

Watershed Rehabilitation
Cost Analysis Summary Report

Unit 85-2
The 1800 and M-7-5 Roads and Slope

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Watershed Rehabilitation
Cost Analysis Report
Unit 85-2

INTRODUCTION

The 1800 and M-7-5 roads and slope, Unit 85-2, is a side bank hillslope which drains into Redwood Creek along the east slope of Bridge Ridge, and is located between 10 and 15 miles upstream from Orick. The unit consisted of a road corridor through three previously mapped and partially rehabilitated units: 84-2, 84-4 and 84-6. The 1984 rehabilitation treatments concentrated on slope work and haul road spur roads, leaving the 1800/M-7-5 haul road corridor and several remaining short sections of spur roads (1850 and M-7-5-4) for removal in 1985.

Total relief on this unit varies between 1,840 feet and 1,960 feet, ranging from 160 to 240 feet along Redwood Creek, to 2,000-2,200 feet at the ridge top. Above the 1800 and M-7-5 roads, slopes tend to be gentle to moderate (20-45%) with a distinct tread and riser profile. Below these roads the slopes become more uniform and steepen considerably towards the inner gorge of Redwood Creek, averaging between 35 and 65+ percent. Drainages along this hillslope are linear, first and second order, intermittent and perennial streams draining directly into Redwood Creek. Drainages throughout the lower half of the hillslope are landslide controlled with poorly incised stream reaches and some discontinuous channels. Drainage areas average 70 acres along the 1800 road and 30 acres along the M-7-5 road.

The unit is underlain by the schist of Redwood Creek, part of the Franciscan Assemblage (Hardin, et al. 1982). Soil types in this unit have a well defined distribution pattern. The deep, well developed, clay-rich red soils (Trailhead and Forty-four) occur mostly on the gentle to moderate slopes along & above the M-7-5 and M-7-5-4 roads. The soils of the middle to lower slopes, between the 1840 and M-7-5 roads down to Redwood Creek (including the 1800 Road), are predominantly Cooper creek and Slide creek. Small pockets of Devils creek soil occur along wet cutbanks (1800 road), and on major landslide features. Sheared black schist is common throughout the site varying in depth from surface exposures to plus 20 feet, indicating the large mass movement features that dominate the eastern hillslope of Bridge Ridge.

In summary, the grand total rehabilitation project cost was \$140,610.30 (Table 1). Of this total, contract heavy equipment and labor intensive work accounted for 77 percent and 7 percent, respectively.

Evaluation & documentation phases make up the remaining 16 percent. These costs are discussed in detail in the Erosion Control Work section. A total of 5.2 miles of haul roads were eliminated from further rehabilitation: 1.7 miles of the 1800; 0.1 miles of the 1850; 2.8 miles of the M-7-5; and 0.6 mile of the M-7-5-4. A total of 31,578 cubic yards of channel fill was excavated from 26 haul road stream crossings, and 995 cubic yards from 2 skid trail stream crossings.

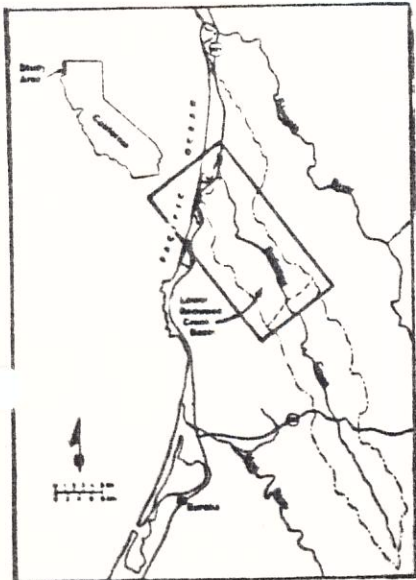
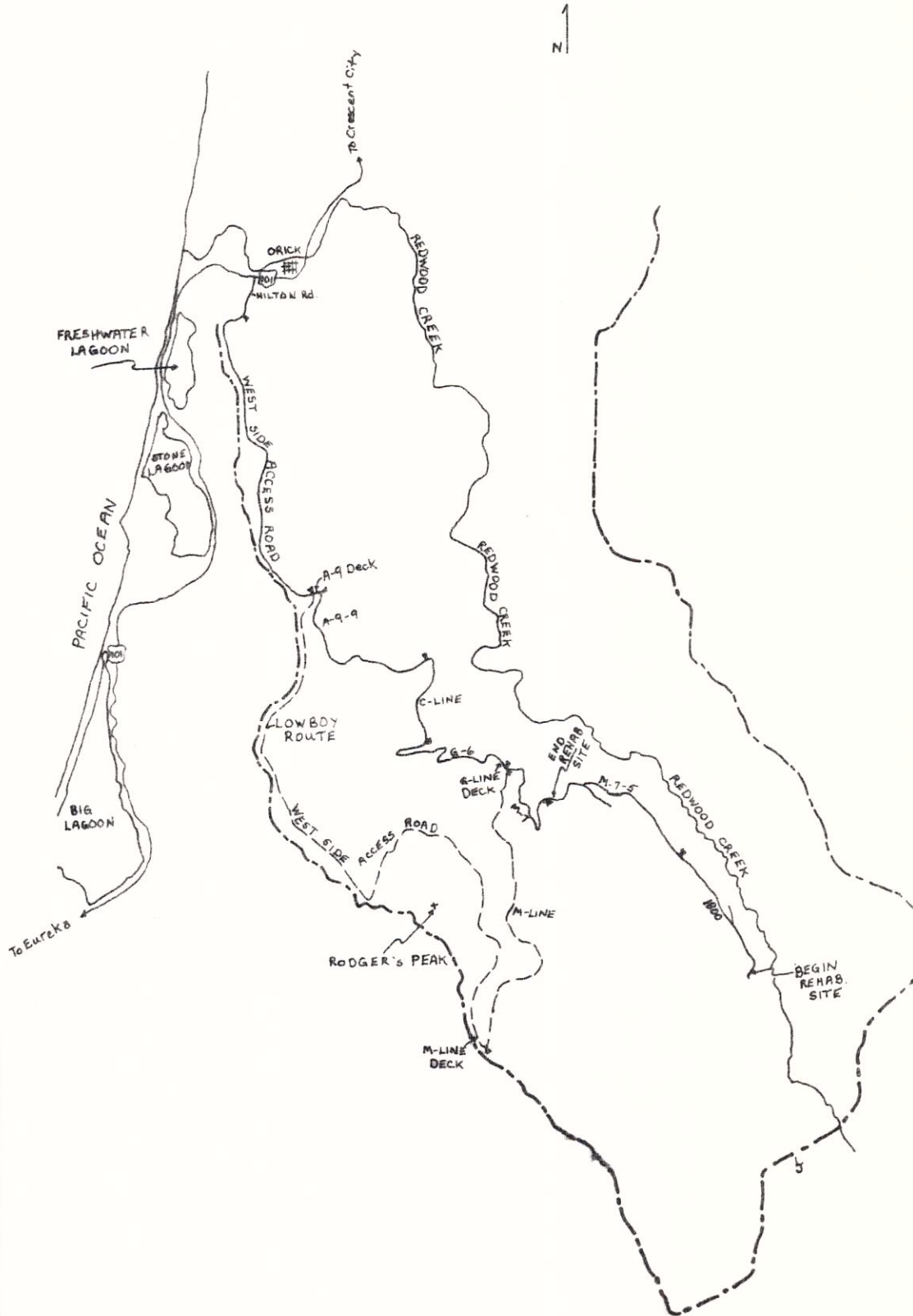
85-2

