments</u>						
Breach culvert R #1, M-3	RNP	4	\$8.37	\$33.48	1	--
Waterbar skid trail	RNP ¹	40	8.37	497.80	5	\$99.56/ea
	RNP ¹	20	8.15			
Log removal @ SX #1	RNP	4	8.37	33.48	job	--

Total Primary Treatment Cost = \$564.76

Secondary Treatments

Straw distribution	RNP ¹	3	8.37	\$86.23	128 bales	0.67/bale
	RNP	7 1/2	8.15			
Straw application	RNP	65	8.37	653.55	128 bales	5.11/bale
	YCC	30	3.65			

Total Secondary Treatment Cost = \$739.78

Miscellaneous

Saw logs @ RX #1	RNP	18	8.37	150.66	10 logs	--
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Total Miscellaneous Cost = \$150.66

Total Labor Costs = \$1,455.20

^{1/} Physical Sciences Technician

LABOR INTENSIVE PHASE

Labor intensive work was performed primarily by Redwood National Park laborers, with minor assistance from YCC. They performed both primary and secondary treatments during the period of August 1 through September 30, 1983. Laborers were not assigned to our rehabilitation unit on a full-time basis. Instead, they were assigned on an as needed basis.

The total cost of labor work (less supervision) was \$1,455.22 or 2 percent of the total rehabilitation costs. Manual labor crews performed both primary and secondary treatments. Their work and associated costs are summarized in Table 6.

Primary treatments included the breaching of a culvert at the very end of the M-3 Road (R1), construction of waterbars on skid trails, and the removal of one log at Sx1. These tasks were performed by labor crews because of poor equipment access and/or the sensitive nature of the work site. Secondary treatments consisted of spreading straw on L1 and at all road crossings. Straw was spread at the rate of 2,000 lb/acre at L1 and 4,000 lb/acre at all road crossings.

In general, we received excellent support from the labor crew and found the new method of laborer assignment much more compatible with our needs.

83-3: M-3/M-4 Rehabilitation Unit Revegetation Report

INTRODUCTION

Site Description.

The M-3/M-4 Rehabilitation Unit is located on the west side of Redwood Creek about 17 miles from the Orick Operations Center via the Westside Access Road (Figure 1). The unit encompasses 490 acres in the eastern headwaters of Bridge Creek. Elevation ranges from 800 feet to 2,150 feet in a low to mid-slope position. The upper boundary of the unit lies 350 feet below the basin divide. The general aspect is northwestern and slopes average 45 percent. The site is generally favorable with lower portions remaining moist all summer.

Copper Creek, Lacks and Devil's Creek soils derived from schist are the predominant soils in the area (see Popenoe). Entisols, undeveloped soils, are also found in the unit. The Bridge Creek Lineament of pervasively sheared schist corresponds to mass movement features which were activated or accelerated since 1964 storms and timber harvesting. Since that time, slope instability to the extent that portions of roads and skid trail systems have been obliterated has been a prominent force in the area. The soils in the unit supported redwood forests prior to harvesting activities, but revegetation potential of some areas has been limited by frequent movement. Revegetation on the deep and moderately deep Devil's Creek and Copper Creek soils is usually rapid. Little soil remains to aid revegetation, however, on cuts made in the drier, more shallow Lacks soils which are usually found on steep slopes and ridges.

