

WORK SUMMARY AND COST ANALYSIS REPORT

Site 80-5

W-Line and Dolason Prairie

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and

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May 1981

**REDWOOD N. P.
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South Operations Center**

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INTRODUCTION

Site 80-5, otherwise known as W-Line and Dolason Hill Prairie, is located on the east side of the Redwood Creek Basin. The drainage area studied, encompasses all tributaries to Dolason Creek, which have their headwaters on the south-facing, spur ridge of Dolason Hill Prairie. Most streams encountered, were small and ephemeral or intermittent. Some were spring-fed. Elevation on the site varied from 160 feet to 2,424 feet.

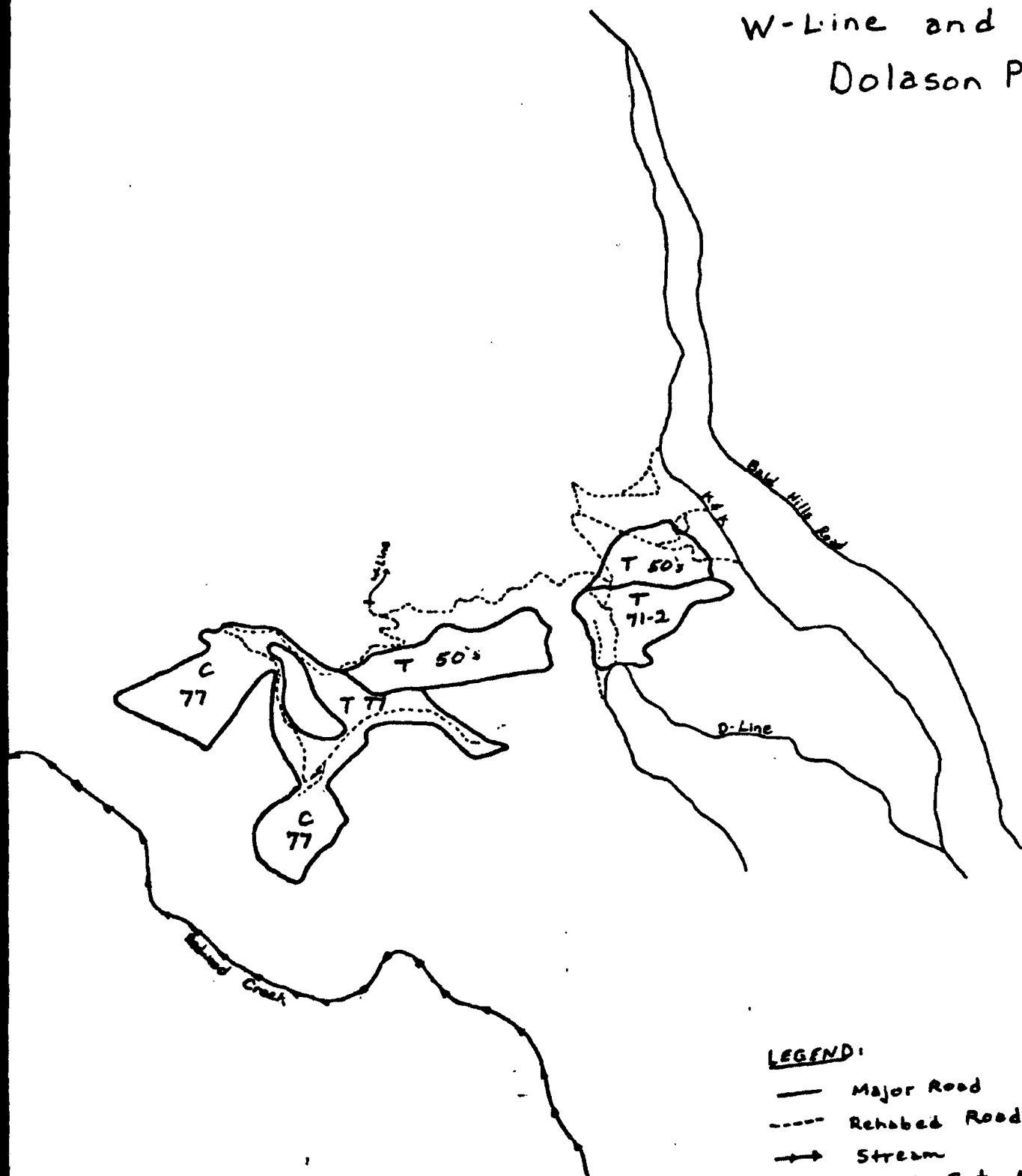
The site is underlain by Franciscan sandstone and shale. There appear to be coherent sandstone beds, generally trending NW/SE which form small benches in the topography, particularly on the upper half of the site. Slopes here, are rounded and stable. Bedrock becomes predominantly shale, grading into a "schisty-shale", and "blue goo" soil becomes more prevalent on the lower part of the site. Slopes increase, streams become more incised and unstable areas are present in the old growth below.

Virgin redwood covers about the lower half of the site(420 acres). Grassland prairie covers 200 acres along the ridge. 154 acres were logged; about two thirds were tractor yarded and one third, cable yarded.

There are two major haul roads on the site, W-Line and Harding's Road, totalling 4.8 miles. Road history, erosional problems and treatments for each, are described in separate sections of the report. Specific costs for work locations are found in the tables at the end. (These tables are probably much more useful and interesting than the text.)

LOGGING HISTORY

W-Line and
Dolason Prairie



LEGEND:

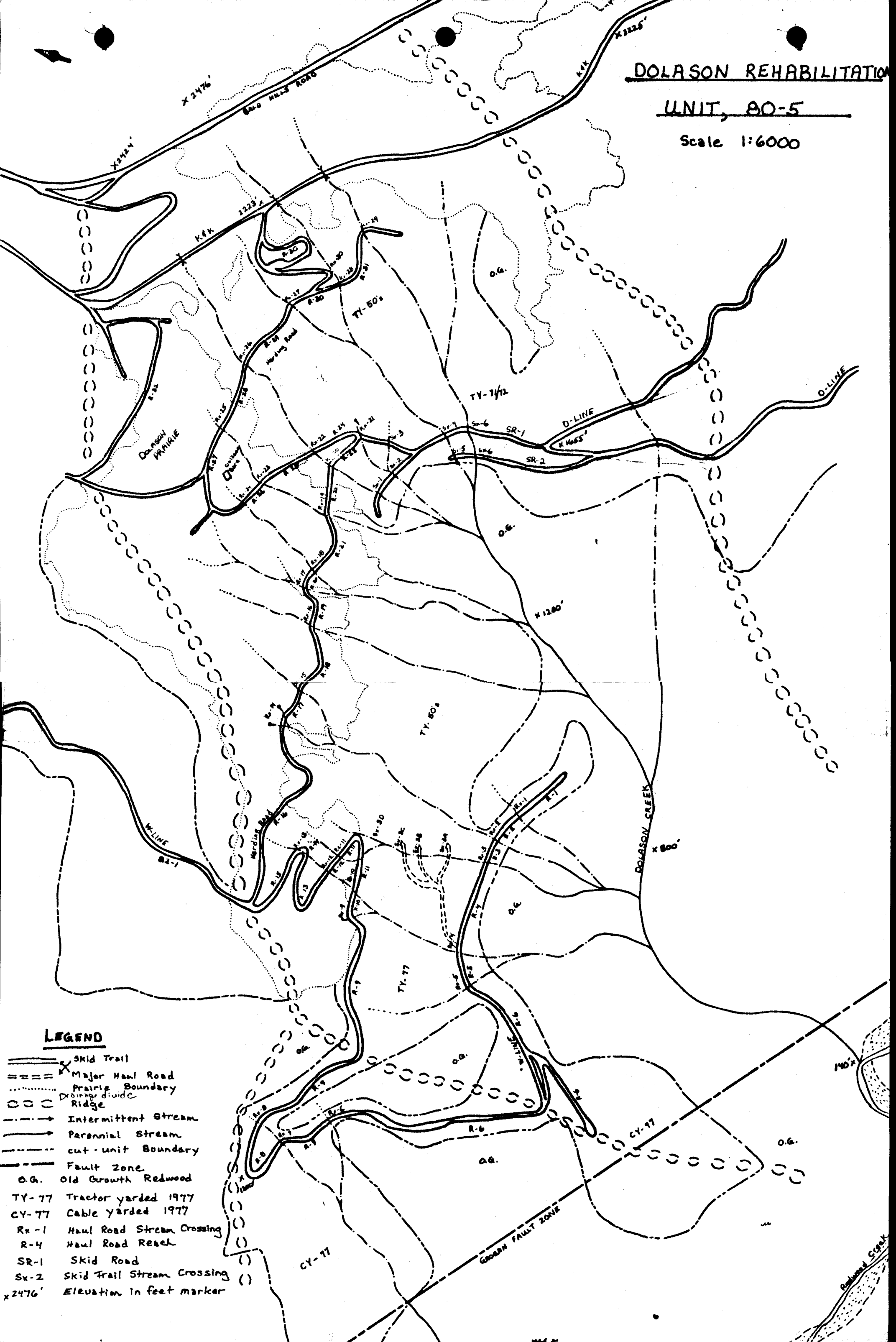
- Major Road
- - - Rehab Road
- Stream
- [C] * Cable Cut, #-year
- [T] * Tractor Cut, #-year

Scale 1:24000

DOLASON REHABILITATION

UNIT, 80-5

Scale 1:6000



LEGEND

- Skid Trail
- == Major Haul Road
- Prairie Boundary
- - - - - Drainage divide
- o o o Ridge
- - - - - Intermittent Stream
- Perennial Stream
- - - - - cut-unit Boundary
- - - - - Fault Zone
- O.G. Old Growth Redwood
- TY-77 Tractor yarded 1977
- CY-77 Cable yarded 1977
- Rk-1 Haul Road Stream Crossing
- R-4 Haul Road Reach
- SR-1 Skid Road
- Sx-2 Skid Trail Stream Crossing
- x2476' Elevation in feet marker

TOTAL COST SUMMARY

Dolason Prairie and W-line were rehabilitated in the summer of 1980 for a grand total cost of \$109,485. This figure does not include vegetation or the aborted W-line rockpit costs. The total drainage areas affected is 774 acres. The area actually worked on is 23 acres.

	<u>Actual Cost</u>	<u>Percent of Total</u>
Total heavy equipment cost*	\$ 82,633	75%
Total labor intensive cost	\$ 11,522	~~77%~~ 10%
Total cost of quarry & transport rock	~~\$ 15,330~~ \$ 16,060	~~15%~~ 15% 1100 yds
Total	~~\$109,485~~ 110,215	100%

*Actual cost of work done on site. Does not include move in and out or lowboy expenses.

The following table shows the breakdown of heavy equipment costs.

<u>Treatment</u>	<u>Table 1 Number of sites or length</u>	<u>Actual cost of work (rounded to nearest dollar)</u>	<u>Percent of total heavy equipment cost</u>
Ripping and opening roads	4.6 miles	\$2,591	3%
Removal of drainage obstructions	48 sites	\$33,518	41%
a) culverts	a) 15	a) \$11,925	a) 14%
b) humboldts	b) 23	b) \$18,036	b) 22%
c) swales, skid trails, others	c) 10	c) \$3,557	c) 4%
Decks	9 sites	\$13,801	17%
Landings	3 sites	\$2,714	3%
Roads	4.8 miles	\$22,106	27%
a) forested or logged	a) 2.9 miles	a) \$8,785	a) 11%
b) prairie	b) 1.9 miles	b) \$13,321	b) 16%
Travel between work sites		\$1,796	2%
Moving materials to work sites		\$3,279	4%
Standby		\$480	0.5%
Standby related to rockpit closure		\$1,803	2%
Other miscellaneous costs		<u>\$545</u>	<u>0.5%</u>
Totals	(3)	\$82,633	100%

HEAVY EQUIPMENT COST BREAKDOWN BY ROAD

Table 2

ROAD	HUMBOLDT CROSSINGS	CULVERT CROSSING	SWALES	ROAD REACHES	DECKS	LANDINGS	TOTAL	COST/MILE
W-Line R-1 to R-25 (2 miles)	\$ 193.50 (2)	\$10,321.25 (11)	\$2,736.75 (10)	\$10,974.00 (21) to	\$10,974.00 (9)	\$1,938.75 (2)	\$39,965.15 Add 3 3718.75	\$19,982.58
D-Line All below H-8 (.5 miles)	7,453.50 (6)	--	--	1,506.50 (2)	--	774.75 (1)	9,734.75	19,469.50
Harding R-26 to K & K (2.3 miles)	10,389.25 (15)	1,603.50 (4)	820.50 (1)	9,436.25 (18)	--	--	22,249.50	9,673.70

Note: (#)=quantity of...