1800/M-7-5 Road Watershed Rehabilitation Unit

MAP A: SITE LOCATION MAP

by Louise E. Johnson

SCALE: 1 inch = 2.3 miles

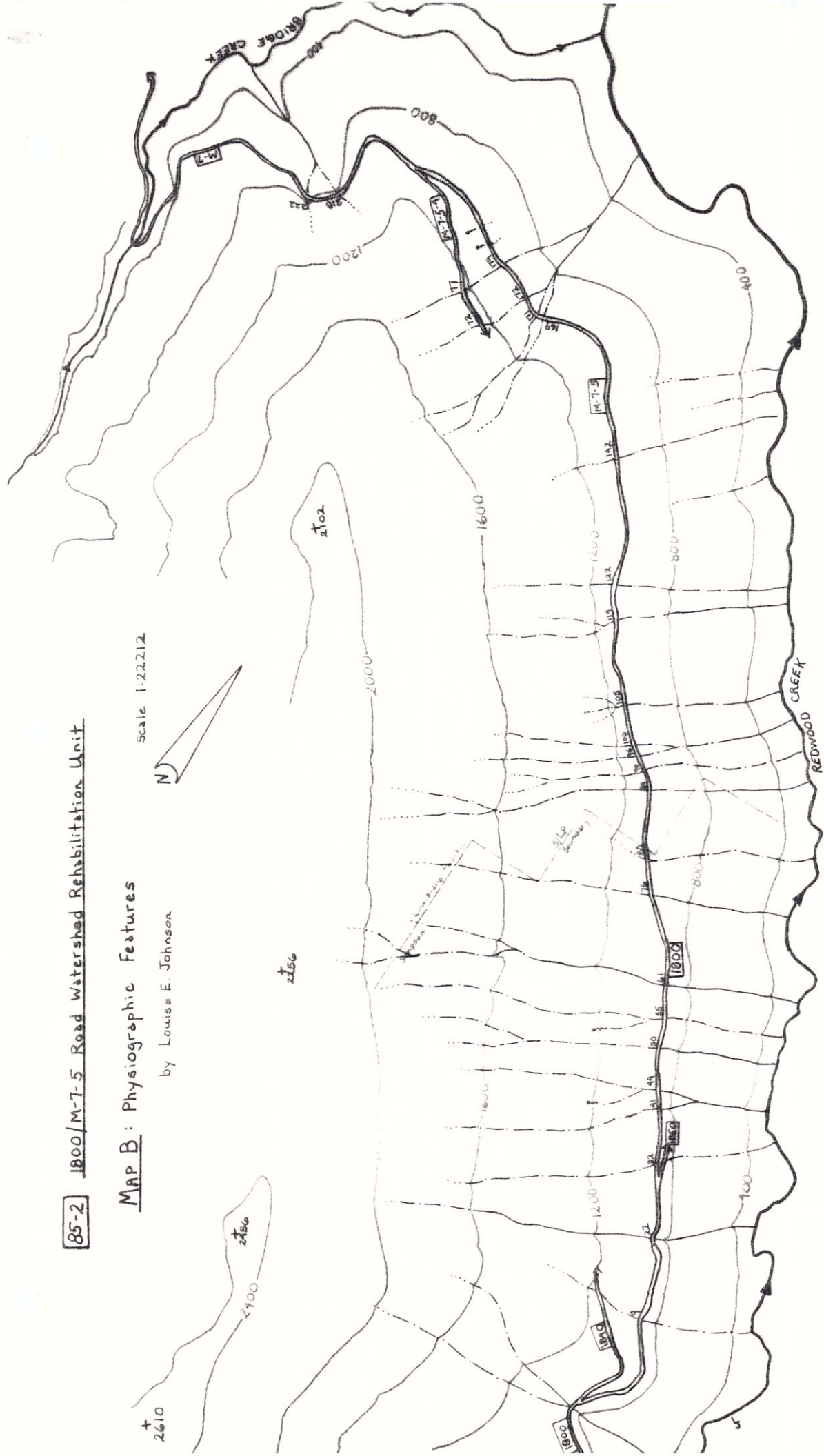


[85-2] 1800/M-7-5 Road Watershed Rehabilitation Unit

Map B: Physiographic Features

by Louise E. Johnson

Scale 1:22212



- LEGEND**
- Streams
 - Haul Roads
 - Contours
 - Simpson/Louisiana Pacific Boundary

TIMBER HARVEST AND EROSION HISTORY

Timber harvest and haul road construction activities occurred during two time periods: 1958-1966 and 1971-1978. During August, 1958, Simpson Timber Company was pioneering the 1800 road from the Redwood Creek crossing up to Elf Creek; by 1960, they had completed the road through to the Simpson/Louisiana Pacific boundary. Between 1971 and 1973, Louisiana Pacific Corporation built the M-7-5 road between 1971 to 1973 from Bridge Creek to the Simpson/Louisiana Pacific boundary. These two major haul roads were connected sometime between 1975 and 1978.

Simpson Timber Company selectively logged between 1960 and 1966, then began clearcut activities in 1974 which continued through 1977. Nearly 90 percent of the Simpson owned portion of the unit was logged, mostly using tractor yarding techniques; only 12 acres were cable yarded. The remaining small patch of old growth is located below the 1850 road along Redwood Creek (Map B-1).

Louisiana Pacific Corporation logged between 1971 and 1978, with tractor-yarded units above the M-7-5 road and cable-yarded units below. From the intersection of the M-7-5 and M-7-5-4 roads down to the Bridge Creek crossing, the entire hillslope was tractor-yarded. Approximately 50 percent of the M-7-5/M-7-5-4 slope remains as old growth in a distinct patch work pattern along the hillslope (Map B-2).

Most of the significant sized erosion features on Unit 85-2 were found along the older 1800 Road and associated slopes. The M-7-5 Road was relatively stable, however erosion potential was high due to the fact that it was unmaintained and had only experienced one major storm.

The 1800 Road was constructed using humboldt stream crossings, a common practice in the early 1960's. The majority of erosion features appeared between 1960 & 1966, and most likely occurred during the December 1964 storm. These features include haul road and skid trail stream crossing fill failures, diverted stream flow gullies, and major stream bank landslides along Redwood Creek. Culverts were installed in many of the humboldt stream crossings at some later date; virtually all were undersized, some were poorly located. Additional erosion occurred in the 1972 & 1975 storms, however there appeared to be less damage than in 1964.

In comparison, the M-7-5 road was constructed with correctly placed & sized culverts. Most of the erosion features along the M-7-5 road were probably a result of the January 1975 storm event. These features consisted of numerous hillslope gullies, a few larger gullies, and some partially eroded stream crossing fills. Lack of erosion features along the M-7-5 road can be attributed to the gentle slopes, relatively non-erosive soil types, small drainage size, and lack of major storm events since much of the road building and logging occurred.

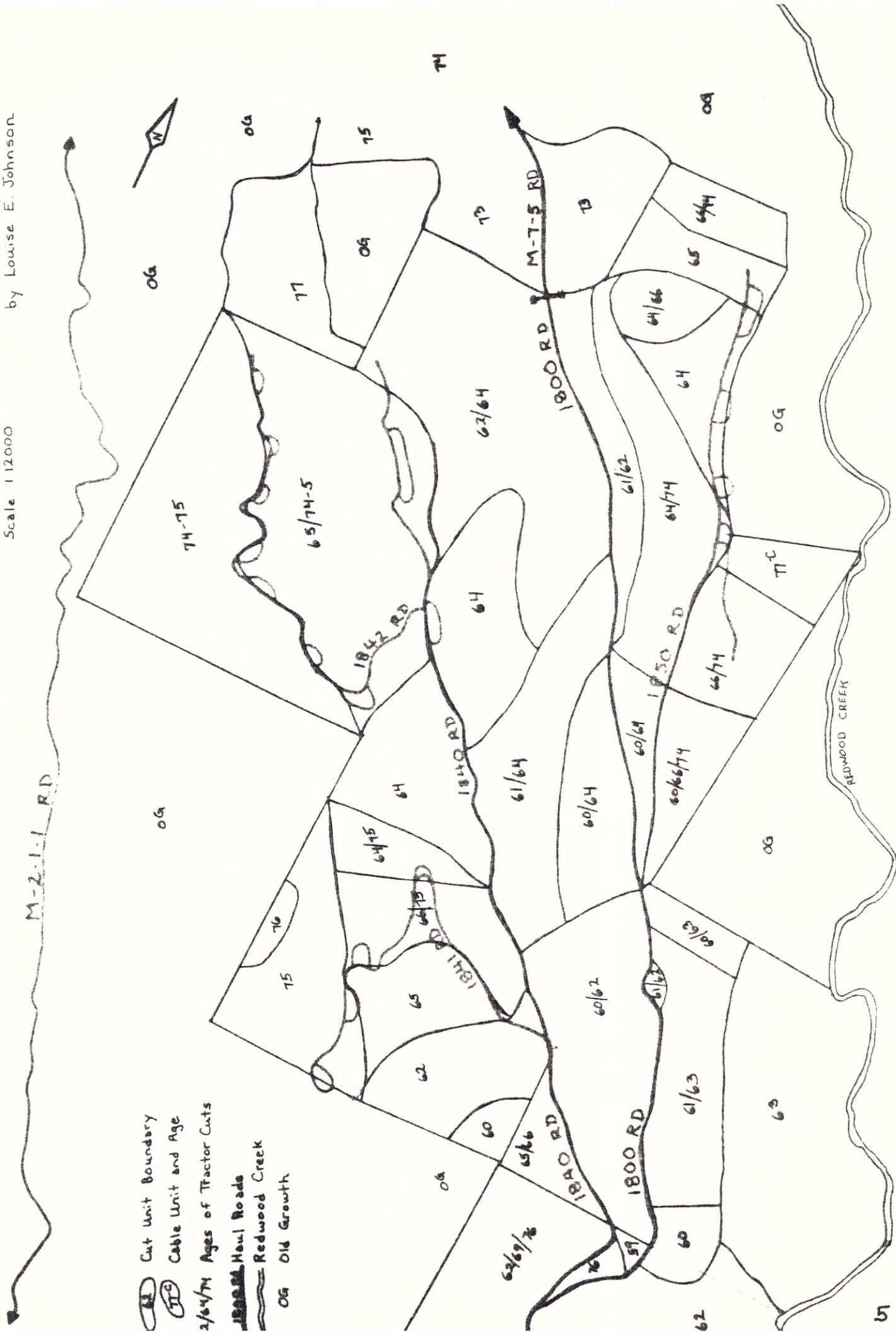
Large scale, slow moving landslides occur along much of the East slope of Bridge Ridge, causing active road displacement of portions of the M-7-5. These large scale mass movement features are probably of natural origin.