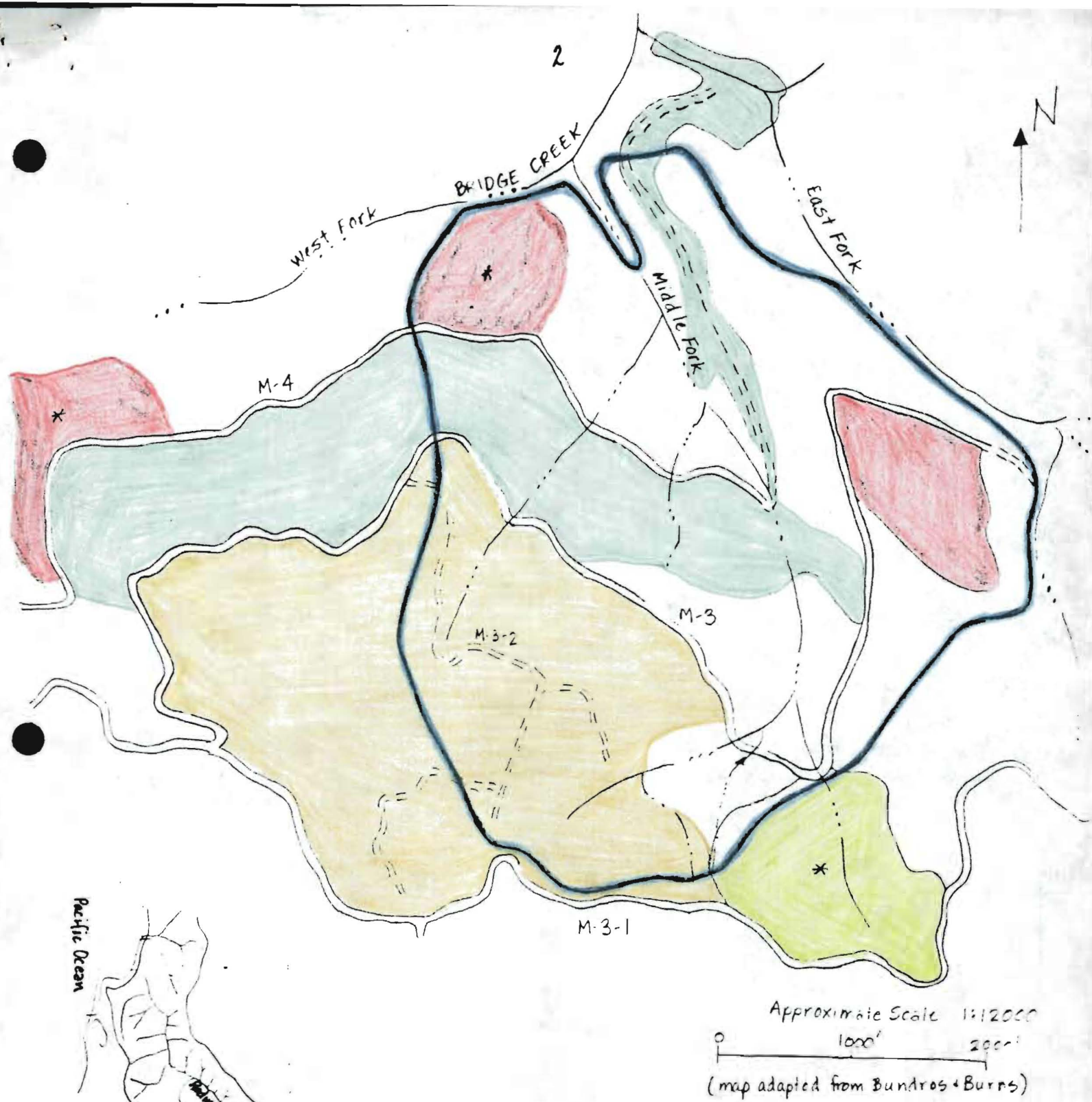


Figure 1

- Major Haul Road
- - - Abandoned Road
- Logged 1954-60, seed trees
- Logged 1962-64, relogged 1972-73, seed trees
- Logged 1975, clearcut
- Logged 1976, clearcut
- * cable yarded
- unit boundary

Slopes above the M-4 road were logged by 1960 utilizing tractor-yarding methods (Figure 1). Seed trees were left to revegetate cut areas. By 1964, the M-3 road was constructed above the upper boundary of the 1960 cut. The major portion of the slope above the M-3 road was harvested in 1962-64, also by tractor-yarding with seed trees left. This slope was relogged in 1972-73. Further logging in the area occurred in 1975 and 1976. Two units were logged below the M-4 road and two above the M-3 road, three by cable-yarding and one by tractor-yarding. The clearcut units were restocked with one-year old containerized redwood seedlings.

