

ARCATA

G-Line I.F.B. Contract
Watershed Rehabilitation Unit 84-1

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REDWOOD N. P.
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South Operations Center

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Site Description

The G-Line Rehabilitation Unit, 84-1, is located on the west side of Redwood Creek basin, about 13 road miles southeast of Orick. The relief of this year's rehabilitation area is 980 feet, ranging from 1,200 feet at the major stem of Tom McDonald Creek to 2,180 feet on the Access Road at the eastern edge of the site. The slope gradients range from 15 percent to 100 percent, the steepest surface lying below the road where the average gradient is 70 percent. Near the head of the hillslope and stream bank failures the slope occasionally exceeds 100 percent. The slope above the road is less steep, with an average gradient of 50 percent.

The hydraulic area of this year's site comprises approximately 375 acres, and the mapped area covers approximately 320 acres from the main stem creek to the Access Road.

The G-Line is a rocked surface haul road 4.3 miles long from its junction with the C-Line at the west end to the G-6 junction at the G-Line deck. The road was rendered impassable due to recent mass movements at 2 locations within the site. One, a debris torrent heading on the slope above the road, destroyed approximately 120 feet of road in late 1982. The other, a translational landslide, removed about 200 feet of road.

This year's project, an I.F.B. Contract, comprised the removal of 3,000 feet (.57 mile) of road. There were six road crossings having a total excavated volume of 14,932 yd³, with 79% of this volume coming from the two largest crossings. Due to the unstable nature of the slope along this year's site, 29,794 yd³ of earth (88% of the total) were truck end-hauled to the fill site at the rock pit.

G-Line 84-1 Land Use History

All of the 84-1 Rehabilitation area had been logged between 1949 and 1978. Approximately 60% of the timber covering this area had been initially harvested between 1949 and 1954. During this period about 170 acres above the G-Line road was selectively harvested using tractor crawlers. In 1959, 1963, and 1967 more tractor select cuts were harvested and hauled on skid trails leading to the B-3 and later, B-5 roads. Some timber was apparently tracted down to the G-Line, utilizing older skid trails constructed for the first harvest. The final tractor logged harvest occurred in 1977 when about 70 acres between the G-Line and Access road was cut to obtain the seed trees.

All of the hillslope below the G-Line down to the major stem of Tom McDonald Creek was clear cut in the late 1940's and early 1950's using cable yarding methods. The earliest cut in this area appears to have been near the G-Line/C-Line junction. The area below the road encompassing this year's site is roughly 15 acres.

The entire G-Line from the C-Line junction to the M-Line junction was constructed prior to 1954. A rock pit located at the G-Line/C-Line junction was developed by 1954 to provide material for these roads.

Erosional Features

The erosional features on this part of the Tom McDonald Creek watershed consisted of mass movements such as a debris torrent and a translational landslide. There are also fill and cutbank failures, and many streambank failures along with small, discontinuous but active scarps occurring mainly below the road in this inner gorge area of the creek. Other erosional features included six stream crossings, five of which were intact. The tributary stream channels are heavily aggraded due in part from using the channels as skid trails. The G-Line road has experienced three major storm events over the past 30 years.

Perhaps the most dramatic feature on this unit is a 600 foot long debris torrent at Sta. DDG 8+88 which had obliterated a small but well incised stream visible on the 1954 aerial photos. The first failure occurred between 1954 and 1962 in an area of skid trails above the road which were constructed prior to 1954. There have been two recurrences since. One between 1973 and 1975 and one in December of 1982. The last movement removed about 120 feet of road reach and deposited colluvium and organic debris in the road prism down to the main stem stream. The most recent head scarp has about 10 feet of vertical displacement. Older head scarps are located further upslope (see Map C). The gully formed in the debris torrent extends above the road where it has cut four to six feet to schist bedrock.

The other movement feature at Sta. G22+00 is a translational landslide that, although not visible on the earlier aerial photos, has existed for some years. The toe is located along the left bank of the main stem creek. The latest movement, first observed in early 1982, produced headscarps along and just above the road with two to five feet of vertical displacement and covered about 200 feet of road each. Seeping water from the cutbank and from the scarps has caused gullying near the right flank. The surface was very saturated and unstable below the scarps, and most of the vegetation near the road along the down station end of the slide has been removed by these recent earth movements.

The crossing at DD G12+58 is the main stem tributary of Tom McDonald Creek. It is a perennial stream draining about 280 acres has experienced at least one washout during its 30+ year existence (Mainstem). A piece of a three to four foot diameter culvert was found buried below the crossing at the present thalweg level. Although complete washouts were not visible on the aerial photos, fill failures along the outboard edge are apparent on the 1962 and 1973 photos. The channel above this crossing was used as a skid trail and there is a logjam just below a skid trail crossing about 400 feet upstream from the crossing. There are old alluvium deposits downstream from the crossing that are about eight feet above the present thalweg. The channel is quite aggraded above and below the crossing which has resulted in bank under cutting and streambank failures.

The other large crossing at DD G29+10 drains 51 acres and has also experienced fill stability problems. A bolt-secured log buttress, which once supported the outboard edge of the crossing, was found broken and scattered below the CMP. This culvert was misplaced and caused small gullies for about 150 feet before returning to the natural channel. The excavation restored the flow to its proper channel. The upstream reach had also been used as a skid trail. A skid trail crossing about 100 feet above the road had partially failed, producing a small "cave" with overhanging fill 10 feet high. The water flowed into this "cave" and went subsurface, emerging a few feet downslope on the other side of the fill. From there a ditch was constructed to carry the flow to the culvert. This skid trail crossing and the fill down to the road was excavated as part of the DD G29+10 road crossing.

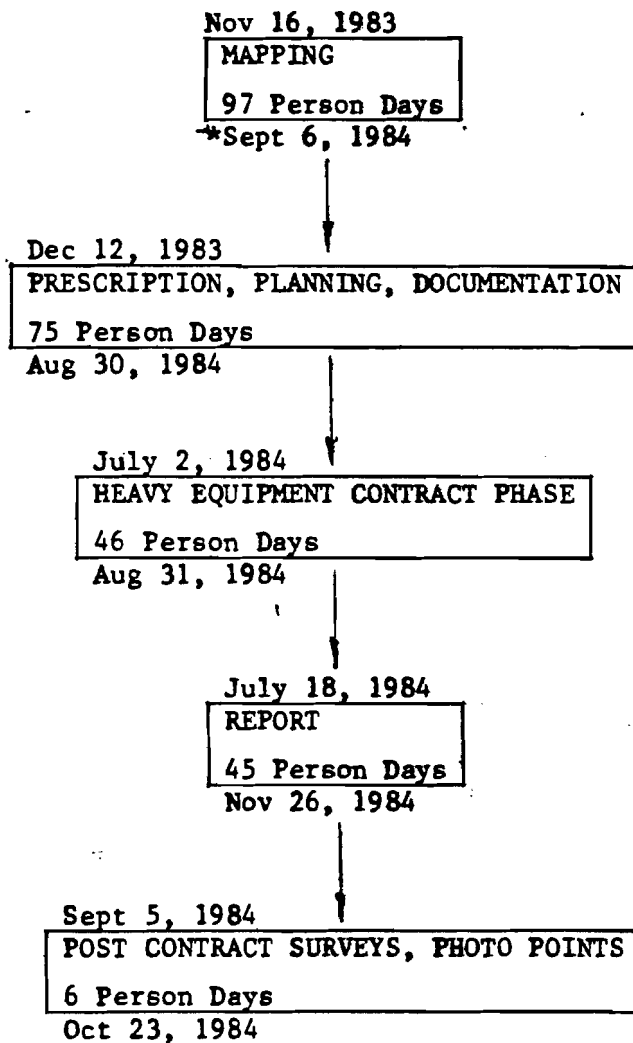
Erosion Control Rehabilitation Work

The normal work schedule used for non-contracted work had to be greatly compressed for the G-Line site, due to the required additional administrative time (of three months). Thus, instead of getting ready for doing the prescription phase at the beginning of March, the entire contract had to be finished and turned in to the Contracting Officer (C.O., hereafter) by that time. In addition, the software required to achieve this degree of time compression was not fully operational until the last month prior to the deadline. This software problem caused a real bottle-neck to occur in the work flow. Fortunately, the intensity of work required on this site was so substantial that only 1/2 mile of road could be treated with the funds available, thus the amount of surveying and plan sheet preparation required was reduced to roughly 10% of the normal amount. In addition, many of the other geologists helped out with the mapping phase. Without these two mitigating factors, the work could not have been completed until at least 1.5 months after the deadline. This situation is now alleviated by assigning already-mapped units to contracting rehabilitation teams. In addition, the software for the hand-held field computers is now completed and fully operational.