85-2

MAP C-1: LOGGING HISTORY

Scale 1:12000

by Louise E. Johnson



469-72

1800/M-7-5 Road Watershed Rehabilitation Unit **85-2**

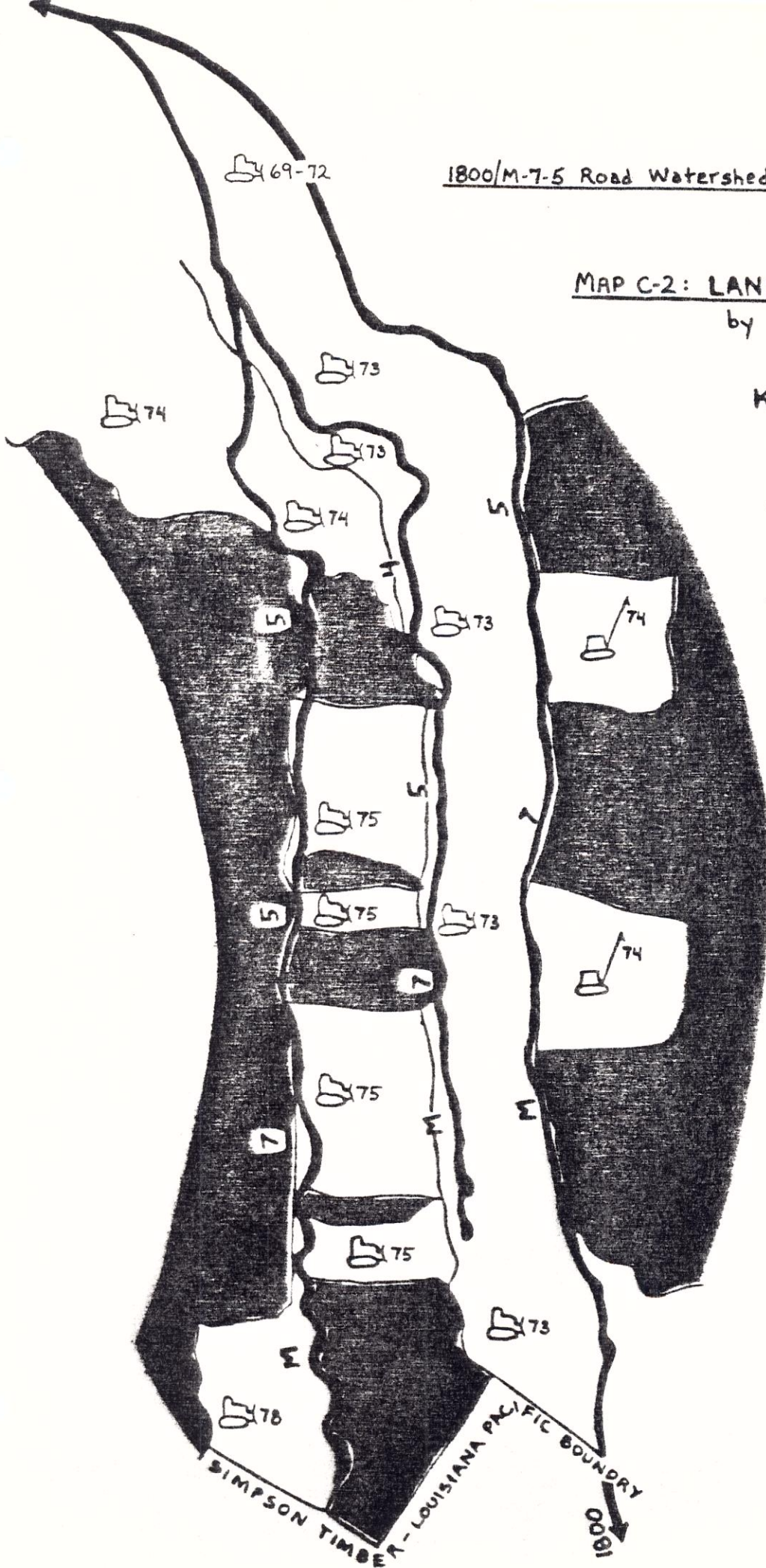
MAP C-2: LAND USE HISTORY

by Michael Sandecki (84-2)
(changes by L.E. Johnson 85-2)

KEY

- UNCUT TIMBER
- 🏠 YEAR HARVEST BEGAN
TRACTOR METHOD
- 🏠 YEAR HARVEST BEGAN
HIGH LEAD METHOD

SCALE 1:12,000



Potential erosion on both roads existed as intact stream crossing fills (ranging in size from 166 to 2,905 cu. yds.) and potential stream diversions which could have caused gullying and stream bank landslides. For more complete detail on potential and existing erosion features refer to the Erosion Potential Forms on file for Unit 84-4. (See Table 2 for cross reference list of stream excavation and erosion potential numbers), and the geomorphic maps for Units 84-2, 84-4 and 84-6.

EROSION CONTROL WORK

Evaluation Phase:

The evaluation phase includes mapping, prescribing treatments, surveying, establishing photo points, planning the work schedule and contract preparation. This phase involved approx 180 person-days, between January and June, 1985. The following is a more detailed cost breakdown of the evaluation phase:

Mapping (1985)	\$2,207.33
Prescriptions (includes photo points)	1,044.74
Surveying and Staking for contract	9,737.67
Contract Preparation (office)	4,969.90
Total	\$17,959.64

Since this rehabilitation unit consisted of a road corridor through previously mapped & treated units, mapping time & cost in Fiscal year 1985 was minimal. The majority of mapping necessary to do this unit was done in 1984 by Johnson, Kenning, Routon, Sandeck, Spreiter & Utley, in conjunction with Watershed Rehabilitation Units 84-2, 84-4 and 84-6. Mapping costs totalled \$12,177.00 in 1984, which would bring the total cost of the evaluation phase to \$30,136.64.

Prescription costs are relatively low for Unit 85-2. In preceding years however, surveying was included with prescriptions. Due to the more detailed surveying (and associated flagging & staking) necessary for a contract site, a great deal of time was spent on this category and time records were kept separately for surveying & staking as opposed to all other prescription tasks. The old "Humboldt" crossings on the perennial streams of the 1800 Road proved to be the most time consuming to survey: they often merged with skid trail or pioneer road crossings below the main road. It was difficult (impossible, in some cases) to determine where a stable base level could be achieved. The younger, cleaner fills on the M-7-5 Road fit more readily into the contract surveying system. The cost of surveying could easily have been cut in half for an hourly equipment rental job because the pre-excavation surveys are used mainly for in-house cost estimates, and there is more flexibility when it comes to the actual excavation.

However, in order for contractors to make a reasonable bid, they need to be able to see the best possible estimate of size [extent] & bounds of excavation. This can only be done following detailed surveying & staking in the field.

The actual contract preparation was also fairly costly. This includes laying out plan sheets, drafting, typing, proofing, etc. None of this would be done on an hourly equipment rental job. Surveying and contract preparation was done by Louise Johnson, Paul Routon, Mike Sandecki & Terry Spreiter.

To compare the cost of the evaluation phase on contract & hourly jobs, one could eliminate roughly half of the surveying cost and all of the contract preparation cost for a evaluation phase cost of roughly \$8,100, saving nearly \$10,000. Looking at the cost of our evaluation phase in other years, this is a reasonable figure, given the small amount of mapping needed in 1985. It also shows the necessity of completing the mapping for contract jobs a year in advance. An additional unknown amount of time & money was spent on administrative overhead for such things as contract advertising, printing, soliciting bids, bid opening and recording and decision making. This would amount to roughly several thousand dollars beyond what would be spent for a rental unit. The park could have possibly saved as much as \$12,000 in the evaluation phase by doing the unit by rental agreements. in the evaluation phase by doing the unit be rental agreements.

Heavy Equipment Phase

Introduction

The majority of the erosion control work on watershed rehabilitation unit 85-2 was done under a fixed price contract (#8485-85-05). The contract consisted of 28 stream crossing excavations, and ripping and draining 4.4 miles of haul road. A total of 5.1 miles of haul road was treated in some manner. Three bids were received: \$89,384.25 from Twin Parks Lumber Company, \$110,328.14 from W.K. Construction and \$225,960.41 from Nally Enterprises. The contract was awarded to the low bidder, Twin Parks Lumber Company, on July 3, 1985.