Table 3
HEAVY EQUIPMENT LIST

EQUIPMENT	DESCRIPTION	OPERATOR/OWNER	COST/HR
50C Case	Bulldozer	Gary Netherby/Whitey Brown	\$60.00
690 B John Deer	Excavator	Larry Lambert	64.50
rie 22-B	Crane Drag-line	Ralph/Carl Kjer	77.50
50C Case	Extendahoe (Backhoe)	Vern McGaughey	30.00
AT D6B 44A	Bulldozer	Ivan Koonhauser/Carl Vollweiler	33.00
50 Case	Bulldozer	Rusty Vorous	65.00
AT TD 25	Bulldozer	Robert Moore/Ted's Construction	73.50
oader	Loader	Henry Budeau	35.00
AT 955 2 1/2 yd.	Loader	Mike/Hal Reardon	55.00
se W18	Loader	John Lister(?) / Robert Figas	45.00

ABBREVIATIONS

- C-# Culvert number ____.
- S-# Swale or small channel, fill crossing.
- H-# Humboldt crossing, logs suspected, but not always found.
- D-# Deck or wide spot on road (switchback corners).
- L-# Landing, usually associated with cable-yarding.
- R-# Road reach, usually from one crossing to the next.
- R/Q-# Road reach with very wet slumping and/or gullied cutbanks.

Numbers are not in a logical order, as it turns out. They originally indicated the order we planned to do things in.

RIPPING AND OPENING ROADS

All roads other than W-line had to be opened for future access using a TD 25 bulldozer. Fourteen partially or totally blown out crossings had to be reconstructed in order to deliver rocks, check dam boards, and straw to each work site.

The TD 25 was equipped with two 24-inch ripper teeth which had an effective ripping depth of 18 inches. All road surfaces were ripped three times (passes). We neglected to rip the inboard ditch on W-line. Possibly the inboard ditch is still carrying subsurface flow which might have caused the small slumps in the switchback area on W-line.

Table 4

<u>Category</u>	<u>Hours</u>	<u>Cost</u>	<u>Total Cost</u>
Open	13 1/2	\$73.50	\$ 992.25
Rip	21 3/4	73.50	<u>1,598.63</u>
		Total	<u>\$2,590.88</u>

List of blown-out stream crossings and gullies which were filled during road opening: H-4, H-5, H-7, H-9, H-10, H-10 1/2, H-11, H-12, H-13, H-15, H-16, H-23, S-13, R-40, and Dolason Creek and associated gullies.

4.6 miles Ripped

W-LINE: INTRODUCTION

W-line was a major haul road built by Arcata Redwood Company (ARCO). It starts at the Bald Hills Road, just below Elk Camp Prairie, and winds down through old growth and logged land for 4.5 miles, ending at Dolason Creek. The lower two miles, beginning where the road enters Dolason Prairie, were rehabilitated in the summer of 1980. The remaining 2.5 miles are scheduled for removal in 1982. Several highly controversial areas along the lower W-line were logged in 1977, just prior to park expansion. These consist of two cable-yarded units (L-1 and L-2), a tractor-yarded unit on the prairie fringe, coincidentally also an archaeological site (between D-6 and D-7, extending down to C-4 and C-5), and 200 foot wide "right-of-way" cuts along the entire road reach.

The first 0.6 miles of road switchbacks through the prairie (R-25 to D-8), following Harding's logging road, built in the early 1950's. This was upgraded and heavily rocked in 1977. Erosional problems in this area are discussed later in the Harding Road section.

The remaining 1.4 miles of road, mostly through old growth, was also rocked and had eleven intact culvert crossings. Most of the culverts were correctly placed and had caused only minor erosion. However, it must be kept in mind that there have been no major storms since 1977. A slump occurred above C-8 in March 1980, blocking the channel and culvert inlet, and diverting flow across the road prism. This was causing gullying and failure of the saturated outside edge of the road. In many places, the road passed through headwater bowls, disturbing the natural subsurface flow.

There were numerous areas where road stability was questionable, indicated by the presence of ponded water, seeping cutbanks, tension cracks, and small scarps.

R-10 was the most unstable; a 400 foot long section of the edge of the road had failed, debris avalanche style, down a 80-90% logged "right-of-way" slope; small mudflows reached several hundred feet into old growth below.

There were six decks, all with slash and logs perched around their edges; in some places debris was shoved up against the old growth redwood below. Most of these decks were built away from stream channels, and posed no immediate problems. The two cable yarded landings were built on moderately sloping ridges and have virtually no erosional problems.

The site-specific section which follows includes site conditions before rehabilitation, and details on how the treatments were done. Sites are discussed in the order in which they were completed. Costs, treatments, volumes, road lengths, etc. are summarized numerically in Table 1-4. This is probably the most useful part (not as boring either!).

W-LINE: SITE-SPECIFIC DETAILS

R 1

This short road reach was used during the salvage operation, but had no erosional problems. After salvage was finished, it was gently outsloped by the excavator. One water bar was also constructed.

D-1

The edge of the deck closest to C-1 had tension cracks, and perched slash. The crane pulled this material back, and the cat spread the fill, providing a gentle outslope to the deck.

C-1

A working 24" culvert with trash rack and half-round, set close to the original stream grade. There had been 2' of downcutting below the end of the half-round, and tension cracks were present at the outside edge of the road. The channel is in old growth above and below the roadway, with no significant problems.

The channel was excavated by the crane and cat. The crane did most of the digging; the cat moved fill away from the crane and used it to outslope the surrounding road reaches, did some winching, and periodically made level pads for the crane to work from. The cat was also working on outsloping Deck-1, while waiting for fill from the crane.

60 yds. Rock

See comments at end of C-2.

C-2

C-2 was a working 36" culvert with trash rack and half-round, laid close to the original stream grade. One to two feet of both the inside and outside edges of the road over the culvert had failed, and more tension cracks were present at the outside edge of the road. Up to 2 feet of sediment had been deposited in a level reach of channel above the trash rack. Downcutting below the half-round totalled 6 feet. The channel above and below is in old growth, with no significant problems. This channel carried the most flow of all channels worked on: observed maximum flow was measured as 7 feet wide by 2 feet deep, and was roughly estimated to be traveling at 1 foot per second. This calculates

to be 14 cfs, but this figure seems high.

The majority of this stream excavation was done by the hydraulic excavator and cat. The crane did some preliminary work, pulling up material thought to be beyond the excavator's reach. This turned out to be unnecessary; a skid trail below the main road provided access for the excavator, and the excavator ended up redefining and cleaning up the crane's work. While the excavator was working below, the cat removed much of the fill over the culvert, using the dirt to start out sloping the road. Then the excavator came back up, removed the culvert and defined the channel.

Rocking took a long time here because, due to the narrowness of the road, rock had to be dumped about 200 feet away from the crossing. Originally we had planned to have the cat push rock over to the excavator; the excavator would then place it in the channel. However, the cat ended up with more dirt than rock by the time he got to the channel, and so the excavator ended up moving and placing the rock alone (took 5.5 hours). This walking back and forth was extremely inefficient; a loader was what we needed. Only minor hand adjustment was required.

80 yds Rock

Comments

This was our most expensive crossing, per cubic yard removed for several reasons, one being the rock, mentioned above. The other main reason is the crane; this is also why C-1 was so expensive. The crane required a level pad to work from. In order to shape the channel properly, he often needed several pads to give him different working angles. This required that the cat stop what he was doing and build pads, or upgrade the access to a level spot. Eventually the crane had to remove these pads. Another problem with the crane (or possibly just the operator?) was the inaccuracy in casting. It often required several casts to correctly place the bucket. The bucket also had a tendency to knock loose large dirt clods and other loose ravel which ended up downslope, often in the channel, out of reach of all equipment. The crane was also totally dependent on another piece of equipment (cat or loader) to remove his fill.

In comparison, the excavator was able to independantly maneuver and work on slopes: this allowed the cat to remove much of the fill over the crossing

before the excavator started. Often the excavator was only needed to deepen or define the channel. The excavator could dig fast and accurately, and often was able to distribute (or outslope) his own fill. It was seldom necessary for the excavator to stop working while the cat moved the fill. He was also able to remove logs or culverts by pinching them between the bucket and the boom.

In summary, due to the crane's slowness and its need for the constant presence of a cat, the cat is not free to go ahead and start working down over the next crossing, and is therefore not kept busy. It is an inefficient way to use a cat.

The excavator and cat can work relatively independently. The cat can outslope almost continually using the excavators' fill, and also that removed in the preparation of the next crossing. The cat is continually working, and is able to reduce the amount of fill the excavator will have to move.

C-3

Culvert 3 was a working 24" culvert with trash rack and half-round, laid close to the original stream grade. Tension cracks were present at the outside edge of the road, and there had been only minor downcutting below the half-round. Water had also been seeping through the fill below the culvert. A large spring area in the cutbank to the left of the channel required a spring drain. The channel is in old growth below with no significant problems. The area above was select-cut in the 1950's and then clear cut in 1968, both by tractor. This channel had 3 skid trail crossings which were diverting flow out of the channel (the "S" crossings), and 1 semi-intact Humboldt crossing. (This Humboldt crossing was left in place-because the amount of flow was not anticipated to cause any major problems.)

This stream excavation was done almost entirely by the excavator, with minor assistance from the cat.

Efficiency could have been improved here by changing the design of the spring drain. It was planned to join the main channel at an acute angle, midway down the excavated channel. This required a long drain and so more digging and dirt moving. It is quicker to build drains from the in-board ditch that join the

main channel at near right angles, and at the top of the excavation. However the design should also depend on how much flow is expected and whether the channel is rocked or check-dammed. This spring has, so far, produced less flow than expected. However higher flows, especially in unprotected drains, may downcut, and deposit their load in the main channel; this fan may divert flow into a side bank. (This happened at H-11 where we joined a drain at right angles.) Spring drains seem more likely to cause problems in check dammed channels than heavily rocked channels: they can saturate side banks where check dams are keyed in.

This channel was rocked primarily by the excavator, with only minor hand adjustment required.

80 yds. Rock

All the fill from culverts 1, 2, & 3 was used to outslope surrounding road reaches.

S-2, S-3, & S-4 (the "S" crossings)

S-2, S-3, and S-4 were adjoining skid trail crossings on the channel above C-3, left by the 1968 tractor logging operation (or possibly put in during the 50's?) All 3 skid trails were angling downslope when they crossed the channel, and flow was diverted from the channel down the skid trails.

In addition, most of the runoff from the lower prairie had been concentrated into the W-line in-board ditch, which drained onto the slope adjacent to the natural channel developing an 8-10 foot deep, 20 foot wide gully (also discussed under W-1) joined the natural channel just above S-4. Several feet of sediment (eroded from the gully system) was carried down the skid trails to a gently sloping area to the right of the channel, where water fanned out creating a large marshy area. This near level area may have been used as a deck during the 1968 logging, based on observations of old air photos. Subsurface flow from the marshy area contributed to cut bank failures on the W-line below, described in the next section, R/Q-5.

These skid trail crossings were removed by the excavator alone. They contained no logs. Access via skid trail was improved by the cat; and the excavator took one-half hour to travel to the site from the W-line, near C-4.

The original plans were to put check dams in this channel, however a loader and rock was available at the time the excavation was finished, and rocking

seemed more cost effective.

30 yds Rock

Rock was dumped on the W-line and ferried up to the crossings by a large rubber-tired loader. The loader operator, John Listof, of Figas Construction Company was irresponsible and reckless. He got the loader stuck in the channel several times (he was supposed to be dumping from the edge of the channel, but was going so fast he didn't stop in time.....). On the last load of the day he got totally stuck in the channel, and could not get out unassisted. While I went down to ask the excavator to come up and pull him out, a Figas dump truck driver, Wes Roberts, decided to give it a try. In his attempts, he damaged a redwood tree and destroyed the stream excavation by ramming the sideslopes and knocking several feet of fill back into the channel. I heard this happening but got there too late to prevent the damage. It took 1 1/2 hours of excavator time to get the loader out, and another two hours to repair the damage. We used a small cat (850 Case) with a 4 in 1 bucket to move the remaining rock; this cat also had rippers on the back, which were used to rip the access road after the work was completed. Hand placement of rock was both necessary and time consuming here because the access forced the loader to dump rock at limited locations. Rock was moved up and down the channel by hand and wheelbarrow.

R/Q-5

R/Q-5 was a 600 foot long road reach with very wet slumping cut banks. The area immediately above was tractor logged in 1977, and slopes above that were tractor logged in the 1950's and again in 1968. Much of the surface flow was coming from the skid trail diversions above (the "S" crossings). Subsurface flow, emerging in the cutbanks, was also increased due to diverted flow soaking into the level area above. One hundred fifty feet of the outside edge of the road had tension cracks and beginning to settle.