Prelogging vegetation was dominated by old-growth redwood (Sequoia sempervirens) with significant components of Douglas-fir (Pseudotsuga menziesii), tanoak (Lithocarpus densiflora), western hemlock (Tsuga heterophylla), and madrone (Arbutus menziesii). Understory vegetation was characterized by rhododendron (Rhododendron macrophyllum) and many ferns, especially swordfern (Polystichum munitum). Post-logging vegetation in cut areas and along the road is dominated by red alder (Alnus rubra) and coyote brush (Baccharis pilularis var. consanguinea). Many other species are becoming established: black-berried huckleberry (Vaccinium ovatum), whipplea (Whipplea modesta), redwood sorrel (Oxalis oregana), salal (Gaultheria shallon), trillium (Trillium ovatum), iris (Iris, sp.), five-fingered fern (Adiantum pedatum), berries (Rubus, sp.), deerfern (Blechnum spicant), coltsfoot (Petasites palmatus), many bryophytes and ruderal species such as fireweed (Erechtites, sp.), and dandelion (Hypochoeris radicata).

Three main erosion problems were addressed by heavy equipment activities: mass movement features, gully systems, and haul road/skid trail stream crossings.

Physical treatments were prescribed to improve surface drainage and sediment

distribution, disperse hillslope runoff, and completely remove channel fill. Heavy equipment activities between July 14 and September 12, 1983 removed 1.6 miles of the M-3 and 0.5 mile of the M-4 major haul roads, excavated 6 haul road crossings and 3 skid trail crossings, ripped 1.3 miles of the M-3 road, and outsloped 1.1 miles of roads, skid trails and landings. Degree of out-sloping varied from regular (fill remains on site) to complete (no fill remains on site). Straw mulch was spread by RNP and YCC labor crews at a rate of 2000 pounds per acre on L1 and 4000 pounds per acre at 5 of the 6 road crossings_A (Fig. 2). Only selected sites totalling 3 acres were mulched because outsloping prescriptions along most of the narrow haul roads precluded efficient straw distribution prior to rehabilitation activities and cost of transporting straw prevented economical distribution afterwards. See Bundros and Burns (1984) for detailed description of heavy equipment and labor intensive erosion control work.

Revegetation Objectives.