Project Time Schedule

Figure 1 shows the time schedule for the entire G-Line project, from inception to completion, in block diagram form. The mapping was very much a team effort involving Ken Utley, Mark Alpert, Mike Kenning, and Mike Sandeck. This was necessary, since the project could not be started until November 16, 1983 due to the previous year's commitments. The final finished contract had to be turned over to the C.O. by March 1, 1984 in order to meet the June 1, deadline for contract award laid down by Mr. Spalding. Normally, the mapping is finished by March 1 so the only way to have the entire project done (mapping, peer review, prescription, surveying, plan sheet preparation, and technical specification writing) by that date was to bring in outside help and hope for the best. Oddly enough, even though I was the site leader, I was so involved in developing the software required to put out the contract that I never did do any of the mapping on the site and had very little first hand knowledge of its needs. This became obvious during the peer review, when I couldn't answer even simple questions about the site's problems so as

Figure 1



KEY:

Start Date
Work Schedule PHASE
number person days
Finish Date

* Map Tracing accomplished as time allowed.

to guide the group's focus toward a finalized consensus on the needed prescriptions. The mapping phase (97 person days) and prescription/planning/documentation phase (75 person days) occurred mostly between November 16, 1983 and March 1, 1984.

Contract/Equivalent Rental Cost Analysis Methods

The actual equipment work done to fulfill the contract was done in much the same way that it would have been done with rental equipment. Thus an "equivalent rental cost" could realistically be projected on the basis of the equipment hours worked at each site. This is the first time in the Park's rehabilitation work where a contractor's use of the equipment was so efficient that such a direct comparison could be achieved.

Equivalent rental costs were made for each bid item by multiplying the total hours that each piece worked by its normal hourly rental rate to the Park. The timekeeping at each bid item site was split into functional units such as: excavation; loading and end hauling fill; shaping fill at the fill site (G-Line rock pit); road maintenance (with dozer work and water truck work kept as separate categories); and straw bale placement. In addition these categories were grouped into "phases" based on the bid schedule organization where straw and non-straw (excavation, tracking, etc.) costs were bid separately. The full breakdown of all data is shown in Table 4, with the bid items listed in station sequential order.

Wherever possible the tables in this report list both the costs for work as bid and via the equivalent rental translation. The following assumptions were made in deriving all equivalent rental costs:

- 1) the contractors equipment use (listed hours) was the same that we would have incurred via rental equipment;
- 2) down time for one piece which caused another piece(s) to be idle was treated as if the delayed piece was also down, for rental equivalent cost purposes. This is like having a rental equipment site in which all pieces are owned by the same person, so that no standby time would be paid to pieces put out of work by a breakdown in any other piece. Although this type of rental "show" is rather improbable, it is possible and provides a rental equivalent cost which gives as much of a direct comparison as possible;
- 3) equipment which enjoyed only occasional use was "paid", for equivalent rental purposes, only during times of actual use. This has a precedent in rental equipment work since often an owner-operator will bring on a second piece of equipment that is occasionally needed, with the understanding that he is paid for that second piece only when he is working it.

The above assumptions tend to produce a slightly lower rental equivalent cost than the average rental site would incur, but the overall simplicity of application and reproduceability more than make up for it by filtering out ambiguities in the comparison.

Objectives, Methods, and Summary Costs

The objective of this year's events was to remove the many large, incipient (and potential) fill failures along the G-Line road, on either side of where it crosses the main stem of Tom McDonald Creek, as well as to remove all stream crossings in that reach. None of the six stream crossings was in immediate danger of failing, but all would have been significant sediment sources in the event of a culvert failure, especially as access or maintenance would have been destroyed by the essential road fill removal work between the crossings. None of the paid (bid item) work was done for the sake of appearance. The closeness of Tom McDonald creek, coupled with the evidence seen of developing deep seated failures dictated a fill-endhauling approach to most of the work. Since no local fill sites were available, all of the 29,794 yd³ of endhauled material was transported to the G-Line rock pit. This pit has a total capacity of 60,000 yd³ and the average endhaul involved a two mile round trip. The fill at the pit was used to rehabilitate the pit itself, thus removing a persistent eyesore without additional cost.

The G-Line unit contained only 0.5 miles of the (G-Line) main haul road. No slope work was required in this stretch, so all work was confined to the haul road itself. However, "slope" work may be considered to have been done below the road, since the intensity of work in many places involved fillslope cuts all the way down to the stream with cuts having an elevational range (top of cut to bottom of cut) of up to 58 feet.

All stream crossings were fully excavated to approximate their preconstruction configuration. In most instances, this resulted in a roughly straight line profile for the top to the bottom of excavation, however in-place rock and channel debris were not removed. For example, an extensive, competent rock ledge was encountered during the excavation of the main stem crossing (bid item DD 12+58). The ledge was up to three feet above the tentative straight line grade for this crossing, but the prescription was modified to make this new grade. This tentative grade approach was used throughout the contract to avoid extensive cuts into virgin material. The contract was set up on the basis of the total volume of material that would be removed if excavation proceeded without a hitch all the way down to the (tentative) grade line specified on the plan sheets. This tentative grade was shown in the field by grade stakes. The Contracting officer's representative (C.O.R.) could stop excavation at any point down to the grade line, based on his judgement. The bid unit was the cubic yard. All excavations except deep dishes (D.D., hereafter) that were brought down to the grade line were authorized for 100% payment of the original bid price. Those (non D.D.) that were stopped prior to reaching grade were authorized for payment of 80% of the original bid price right away, with the remaining portion being withheld until the post heavy equipment surveying revealed the true volume actually removed. The rest of the payment for each incompletely excavated bid item was then calculated by multiplying the unit bid cost (\$/yd³) by the yardage which the survey showed had not been paid for. These funds were included in the final payment.

Deep Dish (D.D.) excavations were all paid at 90% of the original total bid, with final payment being similarly on the unpaid for volume, as determined by surveying. D.D.'s (stream crossings) are almost always modified to some extent during excavations and they are the most complex prescription type, thus the approach was used on all of them even if they appeared to have been done to specifications. This assured fairness to both sides.

Since full descriptions of all prescription types (D.D., TOS, BOS, OS, and XRD) are available through in-house literature, the information will not be duplicated in this report. Full documentation of the latest prescription methods will be included in the HP41CX users guide currently in preparation by Ed Wosika and Roy Mita.

Table 1 shows the summary costs of all work done on the G-Line site (84-1). The total site cost ran \$176,508.64. Of this: 8.5% was involved with the evaluation/contract preparation phase; 79% event for the contracted heavy equipment phase; 10% for the labor-intensive phase; and 2.5% for the final survey/report writing/photopoints (post H.E.) phase.

The reader should note that the placing of the straw bales (\$330.75 bid) was included in the heavy equipment phase costs, since it was a contract bid item done by heavy equipment. This resulted in a great savings over doing the same work by hand as part of the labor intensive straw mulch spreading. Conversely, the labor intensive phase contains \$5,600.00 worth of RNP backhoe time. This is the estimated machine cost (sans operator) to the park for the work by this piece (prior to the contracted work) in doing vegetation clearing. The hoe was used to drag felled vegetation up to the road. The labor cost of this operation was \$10,025.00. The vegetation clearance was required (within the limits of excavation) all along the contracted road reach due to the great density, height, and stem size of the existing second growth vegetation. Heavy equipment work would have been greatly hampered by this large volume of organics, thus the contract was let with the understanding that all standing vegetation greater than 4" D.B.H. would be removed by the park prior to contract work. In spite of the large cost (\$15,713.32) of this item, its timely implementation kept the overall cost of the bid items from being excessively high. In addition, the contract is awarded so late in the year that burning conditions might not be favorable for eliminating the large volume of organics produced. In house work seems the wisest option overall. The only detractor is that only the backhoe is available to do the yarding.