This section of road was outsloped rather than cross road drained because of a) the instability of the outside edge of the road, and b) the lack of defined channels below the road. Rather than concentrating flow in a few places, outsloping encourages water to spread out, allowing for greater absorption by the soil and availability for plant life.

This outsloping was done entirely by the excavator at a cost of \$.52 per linear foot.

C-4

C-4 was a working 24 inch culvert with trash rack and half-round. It was laid close to original stream grade, and as a result, there had been little down-cutting. This channel has its headwaters (a large spring) in the 1977 tractor logged area above. The natural drainage has much slash and had been driven across in numerous spots. Most of the flow now comes down a series of skid trails, some of which have 2' x 2' gullies.

This stream excavation was done by the excavator and a small cat (850 Case) with a 4 in 1 bucket (standing in for the 1150 Case, which broke down). The cat removed most of the fill and the culvert, and the excavator defined and rocked the channel.

Flow was expected to continue from the right inboard ditch (fed by a small gully), so it was enlarged and rocked. Only minor adjustment of rock by hand was required. It turns out that this drain carries almost equal flow to the natural channel.

D-2

D-2 was a mid-sized deck, with very fresh but small (<1 foot) vertical displacements, abundant tension cracks and ponded water. The terrain below is fairly gentle, and is seemed unlikely that deck failure would have created any major erosional problems.

A small amount of fill was pulled back by the excavator and cat, used to outslope the inboard ditch area, and improve drainage on the deck. A steeper section above the lower part of the C-4 excavation was pushed down onto a gently sloping bench by the cat.

C-5

C-5 was a working 24 inch culvert with trash rack and half-round. The channel below the half-round had been completely obliterated (by fill pushed over the edge of D-3), and looked more like a skid trail than a channel, until it entered the old growth. Flow from the half-round was diverted left, through and around a small pond, and then back to natural channel. The channel above was originally a gentle swale which had been driven through numerous times during the 1977 tractor logging operation.

The channel excavation was done in the usual way with the excavator and cat. Two spring drains were provided: the left for seepage from a slumping cut bank, the right for runoff from skid trails. Due to the lack of defined channel below, the lower left bank was reconstructed with fill.

This channel took more rock than expected-hence only the steeper upper part was rocked, primarily by the excavator. The steeper left spring drain was rocked by hand; rock was gathered from a rock area several hundred yards away, and ferried to the site in a pickup truck.

The lower, gently sloping channel reach has two check dams and four submerged spillways. The submerged spillways were intended to provide local base levels, keep the flow centered in the channel, and be quick to install. The boards were sunk about 10 inches into the channel bed, so the spillway was level with the channel bottom. However, during the December 1980 storm, about 6-8 inches of downcutting occurred below each submerged spillway. In the future, energy dissipation should be provided for submerged spillways (or better yet, don't bother using them!). Fortunately, at this time the downcutting has not exposed the bases of the check dam boards, so they have not been undermined (yet). They are now working as small check dams; we added slash for energy dissipation. (some of the slash has been carried away; it should be staked in place.)

D-3

D-3 was a large deck, built on a ridge. Water was seeping from the cutbank, ponding in the in-board ditch and on the outside edge of the deck. Slash and logs were piled near vertical around most of the deck edge; fill and slash were piled up to 10 feet deep against a ring of old growth redwoods on the edge of the C-5 channel.

The excavator pulled the outside edge of the deck up, and the cat worked the fill into the in-board ditch, providing a gentle outsloping. The cat winched up numerous logs, and pushed a section of deck edge down onto a stable bench. This was a faster way to move dirt to a stable position than having the excavator pull it up. However, the cat got stuck several times and was unable to get back up the slope without the assistance of the excavator. This might have worked better with a larger, more powerful cat.

R-8 and R-9

R-8 and R-9 were a double road through-cut providing access to a landing on a ridge (L-1) from two directions. The through-cuts were diverting and concentrating surface flow, but had not exposed any seeps. Sandstone boudin structures were present in the cutbank. At the lower point where the two roads joined (R-8), considerable fill had been pushed over the edge and piled against old growth redwoods, and had a slope of 90 percent. This was pulled back by the excavator, to reduce the chances of it slumping in the future.

The double through-cut (R-9) was outsloped by the cat; two roads were blended together to allow drainage to return to natural in this headwater area.

R-7

R-7, providing access to Landing 1, was stable and on a gentle slope near a ridge. The 1150 cat dug four waterbars to prevent water from flowing down the road.

L-1

Landing 1 was built on a ridge with gentle slopes, except on the northwest side. This steeper area had a lot of slash perched on the edge, and ponding water.

This landing was ripped, and the steep slashy section was pulled back by the excavator. The fill was used to provide a gentle outslope, improving drainage off the landing.

R-10

This was a very unstable section of road; the outside edge of the road had failed in debris avalanche style, traveling 200 feet down a 80-90 percent logged slope. Old growth at the base of the slope acted as a barrier, holding back logs, rootwads, and up to 10 feet of sediment. Mudflows have traveled several hundred feet down through the old growth, depositing several feet of sediment behind logs and other natural barriers.

The cut bank above the road is extremely wet in spite of being within several hundred feet of the ridge. It is not uncommon for cutbanks through ridges in a sandstone/shale terrain to be springy. Surface flow, concentrated by skid trails along the ridge, and the emerging ground water was ponded on the

road and in the in-board ditch area.

Below the R-11 road reach is a series of skid trails - these end or disappear below R-10. If these skid trails were originally present below R-10, they may have helped initiate the slumping and debris avalanching. This was an extremely steep area which should never have been logged. However it was within the road "right of way", and ARCO has a habit of logging the right of way to pay for the road. (no timber harvest plan required.)

Several springs below the road had also been uncovered by the failures and probably also contributed to slope instability. This water was beginning to gully the surface of the failures and was adding to the possibility of future failures.

Treatment here consisted of pulling back the outside edge of the road, and filling the in-board ditch, done by the excavator. This moves potential failure material to a more stable location, improves drainage and cuts down on the amount of ponded water soaking in and lubricating the failure plane.

R-11, S-5 and S-6

The road here passed through the headwaters of a small drainage. There is no defined drainage above the road, just a broad bowl. Due to road construction and removal of slope support, the entire soil mass in the steep bowl was settling. There are 2-3 foot high recent scarps around the head and edges of the bowl; older, rounded scarps are present as well. The outside edge of the road was also settling. Tension cracks were present here, and also in skid trails below (in the ARCO road "right of way"). All flow from the basin above the road was diverted by the in-board ditch to the next drainage to the right.

This area was mildly outsloped in order to restore drainage flow across the road prism, add support to the toe of the slumping bowl above, and pull back potential failure material at the edge of the road. The excavator also gently outsloped - swaled the skid trails below, stabilizing the failing edges. It was not anticipated that the amount of flow from the bowl would cause any further erosional problems here; straw was the only-secondary treatments.

C-6

C-6 was a working 24 inch culvert with trash rack and half-round, placed on a broad divide. It was carrying flow from two drainage headwaters over a ridge and delivering the flow into the next drainage bowl. Culvert discharge had produced rills and some small gullies as it crossed the logged area, but below in the old growth the flow fanned out and deposited its load.

This culvert was removed by the cat and the area was mildly outsloped to allow drainage to return to a more natural pattern.

R-12 and C-7 ("Redwood Bowl" or "Red Spider Gulch")

Road reach 12 passes through another bowl-like headwaters area. Here, however the area drained is larger (the ridge is higher here) and flow is beginning to concentrate in defined channels just below the road.

C-7 was a working 24 inch culvert with trash rack and half-round, located on a small rise within the bowl. The in-board ditch collected water from the entire bowl, and the culvert discharged it toward the right tributary; some rilling had occurred.

There were tension cracks and minor slumping at the outside edge of the road. The cutbanks were very wet and had slumped in numerous spots. The in-board ditch was blocked in three spots, causing water to be ponded on the road bed.

The culvert was removed by the cat, and the road was mildly outsloped by the excavator - cat combination. The excavator worked his way along the edge of the road, pulling road sidecast and slash up, and dumping it in the in-board ditch. The cat followed and smoothed out the piles, working material into the cutbanks, and compacting the fill. Three swales were made in the outsloping at the center of natural depressions in the bowl to direct flow towards the developing channels.

In retrospect, I think we should have pulled back more material at the outside edge of each swale, steepening but evening out the grade of each swale. Presently there is some erosion occurring where flow goes over the "hump" at the former outside edge of the road.

C-8

C-8 was a culvert that was plugged by a slump which occurred in March 1980. The culvert was not laid at the original stream gradient; about 4 feet of downcutting had occurred below the half-round which was partly detached. This was among the deepest crossings on our site (C-1, C-2, and C-3 were also very deep). The stream becomes well incised just below the road; above the road the drainage is a broad bowl filled with slash. Cut banks across the bowl were 5-7 feet high and seepy. Slumping of the slash-covered slopes had occurred repeatedly here. Slash and rootwads were precariously perched on the edge of the 30 foot raw slump face.

The crane did preliminary work on the furthest reaches of the excavation. We had problems here again with the crane knocking loose large dirt "clods" (up to 2 feet in diameter) and having them end up in the channel out of everyone's reach.

The excavator and cat were used to winch and knock down logs and slash that were perched above the channel (to prevent them from falling later and blocking the channel). The excavator clawed at the upper part of the scarp face, making it less vertical, and also making a 3 foot wide bench 3-4 feet below the top of the scarp, to help catch material that might fall. Some of the slash was dragged to L-2; a lot was buried along the in-board ditch to the right of the crossing. The remainder of the channel excavation was done by the excavator and the cat. One hundred and fifty yards of fill was end-hauled from this site, (using 2 dump trucks) and used on D-6 to fill the in-board ditch through the archeologic site. This was recommended by the archeologist, to prevent further ground disruption at the ancient village site.

Rock for this crossing had to be dumped 250 feet away from the channel. The backhoe, working on crossings in the upper prairie, was brought in to help move the rock. The excavator distributed the rock as evenly as possible, but due to the large size of rock, we needed more to provide coverage for the entire channel. An additional 30 yards of rock was delivered and dumped directly into the channel. This proved to be a minor disaster.

The rock delivered contained nearly 50 percent dirt, and this all ended up in the channel. The excavator spent a considerable amount of time trying to sort rock and dirt. These factors combined to make this one of the most expensive crossings per yard.

Dumping rock directly into the channel also affected the labor intensive costs. We ended up with a rocky hump in the middle of the channel which was very time consuming to remove. Many rocks needed to be moved by hand because the excavator was unable to reach the far bank for rock placement.

R-13

This road reach crosses the slope just below a drainage divide. The only problem here was that the in-board ditch concentrated the overland flow from above and directed it into the C-8 channel.

The outside edge of the road was pulled back and the in-board ditch filled mostly by the excavator. The cat smoothed and compacted the outslowing to allow drainage across the road prism.

L-2

This landing, built on a ridge, was dry and stable. The level areas were drained by a system of radiating ditches constructed by ARCO following timber harvest in 1977.

These ditches are working well; there had only been minor rilling on the sides of the landing. There were no signs of potential failure. This area was left as we found it. It was not ripped because this would have necessitated rebuilding the ditches. It was also considered useful to compare this radiating ditch system with other types of landing treatments.

Above the landing, on the outside edge of the switchback, road side cast and slash was piled up against old growth redwoods. The in-board ditch from the W-line above R-14 drained over the divide onto this unstable mess; tension cracks and small gullies were present. The additional water had been deposited in the channel below.

The excavator pulled back the oversteepened side cast and slash from around the bases of the trees, and the cat used the fill to eliminate the in-board ditch and outslope the ridge area, returning drainages to their natural basins.

R-14

The in-board ditch of this road reach was concentrating and diverting surface flow across a ridge and adding to problems mentioned above. Outsloping was done here almost entirely by the cat. It was outsloped rather than waterbarred because of its proximity to the ridge, this disperses rather than concentrates flow in areas without defined channels.

NOTE: Conditions and treatments were similar from L-2 to R-18 (includes C-9, C-10, C-11, R-15, R-16, R-17, D-5, D-6, D-7), hence these were grouped together.

C-9, C-10 and C-11

These were all working 24 inch culverts with trash racks and half-rounds. In each case the culvert was placed near the center of a swale, but there was no defined channel above or below. The in-board ditch collected overland flow from the bowls above the road, and, where discharged from the culverts, the concentrated flow had caused minor downcutting.

These culverts were removed by the cat and left as outsloped swales.

R-15, R-16 and R-17

This section of road had locally seepy cutbanks. The in-board ditch concentrated and diverted flow to the culverts mentioned above.

To eliminate the problems associated with concentrating surface flow in drainage headwaters, the in-board ditch was filled and the road was gently outsloped. There have been a few very minor slumps in the wetter sections of the outsloping.