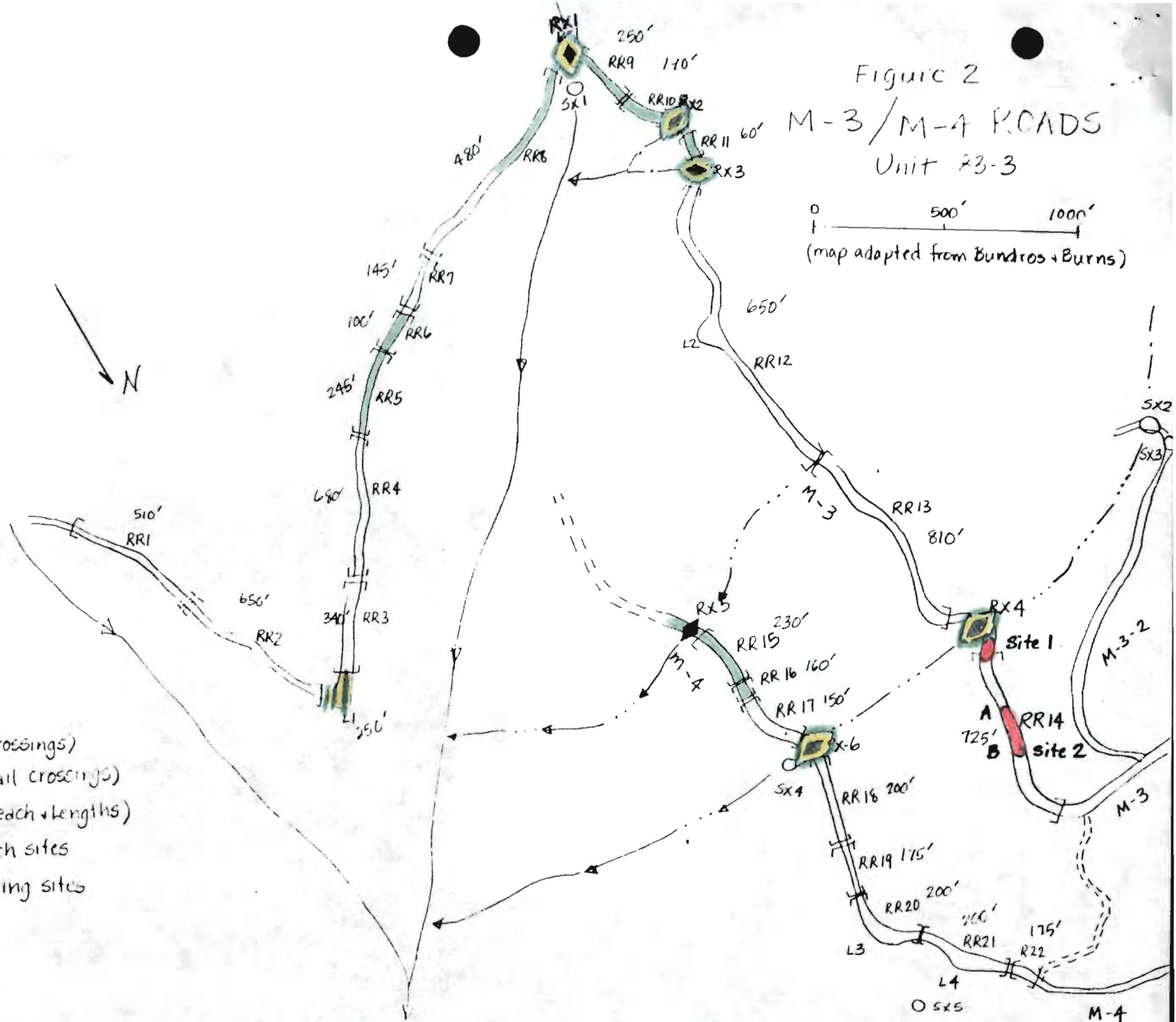
Prior to rehabilitation, portions of the M-4 road were completely overgrown by red alder. In less than ten years after logging, the site had been colonized and alder grown to greater than 20 feet. Even though well-established vegetation was destroyed to gain access to correct severe erosion problems, revegetation will be rapid. Summer moisture is not a limiting factor on much of the site.

Since the site was formerly dominated by redwood and conditions still present are favorable to redwood, the goal of revegetation is to re-establish redwood as quickly as possible. Natural redwood regeneration is variable by year and frequently very slow. Little redwood might be established for a number of years if seedlings were not planted. Redwood seedlings were planted along the entire

Figure 2
M-3/M-4 ROADS
Unit 23-3

0 500' 1000'
(map adapted from Bundros + Burns)

- ◆ RX (Road Crossings)
- SX (Skid trail crossings)
- [] RR (Road Reach + Lengths)
- Straw mulch sites
- Alder planting sites
- Test Plots



lengths of both the M-3 and M-4 roads and at crossings. Since Douglas-fir is a more rapid colonizer and an abundant seed source is available, no Douglas-fir seedlings were planted. Alder seedlings were planted at crossings to provide rapid vegetative cover, in wet areas along outsloped roads to help provide slope stability and at L1 to provide shade for redwood seedlings^(Fig. 2). Natural seeding of alder along the roads is expected to be heavy in many areas and may benefit planted redwood seedlings by excluding the less shade-tolerant Douglas-fir seedlings resulting in a higher percentage of redwood. Skid trails and the M-3-2 road were narrow and did not require treatment.