Heavy equipment used by the contractor consisted of 3 bulldozers and an excavator. The bulldozers were all Caterpillar D 8 H's with 4-way, hydraulic straight blades. Two were equipped with winches; the third had rippers and was only on site for a few days to do the decompacting. The 2 bulldozers with winches were on-site for most of the work period; one had 24" wide tracks, the other had extra wide 28" tracks which were essential for working with wet ground conditions. The excavator was a Caterpillar 225 with a 1 yard bucket. Two pick-up trucks were used to distribute straw bales. A dump truck with fuel trailer and a fire truck were also on site. All work, including straw distribution, was done by Jay Franke and Wendell Larkin of Twin Parks Lumber Company. Jay Franke primarily ran a bulldozer (ripper and winch); Wendell Larkin alternated between the excavator and the other bulldozer.

The notice to proceed was issued on July 10th and work commenced immediately. During the first week, the entire length of road was ripped, and straw bales were delivered. The rip dozer was then replaced by the wide tracked winch bulldozer.

This bulldozer worked alone on the job for the next 2 weeks. doing drains. completing the first crossing, and removing the bulk of the volume from the next 5 crossings. The second bulldozer and the excavator began work at the

end of the third week. At this point, the equipment moved back to complete the first crossings. From then on, work was completed in station-sequential order. At stream crossings, the 2 bulldozers would remove as much of the fill as possible, working either on the same crossing (if it was large or had a distant fill site) or on adjacent crossings (if they were small, or if one was nearing completion). The excavator was only used occasionally during the preliminary excavation phase, and usually finished the excavation by defining the channel.

Rain interrupted the job once in mid-September (Friday the 13th) making the ground too mucky to work. Dry weather during the weekend allowed work to begin again on the following Tuesday.

Due to the fact that several stream excavations on the 1800 Road were considerably bigger than estimated, a time extension was needed in order to complete the job. This was granted on September 16th, and the entire project was completed on October 1st.

The final price of the contract, based on the actual surveyed volumes was \$99,961.75. The fact that this is 10% over the initial bid price reflects the often unpredictable volume of stream excavations, especially old Humboldt style crossings as on the 1800 Road.

Table 4 shows average and total costs for the erosion control work, along with estimates of what it would have cost to do the same work by rental. Heavy Equipment Rental Equivalent (HERE) costs were calculated using actual equipment hours worked, and hourly rental prices from this year's equipment list of \$85 an hour for the CAT D8 H bulldozer and \$100 an hour for the CAT 225 excavator. Further details and comparisons between contract & hourly rental costs are discussed for stream crossings and drains in the following sections.

Stream Crossings

Twenty six stream crossings were excavated along the major haul roads, and two were done upslope of the road on skid trails. Stream crossings were excavated to prevent flow diversions and washouts which would have contributed sediment directly to perennial and intermittent streams, and ultimately to Redwood Creek. Excavations were designed to tie into stable base levels at, or near, the original channel bed level. For the most part, excavations were designed with 50% side slopes, however in a number of cases, this proved insufficient for complete removal of perched unstable fill & organic debris, and side banks of 30-35% proved more realistic.

Table 5 shows average costs as bid, HERE cost estimate, and excavation rates for the different size categories. Table 6 details this information for each crossing. Actual excavation rates and HERE costs were the highest and lowest respectively of all Spreiter & Johnson's preceeding years, and are among the best the park has thus far seen. This is due to maximizing the use of the bulldozers and being able to have one operator trade off between the excavator and bulldozer. Usually on a rental job, the excavator must be kept busy whether or not it is working at peak efficiency, to avoid stand-by

charges. Since this was a contracted job, the contractors were able to save money by not hiring a third operator, and it actually allowed more efficient use of the machinery. There are certain times during most excavations when an excavator is the most effective machine to retrieve the fill such as steep fill cones, places where sidecast would be difficult to recover, around stumps or other obstructions, channel bottoms, exceptionally wet ground, etc. The volumes involved are usually small, and a bulldozer is still needed to transport the fill to the approved fillsite, so it works well to have one operator who can do both. Additionally, many times there isn't room for both excavator and dozer to be working simultaneously, and one would be waiting anyway. However, a large bulldozer is still the most efficient way to move the bulk of the fill from the channel to the fillsite, and as such, it should be used to the maximum.

The extra wide tracks enabled that D-8 to continue excavating in conditions where the other D-8 would get stuck, and this reduced the amount of final "mucking out" for the excavator.

For contract versus rental cost comparison purposes, the HERE cost for each crossing & size category is shown on Tables 5 and 6. However, since it is unlikely that the park could rent an excavator and bulldozer with one operator, an adjusted HERE total cost was calculated using bulldozer: excavator hour proportions more similar to that of a rental site. Using data from Unit 84-4, with similar crossings, overall hour proportions of 55% bulldozer to 45% excavator, and an average excavation rate of 55 cu. yds. per hour, the adjusted HERE shows that the government could have saved a minimum of \$12,261 by doing the stream crossings by hourly rental agreements. If the government could have done the crossings exactly as done by the contractors, savings would total \$17,763.

The reader is referred to the tables for details on specific crossings and average costs. HERE's in the tables are unadjusted and represent maximum savings which could have been achieved under hourly rental agreements.

Road Treatments

Ripping and draining was the only erosion control treatment recommended for the haul roads on this unit. The mapping revealed no road stability problems that could be effectively treated by outsloping. There were no potential or existing fill failures that could contribute significant quantities of sediment to the stream system. Several large landslides or earthflows exist that have disrupted the roads, but they involve so much of the hillslope that it was felt that outsloping the road would have minimal impact on the mechanisms triggering the slope movement.

The road was ripped to a depth of two feet, using the CAT D-8 H with two rear mounted 36 inch ripper teeth. Decompacting the road increases infiltration on the road surface and makes it easier for vegetation to become established. For the most part, in-board ditches were not ripped, because they were to be used to collect slope runoff and direct flow to the cross road drains. The actual cost of this work as bid was \$11,640 (see Table 4). The HERE cost is \$3,125. The government could have saved \$8,515 by doing the work under an hourly rental agreement.

Where inboard ditches were expected to carry considerable spring flow, they were cleared of vegetation and widened. This work was generally done by the excavator. Cross road drains were constructed at frequent intervals to disperse the runoff. These were mostly done by the bulldozers. The excavator was used on some of the deeper drains, and on some drain outlets.

The actual and HERE costs are detailed for each drain reach in Table 8. Overall, cross road drains averaged 46 feet long and had a HERE cost of \$.80 per foot of drain. In board drains averaged 90' feet long, with a HERE cost of \$.64 per foot. Actual cost as bid was \$1.00 per foot for both cross road and in board drains.

As Table 4 (Summary of Average Costs) indicates, approximately \$2,275.75 could have been saved if this work had been done on hourly rental agreements. Methods of drain construction and equipment used would have been very similar, thus no HERE cost adjustments were necessary.

Miscellaneous Heavy Equipment Costs

This category includes all equipment time which can not be assigned to a specific worksite, including breaks, procedural discussions, travel, moving straw bales (other than for Bid Item 5), getting stuck or helping get unstuck, breakdowns, blading the road to keep it drivable, and moving culverts. None of these were listed as individual bid items, but have been lumped under item 4, "Miscellaneous Cost", for comparison purposes. The contractors spent more time on breaks and down time than the park would normally have paid them for on an hourly rental agreement. On Table 8 the HERE costs for these items have been adjusted downward to reflect this.

LABOR INTENSIVE PHASE

The labor intensive phase involved two main tasks: pre-season brushing and post-excavation mulching. Cost are shown on Table 9.

Application of straw mulch on stream crossing side slopes to control surface erosion was the only secondary erosion control treatment done on Unit 85-2. Straw bales were distributed as part of the contract (Bid Item 5). Redwood National Park (RNP) and Redwood United Inc. (RUI) labor crews were responsible for spreading the straw. Comparison of distribution costs with last year's shows that straw distribution was more expensive by contract by roughly \$1.00 per bale. The transportation distance was similar in both years. Spreading cost per bale was \$.85 less than last year, in spite of longer walks in to the worksites (up to three miles one way).

The miscellaneous labor intensive work category includes pre-season brushing and travel. All stream crossings were brushed to provide visibility and access for surveying, photo points and the contractor's pre-bid inspection. Trees over about 8 inches in diameter were left standing, but were limbed; smaller trees and dense undergrowth was removed. Debris was left on the road, and buried during the equipment work when convenient. Brushing costs totaled \$3955.93, and were comparable with brushing costs on other sites.

The travel category cover person-hours of travel between Orick and the contract site, a round trip of 3 hours. This totalled \$2,751.01.