The overall difference between the contract and the projected equivalent rental costs was \$9,713.50, in favor of the contracted method. This represents a 5% savings over rental equipment applied in just the same way. The large potential variability of both rental and contract costs as applied to any given project are such that this year's cost differential cannot be considered decisive, though it does show that under the proper circumstances both approaches will produce roughly comparable costs. The winning contract's bid was well within the range of estimated cost for the project (the pre heavy equipment estimate, not the equivalent rental cost) and the contractor, "Whitey" Brown, was a fine performer. The next high bid, however, was over twice that of Mr. Brown's and could not have been seriously considered in any case. The park is well advised to award a contract only if it is within the range of costs estimated by the project leader. The project leaders have proven themselves capable of providing dependable cost range estimates.

Heavy Equipment Phase

Although the contract was awarded June 1, the actual beginning of work was set back to the beginning of July, due to the typically wet ground conditions

that early in the year. As a general rule July 1 would be a much more practical deadline date for contract award than June 1, as this year's ground conditions are in every way typical of what can be expected throughout the Redwood Creek Basin. This schedule shift would provide a longer preparation time, making larger contracts possible, or more of them.

Mr. Brown began heavy equipment work on July 2, and completed it on August 30, within the 60 calendar day time slot specified by the contract. He used two primary excavating pieces: a Caterpillar D8H dozer with rippers; and a Case 980 B hydraulic excavator, equipped with a 1 1/4 yd³ bucket. Loading fill was accomplished mainly by a Case W24 wheel loader, with a 3 yd³ bucket. Up to six 10-yd dump trucks ferried the fill to the rock pit. In addition a Case 1450 dozer (small) handled most of the fill shaping at the rock pit. Some interweaving of these equipment applications occurred as dictated by pragmatic considerations. Since the W24 loader often was broken down, the 980 excavator filled in on the truck loading as needed. This was practical, since the W24 was seldom down for more than a couple of days at a time. Extended W24 down time would have crippled the project, as the D8 would have rapidly done all of the work it was capable of without the assistance of the excavator. Other pieces were shuffled around too, as the need arose. The 1450 dozer, due to its high flotation, replaced the D8 whenever extremely wet locations were encountered (spring uncovered, etc.). Likewise, the D8 was occasionally run down to the rock pit to help the 1450 catch up with the critical fill handling work there.

The limited amount of maneuvering room available at the rock pit for trucks, plus the considerable climb (50 ft. average) up into the main dump site required careful attention by the contractor to avoid bottlenecking. Mr. Brown devised an ingenious switchback road system within the pit itself so that virtually all fill could be trucked to its final resting elevation, thus avoiding much uphill pushing. Even so, the 1450 dozer had difficulty keeping abreast of the large fill flux. Adding to this problem was the fact that much of the fill was quite moist. Since the incoming fill was used to gradually raise the elevation of the dump site, this excess moisture often turned the approach ramp into a quagmire that threatened to suspend trucking work. The contractor tried to hoard all dry material for use on the approach ramp, while pushing the wet material away from the dump site as soon as it was delivered. This worked with varying degrees of success, but did keep the project rolling. No better approach could have been taken. The final shaping of the rock pit redaylighted the springy area at center of the pit and brought the extreme ends of the pit up to their prescribed maximum grade lines. The overall job was very nicely done, in spite of the fact that this work was neither a specific bid item nor even verbally described in the (hastily prepared) contract. This is typical of the fine attitude displayed by Mr. Brown throughout the duration of the contract. However, this item again points up the need for a less restrictive deadline for contracts. Hastily slapped-together contracts could end up costing the park much more than the price awarded the low bidder. Such haste will always produce oversight. This is particularly irksome, since the present deadline date produces an award date that is a full month before ground conditions permit equipment to begin work.

Average heavy equipment costs, including their projected rental equivalents, are provided in Table . Tables 3A through 3C treat, respectively: Haul-road Crossing Costs; Exported-Fill Type Outsloping (TOS & BOS) Costs; and Local (non-exporting) Outsloping Costs. Each table groups the treatment items by the standard Redwood National Park size scale. Note that the cost items in parenthesis ignore straw bale placement, which non-parenthetical cost items reflect the heavy equipment total cost (including straw bale placement). Table 4 gives the hourly breakdown for each bid item, listed in station-sequential order. It is normal to make such a listing part of the appendix and to include in the text only tables dealing with items from specific treatment types, but the number of items in this contract is so small that it was felt that a station-sequential listing would serve as well. No attempt is made herein to interpret the tables for the reader, as they speak well for themselves in showing the relatively comparable unit costs produced by the two methods (rental versus contract).

Evaluation of Heavy Equipment Application

The contractor's previous experience in the park (each year since 1979) showed in his bid prices, his choice of equipment, and in the manner in which he used his equipment. The site included several rather tricky worksites, involving all of the following factors: large depth of cut; probable moisture at depth; possible dense organics; very large yardage per bid item; endhauling of all excavated material. These factors added substantially to the risk factor in making bids.

The primary technique used to handle these difficult situations (on non-Deep Dish items), was the creation of a long ramp on the hillslope. The ramp would have its lower terminus at the bottom of the hillslope, on the downstation (beginning) end of the bid item reach. The ramp usually involved 200 to 300 feet of length (in an upstation direction) in coming to road elevation. To begin creating the ramp, the D8 and excavator would start at road level at the downstation end of the item, cutting earth to grade, while pushing the spoil to the waiting loader. As the excavating pieces cut deeper the ramp would be created and lengthened. They always followed the grade line down the hill thus leaving a finished slope uphill of them at all times. Once they reached the button of the cut (at the beginning of the reach) they had a 200 to 300 foot long ramp reaching to the loader which had been moving down the road incrementally as the ramp lengthened, loading trucks all the time. From there it was a simple matter for the D8 to take shaving cuts all along the length of the ramp while the excavator worked the ramps lower end. Thus the D8 both pushed fill for the excavator and did local excavation all along the ramps length. In this way the position of the ramp proceeded upstation along the road as the work progressed, with no further increases in its length. The D8 operator had only to get off and check the grade of the slope (he was cutting) above him at various points along the ramp as excavation continued. This technique was fast, since the D8 had to do no quartering cuts (as in O.S. type outsloping) and never had to push up a steep hill. The spoilage off the ends of his blade built up berms along the ramp which then contained future bladefulls without spillage. The excavator concentrated on these areas which would have been very hard for the D8 to work on, thus the cooperator produced a pleasing synergy.

The stream crossing (Deep Dish) excavators were all handled in the standard fashion, with both pieces digging at all times, but with the D8 also ferrying spoil for the excavator. In all major excavations, a combined production rate of around 100 yd³ per hour was maintained or roughly 1,000 yd³ per (10 hr) day.

One interesting item shown in Table 4 is the difference between bale placement costs for the bid price versus that for equivalent rental. In every case, the equivalent rental price is higher, usually by a substantial amount. This is due to the bookkeeping method used, wherein straw bale placement was "billed" for not only bale delivery and placement, but also for any associated delays in other equipment. Obviously the contractor was only considering the directly affected equipment in his bid. This difference is further handled in the discussion section of this report.

Labor Intensive Phase

There were two distinct portions to the labor intensive phase, the first being the pre-contract vegetation clearance and the second being the spreading of a straw mulch over the completed (heavy equipment) work. Table 1 shows that the total labor intensive cost was \$17,913.17, or 10.2% of the total project cost. Table 5 shows the cost breakdown with greater resolution. All mulching was done at a 6,000 pounds per acre intensity, and all portions of the contract were strawed, with the single exception of the crossroad drain reach.