D-5--lower (I accidentally labeled 2 decks D-5)

This was a ridge deck, with steep slopes below, and with ponded water on about half of its surface. If the edge of the landing failed, it would have had an adverse impact on the surrounding old growth.

The edge of the deck was pulled back by the excavator. The cat^g used this material to fill the inboard ditch, and to rebuild a low drainage divide (to prevent water from flowing around the ridge to the next bowl).

D-6

D-6 was a stable deck, built on a divide. There was some ponded water, but the main problem here was that the in-board ditch concentrated headwater runoff and carried it across the divide.

This area is part of an archeologic site. To avoid further disruption of the site, the deck was not ripped, and the in-board ditch and ponds were filled with material removed from C-8. The rocked road surface was decom-paced (12-18 inches deep) using the angled blade of the 1150 cat. A cross road drain was dug by the excavator on the upper side of the deck, to reopen the drainage from a broad bowl, and to break up any flow that might be coming down the road.

D-7

This was another stable deck on a small divide. All that was done here was to outslope the in-board ditch area with the cat.

NOTE: The remainder of the W-line (the switchbacks) is discussed under Harding's Road as it was part of the original logging road system built in the 1950's. When the W-line was built, this section was widened and rocked.

HARDING ROAD: INTRODUCTION

Harding Road was built in the early 50's, and was a major logging haul road. It started at the Bald Hills Road and switchbacked down, mostly through grasslands to the base of Dolason Prairie. The switchback area is commonly now referred to as part of the W-line, but has actually been in existence since the early 50's. The forested area to the south of the road was selectively logged several times, beginning in the early 1950's. All yarding was done by tractor.

The road passes over ephemeral and intermittent streams at 15 locations using humboldt crossings. Only three crossings remained intact with no erosional problems. Most crossings were plugged (or non-functional from the start?), and were diverting flow down the inboard ditch; gullying the ditch and the slope or channel below where the flow finally broke through the road.

Special problems arise in prairies due to road construction. Subsurface flow in the prairie soils (at least those underlain by interbedded sandstone and shale) is confined to the lower part of the A horizon (12-18 inches deep) by a less permeable, clayey B horizon. This means that road cuts or gullies intercept subsurface flow at an unusually shallow depth, and the continuous seepage increases bank sluffing. The shallow subsurface flow encourages gully growth by piping where the flow is concentrated in natural swales. Piping is accelerated, or initiated in new areas, when road cuts or gullies create free faces, allowing the soil-water to drain faster than normal. A major consideration in deciding to totally outslope prairie roads and gullies relates to this: hopefully, by reburying the seeping A/B horizon boundary, the subsurface flow will remain in the soil, and piping will be decreased. In addition, prairies are of high aesthetic value in the park. Total outslipping eliminates the road scars. Gullies are harder to treat: those in natural swales will always carry flow, because soil water will collect there, even if the surface runoff feeding them is decreased. Gullies in unnatural places (ridges, etc.), created by improperly placed culverts or drains, can be successfully filled. We filled a 12' x 8' x 100' long gully (caused by the inboard ditch collecting flow from most of the switchback area of the prairie, and discharging it onto a slope adjacent to, but not in, a natural channel.), which is so far doing fine. There may be a limit to what can be filled but we might as well try some bigger ones and see what happens.... If the fill doesn't hold, it probably won't look that much worse than it did to begin with.....hopefully the fill won't go straight to Redwood Creek.

Some of the biggest erosional scars on Dolason Prairie were caused by plugged or non-functional humboldt crossings on Harding Road. The sequence of events, or at least the causes are briefly described here.

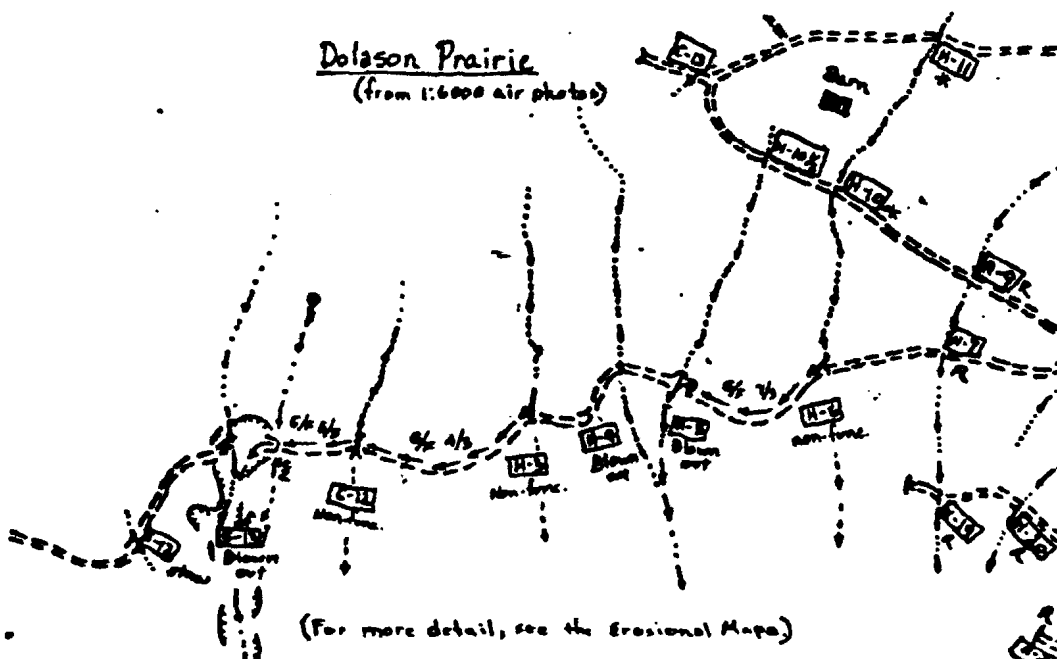
Flow from H-6 was diverted down the road to H-5, and had enlarged the inboard ditch for 450 feet to a 7' x 3' gully. The combined flow of two drainages washed out the road at H-5, but caused only minor enlargement of the channel below. Flow at H-4 remained within it's drainage, but had washed out 50 percent of the crossing fill.

H-3 did not function, and flow ran down the ditch to C-12 for 500 feet, enlarging it to an average of 4' x 3'.

C-12 had a culvert but the inlet was 12 inches above the bottom of the ditch, so the combined flow from C-12's and H-3's channels continued down the ditch for 200 feet to S-13. The ditch here averaged 5' x 5'.

S-13 encompasses two small channels. One (left fork) was simply filled and the flow diverted down the ditch to the other channel (right fork) which had a humboldt crossing. The combined flow from the three non-functional crossings caused the humboldt crossing to wash out. This lowered the base level for the inboard ditch, initiating downcutting. A 12 foot high head-cut developed which retreated 100 feet to the left fork, causing erosion of about 100 cubic yards of the former divide between channels. (The rate of retreat can be observed in old air photos.)

The natural channel was severely gutted for 700 feet downstream, with numerous side bank failures and raw stream banks.



HARDING ROAD SITE-SPECIFIC DETAILS

H-1

H-1 was expected to be a Humboldt crossing but no logs were uncovered during excavation.

This drainage was left as shallow swale, and contours were blended with the outsloped road. Secondary treatment consisted of a heavy application (3-4" deep) of straw.

Somewhat of a hump was left at the outside edge of the road, and a small amount of erosion (rilling) has occurred here.

H-2

H-2 was a very small Humboldt crossing on a wooded prairie channel. The excavator and cat worked on this, with the cat doing the initial dirt removal, and the excavator defining the channel and placing rock.

The lower part of this stream splits, flowing around a medium-aged clump of redwood trees. Initially, only the left side was rocked but runoff from the December 2, 1980 storm overtopped the rocks and flowed down the right side as well, causing some downcutting. This side has now been protected with locally gathered rock.

R/Q-21

Road construction here initiated slumping and gullying in the slope above. The slope has been stabilized by young Douglas fir, but surface flow and seepage were still carried by the inboard ditch to an active eight foot deep, six foot wide gully. Rocks had been dumped in the headcut, but flow had cut around the rock, causing continued side bank failure.

This area was gently outsloped (allowing flow to disperse) using fill perched above a newly constructed channel (W-1). This fill had to be moved about 75 feet, which explains the higher outsloping cost here.

The banks of the gully were laid back, and the rocks placed more effectively by the excavator.

Some rilling and minor slumping occurred on the slope where fill was pulled back. This was effectively treated by spreading additional straw mulch.

S-7

This swale was filled with dirt when the road was constructed, and its flow was diverted down the inboard ditch. Fill was removed by the excavator and cat in the usual way. Below the road, the flow fanned out in a level area. Check dams were installed in this channel. One needed to be repacked with less rocky fill; all are now working well.

S-8

S-8 was another dirt-filled swale, opened by the excavator and cat. The channel had fairly steep side slopes; surrounding cut banks were high. These factors combined to make removal and outsloping of the fill more time-consuming than usual.

This channel has a fairly even grade (35%), and not much flow was expected. Labor intensive treatment consisted of a heavy application of straw (4-5" deep), held in place by jute netting. This worked fairly well, except in the lower, slightly steeper section where about a foot of downcutting occurred under the jute netting.

D-4

D-4 was a wide switchback corner. Inboard ditch flow collected along R-23 was directed onto the slope, partly through a culvert and partly across the road, creating several gullies down the steep fill face. Cutbanks were 10-15 feet high.

The crane spent a long time here pulling up material thought to be beyond the reach of the excavator. The crane is an inefficient way to move large volumes of fill. The crane removed the culvert, which was also extremely inefficient. The cat probably could have done it in 1/3 the time. The crane also needed the cat to remove his accumulated piles of fill, meaning that the excavator was left alone for periods up to several hours. This decreased excavator efficiency.

Outsloping of this area was completed by the excavator and cat. The excavator finished ahead of the cat and started work on outsloping R-23.

R-23

The lower part of this section of road had slumping cutbanks, vegetated with braken fern and juncus. There was also a large gully or slump, plugged with rock, above the road. However, no seepage, and only a minor amount of water in the inboard ditch, was observed during the mapping phase (March-April-May).

This road was outsloped by the excavator and cat: the excavator pulled up the road sidecast, and the cat worked it into the ditch and cutbank, blending outsloping with natural contours as much as possible. In this section of road, the excavator got ahead of the cat, and the cat operator felt rushed to catch up. Consequently, the fill was not compacted as much as in other areas. The terrain here was also very steep, making cat work more difficult.

These problems, in conjunction with more seepage from the slumps and gully than expected and possibly with not having ripped the inboard ditch, has caused several small failures in the outsloping. Another contributing factor may be that in order to end up with top soil on the surface, all the road rock was pushed toward the ditch, creating a French drain effect. Flow from these failures may have been concentrated again on the unripped inboard ditch of R-22, causing a large "blowout" in the outsloping on a very dry section of road. However, these failures seem to blend in with the slumpy nature of the surrounding slopes. (For details on these failures, see the December 1980 storm notes).

D-5 and S-10

D-5 was another wide switchback corner on steep terrain. Road construction initiated slumping and gullying on the slope above. This was still active and very springy during the mapping phase. Inboard ditch drainage from R-24 and the slump area crossed the road and created a large gully (12' wide by 8' deep) down the steep fill slope. A lot of boulders had been dumped in the headcut for energy dissipation.

The crane worked here, supposedly pulling up the lowest portion of the side cast. However, he ended up working on the upper part of the slope as well, which was within reach of the excavator. We finally realized this and decided to let the excavator finish the job.

To help drain subsurface flow from the slump area, a crude French drain (using 3-8" diameter road rock) was constructed using the old inboard ditch. A swale was dug across the road, directing slump drainage into a natural prairie swale below the road.

The wet cutbanks of the slump were not completely outsloped, but were contoured to drain into the swale. We decided to fill the gully because it was faster for the cat to push dirt down into it than to have the excavator lay back the sides.

This area has held together very well, so far. There is no evidence of subsurface flow in the filled gully. The swale was treated with a heavy application of straw (3-4") and only very minor downcutting (rilling) has occurred.

R-24

R-24 was a road reach whose inboard ditch was causing the problems mentioned above.

The road was outsloped by the excavator and cat. Three small, actively piping gullies (migrating headward from the cutbank) were plugged with large rock (2-3' diameter) and dirt, and then outsloped.

A small failure with continued seepage occurred in the vicinity of the outsloped gullies. In a normal or heavy winter, these may blow out, but hopefully, the rock will prevent this.

R-25

R-25 was another very large switchback corner, which cut through a ridge. Although there were no major drainage problems, it is a highly visible grassland ridge and this area was outsloped completely. At the new end of the W-Line, a culvert was removed and replaced with a cross-road drain.