VEGETATION TREATMENTS

One-year old containerized seedlings were purchased from Louisiana-Pacific Corporation Nursery in Crannell, CA. All seedlings were grown in one-inch by six-inch cavities in styroblocks. Alder seedlings planted on this site were not inoculated by park personnel but were well-nodulated at planting time. Source of inoculum was assumed to be Little River which supplies water to the nursery. All stock appeared to be healthy and robust at planting time. A total of \$1310.54 was spent on plant materials, including the cost to transport seedlings to the rehabilitation site, \$0.161 per seedling. Plant material costs are listed in Table 1.

TABLE 1. Plant Materials Costs.

PLANT MATERIALS	# PLANTED	MATERIALS Cost/Tree	COSTS Subtotal	TRANSPORTATION COSTS ¹		TOTAL
				Cost/Tree	Subtotal	
Redwood	5570	\$0.149	\$829.93	\$0.012	\$66.84	\$896.77
Alder	2570	\$0.149	\$382.93	\$0.012	\$30.84	\$413.77
TOTALS	8140		\$1212.86		\$97.68	\$1310.54

1. Costs include vehicle and labor to transport seedlings from nursery to Orick and to rehabilitation site.

Trees were planted by combined RNP in-house and Redwoods United, Inc. labor crews on December 12-13, 1983 and January 23, 1984. Weather conditions in December were rainy, resulting in very wet planting conditions. The fair weather in January produced mild planting conditions. All seedlings were planted at eight-foot spacings or approximately one tree per 64 square feet. At crossings where both redwood and alder were planted, densities were one tree per 32 square feet. Planting was done with dibbles and hoedads. No fertilizer tablets or browsing protection were used.

A total of 9.1 acres were planted (6.7 acres on M-3 and 2.4 acres on M-4) with 5570 redwood and 2570 alder seedlings planted. Table 2 gives a summary of treatments by site. Table 3 lists labor costs and hours worked by planting personnel and supervisors. Labor costs for tree planting were \$3007.20 or \$0.369 per tree. Combined cost for the purchase and planting of seedlings was \$4317.74 or \$0.53 per tree. Table 4 gives a summary of revegetation costs. Included in the tables is approximately 2 hours per day of non-planting time allowing for transit to and from the site, loading trees and planting tools into vehicles and training time. This site was the first site to be planted this year so crews needed review or instruction in proper planting techniques. Trees were removed from styroblocks at the vehicles and placed in planting bags. A few seedlings were somewhat battered or exposed by this method but most were in good shape when planted. Planting was accomplished smoothly and was well-coordinated.

TEST PLOTS

Two test plots were established on this site to document seedling survival (Figure 2). Site 1 is in a mulched area at RX4. Sixteen alder and 14 redwood

TABLE 2. 83-3: M-3/M-4 Tree Planting Summary.

ROAD	SITE ¹	AREA (sq.ft.)	DATE PLANTED	NO. OF TREES PLANTED	
				Redwood	Alder
M-3	RR1	20400	12-12-83	350	150
	RR2	26000	12-12-83	350	
	L1	10000	12-12-83	200	250
	RR3	13600	12-12-83	200	
	RR4	27200	12-12-83	350	
	RR5	9800	12-12-83	150	50
	RR6	4000	12-12-83	60	100
	RR7	5800	12-12-83	90	100
	RR8	19200	12-12-83	180	90
	RX1	3300	12-12-83	50	50
	RR9	10000	12-12-83	100	50
	RR10	7600	12-12-83	100	50
	RX2	7900	12-12-83	100	75
	RR11	2400	12-12-83	30	25
	RX3	4800	12-12-83	200	
			12-13-83		180
	RR12	26000	12-12-83	250	
	L2	8000	12-13-83	100	
	RR13	32400	12-13-83	450	
	RX4	24500	12-12-83		400
			12-13-83	400	400
	RR14	31000	12-13-83	340	
subtotal		293,900 (6.7 A)		4050	1970
M-4	RX5	13500	12-13-83	50	50
	RR15	9200	12-13-83	100	100
	RR16	6400	12-13-83	50	50
	RR17	6000	12-13-83	75	
	RX6	29600	12-13-83	400	400
	RR18	8000	12-13-83	100	
	RR19	7000	12-13-83	75	
	RR20	8000	12-13-83	100	
			1-23-84	170	
	RR21	8000	1-23-84	200	
	RR22	7000	1-23-84	200	
subtotal		102,700 (2.4 A)		1520	600
TOTAL		396,600 (9.1 A)		5570	2570