DOCUMENTATION PHASE

Following completion of the erosion control phase, the work was surveyed and actual volumes were determined. Photo points were retaken, and then the annual report was written. Total cost of this phase was \$4703.75. Work was done by Louise Johnson and Terry Spreiter, and was completed in January 1986.

OVERALL COMMENTS

In general, watershed rehabilitation contracts using heavy equipment are likely to cost more than work done under hourly rental agreements. First of all, contracts take considerably more government personnel time to prepare and administer than do rental sites. On this contract approximately \$12,000 was spent on contract preparation, over and above what would be spent to prepare a rental site. This could have been spent mapping and preparing another site. The bids (and final cost) are likely to be higher than the in-house cost because the contractor must shoulder the responsibility for managing the work. The cost of bid and performance bonding, and Davis Bacon-Wages will also tend to keep bid prices high.

Comparing the final heavy equipment contract cost (heavy equipment only) with the HERE cost, the government could have saved \$26,341.75 by doing the site rental style. Table 4, Summary of Heavy Equipment Costs, shows the government's savings and losses per job category. However, it is difficult to make actual cost comparisons between job categories due to the way bid schedules are commonly filled out: Due to the two month delay in contractors receiving their first payment, the first items on the bid schedule may be inflated so as to get enough cash inflow to cover their fuel and start up expenses.

However, the park can learn more efficient techniques or uses of equipment from contractors. They are inspired to work at peak efficiency and are free to try whatever methods seem appropriate. Also having the contractors in charge allows them to use the most efficient piece of equipment for a task, particularly if they are owner-operators, skilled in operation of several pieces of equipment. Often the operator knows long before an observer when his piece of equipment is no longer at peak efficiency, and adjustments in the plan of attack can be made as soon as possible.

The contractors on this site used a very effective technique for stream crossing excavations. The majority of the fill was removed using one or two large bulldozers. The finishing work was left for one operator who alternately ran the bulldozer and the excavator, as needed. Bulldozers are more effecient at moving the majority of the fill, and getting it all the way to the fillsite. Some crossings can be completed with a bulldozer alone, depending on side slope steepness and what is encountered near the original stream channel bottom. Many crossings, however, are best completed by an excavator. Excavators are good at defining the final excavated stream bottom,

digging in places where space is limited by stumps, logs and/or rocks, and for pulling back steep outboard fills. In these situations, space is often limited so only one piece can work at a time anyway, and having one operator alternating between the bulldozer and the excavator avoids the idle or low efficiency time which can occur in hourly rental work. It would be beneficial to the government if we could hire equipment on engine time only.

Open honest communication is a key to efficient operations on both contracted and hourly rental sites, both between operators, and between operators and site project leaders. Everyone must remain open to suggestions, admit failures or inefficiencies. People tend to want to stick to their own idea (whatever it maybe) beyond its useful purpose. Everyone must be constantly alert for possible improvements in plan of attack or coordination of work. A sense of partnership between operators helps communication and cooperation.

This is more evident on contract sites than on rental sites. However, efficiency and cooperation on rental sites may be improved if pairings of operators that proved successful in the past can be repeated.

One improvement in the content of the contract that we will be making next year, will be the elimination of the bid item of straw delivery. The park labor personnel are much more cost effective and efficient at delivering the straw prior to heavy equipment work beginning. The only problem that could arise would be the initial straw order may not be delivered to the park prior to a contract start up date, though this could be eliminated through good scheduling and advance purchase orders.

Another improvement would be standardization of contract terminology and layout. This process was begun for the 1986 contracts, and will be finalized in the winter of 86/87.

85-2 TABLE 1
SUMMARY COSTS OF EROSION-CONTROL REHABILITATION WORK

Task	Geologist & Technician	RNP Employees	Laborers	Redwoods United	Heavy Equipment Contract	Materials	Total Task Cost	% Total Cost	Phase Totals	Phase %
Mapping	2207.33 ¹	--	--	--	--	--	2207.33	2%	\$17,959.64	13%
Prescription & Contract Preparation	15752.31 ²	--	--	--	--	--	15752.31	11%		
Primary Treatment	8497.39	--	--	--	88061.75	--	96559.14	69%		
Secondary Treatment	--	--	--	--	-- ³	--	--	--	\$107,559.14	77%
Miscellaneous	--	--	--	--	11000.00 ⁴	--	11000.00	8%		
Travel	--	1000.01	--	1751.01	--	--	2751.01	2%		
Secondary Treatment (Straw)	--	822.78	--	1024.25	900.00	933.80	3680.83	3%	\$10,387.77	7%
Miscellaneous (Brushing)	--	1159.43	--	2796.50	--	--	3955.93	3%		
Cost Analysis and Report	4703.75	--	--	--	--	--	4703.75	3%	\$4,703.75	3%
TOTALS:	\$31,160.78	\$2,982.22	--	\$5,571.75	\$99,961.75	\$933.80	\$140,610.30		GRAND TOTAL: \$140,610.30	
% OF TOTAL:	22%	2%	--	4%	71%	1%				

Footnotes

1. Majority of mapping for this site was done in 1984. See Summary Reports from 84-2, 84-4 and 84-6.
2. Includes prescriptions, surveying, staking, photo points & contract preparation. See text for cost break down.
3. A few hours of equipment time was spent moving straw, but since this was not a separate bid item, it was included here with primary treatments. See Table 8, Miscellaneous Heavy Equipment Cost for rental equivalent cost.
4. Includes move in/out (\$5,000.00), miscellaneous costs (\$5,000.00) and record keeping (\$1,000.00), as bid.

85-2 Table 2

85-2 Stream Crossing Number

A 22+40
A 32+01/02
A 32+03/04
A 41+70
A 44+00
A 50+90
A 55+10
A 61+10
A 76+
A 80

84-4 Erosion Potential Number

L-32
L-31/L-49
L-45
L-30
T-27/T-28
T-26
T-25
T-24
T-20
T-45

Remainder of crossings mapped by Kenning, Routon, Sandeck & Utly ____ No erosion potentials done.

85-2 Table 3

Bid Summary for 1800/M-7-5 Roads

	Nally Enterprises Total Amount	WK Construction Total Amount	Twin Parks Lumber Co. Total Amount	RNP Estimate Total Amount
Grand Total Bid:	\$225,960.41	\$110,328.14	\$ 89,384.25	\$ 70,078.48
<u>Proposed Work:</u>				
1800 rd. and M-7-5 rds:				
Through A 103+83	\$120,473.80	\$ 57,017.17	\$ 46,639.25	\$ 37,517.04
A 103-83 through A 202+00	77,966.36	38,316.91	30,195.00	23,029.49
A 202+00 through A 229+00	27,520.25	14,994.06	12,550.00	9,531.95
Total Bid Overage	\$155,881.93 (220% over RNP)	\$ 40,249.66 (57% over RNP)	\$ 19,305.77 (27.5% over RNP)	

85-2 Table 4
SUMMARY OF AVERAGE COSTS OF HEAVY EQUIPMENT EROSION CONTROL TREATMENTS

Treatment	# of Worksites	Total Quantity	TOTALS		Government Savings or Losses	AVERAGES			
			Actual Contract Total Cost	HERE Total Cost		Average Bid Cost Per Quantity	HERE ¹ Cost Per Quantity	Rate	Comments
Ripping	--	23,280 ft or 4.4 miles	\$11,640.00 ✓	\$3,125.00	-\$8,515.00	\$.50/ft	\$.13/ft	745 ft/hr	Road averaged 30' wide
Cross Road Drains	168 drains	7,735 ft	\$7,735.00 ✓	\$6,204.55	-\$1,530.45	\$1.00/ft	\$.80/ft		
In Board Ditches	23 drains	2,072 ft	\$2,072.00 ✓	\$1,326.70	-\$745.30	\$1.00/ft	\$.64/ft		
Stream Excavations	28 crossings	32,573 yd ³	\$66,614.75 ✓	\$47,691.25	-\$18,923.50	\$2.04/yd ³	1.46/yd ³	61 yd ³ /hr	
Miscellaneous (Bid item 4)	see Table	--	\$5,000.00	\$11,872.50	+\$6,872.50	--	--	--	
Move in/out (Bid item 1 & 2)	--	--	\$5,000.00	\$1,500.00	-\$3,500.00	--	--	--	
Totals	--	--	\$98,061.75 ²	\$71,720.00	-\$26,341.75	--	--	--	

¹ HERE = heavy equipment rental equivalent = actual hours spent for each task, using rental rates of \$85.00 per hour for D-8 and \$100.00 per hour for 225.

² Non-heavy equipment bid items total \$1900.00. Total contract is \$99,961.75.