R-26

R-26 was outsloped by the excavator and cat. We buried a major spring about 100 feet to the right of S-13. This section, about 10 feet across, failed mud flow-fashion, during the first (and only) major storm of the winter. It now resembles a spring drain intentionally constructed by the equipment. However, it was probably cheaper to completely and uniformly outslope the area, than to work around the spring, shaping a spring drain. By outsloping over springs or seeps, you have a chance that it will remain in place. If it does, the area looks that much better. If it doesn't, you at least have a naturally constructed drain, which may be more stable than one designed by people.

S-13

The channels through this blown-out crossing (described in detail in the Harding Road introduction) were reconstructed by the excavator, with dirt removal support by the cat. Rather than returning the spring flow to its natural swale below the road, it was left joining the main channel where we found it. Its channel was widened and the 12 foot vertical side slopes were laid back. If we had returned it to its natural channel, downcutting would undoubtedly occur because its base level had been lowered by about 10 feet due to downcutting in the main channel (natural swale is now a hanging valley). There would also have been problems keeping the flow from its now well-established gully.

The right fork was also widened and its sides laid back. The logs of the old Humboldt crossing were left in place (embedded in the bank) because the stream had already reached an even grade adjacent to them; they were actually helping stabilize the bank.

The slumping, springy cutbank between the two channels was laid back, and a bench was left to catch and prevent failure material from plugging one of the channels.

Both channels were rocked. One problem arose here in that rock was stockpiled on the wrong side (the beginning side) of the channel. We had changed our approach direction after rock was dumped. The backhoe was used to ferry rock to the other side, and also to place some rock directly into the channel. The remainder of the rock was placed by the excavator.

These channels required quite a bit of labor intensive work, rearranging the rock. We could have definitely used more rock here. We were faced with a choice of putting rocks in the center of the channel, preventing downcutting, but deflecting flow into banks, or placing rock on the sides, but allowing some downcutting. We chose the latter, but then readjusted some rock after the first heavy storm to stabilize the small headcuts which developed.

R-27, 28, 29 and 30

These prairie road reaches, mostly all with gullied inboard ditches, were all completely outsloped by the excavator and cat, using both sidecast and fill from crossing. The cat was kept constantly busy, moving dirt and compacting the outsloping. All seeps were buried.

There have been a few minor slumps in the outsloping, but no significant failures.

C-12

This non-functional culvert was removed, and the channel completely excavated and shaped by the cat.

It has an even, gentle gradient (25%) and is a minor channel, so treatment was limited to a heavy application (4-5") of straw.

The straw has worked exceptionally well. After the first storm, there were only a few inches of downcutting. The straw was moved out of the main flow route, but tended to clump, creating little nickpoints and meanders (see storm photos #45-47).

H-3

H-3, intact, was removed by the excavator and the cat. The cat did most of the major dirt removal before the excavator took over, resulting in the gentle side slopes. Checkdams were used for the secondary treatment here. They were designed as mini-checkdams with 6 inch effective height, and 6-10 inches of unprotected channel fall between dams. These were the most expensive per check-dam for reasons discussed in the labor intensive section.

The rock that was placed below each splashboard was not staked in place, and was moved during the December, 1980 storm, resulting in 6-10 inches of downcutting below each dam (see storm photos #55-59). If mini-dams are used in the future, it is important to make sure that either rock is staked in place on the unprotected section of channel fall, or that the rock is big enough not to be carried by storm flow.

A hump was left in this channel, between the excavated reach and the natural channel below. About 2-3 feet of downcutting occurred below the last checkdam here. This should have been excavated more completely, or more checkdams installed.

H-4

H-4 was a partially blown-out Humboldt crossing, removed by the excavator and cat.

We left a log in this channel, in the right bank. It was discovered after we had finished that sideslope, and to remove it would have entailed redoing the entire side. It looked like if we left it in place, it would provide slope support and prevent side bank erosion.

Rocks were placed along the bottom of the log to prevent undercutting, and along the rest of the channel by the excavator. Only minor hand adjustment was required.

H-5

H-5 had blown-out and reached an even grade, but access forced us to fill it. The fill was then removed by the excavator and the cat. A very large rock (outcrop ?) at the end of the channel was left in place. It was acting as a stable base level for the channel, although it may cause some erosion if high flows are deflected into the bank.

This channel was sparsely rocked. It downcut about a foot in some spots, but bedrock is now exposed and it appears to have stabilized.

H-6

H-6, intact, was worked on by the excavator and cat in the usual way, with the cat doing the initial fill removal.

Several logs were removed from this crossing and it was left at an even grade which blended well with the natural channel above and below. However, the first winter storm uncovered two more logs at the bottom of the channel.

This channel was rocked, but could use more rock. There was a choice here similar to that at S-13: protect the sides or the bottom. We chose the sides again, and there has been 12-18" of downcutting locally. Downcutting is now limited by the logs. Hopefully, flow will not erode around or under the logs in the future, but it is a definite possibility.

H-7

H-7, blown-out but refilled for access, was removed by the excavator and cat in the usual way. There were some very large logs in this channel. There may still be one left, or it may be a stump; neither piece of equipment was able to remove it.

Flow from the major spring to the right of the channel was channelized into a broad drain, which joined the natural channel just below the excavation.

The main channel was rocked by the excavator, with only minor hand adjustment required. The spring channel was left unprotected but covered with straw. It has an even grade and has not downcut.

H-8

H-8, intact, was an unusual crossing. There was an indistinct channel below, totally thrashed with logging debris. There was no channel above, but there was a spring. Several logs were removed here, and taken down R-40 and buried. The channel was left as a broad swale and rocked. Initial rock placement was by the excavator; however, most of the rock was stockpiled too far away for him to efficiently move it. We ended up gathering and placing about half of the rock by hand, with help from a Redwoods United crew of four.

Unfortunately, there was less flow than expected, so this labor intensive, unpleasant job, was probably not necessary. Straw would have worked fine.

H-9

H-9, blown-out but refilled for access, was removed by the backhoe and an ancient D-6 cat. The D-6 was able to work down over the crossing, preparing the site for the backhoe, but could not effectively outslope because of its blade. In order to change the angle, the operator, or more commonly the geologist or tech, had to get out, pull some pins and move the blade manually.

Since it was impractical to do this between each pass, it meant that to keep it from side casting fill off the edge of the road, it could only push dirt from one direction; therefore moving dirt usually took at least twice as long. This cat was also continually breaking down. Either the backhoe had to move the fill in its loader bucket, or we had to pull the 1150 away from the excavator to help out.

There were also some problems with the backhoe. It had a very small bucket, about 1/8 cubic yard most of the time, and because of its limited turning radius, it was often impossible to directly move each bucketful out of the channel. Each bucketful of dirt was usually moved 3-4 times before it was within reach of the cat. These are limitations inherent to backhoes; however, we had an excellent operator.

This particular crossing was not as deep as many others done by the backhoe, so moving each bucketful several times was not necessary and this is reflected in a reasonably low cost per cubic yard.

This channel was rocked by the backhoe. Only minor adjustments by hand were necessary.

H-10

H-10, blown-out but refilled for access, was removed by the backhoe, with assistance from the Mesozoic^{D-6} cat. The backhoe had problems laying back the side slopes to a stable angle. Had the D-6 been more maneuverable, it could have helped by

back-blading the fill from the channel. The backhoe bucket was so small that it seemed to take forever to move the volume of fill necessary to de-steepen the slope.

Finally, the 1450 Case with a 6-way blade was brought in, and in half an hour, it did what might have taken the backhoe several more hours to do.

This channel has a very even, gentle gradient (10%). Four mini-checkdams were installed here with about 4 inches of unprotected channel fall between each dam. These worked well here; however, in retrospect, this channel could probably have been left unprotected.

H-10 1/2

This small, partially blown-out, Humboldt crossing was removed by the backhoe. The backhoe was able to borrow a much larger bucket for several days and this definitely increased its efficiency.

This channel was left unprotected. During the December storm, a 2.5 foot headcut developed and migrated about half way up the excavated channel. We added as much rock as could be found to the channel and hopefully, this has stabilized the headcut.

R-34

This long road area was totally outsloped, mostly by the 1450 Case. The backhoe pulled back the edge of the road near H-11, where the slope was too steep for the cat to push uphill.

Seeps along the A/B horizon boundary were successfully buried. However, more flow than expected emerged from a spring above the road, which is the source of the flow at H-10 1/2. Subsurface flow from this area caused a major blow-out in the outsloping below. It is morphologically similar to the one in the switch-backs (R-22), but this one has sustained flow and evidence of piping. No water has been observed in the R-22 slump since it occurred. We should have created a swale in the outsloping here, which would have directed flow toward H-10 1/2.

H-11

This Humboldt Crossing, beginning to collapse but still working, was removed by the backhoe. Fill removal and surrounding outsloping was done by the 1450 Case. An open spring drain was constructed using the old inboard ditch, draining a cutbank spring to the left of the channel.

The lower part of the drain is much steeper than the upper part and downcutting has occurred in the "hump" area. Most of the sediment was deposited behind the top checkdam. This deflected channel flow into the side bank, causing some erosion, and may have helped initiate leakage around the top check dam.

The bottom checkdam leaked on both sides because of being packed with rock. For more details, see the winter maintenance section.

Downcutting associated with failure of this checkdam has exposed a log which is part of the Humboldt crossing. This was not observed during the heavy equipment phase; it looked like a natural channel nickpoint. If we had noticed this and removed it, we would have had a better match between excavated channel grade and the natural channel below.

2

The Humboldt Crossing was partially blown-out, with a steep-walled, even graded channel through the fill. The channel was filled for access and the fill removed by the backhoe with cat assistance. The D-6 worked down over the crossing, distributing fill up and down the road. It broke down (again), and was replaced by the 1150 C. Efficiency of the backhoe increased dramatically. The 1150 C's operator was able to maneuver his cat further into the channel to retrieve fill, reducing the need for the backhoe to move each bucketful multiple times.

At the lower end of this crossing, 3-4 large logs had been stacked perpendicularly across the channel. Removing them would have required deepening the excavation nearly 8 feet. They looked very stable and there was little seepage emerging from them, so we left them. A spillway was cut in the top log, and it is acting as a checkdam.

The channel was rocked by the backhoe. Some hand adjustment was necessary. It is working well.

H-13

H-13 was a large Humboldt crossing, on a well-incised channel. Flow had eroded through the fill, leaving a steep-walled, even graded channel. However, this was filled for access reasons. The excavation was done by the backhoe, with assistance from both cats (the D-6 broke down again). This and H-15 are the deepest channels done by the backhoe. One log was left in the bank.

This channel was rocked by the backhoe, with only minor hand adjustments necessary, and is working well.

H-14

This intact crossing was removed by the backhoe, with assistance from the D-6. This crossing was fairly expensive because of redoing a side slope. We originally thought it could be done without disturbing several 12 inch diameter trees on the lower outside edge of the fill. However, the slope looked too steep to remain stable, so the trees were finally removed and slopes laid back more.

This channel also appears to have at least one log left in it; however, most of the flow is on the surface.

This channel was rocked by the backhoe. Only minor hand adjustment was required.

H-15

This deep Humboldt crossing, about 50% blown-out, was removed by the backhoe and D-6. There are springs on both sides of the channel. Open drains were provided. The left side slope is steeper than we would have liked. A small slump has occurred here.

This channel was rocked by the backhoe. Very little hand adjustment was required. This excavation is working well.

H-23

H-23 was a failing skid trail crossing, removed by the backhoe and D-6 cat. This crossing had to be partially filled in order to get equipment across for laying back the left bank. I am not sure this was worth doing.

D-LINE AREA

D-Line area includes H-16 and R-40, H-16½, H-17, H-18, H-19, H-20, H-21, H-22, Dolason Creek, L-3 and all surrounding roads. Only a few crossings are discussed in detail.

This area was tractor logged in 1971-2. Drainages were plugged with Humboldt crossings, but most were still intact. H-16 and dolason Creek had caused the greatest amount of erosion, diverting flow out of the natural channels and gullying the slopes below.

Six crossings were removed by the excavator and 1150C. These crossings were very closely spaced, so the intervening road reaches were outsloped with crossing fill. Road costs were included in the crossings.

Not all of these crossings were completely excavated; logs are now visible at H-19, H-20, H-21 and Dolason Creek. However, it looks like (hopefully) most of the flow is now on the surface, and the rocks should help prevent major problems in the future.

H-16 and R-40

H-16 was an intact Humboldt crossing on a skid trail (R-40) angling down the slope. Flow from this well incised drainage was diverted down the steep skid trail and had eroded a large gully (10' wide X 10' deep, average), paralleling the natural channel.

The excavator removed logs from the channel, plugged the gully with fill, and built up the blown out bank (with logs and fill) to keep flow off the skid trail.