While the vegetation clearance is rather straightforward, the true picture of the straw mulch operation is not readily apparent from Tables 1 and 5. This is due to the fact that the straw placement was a bid item, this being tabulated with the other heavy equipment work. The total mean bale cost would really be:

$$\begin{aligned} &\text{Labor Cost } (\$2.74/\text{bale}) + \text{Straw Cost } (\$2.85/\text{bale}) + \text{Placement } (\$.75/\text{bale}) \\ &= \$5.74/\text{bale}. \end{aligned}$$

The rental equivalent price (including all equipment delays) would up the per bale placement cost to \$3.73, thus the total rental equivalent price per bale would be \$8.72. The contractor gave us a very good price indeed on the straw placement, considering the fact that he had to stop the entire equipment string each time he wanted to bring in straw. A much more efficient way is used by site leader Greg Bundros, whose data is included here for comparison. Greg had the in-house labor crew place straw along the road, in the inboard ditch, at the spacing at which they would be when spread. He flipped the bales off the truck as it moved slowly along (no truck stops). One person followed behind, pushing errant bales back into the ditch. At crossings, the straw was piled below the place where it would be stored. The first thing the excavator did, upon arrival, was to proceed down the road; lifting each bale high on (or above) the cutbank, beyond the limits of excavation. The excavator would stop at crossings to transfer the bale pile to its resting spot. One laborer was used to help load bales into the excavator bucket (avoids broken bales). This total equipment cost per bale using this method was \$0.57. Thus the "equivalent rental" cost derived above is not realistic since we would have used the more efficient Bundros approach,

producing a total unit cost similar to that of the contract bid. Contractors should be encouraged to use the approach, as it eliminates all chain-reaction straw delays during excavation, thus lowering their overhead (and bid price).

The 6,000 p.p.a. mulch density worked well, being just dense enough that the ground was obscured (protected). I continue to favor this mulch density.

DISCUSSION

Contract Versus Rental

Since the techniques used by the contractor were so similar to our own and his unit bid prices were so similar to what we would have had it makes no sense to develop an in depth comparative analysis between the rental and contract approaches. When an excellent, efficient contractor bids on a job, the unit prices will be roughly the same as the unit costs incurred by an excellent, efficient site leader doing the same work. Since the bidders know their bids must hit this projected rental cost fairly close for them to be seriously considered, this should produce a cluster of reasonable bids. This did not happen with the G-Line bids. While Mr. Brown's bid was well within acceptable bounds, those of the other bidders were quite a bit above the upper limit. This may have been due to the extreme intensity of the work, but in any case is unfortunate as the other bids could not really be considered. This cripples competition. It can be mitigated by applying the contract method to the simpler sites available in any given year. This was the intent this year, but by the time the project's requirements unfolded during the mapping phase, it was too late to change sites. Future contract sites are to be started on areas already mapped, so the problem should not reoccur.

Volume Estimates/Plan Sheet Preparation

All prescriptions on this site were developed using the special software that was (concurrently) developed for the hand held Hewlett-Packard HP41CX micro-computer. The software algorithms were laid down mainly by Roy Mita specifically for speeding up the surveying/plan sheet preparation phase of the contracting schedule. Bill Lennox developed an automatic prescription analysis and printout program for the Deep Dish prescription on the HSU Cyber computer. This main frame work is still embrionic, but the HP programs are fully operable and produce accurate data output quickly. This time savings is really what makes contracting possible at all, since the time schedule is so much more compressed than that for rental equipment. An in-house operators manual for the HP software is currently being written. The plan sheet preparation will be greatly speeded up and accurized through the continued computerization of the data reduction process on the newly available IBM PC's and the soon-to-arrive Tectronics plotting computer. All of these advances are useable in the preparation of rental equipment specifications as well.

Table 1

Task	RNP Employees		Outside Labor		Heavy Equipment (Contract)	Equivalent Rental Cost Heavy Equip.	Total Task Cost		% Total Cost		Phase Total	
	Hydrologist & PST	Laborers	Redwoods United	YCC			Contr. Equip.	Rental	Contr./Equip.	Rental	Contr./Equip.	Rental
Mapping	hydro=\$1,078.53 PST = 6,490.41	--	--	--	--	--	\$ 7,568.94	--	4.32/4.09	--	--	--
Prescrip/ tions	hydro=\$5,199.84 PST = 2,165.94	--	--	--	--	--	7,365.78	--	4.20/3.98	\$14,934.72	8.46/8.02	--
Access (Equiv. in/ out, site prep)	--	--	--	--	3,120.00 ¹ (6,960.00)	3,240.00	3,120.00/3,240.00	--	7.78/7.69	--	--	--
Primary Treatments	hydro=\$3,753.60 PST = 791.20	--	--	--	130,656.00	138,098.75	135,200.80/142,643.55	--	77.08/77.05	--	--	--
Secondary Treatments	--	--	--	--	330.75	1,644.00	330.75/1,644.00	--	0.19/0.89	--	--	--
Misc.	--	--	--	--	710.00	1,547.50	710.00/1,547.50	--	0.14/0.84	139,361.55/ 149,075.05	78.96/80.05	--
Veg. Clearance	hydro=\$ 88.32 (RNP Hoe) 5,600.00 10,025.00	--	--	--	--	--	15,713.32	--	8.96/8.49	--	--	--
Straw (	--	517.50	345.00	80.50	--	--	943.00	--	0.54/0.51	--	--	--
Misc.	--	1,256.85 straw cost	--	--	--	--	1,256.85	--	0.72/0.68	17913.17 17,319.17	10.15/9.62	--
Report	hydro=\$1,987.20 PST = 1,857.60	--	--	--	--	--	3,844.80	--	7.56/7.48	--	--	--
Survey, pp's	hydro=\$ 110.40 PST = 344.00	--	--	--	--	--	454.40	--	0.26/0.25	4,299.20	2.44/2.31	--
Totals	\$23,867.04	\$17,399.35	\$345.00	\$80.50	\$134,816.75	\$144,530.25	\$176,508.64/186,222.14 (difference=\$9,713.50=5.2%)	--	--	--	--	--

1) Contractor paid dumps 1.5 hours travel for each day worked. For 116 dump truck days, this = 116 X 1.5 X \$40 = \$6,960. He obviously did not included in totals on this Table.

Table 2: Summary of Average Costs of Heavy Equipment Treatments

Treatment	Equipment	# of Work-Sites	Total Quantity	Total Cost		$\bar{x}$ \$/Worksite		$\bar{x}$ Unit Cost		Unit Cost Range	Equiv. Rental
				Bid	Equiv. Rental	Bid	Equiv. Rental	Bid	Equiv. Rental		
Haul Road Crossings	D-8; 980; 1450; W24; Trucks	6	Endhauls ¹ 14,481yd ³	\$ 59,372.10	\$ 77,389.00	\$ 9,895.35	\$13,065.08	\$4.10/yd ³	\$5.41/yd ³	\$4.10-4.10 yd ³	\$4.11-9.45 yd ³
Total Outslope	D-8; 980; 1050; W24; Trucks	2	Endhauls ¹ 9,864yd ³	40,442.40	41,838.25	20,221.00	20,950.63	4.10/yd ³	4.25/yd ³	4.10-4.43 yd ³	4.24-4.43 yd ³
Benched Outslope	D-8; 980; 1450; W24; Trucks	1	Endhauls ¹ 4,998yd ³	20,491.80	12,412.50	NA	NA	4.10/yd ³	2.49/yd ³	NA	NA
Outsloping	D-8; 980; 1450	5	local fill 4,061yd ³	10,152.50	6,099.00	2,030.50	1,219.80	2.50/yd ³	1.50/yd ³	2.50-2.50 yd ³	1.30-2.21 yd ³
Crossroad Drains	980	1	"no" fill 290ft	197.00	360.00	NA	NA	0.68/ft	1.24/ft	NA	NA
Primary Treatment Totals		15	total yd ³ =33,404 (endhauls ³ 130,656.00 =29,343yd ³ ; ³ local=4,081yd ³)	130,656.00	138,098.75						
Placing Straw Bales	D-8; 980; W24; Trucks	14	441 bales	330.75	1,644.00	23.63	117.43	0.75/bale	3.73/bale	.75-.75 bale	0.52-72.00 bale
Access (in/out)	D-8; 980; W24; 1450 6 Trucks	NA	NA	3,120.00 ² (10,080.00) ²	4,040.00 ² (10,080.00) ²	NA	NA	NA	NA	NA	NA
Misc. ³	NA	NA	NA	710.00	1,547.50	NA	NA	NA	NA	NA	NA
Total Heavy Equipment Costs		15		\$134,816.55	\$145,330.25						
				(total \$ of all bid items)							

1) All yardage from Deep Dishes, TOS, and BOS was endhauls by truck an average of 1.0 mile along a watered primary haul road in good condition.
2) Contractor paid each truck 1.5hrs/day for travel, which we only pay (rental) 2 hrs each in & out once. Value in "()" represents cost via this unused method.
3) Includes: "Miscellaneous" bids and record keeping bid non site specific equipment work (equiv. rental column only)