85-2 Table 5
AVERAGE STREAM EXCAVATION COSTS

Size Category (cu.yds)	# of work sites	Range of Volumes (cu.yds)	Equipment percent	Range of Hours (total hrs)	Total Actual Cost	Range of Actual Costs	Total Rental Equiv. Cost	Range of Equiv. Costs	Total Volume cu.yds	Avg. Rental Equiv. cost/cu.yd	Range of Rental Equiv. cost/cu.yd	Avg. Exc. Rate (cu.yd/hr)
Small 0-400	5	166-381	Bulldozer 91% Excavator 9%	2-12 (28) 0-2 1/4 (2 1/2)	\$2870.50	\$315.00-842.00	\$2630.00	\$195.00-1020.00	1475	\$1.78	\$1.11-2.98	48
Medium 400-800	8	429-660	Bulldozer 72% Excavator 28%	2 1/4-12 (49 1/4) 1/2-4 3/4 (18 3/4)	\$6577.25	\$447.00-1539.00	\$6081.25	\$341.25-1170.00	4233	\$1.43	\$.75-2.14	62
Large 800-2000	9	945-1969	Bulldozer 71% Excavator 29%	7-29 (143 3/4) 1 1/4-11 (56 3/4)	\$24506.50	\$1950.00-4439.75	\$17893.75	\$1102.50-3490.00	12404	\$1.44	\$.88-2.17	62
Extra Large 2000-3000	6	2032-2905	Bulldozer 78% Excavator 24%	13 3/4-54 3/4 (181 1/4) 3 3/4-15 (57)	\$32660.50	\$3789.50-8037.25	\$21106.25	\$1568.75-5028.75	14461	\$1.45	\$.76-1.98	61
TOTALS	28	166-2905	Bulldozer 75% Excavator 25%	2-54 3/4 (402 1/4) 0-15 (135)	\$66614.75	\$315.00-8037.25	\$47691.25	\$195.00-5028.75	32573	\$1.46	\$.75-2.98	61

85-2 Table 6
STREAM EXCAVATION COSTS

Excavation Site Number	Post Survey Volume	CONTRACT BID COSTS:		Actual Equipment Hours:		Total Cost	Cost/ Yd ³	Excavation Rate Yd ³ /hr.	Average Push Distance	HERE:	
		Cost Yd ³	Total Cost	D-8 (\$85)	225 (\$100)					Total Cost	Cost/ Yd ³
A9+70	342	\$2.00	\$684.00	9.25	-	\$786.25	\$2.30	37	125	\$102.25	-
A22+40	1,969	1.51	2,980.00	20.50	11.00	2,842.50	1.44	63	222	-	\$137.50
A32+01/02	2,545	2.08	5,295.00	54.75	3.75	5,028.75	1.98	44	369	-	266.25
A32+03/04	545	1.50	817.50	12.00	1.50	1,170.00	2.15	40	125	352.50	-
A41+70	2,451	1.50	3,676.50	24.75	14.00	3,503.75	1.43	63	93	-	172.75
A44+00	2,032	3.00	6,096.00	31.25	13.25	3,981.25	1.96	46	460	-	2,114.75
A50+90	1,153	1.75	2,017.75	11.00	5.25	1,460.00	1.27	71	230	-	557.75
A55+10	553	1.00	553.00	9.25	1.75	961.25	1.74	50	72	408.25	-
A61+10	2,905	1.75	5,083.75	27.00	10.25	3,320.00	1.14	78	207	-	1,763.75
A76+15	533	1.00	533.00	2.50	2.25	437.50	.82	112	95	-	95.50
A80+30	429	1.00	429.00	4.00	.50	390.00	.91	95	115	-	39.00
A84+55/56	606	2.00	1,212.00	7.00	4.25	1,020.00	1.68	54	149	-	192.00
A90+25	1,295	1.75	2,266.25	7.00	5.25	1,120.00	.86	106	118	-	1,146.25
A96+30	376	1.50	564.00	7.00	-	595.00	1.58	54	112	31.00	-
A100+00	381	2.00	762.00	4.25	1.75	536.25	1.41	64	258	-	225.75
A105+65	2,055	2.00	4,110.00	13.75	4.00	1,568.75	.76	116	160	-	2,541.25
A114+80	660	2.25	1,485.00	7.50	4.50	1,087.50	1.65	55	220	-	397.50
A122+00	210	1.50	315.00	2.75	-	233.75	1.11	76	64	-	81.25
A141+25	166	1.25	207.50	2.00	.25	195.00	1.17	74	100	-	12.50
A169+55	1,225	2.25	2,756.25	8.75	6.00	1,343.75	1.09	83	416	-	1,412.50
A171+30	2,473	3.25	8,037.25	29.50	9.00	3,407.50	1.37	64	591	-	4,629.75
A172+30	975	2.00	1,950.00	16.50	3.25	1,727.50	1.77	49	360	-	222.50
A172+31	450	1.00	450.00	2.25	1.50	341.25	.75	120	50	-	108.75
A179+15	1,366	1.75	2,390.50	10.50	5.00	1,392.50	1.02	88	306	-	998.00
L72+25	457	1.75	799.75	4.50	.50	432.50	.95	91	128	-	367.25
L77+00	1,915	2.25	4,308.75	29.00	9.00	3,365.00	1.76	50	173	-	943.75
A218+40	945	1.75	1,653.75	10.25	1.25	996.25	1.05	82	173	-	657.50
A222+80	1,561	2.25	3,512.25	29.00	8.00	3,265.00	2.09	42	521	-	247.25

28 crossings 32,573 yd³ \$1.99/yd³ \$64,945.75 397.75 hrs. 127.00 hrs \$46,508.75 \$1.43/yd³ 62yd³/hr. Ave. 215 ft.
 76% 24%
 Loss= \$894.00 \$19,331.00
 \$18,437.00

*28% over
the HERE

85-2 Table 7
CROSS ROAD AND INBOARD DITCH DRAIN COSTS

Cross Road Drain Reach Station #'s	#	Cross Road Drains Length (feet)	Range of grade (deg.)	Inboard Drains #	Length	Total Drain Length	Equipment Hours Bulldozer CAT D8	Excavator CAT 225	Actual ¹ Cost	Heavy Equip. Rental Equiv. Cost	Heavy Equip. Rental Equiv. Cost/ft of drain
Z79+00 to A7+90	12	490	3-7	2	61	551	6.25	-	551.00	531.25	.96
A10+75 to A18+84	9	348	4-11	-	-	348	7	-	348.00	595.00	1.70
A20+39 to A20+76	1	46	5	-	-	46	.25	-	46.00	21.25	.46
A23+50 to A23+61	1	40	5	-	-	40	.25	.25	40.00	46.25	1.15
A24+56 to A27+10	3	114	4-5	-	-	114	1.75	-	114.00	148.75	1.30
A29+29 to A31+85	2	133	7-14	1	185	318	1.50	-	318.00	127.50	.40
AA2+05 to AA4+25	2	75	3-4	-	-	75	.25	-	75.00	21.25	.28
A32+91 to A37+50	4	155	4-7	-	-	155	2	.25	155.00	195.00	1.25
A37+50 to A40+57	2	88	4-5	2	201	289	.75	2.50	289.00	313.75	1.08
A45+20 to A47+20	2	83	5-6	1	86	169	.25	.50	169.00	71.25	.42
A51+20 to A53+94	2	88	5-6	-	-	88	-	.75	88.00	75.00	.85
A56+20 to A58+25	2	94	3-6	-	-	94	-	.25	94.00	25.00	.26
A62+60 to A74+40	10	357	5-8	5	496	853	3.50	1.25	853.00	422.50	.49
A76+54 to A78+00	1	70	9	-	-	70	.50	1	70.00	142.50	2.03
A81+32 to A82+00	1	29	9	1	71	100	.50	-	100.00	42.50	.42
A87+00 to A88+45	2	88	5-6	-	-	88	.50	.25	88.00	67.50	.76
A91+00 to A96+00	3	103	4-5	-	-	103	.75	-	103.00	63.75	.61
A98+18 to A98+69	1	45	3	-	-	45	.25	-	45.00	21.25	.47
A100+80 to A103+83	4	180	5	-	-	180	.50	.50	180.00	92.50	.51
A108+87 to A114+28	10	414	5-12	-	-	414	3	2	414.00	455.00	1.09
A115+30 to A116+00	1	40	6	-	-	40	.25	-	40.00	21.25	.53
A118+00 to A121+04	2	90	5	-	-	90	.50	-	90.00	42.50	.47
A122+20 to A141+25	15	851	3-8	2	239	1090	8.25	.75	1090.00	776.25	.71
A142+72 to A163+00	15	829	3-8	-	-	829	8	-	829.00	680.00	.82
A167+78 to A169+00	2	111	5-6	-	-	111	.50	-	111.00	42.50	.38
A172+70 to A173+70	1	100	4	1	88	188	.25	-	188.00	21.25	.11
A180+43 to A202+00	12	573	5-13	4	278	851	5.75	3	851.00	788.75	.92
L74+05 to L74+36	1	40	5	-	-	40	.25	-	40.00	21.25	.53
L79+42 to L101+00	10	383	4-7	-	-	383	2	-	383.00	170.00	.44
A202+00 to A215+35	13	681	4-9	-	-	681	7	-	681.00	595.00	.87
A219+21 to A221+50	3	194	5-7	-	-	194	1	-	194.00	85.00	.43
A223+47 to A227+57	4	172	5-8	4	367	539	4.50	1.50	539.00	532.50	.98
Optional XRDs	15	631	5-10	-	-	631	3.25	-	631.00	276.25	.43
	168	7735 ft.	3-14°	23	2072 ft.	9807 ft.	71.24 (82%)	14.75 (18%)	\$9807.00	\$7531.25	.76 ft.