Fill removal, winching, stump burial and outsloping of the gully area were done by the cat. Some of the fill from H-20 and H-22 was also used to fill the gully.

Check dams and a chicken wire slope support fence (invented and patented by Ms. Louise Johnson) were installed here and are working well.

H-16½, H-17 and H-18

These three crossings were left as we found them, for access and vegetation reasons.

H-16½ and H-17 were 25 year old blown-out crossings. Flow at both sites had eroded through the fill, leaving narrow steep-walled channels. Banks are revegetating and stabilizing on their own. H-18, on Dolason Creek is only 8-9 years old and probably should have been removed. Flow is starting to erode through the fill; there is a very slight chance flow could be diverted out of the channel down a skid trail. However, removing this crossing would have meant filling H-17 for access and eliminating dense stands of 25 year old trees growing along the skid trails.

LABOR INTENSIVE WORK: SUMMARY

The majority of labor intensive work (excluding vegetal treatments) on this site was done by Redwood National Park's labor staff: W. Quinn, Jason Miller, Rick Abrams, and Daryl Slawnokowski. Larry Hester and Tim Tanno also worked briefly on the site. Supervision and assistance was provided by Louise Johnson and Bob Mallonee.

During the heavy equipment phase, two laborers (Quinn and Miller) worked on the site brushing work and access areas, providing winching assistance, and towards the end, starting on the secondary treatments.

Secondary channel treatments consisted of rocking, check dam construction, or combinations of straw and jute netting or curlex.

Straw mulch was spread over the disturbed ground to discourage surface erosion and rilling, and to improve soil moisture conditions for vegetation.

Other miscellaneous tasks were completed as necessary.

Table 5

LABOR INTENSIVE COST SUMMARY

	<u>Cost</u>	<u>Percent of total labor intensive cost</u>
Check dam construction	\$4,109.89	35.5%
Rocking of channels	1,247.02	11%
Jute netting and curlex	801.13	7%
Straw	1,502.38	13%
Douglas-fir and shed removal	410.85	3.5%
Chicken wire slope support fence	43.20	1%
Skid sled	75.60	
Other labor intensive costs	<u>3,332.44</u>	<u>29%</u>
Total Cost*	\$11,522.51	100%

Pay rates listed in the following tables are:

GS-9, \$8.18/hr; GS-5, \$5.40/hr; CETA, \$3.10/hr; WG-3, Step 1, \$6.75/hr; WG-3, Step 2, \$7.03/hr; WL-3, Step 2, \$7.74/hr; WL-3, Step 1, \$7.43/hr.

*These figures do not include cost of materials

Table 6Unit Costs for Labor Intensive Work

<u>Item</u>	<u>Quantity</u>	<u>Cost</u>	<u>Unit Cost</u>
Check dam construction	41	\$3,442.06	\$83.95 ea.
Rocking of channels	5,514 ft. ²	990.09	.18/ft. ²
Jute netting and curlex	2,828 ft. ²	801.13	.28/ft. ²
Chicken wire slope support fence	40 ft. ²	43.20	1.08/ft. ²

LABOR INTENSIVE WORK: COST BREAKDOWN

Check Dam Construction

Cost include construction and transport of equipment and materials to each specific site. Does not include costs to mill the redwood boards.

Table 7

Site	#Dams	Unit Cost	Person-Hours	Cost/Hour	Cost	Subtotal
C-5	6	\$ 12.05	5	\$7.43	\$ 37.15	
			5	7.03	35.15	\$ 72.30
H-10	4	88.18	24	7.43	178.32	
			16	7.03	112.48	
			8	7.74	61.92	\$ 352.72
H-16	7	84.70	24	7.43	178.32	
			24	6.75	162.00	
			24	5.40	129.60	
			8	3.10	24.80	
			12	8.18	98.16	\$ 592.88
H-3	5	202.53	16	7.43	118.88	
			28	7.03	196.84	
			92	6.75	621.00	
			8	5.40	43.20	
			4	8.18	32.72	\$1,012.64
S-7	8	75.64	76	6.75	513.00	
			11	5.40	59.40	
			4	8.18	32.72	\$ 605.12
W-1	6 (sm)	62.10	36	6.75	243.00	
			24	5.40	129.60	\$ 372.60
H-11	5	86.76	30	7.43	222.90	
			30	7.03	210.90	\$ 433.80
Totals	41		509			\$3,442.06

Number of Check Dams = 41

Unit Cost = \$83.95/check dam

Cost of Lessons (29 Person-Hours) = 190.37

Initial moving costs of check dam boards to each specific site = 477.46

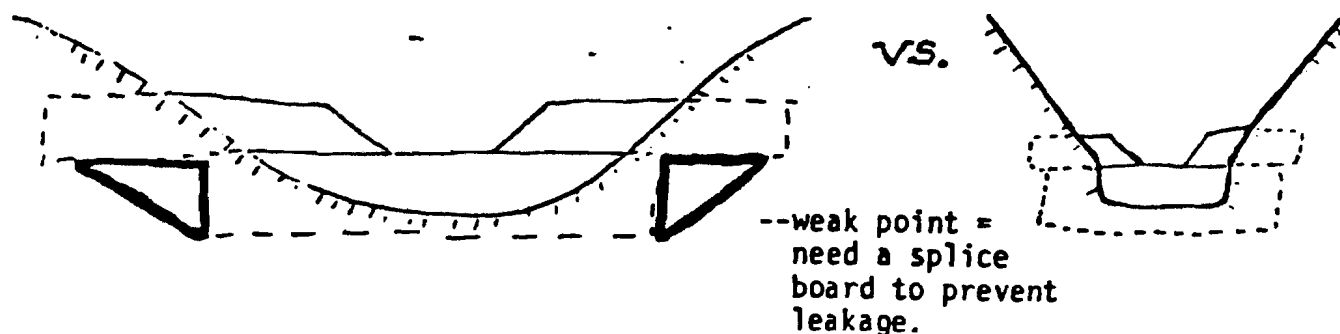
(42)

TOTAL COST

\$4,109.89

COMMENTS:

Unit Cost is comparatively high because stream excavations were made to match the natural side slopes above and below, requiring wider check dams than anticipated. Many check dam boards were also narrower than expected, because of splitting during handling and transit (possibly due to being unseasoned wood). In order to build dams to desired effective width and height, much time consuming splicing was required. Also most dams failed at these splice points.



Personnel problems at H-3 helped drive up the cost per check dam. Our original two laborers were to be laid off, requiring new people to be trained. It seems that efficiency goes down when there are more than two people working on a channel (more time tends to be spent "shooting the breeze"). We also had severe motivation problems with one of the laborers who was to be laid off.....he basically refused to work for the last two days. A final factor which increased cost was that rock, used to help protect stream banks, had to be gathered at a greater than average distance from the channel.

The unit cost at C-5 is low because no splash boards were constructed on four of the six dams; these four are submerged spillways.

Rocking of Channels

Channels were rocked initially by heavy equipment. Labor intensive work included placement and adjustment of rocks in each channel, and locally gathering smaller rocks (4-12" diameter) to fill the gaps (chinking). Hand placement/adjustment of rocks [in the channels after heavy equipment finished] took longer than anticipated because of the exceptionally large stock supplied by Ted's Construction Company (W-line Rockpit). Large rock is not only heavy but leaves large voids, which requires more chinking, and also may block or divert flow.

8 Site	Area (ft. ²)	Person- Hour	Cost/ Hour	Cost	Subtotal
D-5	250	3	\$7.03	\$21.09	
		6	5.40	32.40	
		3	8.18	24.54	\$ 78.03
S-1, 2, 3	800	6	7.43	44.58	
		8	7.03	56.24	
		3	5.40	16.20	
		2	8.18	16.36	133.38
C-4	472	1	7.43	7.43	
		6	7.03	42.18	
		1	5.40	5.40	55.01
C-5	300	1	7.43	7.43	
		1	7.03	7.03	
		15	5.40	81.00	
		7	8.18	57.26	152.72
C-8	264	9	7.43	66.87	
		9	7.03	63.27	
		5.5	5.40	29.70	
		5.5	8.18	44.99	204.83
H-12	300	4	7.43	29.72	
		4	7.03	28.12	
		7	5.40	37.80	95.64
Dolason Creek	1750	10	6.75	67.50	
		10	5.40	54.00	
		5	8.18	40.90	162.40
H-22	399	2	6.75	13.50	
		2	5.40	10.80	
		1	8.18	8.18	32.48
S-13	400	4	6.75	27.00	27.00
H-5	294	2	6.75	13.50	
		2	5.40	10.80	24.30
H-6	285	2	6.75	13.50	
		2	5.40	10.80	24.30

TOTALS: 5514 ft.²

\$990.09

Total area rocked = 5514 ft.²
Unit Cost = \$.18/ft.²

36 hours misc. channel rocking = 256.93

(44)

\$1,247.02

COMMENTS:

Miscellaneous channel rocking hours include chinking while heavy equipment was still working at the channel (which commonly totalled less than one-hour per channel), and other short periods of chinking, often at several places in an hour.

Rock adjustment varied from moving only a few rocks to total re-arrangement per channel.

Jute Netting and Curlex

Jute netting and Curlex was applied to channel side slopes, channel bottoms and road out slopes. Costs include transport of materials and equipment to each specific site.

Table 9

Site	Type	Area (ft. ²)	Person- Hours	Cost/ Hour	Cost	Subtotal
C-8	J	960	8	\$6.75	\$ 54.00	
			38.5	5.40	207.90	
			34	8.18	278.12	\$540.60
S-7	J, C	400	4	5.40	21.60	
			4	6.75	27.00	48.60
S-8	J	928	3	6.75	20.25	
			16	5.40	86.40	
			7	8.18	57.26	163.91
D-5	C	500	6	5.40	32.40	32.40
W-1	C	<u>40</u>	<u>3</u>	5.40	16.20	<u>16.20</u>
TOTALS:		2828	123.5			<u>\$801.13</u>

J = Jute netting

C = Curlex

Total Area = 2828 ft.²

Unit Cost = \$.28/ft.²

COMMENTS:

The Curlex netting fiber which holds the aspen shavings together has a tendency to tangle and become detached from the shavings. Also, because of its "fluffy" nature (as opposed to jute, which is heavier and conforms to ground contours), animals seem to get tangled in the netting and have pulled it loose in several places.

Straw

Straw costs include the initial placement of bales on the site, storing and retrieving straw from the feed barn on the airstrip rehabilitation site (used this fall, after rains began), helping the vegetation crew seed and spread straw, and moving straw for Doug Lane's mule team to carry to inaccessible sites needing a greater application of straw for erosion control purposes after the initial vegetation work had been completed.

Table 10

Category	Person-Hours	Cost/Hour	Cost	Subtotals
Moving	8	\$7.03	\$ 56.24	
	14	6.75	94.50	
	12	8.18	98.16	
	30	5.40	162.00	
	8	3.10	24.80	
	32	Redwoods United	252.51	\$ 688.21
Spreading	18.5	7.43	137.46	
	8	7.03	56.24	
	16	6.75	108.00	
	17	8.18	139.06	
	20	5.40	108.00	
	64	Redwoods United	265.41	<u>814.17</u>
			Total Cost	<u>\$1,502.38</u>

Douglas-fir and Shed Removal

The removal of young Douglas-fir trees was suggested by Steve Veirs as part of the prairie restoration program. These trees are among the first to invade disturbed ground (cut banks and road side cast), and result in "unnatural" lines of trees across the grasslands. Their removal also facilitated out-sloping through the prairie.

The lean-to metal shed on upper Dolason Prairie (located on an archeological site) was disassembled and removed per Ann King Smith's (park archeologist) recommendation.

Table 11

Category	Person-Hours	Cost/Hour	Cost	Subtotals
Douglas-fir	18.5	\$7.43	\$137.46	
	15	7.03	105.45	
	7	5.40	37.80	\$280.71
Shed	9	7.43	66.87	
	9	7.03	63.27	<u>130.14</u>
		Total Costs		<u>\$410.85</u>

Chicken Wire Slope Support Fence

A chicken wire fence was installed on the left channel bank at H-16 to protect the stream channel from being obstructed by falling slope debris.

Table 12

Site	Area	Person-Hours	Cost/Hour	Total Cost
H-16	40 ft. ²	8	\$5.40	\$43.20

$$\text{Unit Cost} = \$1.08/\text{ft.}^2$$

Skid Sled

The skid sled (designed to be pulled by a cat) was constructed to transport straw or check dam boards to areas inaccessible by truck.

Table 13

<u>Category</u>	<u>Person-Hours</u>	<u>Cost/Hour</u>	<u>Total Cost</u>
Skid Sled	14	\$5.40	\$75.60

Other Labor Intensive Costs

During the early part of the heavy equipment phase, the laborers spent many hours "assisting" heavy equipment. Often they would only be needed for a few minutes at a time for winching, choker setting, etc. Since this time was not spent working on a specific project it was not categorized. These hours also include travel (to and from work sites), training and/or receiving instructions, counseling, breaks, camp maintenance, and other standby time.