Table 3A: Haulroad Crossing Costs

Type	# of Sites	Vol. Range	Equipment Type	Equipment Range Hours	$\bar{x}$ \$/Site ¹		$\bar{x}$ \$/yd ³		\$/yd ³ Range	
					Contract	Equiv. Rental	Contract	Equiv. Rental	Contract	Equiv. Rental
Small ²	2	197yd ³ 297yd ³	D-8 980 Exc 1450 loader (W24) Trucks	0.8-4.7 2.5-7.3 0.2-0.3 4.2-11.5 5.6-18.9	\$1,249.70 (\$1,012.70)	\$1,788.50 (\$1,551.50)	\$5.06 (\$4.10)	\$7.24 (\$6.28)	\$4.31-5.56 (\$4.10) ⁴	\$4.11-9.32 (\$3.90-7.86)
Medium ²	1	703yd ³	D-8 980 Exc 1450 loader (W24) Trucks	19.8 11.2 5.1 27.2 39.0	\$2,907.05 (\$2,882.30)	\$6,772.50 (\$6,622.00)	\$4.14 (\$4.10)	\$9.63 (\$9.42)	NA	NA
Large ²	1	3,142yd ³ contract 1,880yd ³ Equiv. Rental	D-8 980 Exc 1450 loader (W24) Trucks	22.4 27.7 16.2 17.3 70.2	\$5,877.65 (\$5,858.90)	\$9,616.00 (\$9,498.00)	\$4.11 (\$4.10)	\$5.12 (\$5.05)	NA	NA
Extra Large	2	5,325yd ³ 6,530yd ³	D-8 980 Exc 1450 loader (W24) Trucks	31.8-69.0 59.4-89.0 57.7-85.7 45.5-53.6 221.9-276.3	\$24,345.88 (\$24,302.75)	\$29,279.00 (\$29,083.00)	\$4.11 (\$4.10)	\$4.94 (\$4.91)	\$4.11-4.11 (\$4.10) ⁴	\$4.46-5.52 (\$4.45-5.47)

1) Includes 11 hours spent on each site (excavation, straw, fill handling, etc). Values in "()" are for primary treatment only (exclude straw placement).

2) All crossings endhaunched an average of 1.0 mile (one way).

3) Contractor exceeded vertical limits on this crossing, contract pays for less than full volume excavated, but rental would count all of the volume.

4) No range for this item, as all exported fill work was bid @ \$4.10/yd³.

Table 3B: Exported-Fill Type Outsliping ("TOS" and "BOS" prescriptions)

Type	# of Sites	Vol. Range	Equipment Type	Equipment Range ¹		$\bar{x}$ \$/Site ¹		$\times$ \$/yd ³		\$/yd ³ Range	
				Hours	Range	Contract	Equiv. Rental	Contract	Equiv. Rental	Contract	Equiv. Rental
Medium ²	1	638yd ³	D-8 980 Exc loader (W24) 1450 Trucks	5.5 4.3 6.0 4.9 24.3		\$2,620.30 (\$2,615.80)	\$2,810.00 (\$2,799.50)	\$4.11 (\$4.10)	\$4.40 (\$4.39)	NA	NA
Extra ² Large	2	4,998 9,226yd ³	D-8 980 Exc loader (W24) 1450 Trucks	30.4-87.0 22.8-83.8 22.4-56.0 30.5-93.5 100.5-340.5		\$29,195.95 (\$29,159.20)	\$25,778.13 (\$25,725.63)	\$4.11 (\$4.10)	\$3.63 (\$3.61)	\$4.11-4.11 (\$4.10) ³	\$2.49-4.23 (\$2.48-4.23)

1) Includes all hours spent on each site (excavation, straw placement, fill handling, etc). Values in "()" are for primary treatment only (exclude straw placement).

2) All sites involved an average of 1.0 mile endhaul (one way).

3) No range for the item, since all exported fill work was bid @ \$4.10/yd³.

Table 3C: Local (non-exporting) Outsloping ("OS" prescription)

Type	# of Sites	Vol. Range	Equipment Type	Range ¹ Hours	$\bar{x}$ \$/Site ¹		$\bar{x}$ \$/yd ³		\$/yd ³ Range	
					Contract	Equiv. Rental	Contract	Equiv. Rental	Contract	Equiv. Rental
Small	2	207-390yd ³	D-8 980 Exc Truck	0.4-5	\$763.13 (\$746.25)	\$638.50 (\$621.00)	\$2.55 (\$2.50)	\$2.14 (\$2.08)	\$2.54-2.57 (\$2.50) ²	\$1.93-2.25 (\$1.85-2.21)
				3.8-4						
				0.5-0.5						
Medium	1	778yd ³	D-8 980 Exc Truck	6.8	\$1,969.75 (\$1,945.00)	\$1,410.50 (\$1,260.00)	\$2.53 (\$2.50)	\$1.81 (\$1.62)	NA	NA
				8.0						
				0.3						
Large	2	1,340- 1,346yd ³	D-8 980 Exc LOR Truck	9.8-14.8	\$3,946.25	\$1,969.25	\$2.53 (\$2.50)	\$1.47 (\$1.34)	\$2.53-2.53 (2.50) ²	\$1.43-1.50 (\$1.30-1.37)
				3.0-10.8						
				0-2.5						
				0.0.9						

1) Includes all hours. Values in "()" are for primary treatment only (excludes straw placement).

2) No range. All OS bids were @ \$2.50/yd³.

Table 4: Station-Sequential Listing of Basic Data

Bid Item (size) # bales	Equipment	Hours	Task Costs		Equiv. Rental	Phase Costs		Volume (yd ³)	Unit Price		Primary Cost	Phase's % of Total Cost
			Contract	Exc.		Contract	Eq. Rental		Contract	Eq. Rental		
Deep Dish G1+09 (Medium)	D-8	10.2										
	Exc.	10.9	\$ 870.96	\$ 2,001.00							30.22	
	Ldr.	27.2										
	Trucks	38.5	1,415.25	3,251.50							49.10	
	D-8 (pit)	9.6										
	Exc. (")	0.3	452.45	1,039.50							15.70	
	1450 (")	0.7	143.64	330.00							4.98	
9 Bales	1450 (Rd)	4.4				\$2,882.30	\$6,622.00	703	\$4.10/yd	\$9.42/yd		99.74
	Truck (straw)	0.5	6.75	17.15		6.75	17.15		0.75/bale	1.94/bale	NA	0.23
	Totals		\$2,889.05	\$6,639.50					\$4.11/yd ³	\$9.45/yd ³		0.26
Outslope G1+40 (Medium)	D-8	6.3										
	Exc.	7.0	\$1,945.00	\$1,260.00		\$1,945.00	\$1,260.00	778	\$2.50/yd	\$1.62/yd	100	98.74
	Truck (straw)	0.3										
	D-8 (")	0.5										
	Exc. (")	1.0	24.75	150.50		24.75	150.00		0.75/bale	4.56/bale	NA	1.26
33 Bales	Totals		\$1,969.75	\$1,410.50					\$2.53	\$1.81/yd		10.67
Deep Dish G4+77 (Small)	D-8	2.3										
	Exc.	5.0	\$ 354.62	\$ 680.00							29.12	
	Ldr.	11.5										
	Trucks	18.5	757.48	1,452.50							62.21	
	D-8 (pit)	0.2										
	Exc. (")	0.1	105.60	202.50		\$1,217.70	\$2,335.00	297	\$4.10	\$ 7.86/yd	8.67	99.63
	1450 (")	0.3										
	Truck (straw)	0.4										
6 Bales	D-8 (")	2.2										
	Exc. (")	2.2	4.50	432.50		4.50	432.00		0.75/bale	72.00/bale	NA	0.37
	Totals		\$1,222.20	\$2,767.00					\$4.12/yd	\$ 9.32/yd		15.61

1) Since the contract's task costs for primary work are prorated from the equivalent rental tasks cost, the percentage of contract versus rental costs are identical for this column throughout this set of tables.

Table 4: Station-Sequential Listing of Basic Data (cont.)