¹ contract bid cost per linear foot was \$1.00/foot for all drain locations.

85-2 Table 8
MISCELLANEOUS HEAVY EQUIPMENT COSTS¹

	Actual Time Spent			Heavy Equipment Rental Equivalent ²			Total Equip. Hours	Total Cost	Bid Cost	Gov't Savings or Losses
	D8 Hours	225 Hours	Total Equip. Hours	D8 Hours	225 Hours	Total Equip. Hours				
Breaks	55.75	15.75	71.5	28	28	56	5180.00			
Discussions	25.25	10.5	35.75	25.25	10.5	35.75	3196.25			
Travel	9.5	6	15.5	9.5	6	15.5	1407.50			
Moving straw (other than item 5)	3.75	3.75	7.5	3.75	3.75	7.5	693.75			
Stuck & assist	3.5	1	4.5	3.5	1	4.5	397.50			
Down & assist	10	5	15	3	2.5	5.5	505.00			
Blade road	4.25	-	4.25	4.25	-	4.25	361.25			
Moving culverts	1.25	.25	1.5	1.25	.25	1.5	131.25			
TOTALS	113.25	42.25	155.5	78.5	52	130.5	\$11872.50	\$5000		+\$6872.50

1. These items are not covered under any item on the bid schedule, however they are standard heavy equipment time and cost categories on rental sites. They could be considered to be covered under Bid Item #4: Miscellaneous costs, which was bid at \$5,000.

2. Actual time was reduced in cases where RNP would not have paid for all time spent.
HERE = \$85.00 per hour for D8, \$100.00 per hour for 225.

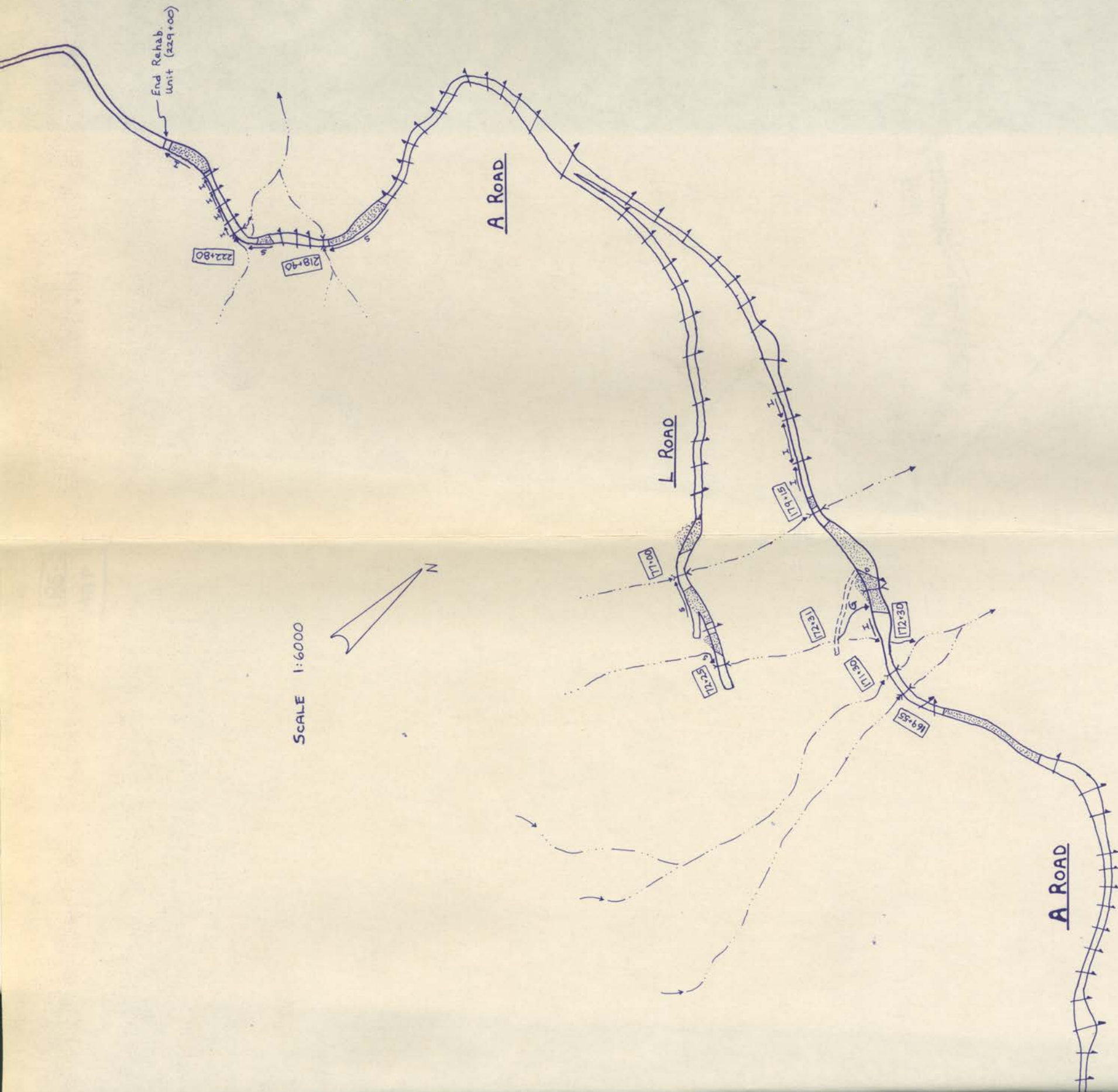
85-2 Table 9
LABOR INTENSIVE COSTS¹

Work Types	Type of Laborers	Person Hours	Cost	Total Cost	Quantity	Cost/Quantity	% of Total
Straw Distribution 2	Contractor	34	\$900.00	\$900.00	322 Bales	\$2.79/bale	
Straw Application 3	RNP RUI	86½ 120½	822.78 1024.25	1847.03	322 Bales	5.73/bale	
Straw Acquisition	--	--	--	933.80	322 Bales	2.90/bale	
TOTAL SECONDARY TREATMENTS =				<u>\$3,680.83</u>	322 Bales	\$11.43/Bale	35%
Brushing	RNP RUI	112 329	\$1159.43 2796.50	\$3955.93	25 crossings	\$158/xing	
Travel	RNP RUI	101 206	1000.01 1751.00	2751.01	--	--	
TOTAL MISCELLANEOUS TREATMENTS =				<u>\$6,706.94</u>	--	--	65%
TOTAL LABOR INTENSIVE COST =				<u><u>\$10,387.77</u></u>	RNP 299½ person hours RUI 655½		
					955 person hours 34 contractor		

1 includes materials costs.

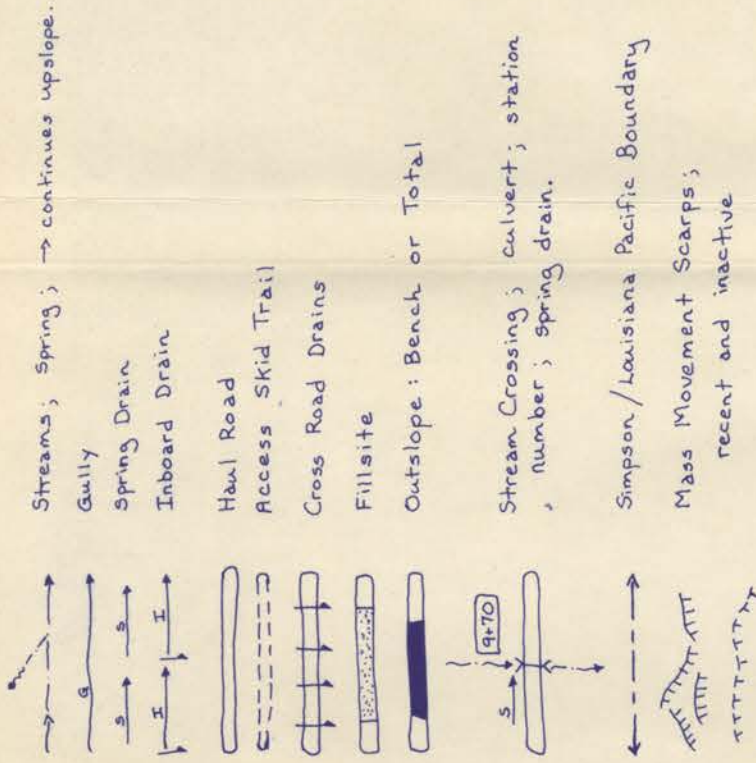
2 contract bid cost.