1. RR = Road Reach, L = Landing, RX = Road Crossing.

TABLE 3. 83-3: M-3/M-4 Tree Planting Labor Cost Summary¹.

DATE	LABOR CREW	HOURS	PERSONNEL COSTS	TRANSPORTATION COSTS	OVERHEAD COSTS	TOTAL COST
12-12-83	Biological Technician	10	\$100.23	\$10.87		\$111.10
	In-house Laborers	50	458.19	15.75		473.94
	Redwoods United, Inc.	124	717.94	125.00	151.73	994.67
12-13-83	Biological Technician	10	100.23	11.99		112.22
	In-house Laborers	20	178.70	13.52		192.22
	Redwoods United, Inc.	103	612.68	125.00	132.78	870.46
1-23-84	In-house Laborers	5	49.28	13.25		62.53
	Redwoods United, Inc.	21	129.82	31.25	28.99	190.06
TOTALS		343	\$2347.07	\$346.63	\$313.50	\$3007.20

1. Detailed labor cost breakdown on file in Orick Vegetation File.

TABLE 4. 83-3: M-3/M-4 Rehabilitation Unit Revegetation Costs.

PLANTING

<u>Redwood National Park</u>	<u>Hours</u>	<u>Costs</u>
Biological Technician ¹	20	200.46
Transportation ²		22.86
Subtotal		\$223.32
In-house Labor ³	70	686.17
Transportation ⁴		42.52
Subtotal		\$728.69
<u>Redwoods United, Inc.</u>		
Personnel	248	1460.44
Transportation		281.25
Overhead ⁵		313.50
Subtotal	338	\$2055.19
TOTAL COST		\$3007.20/8140 trees
COST PER TREE		\$0.369

PLANNING AND REPORTSBiological Technician

General	20	200.46
Experimental Plots	4	40.09
Reports	30	300.69
subtotal	54	\$541.24
TOTAL HOURS	392	

1. Wages include 11% for government benefits - term employees.

2. Transportation includes 97 mi. x \$0.16/mi. plus 2 days @ \$3.67/day.

3. Wages include 7% for government benefits - temporary employees.

4. Transportation includes 147 mi. x \$0.19/mi. (ave.) plus 3 days @ \$4.86/day (ave.).

5. 18% Administrative charge on wages plus transportation.

seedlings were counted in an area delineated by red-painted wooden stakes.

Site 2 is located in RR14, an unmulched portion of road and was divided into two sections and marked by red wooden stakes. Twenty-five redwood seedlings were counted in section A and 30 in section B. Survival and browsing will be checked periodically to gauge the overall survival for the site. In addition, seedlings planted at L1 might be checked to see how the redwoods responded to the interplanted alders. It might be worth noting how the Douglas-fir seedlings naturally invading the landing survive.



Unit: 83-3 Ref# 1-A 6/13/83 PP# 1.2 View from RR1



Unit: 83-3 Ref#1-B 9/2/83 PP#1.2 RR1 W.D.B.



Unit: 83-3 Ref#2-A 6/13/83 PP#27 W.D.B.



Unit: 83-3 Ref#2-B 9/14/83 PP#27 RX-4, C-13 W.D.B.