Bid Item (size) # bales	Equipment	Hours	Task Costs		Phase Costs	Volume (yd ³)	Unit Price		Z of Worksite's Primary Cost	Phase's % of Total Cost	
			Contract	Equiv. Rental	Contract		Contract	Eq. Rental		Contract	Eq. Rental
Outslope G4+83 (Large)	D-8	9.8									
	Exc.	9.3	\$3,295.59	\$1,817.00					98.38		
	1450 (Rd)	0.4	54.41	30.00	\$3,350.00	1,340	\$2.50/yd	\$1.37/yd	1.62	98.89	91.73
	Truck (straw)	0.9									
	Exc. (")	1.5	38.25	166.50	38.25		0.75/bale	3.27/bale	NA	1.13	8.27
Totals					\$3,388.25		\$2.53/yd	\$1.50/yd			
Deep Dish G8+88 (Large)	D-8	21.2									
	Exc.	26.1									
	1450	2.5	\$2,872.39	\$4,656.50					49.03		
	Ldr.	17.3									
	Trucks	69.4	2,245.36	3,640.00					38.32		
	D-8 (pit)	1.2									
	Exc. (")	0.6									
	1450 (")	13.7	741.15	1,201.50	\$5,858.90	1,429yd ² (1,880 actual	\$4.10 ¹ 3.12 ¹	\$6.65 ¹ 5.05 ¹	12.65	99.68	98.77
25 Bales Totals	Truck(straw)	0.8									
	Exc. (")	1.0	18.75	118.00	18.75		0.75/bale	4.72/bale	NA	0.32	1.23
					\$5,877.65		\$4.11/yd ² \$3.13/yd ²	\$6.73/yd ² \$5.12/yd ²			
Bench Outslope G8+98 (Extra Large)	D-8	26.3									
	Exc.	20.8									
	1450	2.0	\$7,679.99	\$4,652.00					37.48		
	Ldr.	22.4									
	Trucks	99.0	8,308.98	5,033.00					40.55		
	D-8 (pit)	4.1									
	Exc. (")	2.0									
	1450 (")	28.5	4,502.83	2,727.50	\$20,491.80	4,998yd	\$4.10/yd	\$2.48/yd	21.97	99.86	99.58
38 Bales Totals	Truck (straw)	1.5	28.50	52.50	28.50		0.75/bale	1.38/bale	NA	0.14	0.42
					\$20,520.30		\$4.11/yd	\$2.49/yd			

2) This excavation exceeded its vertical limits. Contract payment ignores vertically overexcavation volume. Values in boxes (" ") are based upon the total volume. This is the preferred rental equivalent value (based on 1,880 yd³).

Table 4: Station-Sequential Listing of Basic Data (cont.)

Bid Item (size) # bales	Equipment	Hours	Task Costs		Phase Costs		Volume (yd ³)	Unit Price		Worksite's Primary Cost	Phase's % of Total Cost	
			Contract	Equip. Rental	Contract	Eq. Rental		Contract	Eq. Rental		Contract	Eq. Rental
Deep Dish G12+58 (Extra Large)	D-8 Exc. 1450 Ldr. Trucks D-8 (pit) Exc. (") 1450 (") 1450(H ₂ O) Truck (straw) D-8 (") Exc. (") Ldr. (")	56.8 56.6 5.1 44.8 267.1 11.5 2.1 52.6 5.0 4.2 0.7 0.7 0.7		\$11,156.50 12,484.50 5,284.00 175.00		\$29,700.00	5,325	\$4.70/yd \$5.47/yd		38.34 42.90 18.16 0.50	99.79	98.91
60 Bales					45.00	322.00		0.75/bale	5.53/bale	NA	0.21	1.09
Totals					\$21,877.50	\$29,422.00		\$4.11/yd	\$5.53/yd			
Total Outslope G12+96 (Extra Large)	D-8 Exc. Exc. (Stby w/op) 1450 Ldr. Trucks D-8 (pit) Exc. (") 1450 (") Truck(H ₂ O) Truck(straw)	71.5 75.6 7.7 8.5 56.0 324.0 15.5 3.7 85.0 15.0 1.5	\$14,530.13	\$14,995.75						38.41 39.09 21.15 1.35 NA	99.88 0.12	99.88 0.13
60 Bales					37,826.60	39,038.75	9,226	4.10/yd 0.75/bale	4.23/yd 0.87/bale			
Totals					\$37,871.60	\$39,091.25		\$4.11/yd	\$4.24/yd			

Table 4: Station-Sequential Listing of Basic Data (cont.)

Bid Item (size) # bales	Equipment	Hours	Task Costs		Phase Costs	Volume (yd ³)	Unit Price		Phase's % Primary Cost	Phase's % of Total Cost
			Contract	Equiv. Rental	Contract		Contract	Eq. Rental		
Outslope G18+30 (Small)	D-8 980 Exc.	5.0	\$ 975.00	\$ 860.00	\$ 975.00	390	\$2.50/yd	\$2.21/yd	100	97.45 98.01
34 Bales	Truck(straw)	0.5	25.50	17.50	25.50			0.52/bale	NA	
Totals					\$1,000.50		\$2.57/yd	\$2.25/yd		2.55 1.99
Total										
Outslope G20+90 (Medium)	D-8 Exc.	6.0								
	1450	5.5								
	Ldr.	4.3	\$1,324.49	\$1,417.50					50.63	
	Trucks	6.0								
	D-8 (pit)	24.0	1,177.31	1,260.00					45.01	
	Exc. (")	0.5								
	1450(")	0.3								
	Truck(straw)	0.6	114.00	122.00	\$2,615.80	638	\$4.10/yd	\$4.39/yd	4.36	99.83 99.63
6 Bales	Truck(straw)	0.3	4.50	10.50	4.50		0.75/bale	1.75/bale	NA	0.17 0.37
Totals					\$2,620.30		\$4.11/yd	\$4.43/yd		
Outslope G23+30 (Large)	D-8 Exc.	14.8								
		3.0	\$3,365.00	\$1,750.00	\$1,750.00	1,346	\$2.50/yd	\$1.30/yd	100	98.94 90.91
48 Bales	Ldr.(straw)	2.5	36.00	175.00	36.00		0.75/bale	3.65/bale	NA	
Totals					\$1,925.00		\$2.53/yd	\$1.43/yd		1.06 0.09
Deep Dish G26+65 (Small)	D-8 Exc.	0.6								
	Ldr.	2.4	\$ 290.27	\$ 276.00					35.94	
	Trucks	3.6								
	D-8 (pit)	5.6	471.16	448.00					58.33	
	Exc. (")	0.2								
	1450(")	0.1								
	Ldr.(straw)	0.2	43.88	44.00	\$ 807.70	197	\$4.10/yd	\$3.90/yd	5.73	99.54 94.81
5 Bales	Ldr.(straw)	0.6	3.75	42.00	3.75		0.75/yd	8.40/bale	NA	0.46 5.19
Totals					\$ 811.45		\$4.12/yd	\$4.11/yd		