3 walk in time and distance varied between .7 to 3.25 miles round trip.



SCALE 1:6000

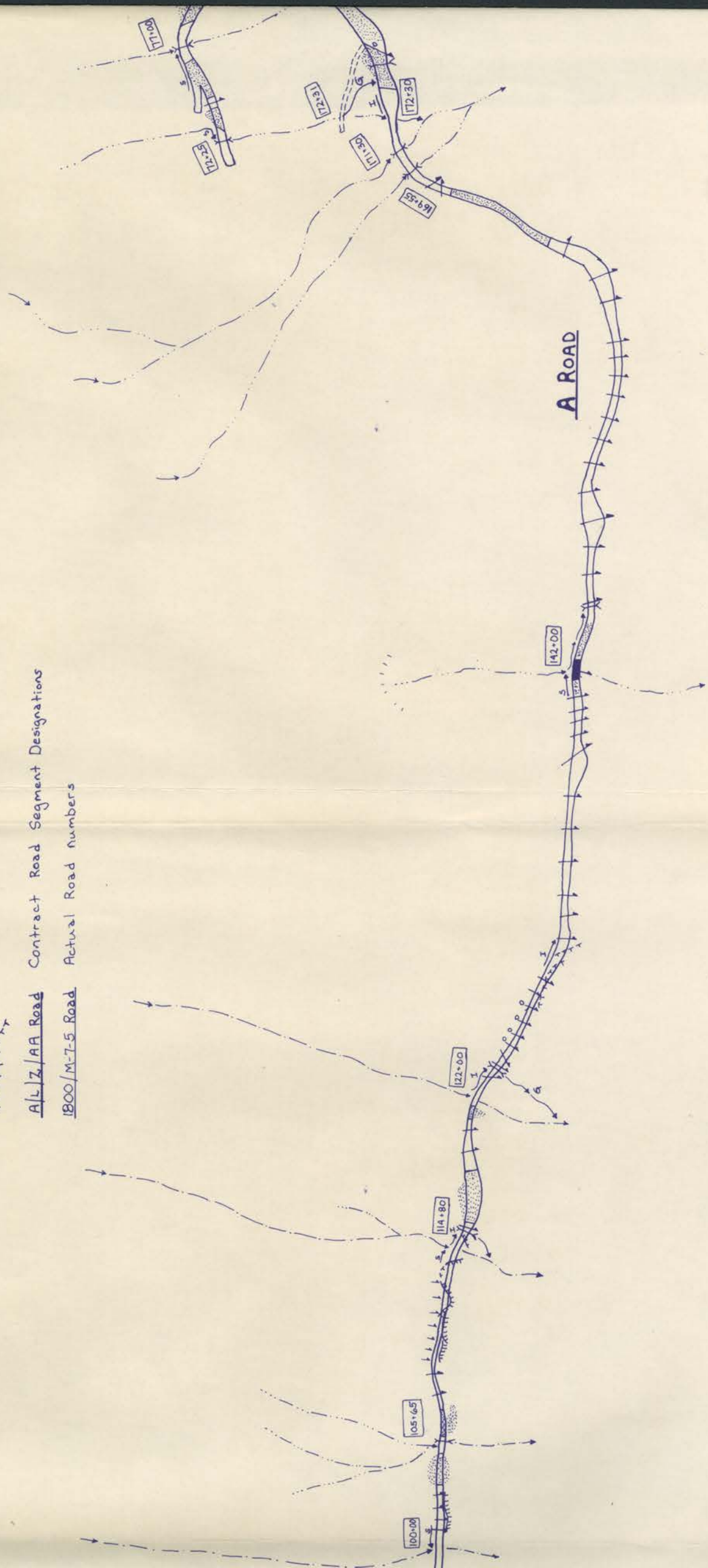
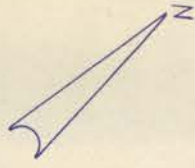
LEGEND



AL/Z/AA Road Contract Road Segment Designations

1800/M-7-5 Road Actual Road Numbers

SCALE 1:6000

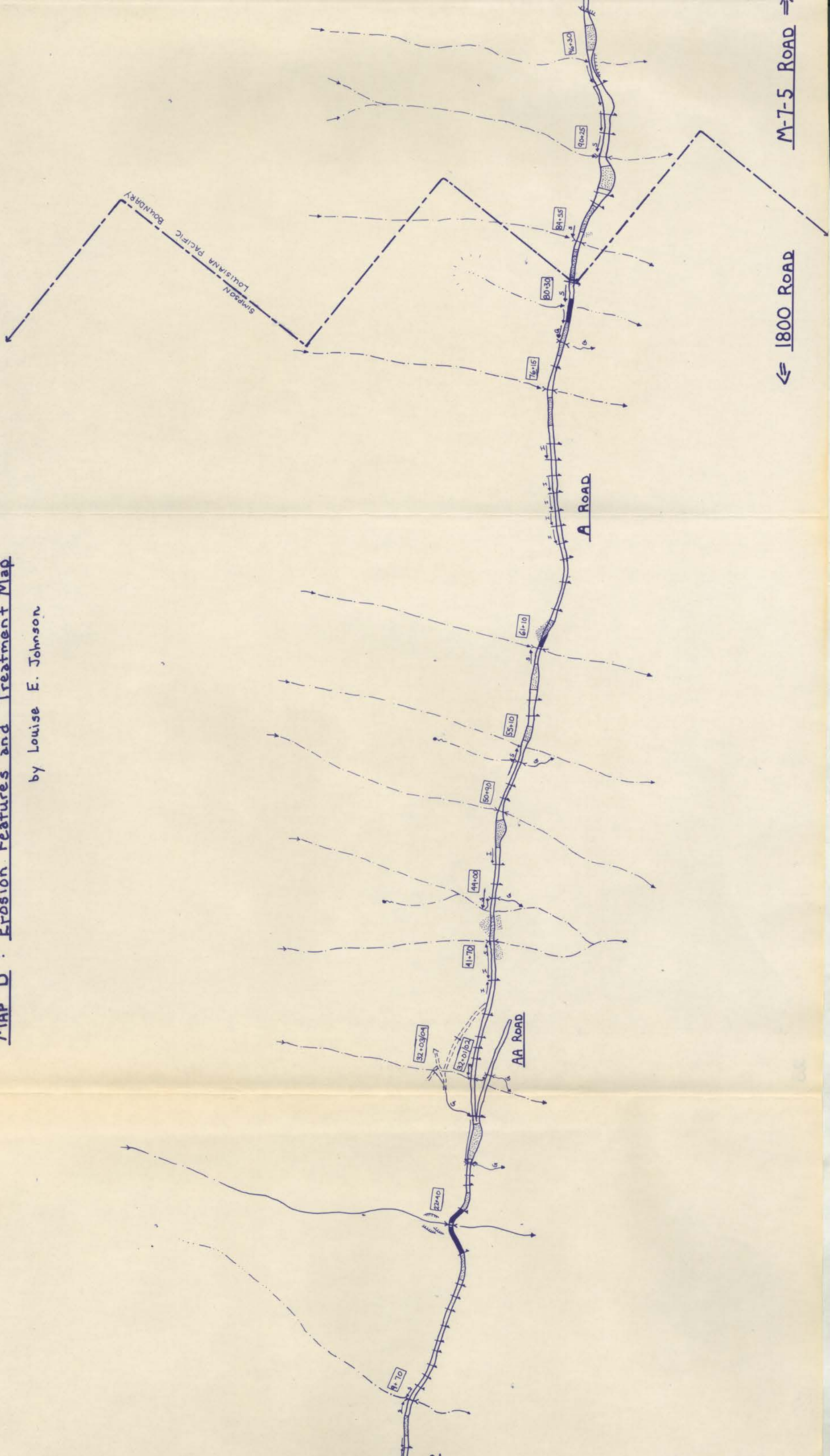


85-2

1800/M-7-5 ROAD WATERSHED REHABILITATION UNIT

MAP D : Erosion Features and Treatment Map

by Louise E. Johnson





Unit: 85-2 Date: 5/29/1985, PP9, SOC



Unit: 85-2 Date: 11/6/1985, PP9, SOC



Unit: 85-2 Date: 5/29/1985, PP12, SOC, (LEJ)



Unit: 85-2 Date: 11/6/1985, PP12, SOC, (TAS+LEJ)



Unit: 85-2 Date: 5/30/1985, PP18, SOC, (TAS+LEJ)



Unit: 85-2 Date: 10/3/1985, PP18, SOC, (TAS+LEJ)



Unit: 85-2 Date: 7/10/1986, PP18, SOC, (RAS)