Total Hours = 470

Total Costs = \$3,332.44

WINTER MAINTENANCE

Check Dams

Seventy-six percent of the check dams required some maintenance with unit repair cost of \$7.60 each. The types of failures included splice board leaks, check dams packed with rock and dirt instead of dirt alone leaked or blew out at the base, splash boards became suspended due to downcutting below, and leaking due to the lack of splicing between the top and bottom boards (mentioned in Labor Intensive section).

Table 14

Site	Quantity	Person-Hours	Cost/Hour	Cost	Subtotal
H-16	7	7	\$5.40	\$37.80	\$ 37.80
C-5	6	4	5.40	21.60	21.60
S-7	8	6	6.75	40.50	40.50
H-11	5	8	5.40	43.20	
		8	8.18	65.44	108.64
H-3	5	2	5.40	10.80	
		<u>2</u>	8.18	16.36	<u>27.16</u>
TOTALS	31	37			\$235.70

Total Cost = \$235.70

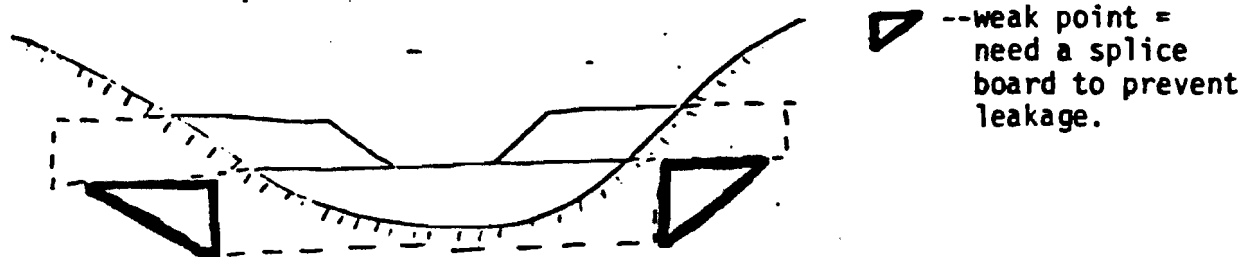
Unit Cost = \$7.60/each

COMMENTS:

At H-11 we had to remove an entire check dam (bottom one) because the water had blown out around both sides of the bottom board. Failure occurred because the dam was not properly spliced when constructed, and it was packed with large rocks and a small quantity of dirt.

The check dam was replaced with as much rock as could be found; rock was staked in place. However, downcutting is continuing below the stakes, and some of the shorter stakes have been undermined, but the rocks so far are remaining. The channel drops off steeply here and it appears that there is at least one log left in the crossing, which either was not visible or was not noticed during excavation. If this had been seen it would have been removed and a steeper, but more even gradient channel would have resulted.

At H-3 and H-11 the splash boards became suspended due to downcutting below. This required lowering the splash boards, thus increasing the effective height of each dam. These mini check dams were an experimental attempt to save on labor costs by reducing the number and size of check dams in prairie channels with a gentle gradient and low flow. They were designed to serve three main purposes: provide frequent stable base levels; keep flow centered in channel; and provide sediment storage for what might wash down from the rehabilitated area. Rather than leveling between dams, they were left with 4-6 inch effective height to catch sediment and minimize fall distance, and thus potential energy, of water flowing over the spillway. The main rock was washed away from the splash boards. Either larger rock or staking the rock in place would have worked. This was tried later at H-11 after the rock was moved by the storm.



The rocking of the failed check dams needed to be replaced with dirt, and a few needed splice boards.

Rocking of Channels

Winter maintenance in rocked channels consisted of adjusting rock placement to prevent stream bank erosion. Commonly the large rock diverted flow out of the center of the channel, around the rocks and into the banks. Rocks were rearranged manually using pry bars and rolling or carrying rock from the center of the channel to the banks. In some cases extremely large rock (up to 4 feet in diameter) was dumped mid-channel by the heavy equipment and could not be moved manually; these are continuing to cause some erosion.

Table 15

Site	Area (ft. ²)	Person- Hours	Cost/ Hour	Cost	Subtotal
H-22	399	6	\$6.75	\$40.50	
		2	5.40	10.80	
		2	8.18	16.36	\$67.66
H-10 1/2	176	4	6.75	27.00	
		2	5.40	10.80	
		2	8.18	16.36	54.16
H-19	390	6	6.75	40.50	40.50
H-7	<u>250</u>	<u>2</u>	5.40	10.80	<u>10.80</u>
TOTALS	1215	26			\$173.12

Total Costs= \$173.12

Total Area = 1,215 ft.²

Unit Cost = \$.14/ft.²

COMMENTS:

H-10 1/2 was originally left unprotected. Following the December 2, 1980, storm, the channel develop a two-foot headcut. We gathered rock locally to use in stabilizing the channel.

At H-7, rock was placed too high on the channel sides, and was not very effective. So we moved the rock further down the channel sides. Flow here was less than anticipated.

Seeding

After the first rains, small slope failures occurred along switchbacks along W-line, and along Harding Road. To help stabilize these failures, a prairie seed mix was spread over the failures.

Table 16

<u>Site</u>	<u>Person- Hours</u>	<u>Cost/ Hour</u>	<u>Cost</u>
R-20, 22, 26, 34 & D-4	2	\$5.90	\$11.80

CONCLUSION

The National Park Service was established to protect unique and valuable natural resources for today and tomorrow's generations to enjoy in a variety of recreational uses. Redwood National Park is unique in itself, for we are involved not only in preservation, but also in restoring these natural resources for future recreational visitor needs. As urban areas expand, more and more people will be seeking the solitude and beauty provided to them by their National Parks. Redwood National Park expects a continuing increase of recreational visitor use, especially as it develops a wider range of programs (interpretive, camping, wilderness use, etc.).

We feel the grasslands are an exceptional place. Meadows have a long history of being a place favored by man - broad open vistas, sun and warmth, and a variety of flora and fauna which can be observed and utilized. Indians lived on the fringes of the prairies - remnants of their dwelling sites can be found, usually in the same places we today would choose to camp or settle for awhile. The early white settlers also chose the prairies for their homesteads - mainly for practical reasons (i.e. grazing), but undoubtedly aesthetic reasons entered into their choices, too.

In the future, as part of the park, the prairies will be used and enjoyed by many travelers - mostly on foot, as the Indians did. It would be nice to be able to see the basin as they saw it for so many thousands of years. This is why we should make utmost effort to restore the prairies to their native state. Roads should be totally out-sloped, and contours blended together; unnatural gullies should be filled; and enlarged gullied natural swales should be blended in with the surrounding topography - whenever possible.

Our feelings towards the Rehabilitation program is two-fold. It's imperative that we focus all our energy, time, and money to the rehabilitation of the damaged watersheds. At the same time, since this is our only opportunity for heavy equipment access, we should work to restore the landscape's natural and scenic beauty as much as possible to what it was prior to man's intervention.

In summary, we prevented massive erosion from occurring in the next Jillion years. W-Line had very few major erosional problems and we admit it was a piece of chocolate cake with vanilla ice cream and a cherry on top, which we washed down with a hundred cases of beer.

STREAM CROSSING RE-CALCULATIONS USING ROAD PRISM VOLUMES

Table 17

<u>Crossings</u>	<u>Yard³</u>	<u>Cost/Yard³</u>
C-1	209	\$ 9.07
C-2	247	8.58
C-3	249	3.71
C-4	132	5.01
C-5	93	9.94
C-6	92	.65
C-8	253	11.46
C-12	75	1.60
H-1	58	1.11
H-2	48	2.69
H-3	147	.64
H-4	83	3.44
H-5	123	2.06
H-6	241	1.87
H-7	228	3.60
H-8	107	6.50
H-9	220	3.92
H-10	48	8.18
H-10½	110	2.41
H-11	133	5.03
H-12	97	9.57
H-13	300	5.20
H-14	202	8.34
H-15	311	3.48
H-19	320	2.19
H-20	275	4.59
H-21	50	9.46
H-22	624	2.09
H-23	122	2.83
Dolason Channel	718	4.73
S-7	95	3.98
S-8	334	.75
S-10	89	2.80

80-5: W-LINE, DOLASON PRAIRIE
 STREAM CROSSING RE-CALCULATIONS: 3RD TIME
 CALCULATION METHOD - AVERAGE END-AREA

<u>Crossings</u>	<u>Yard³</u>	<u>Cost/Yard³</u>
C-1 ✓	233	\$ 8.13
C-2 ✓	318	6.66
C-3 ✓	400	2.31
C-4 ✓	85	7.78
C-5 ✓	60	15.40
C-6 ✓	54	1.11
C-8 ✓	224	12.94
C-12 ✓	132	.91
H-1 ✓	103	.63
H-2 ✓	39	3.31
H-3 ✓	102	.93
H-4 ✓	81	3.53
H-5 ✓	149	1.70
H-6 ✓	278	1.62
H-7 ✓	272	3.02
H-8 ✓	146	4.77
H-9 ✓	153	5.64
H-10 ✓	24 100	16.35
H-10 1/2 ✓	110	2.41
H-11 ✓	118	5.67
H-12 ✓	130	7.14
H-13 ✓	317	4.92
H-14 ✓	212	7.95
H-15 ✓	136	7.95
H-16 } ✓	246	1.27
H-19 } ✓	383	1.83
H-20 } ✓	260	4.86
H-21 } ✓	76	6.22
H-22 } ✓	500	2.61
H-23 ✓	94	3.67
Dolason Channel ✓	816	4.16
S-7 ✓	97	3.90
S-8 ✓	396	.63
S-10 ✓	261	.95

ROAD REACH	Prairie (P) or Forest (F)	RIPPING EQUIP- MENT	EQUIPMENT	HRS	COST	TOTAL COST	(Feet)	COST: Linear Ft.	LABOR INTENSIVE TREATMENT	COMMENTS:
							LENGTH WIDTH: Rd. Bed / O.S. (estimated)			
R-1	F	TD 25	Excavator 1150C	6 4	\$387.00 240.00	\$627.00	350 20/	\$1.79	Plots	One Waterbar ; minor outsloping.
R-2	F	TD 25	SEE COMMENTS	—	—	—	125 20/	—	Plots	} Equipment Hours and Costs included in adjacent stream crossings. Minor outsloping
R-3	F	TD 25	SEE COMMENTS	—	—	—	250 20/	—	Plots	
R-4	F	TD 25	SEE COMMENTS	—	—	—	125 20/	—	Plots	
R/Q-5	F	TD 25	Excavator	5	322.50	322.50	625 20/	.52	Plots	Minor outsloping ; Buried log at the "S" Crossing Skid Trail Intersection
R-6	F	TD 25	SEE COMMENTS	—	—	—	250 20/	—	Plots	Equipment hours and Costs included in adjacent stream crossings. Minor Outsloping.
R-7	F	TD 25	1150C	0.5	30.00	30.00	525 20/	7.50/WB	No Treatment	Four Waterbars ; not outsloped.
R-8	F	TD 25	1150C Excavator	3.5 6	210.00 387.00	597.00	450 20/	1.33	Straw, Seed	Outsloped.

F 8184.50 } 22105.75
P+P/P 13321.25

R-9	F	TD	1150C Excavator	2.5 1.5	150.00 96.75	246.75	1000 20/	.25	Plots	Outsloped.
R-10	F	TD 25	1150C Excavator	4.5 9	270.00 580.50	850.50	425 20/	2.00	Plots	Outsloped.
R-11	F	TD 25	1150C Excavator	4.5 5.5	270.00 354.75	624.75	750 20/	.83	Plots	Outsloped ; Includes S-5 and S-6.
R-12	F	TD 25	1150C Excavator	5.5 8	330.00 516.00	846.00	950 20/	.89	Plots	Outsloped with two bowls at C-7.
R-13	F	TD 25	Excavator 1150C	4 2	258.00 120.00	378.00	500 20/	.76	Plots	Outsloped; Buried logs from C-8.
R-14	F	TD 25	1150C Excavator	10.5 1	630.00 64.50	694.50	575 20/	1.21	Plots	Outsloped.
R-15	F	TD 25	1150C	3.5	210.00	210.00	250 20/	.84	Plots	Outsloped.
R-16	F	TD 25	1150C	1.5	90.00	90.00	250 20/	.36	Plots	Outsloped.