MAP D EROSION TREATMENTS

UPPER G-LINE

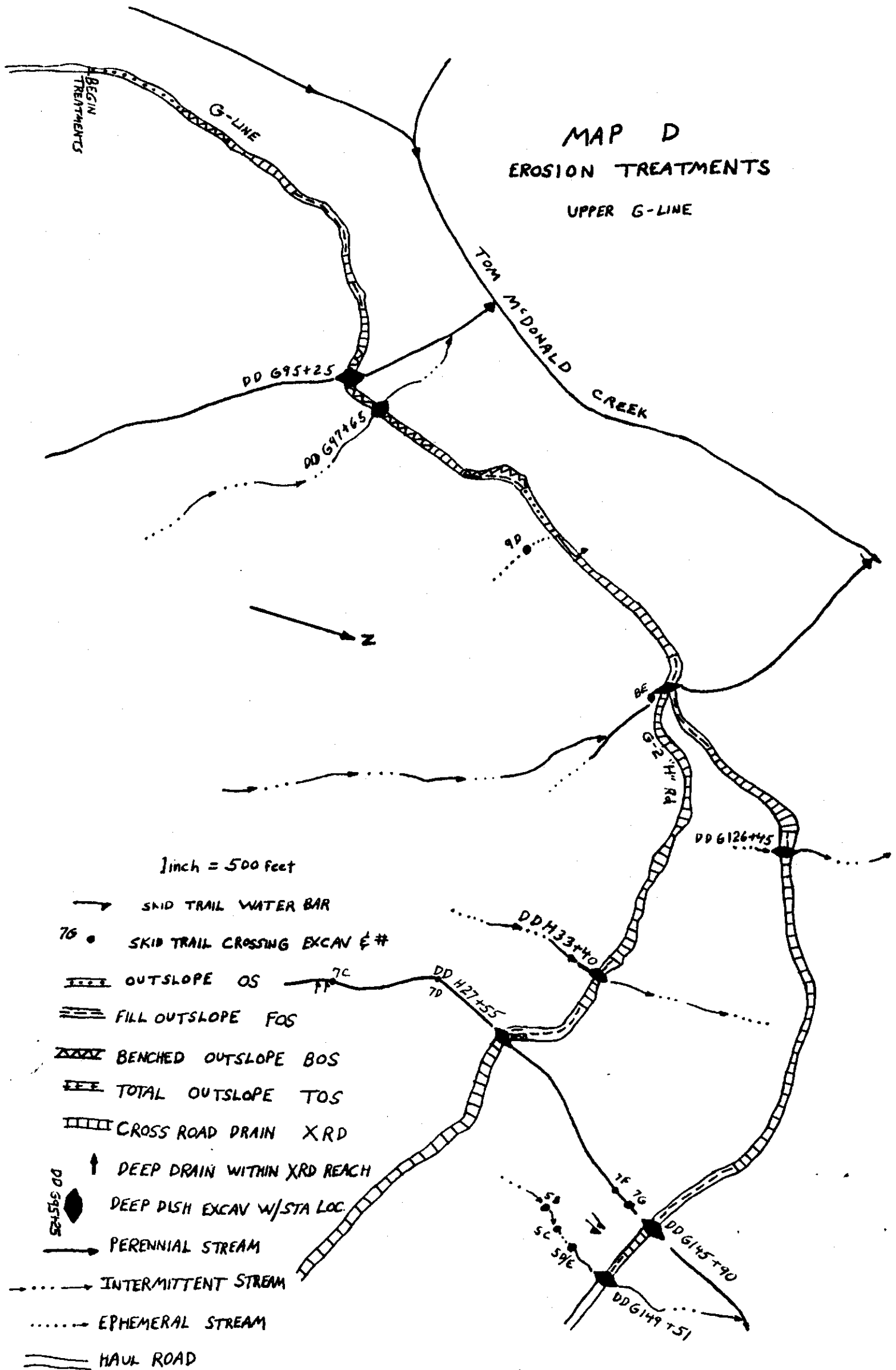


Table 5: Summary of Average Costs of Labor Intensive Treatments

Treatment	Type	Hours	\$/hr	\$	Quantity	Quantity
Spread Mulch	RWU	69	\$5.00	345.00	⁴⁴ ~~4.41~~ bales on	
"	RNP	57.5	9.00	517.50	5.52 acres	\$0.0042/ft ²
"	YCC	23	3.50	80.50		2.14/bale
Subtotal		149.5hrs		\$943.00		\$2.14/bale .33hrs/bale
Vegetation Clearance	RNP	1,125	\$9.00	\$10,113.32 ¹	2.6 acres	
	RNP					
	B-hoe (bare)	280	20.00	5,600.00	" "	
Subtotal				\$15,713.32		\$6,009.62/acre \$0.138/ft ²

Total Labor Intensive Costs = \$16,656.32

- 1) Price includes \$88.32 worth of site leader time not tabulated in the person hours column.

MAP A PHYSIOGRAPHIC MAP

LEGEND

- PARK BOUNDARY
- - - UNIT BOUNDARY
- ROAD SYSTEM
- == HAUL ROADS
- PROJECT REACH

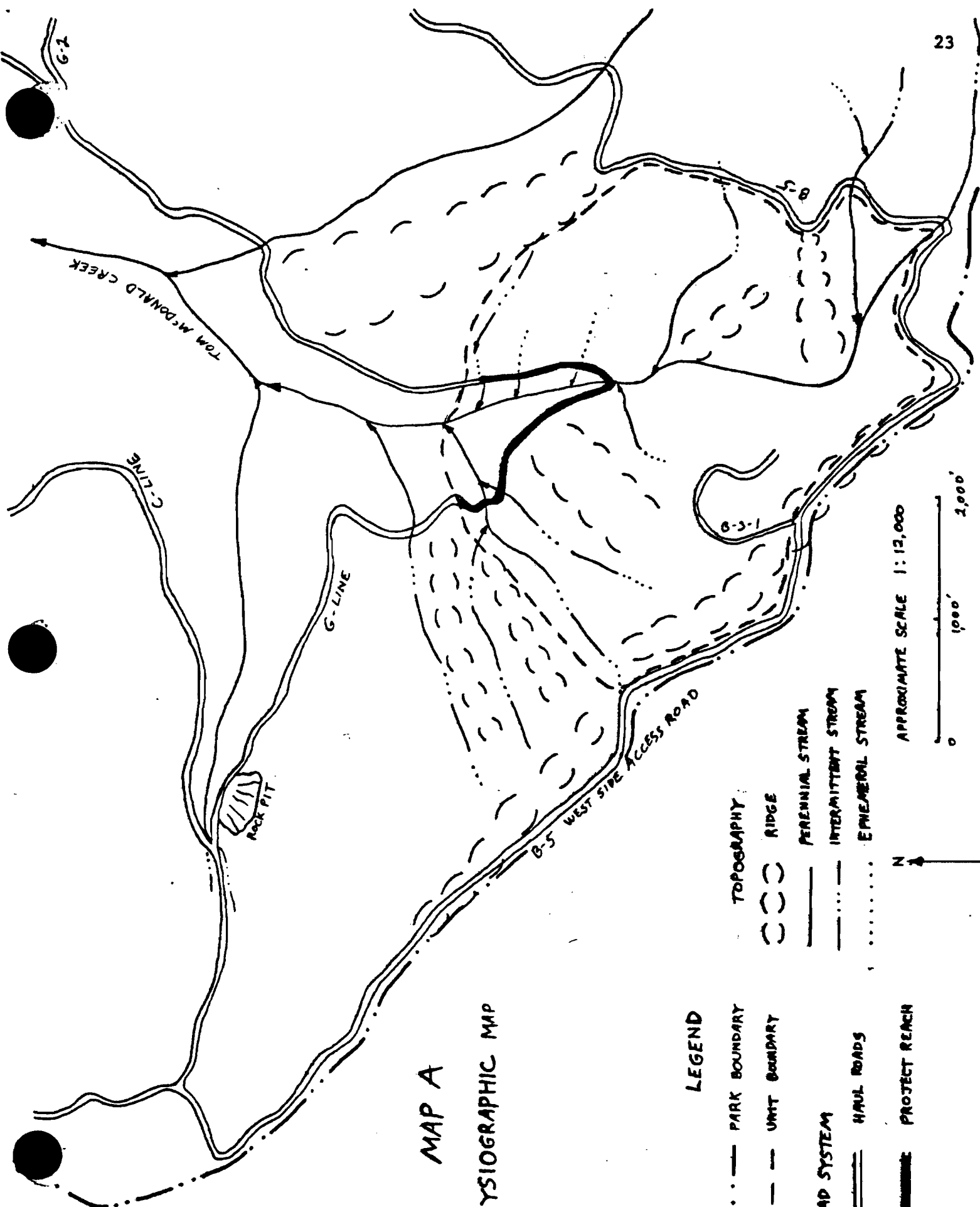
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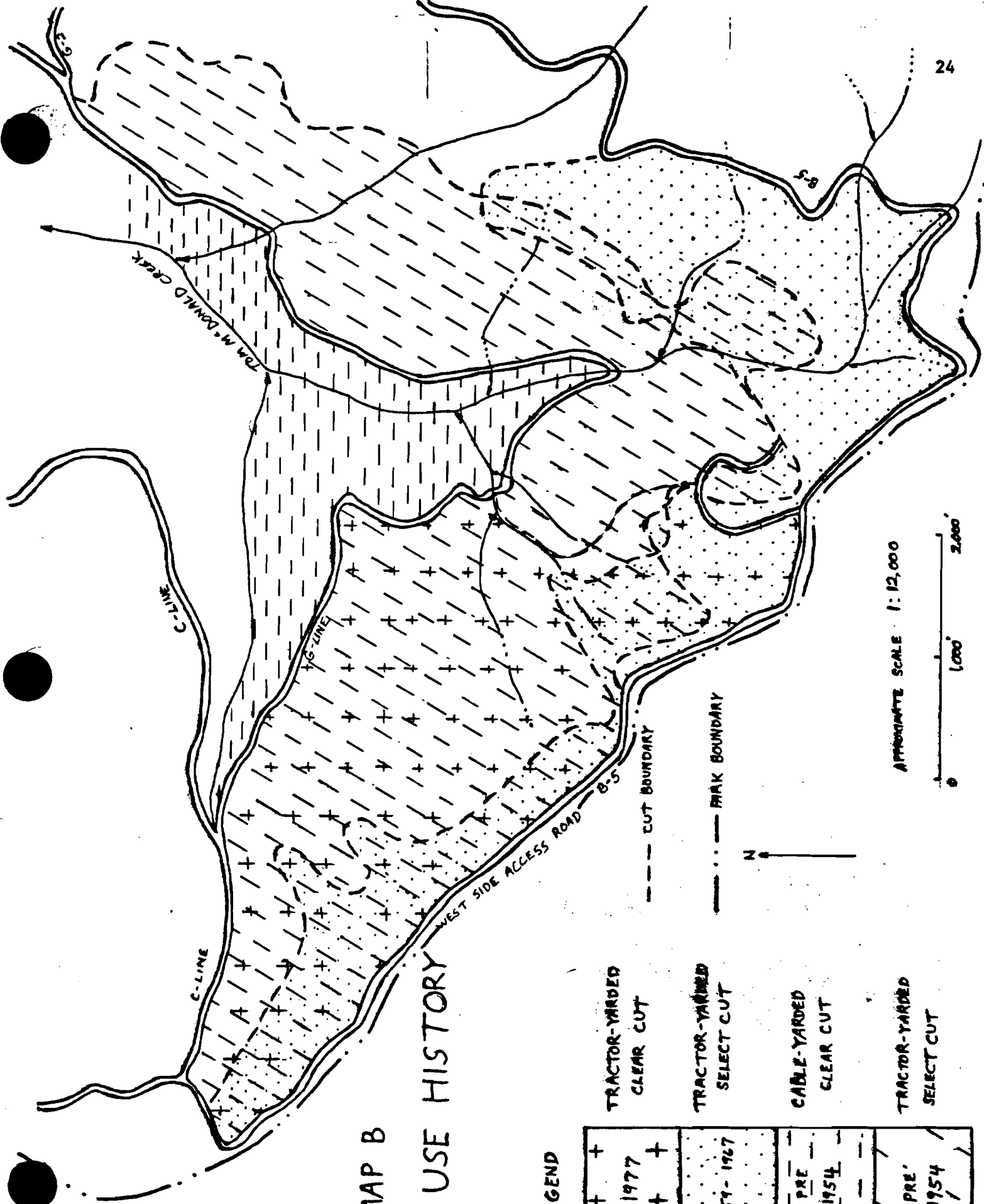
- () RIDGE
- PERENNIAL STREAM
- INTERMITTENT STREAM
- EPHEMERAL STREAM

N

APPROXIMATE SCALE 1:12,000

0 1,000' 2,000'





MAP B

LAND USE HISTORY

LEGEND

+	+
1977	+
+	+
1959 - 1967	
PRE	
1954	
PRE	
1954	

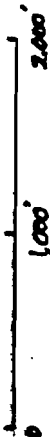
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CLEAR CUT

TRACTOR-YARVED
SELECT CUT

CABLE-YARVED
CLEAR CUT

TRACTOR-YARVED
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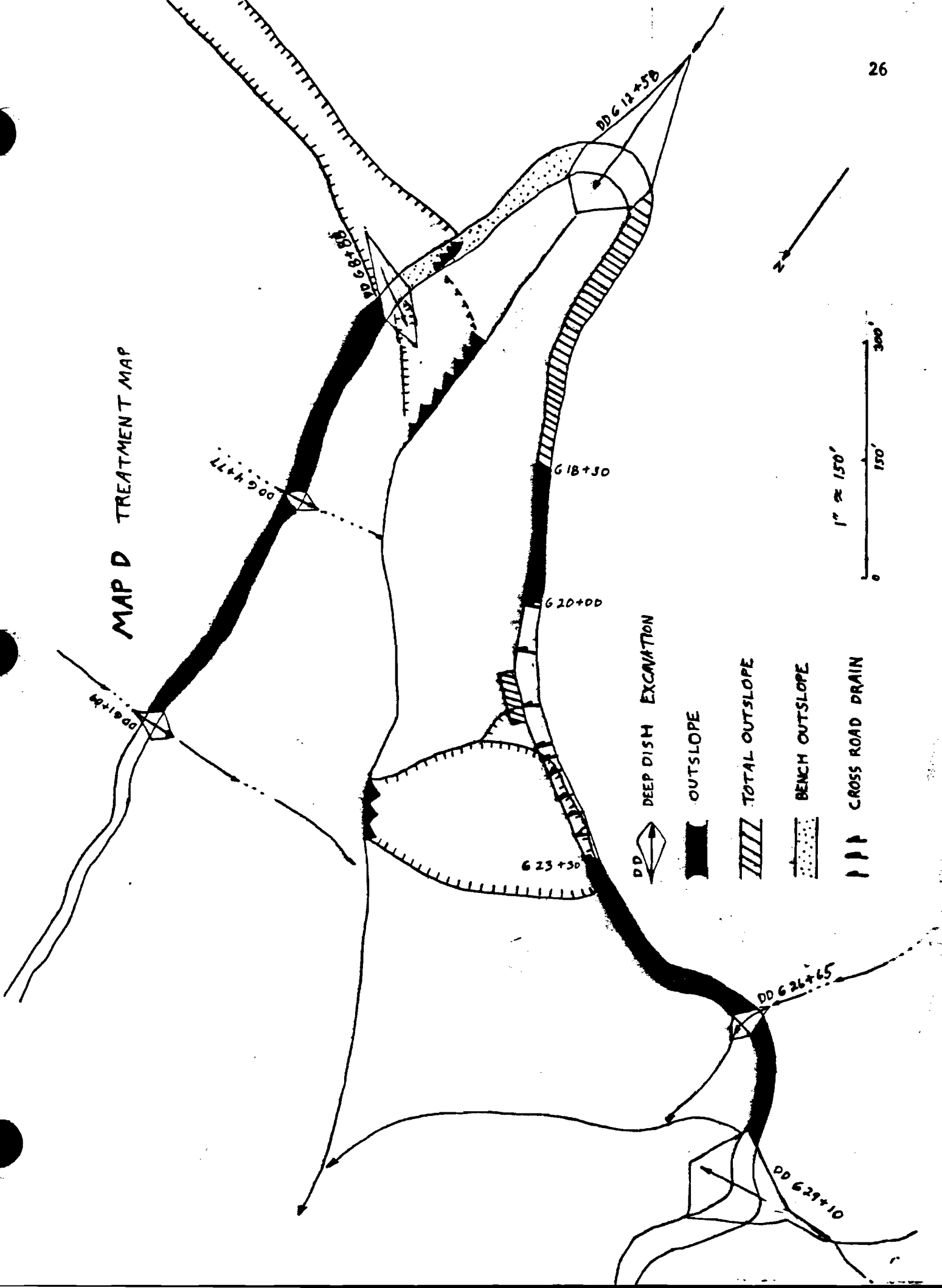
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Map C:

See included Blue Line Sheet
(3 sheets)

MAP D TREATMENT MAP





Unit 84-1 Ref. 1-A 5/29/84 PP#10A G-Line



Unit 84-1 Ref. 1-B 10/23/84 PP#10A G-Line



Unit 84-1 Ref. 2-A 5/29/84 PP#13 G-Line



Unit 84-1 Ref. 2-B 5/29/84 PP#10A G-Line



Unit: 84-1 PP5A 5/29/84



Unit: 84-1 PP5A 8/13/85 NLD



Unit: 84-1 PP21 5/29/84



Unit: 84-1 PP21A 10/23/84



Unit: 84-1 PP21A 8/13/85 NLD