R-17	F	TD 25	1150C	2.5	150.00	150.00	275 20/	.55	Plots	Outsloped.
R-18	F	TD 25	1150C Excavator	2 6	120.00 387.00	507.00	300 20/	1.69	Straw, Seed	Outsloped.
R-19	P/F	TD 25	1150C Excavator	1 3	60.00 193.50	P/F 253.50	225 20/	1.13	Straw, Seed	Outsloped.
R-20	P/F	TD 25	1150C Excavator	3 7	180.00 451.50	P/F 631.50	250 20/	2.53	Straw, Seed	Outsloped.
R/Q-21	P/F	TD 25	1150C Excavator	6 3	360.00 193.50	P/F 553.50	225 20/	2.46	Straw, Seed	Fill moved 100-ft, then outsloped.
R-22	P	TD 25	Excavator 1150C	5 5	322.50 300.00	P 622.50	425 20/	1.46	Straw, seed	Outsloped.
R-23	P	TD 25	Excavator 1150C	2 1	129.00 60.00	P 189.00	325 20/	.58	Straw, Seed.	Outsloped.
R-24	P	TD 25	Excavator 1150C	4 4	258.00 240.00	P 498.00	250 20/	1.99	Straw, Seed	Outsloped. Three gullies (4/2) were filled above Road Reach. 1150C walk Straw in.

R-25	P	TD 25	Excavator 1150C	18 18	1161.00 1080.00	P 2241.00	325 20/	6.90	Straw, Seed	Outsloped. 1150C walked straw
R-26	P	NOT RIPPED	Excavator 1150C	14 16	903.00 960.00	P 1863.00	1400 15/	1.33	Straw, Seed	Outsloped. Buried a Spring 125 ft Northwest from S-13. 1150C walked Straw in (w-line to Ridge). Also included
R-26½	P	TD 25	1150C	2	120.00	P 120.00	300 15/	.40	Straw, Seed	Outsloped.
R-27	P	TD 25	Excavator 1150C	5 6.5	322.50 390.00	P 712.50	500 15/	1.43	Straw, Seed	Outsloped.
R-28	P	TD 25	Excavator 1150C	2.5 4	161.25 240.00	P 401.25	275 15/	1.46	Straw, Seed	Outsloped. Logs from H-3 and H-4 buried in the in-board-ditch (IBD).
R-28½	P	TD 25	1150C	2	120.00	P 120.00	125 15/	.96	Straw, Seed	Minor Outsloping.
R-29	P	TD 25	1150C Excavator	9 2	540.00 129.00	P 669.00	375 15/	1.78	Straw, Seed	Outsloped. 1150C walked in straw near Ridge Area. Logs from H-6 buried in IBD.
R-30	F/P	TD 25	Excavator 1150C	2 3	129.00 180.00	F/P 309.00	325 15/	.95	straw, Seed	Small Douglas Fir trees were cut and buried in the Outsloping.
R-30½	F	TD 25	1150C	3	180.00	180.00	225	.00	Straw,	Minor Outsloping with a Swale.

R-30½	F	TD25	1150C	3	180.00	180.00	225 15/	.80	Straw, Seed	Minor Outsloping with a Swale.
R-31	F	TD25	1150C	7	420.00	420.00	200 15/	2.10	Straw, Seed	Outsloped. Buried logs from H-B.
R-32	F	TD25	D-6	3	99.00	99.00	225 15/	.44	Straw, Seed	Minor Outsloping with logs and Rock placed on the surface.
R-33	r/p	TD25	1450	1¼	81.25	81.25	400 15/	.20	Straw, Seed	Small Douglas Fir trees were cut and then buried in the outsloping.
R-33½	P	TD25	Backhoe 1450	3.5 5	105.00 325.00	P 430.00	175 15/	2.46	Straw, Seed	Minor Outsloping.
R-34	P	TD25	1450 Backhoe	25¼ 8	1641.25 240.00	P 1881.25	1725 15/	1.09	Straw/Hay Seed	Outsloping; buried logs from H-11 and H-10½ in the I.B.D. At the Barn Turn used 10yr. old Hay from Dolason Barn for mulch.
R-35	P	TD25	Backhoe 1450	5 5	150.00 325.00	P 475.00	475 15/	1.00	Straw, Seed	Outsloped.
R-36	F	NOT RIPPED	1150C Backhoe	2 1.5	120.00 45.00	165.00	450 15/	.37	Straw, Seed	Buried logs from H-11 and H-12 in I.B.D. Minor Outsloping.
R-37	F	SEE	1150C	4	240.00	240.00	1950	.12	Straw.	Road Reach below H-23 and below...

R-37	F	SEE COMMENTS	1150C	4	240.00	240.00	1950 15/	.12	straw, Seed	Road Reach below H-27 and between H-13 and H-14 not ripped; above H-13 ripped (6-way blade) and mildly outsloped.
R-38	F	NOT RIPPED	NOT WORKED ON.	—	—	—	525 15/15	—	Straw, Seed	Several trees left on the Road Surface. One Water bar constructed by D-6 while moving to next work site.
R-40	F	TD 25	1150C Excavator	10 2	600.00 129.00	729.00	200 15/	3.65	Straw, Seed	Buried logs from H-16 in Filled Gully (upper reach). Filled Gully at lower reach reach (a 1/4, 200 ft. long). Outsloped.
R-41	P	TD 25	1450 Backhoe	18 1/2 2 1/4	1202.50 67.50	P 1270.00	2100 10/15	.60	SEE COMMENTS	Outsloped. Gathered Local Danthonia Californica Cuttings and used it for Seed and Mulch.
Quagmire Road	F	TD 25	Excavator	5	322.50	322.50	900 18/20	.36	straw, Seed	Outsloping with Swales.
D-Line Road	F	TD 25	SEE COMMENTS	—	—	—	1325 18/20	—	Straw, Seed.	Outsloping. Equipment hours and costs included with adjacent stream crossings.
D-Line Ditches & WB's	F	N/A	1150C Loader	7 1	420.00 35.00	455.00	N/A	N/A	N/A	Two Waterbars on D-Line; and one large ditch replacing damaged culvert.
Skid Trail) to 5" Cross- ings.	F	B50C	SEE COMMENTS 15100 linear 10200 ft	—	—	—	1175 12/12	—	Straw, Seed	Not Outsloped. Equipment time and costs included in "S" crossing (2.3.4). One Waterbar dug with hand tools.
					F 8784.50					
					P + F/p 13321.25			22105.75		

C+K+K 11924.75

STREAM CROSSING	HEAVY EQUIPMENT	HRS	COST	TOTAL COST	DIMENSIONS			COST/ CUBIC YARD	LABOR INTENSIVE			COMMENTS:
					LENGTH (ft)	WIDTH (ft)	ESTIMATED CUBIC YARDS		TREAT- MENT	COST	UNIT COST	
C-1	Excavator	1	\$ 64.50		47	6	490	\$3.87	Rock Adjust- ment	Minor - Not Recorded	—	
	1150C	9.5	570.00									
	Crane	13.5	1046.25									
	1150C (w)	1.5	90.00									
	Excav. (Rx)	1	64.50									
	1150C (Rx)	1	60.00	\$1895.25								
C-2	Excavator	17.5	1128.75		70	9	464	4.57	Rock Adjust- ment	Minor - Not Recorded	—	
	1150C	7.5	450.00									
	Crane	2	155.00									
	1150C (w)	.5	30.00									
	Excav. (Rx)	5.5	354.75	2118.50								
C-3	Excavator	12	774.00		70	7	825	1.12	Rock Adjust- ment	Minor - Not Recorded	—	
	1150C	2	120.00									
	850C	.5	30.00	924.00								
C-4	Excavator	7	451.50		59	8	406	1.63	Rock - gather & adjust	55.01	.12/ft ²	
	850C	3.5	210.00	661.50								
C-5	Excavator	10	645.00		50	6	255	3.62	Rock - gather adjust	102.72	.51/ft ²	
	850C	.5	30.00									
	Excav. (Rx)	2	129.00									
									Check dam (6)	72.30	12.05/ check dam	

C-5	Excavator 850	10 .5	645.00 30.00		50	6	255	3.62	Rock : gather adjust check dam (6)	152.72 72.30	.51/ft ² 12.05/ check dam	
	Excav. (Rx) 850 C (Rx)	2 2	129.00 120.00	924.00								
C-6	1150 C	1	60.00	60.00	35	V	97	.62	NONE	—	—	
C-7	Excavator 1150 C	6.5 3	419.25 180.00	599.25	SEE COMMENTS				Straw	—	—	Culvert removed by 115 Three swaly bowls construct in outslaping.
C-8	Excavator 1150 C Crane 1150 C (w) Backhoe (R)	20 16.5 4.5 3 3	1290.00 990.00 348.75 180.00 90.00	2898.75	49	B	641	4.52	Rock : Adjust Jute Netting	204.83 540.02	.52/ft ² .56/ft ²	
C-9	1150 C	1	60.00	60.00	SEE COMMENTS				Straw	—	—	Remove Culvert, Outslope
C-10	1150 C	1	60.00	60.00	SEE COMMENTS				Straw	—	—	Remove Culvert, Outslope
C-11	1150 C	2	120.00	120.00	SEE COMMENTS				Straw	—	—	Remove Culvert, outslope
C-12	1150 C	2	120.00	120.00	46	2.5	312	.38	Straw	—	—	
C-13	Backhoe	2	60.00	60.00	SEE COMMENTS				Straw			

C-11	1150C	2	120.00	120.00	SEE	COMMENTS	Straw	-	-	Remove Culvert, outslope	
C-12	1150C	2	120.00	120.00	46	2.5	312	.38	Straw	-	-
C-13	Backhoe	2	60.00	60.00	SEE	COMMENTS	Straw	-	-	Removed Culvert.	
Kck Culvert Channel	1150C	2.5	150.00		-	-	-	-	-		
	Back hoe	11.5	345.00								
	D-6	11.5	379.50								
	Backhoe (Rx)	8.5	255.00	1129.50							
Camp Road Channel	Backhoe	3	90.00		-	-	-	-	-		
	D-6	3	99.00								
	Backhoe (Rx)	3.5	105.00	294.00							

11924.75

~~342825~~

STREAM CROSSING	HEAVY EQUIPMENT	HRS	COST	TOTAL COST	DIMENSIONS			COST/ CUBIC YARD	LABOR INTENSIVE			COMMENTS:
					LENGTH (ft)	WIDTH (ft)	ESTIMATED CUBIC YARDS		TREATMENT	COST	UNIT COST	
S-2,3,4	Excavator	12.5	806.25	1293.75	NOT	MEASURED	—	Rock Adjust-ment	133.38	.17/ft ²		
	1150C	1.5	90.00									
	LOADER (R)	5.5	247.50									
	850C (RIP)	2.5	150.00									
S-5	Excavator	2	129.00	129.00	SEE	COMMENTS	—	Straw Seed	—	—	Swaley Outslping.	
S-6	1150C	1	60.00	60.00	SEE	COMMENTS	—	Straw Seed	—	—	Swaley Outslping.	
S-7	Excavator	4	258.00	378.00	50	7	231	1.64	Check Dams (8)	605.12	75.64/CD	
	1150C	2	120.00						Jute Netting	48.60	.12/ft ²	
S-8	Excavator	2	129.00	249.00	58	12	977	.25	Jute Netting	163.91	.18/ft ²	
	1150C	2	120.00									
S-10	Excavator	2	129.00	249.00	146	"V"	687	.36	Straw Seed	—	—	
	1150C	2	120.00									
S-11	Excavator	2	129.00	249.00	NOT	MEASURED	—	Straw, Seed	—	—		
	1150C	2	120.00									

S-13	Excavator	9	580.50	NOT	MEASURED	—	Rock Adjust- ment	27.00	.07/ft ²
	1150 C	3	180.00						
	Backhoe (Ry)	2	60.00	820.50					
W-1	EX	2	129.00	129.00					

S total 3428.25

W total 129.00

S + W 3557.25

STREAM CROSSING	HEAVY EQUIPMENT	HRS	COST	TOTAL COST	DIMENSION			COST/CUBIC YARD	LABOR INTENSIVE TREATMENT	COST	UNIT COST	COMMENTS:
					LENGTH (ft.)	WIDTH (ft.)	Estimated Cubic Yards					
H-1	Excavator	1	64.50	64.50	40	"v"	133	.48	Straw Seed	—	—	
H-2	Excavator	2	129.00	129.00	30	9	84	1.54	NONE	—	—	
H-3	Excavator 1150C	1 .5	64.50 30.00	94.50	40	6	390	.24	Check Dams (5)	1012.64	202.53/CD	
H-4	Excavator 1150C	3.5 1	225.75 60.00	285.75	48	8	276	1.04	NONE	—	—	
H-5	Excavator 1150C	3 1	193.50 60.00	253.50	42	7	337	.75	Rock Adjust. ment	24.30	.08/ft ²	
H-6	Excavator	7	451.50	451.50	57	5	910	.50	Rock: Adjust	24.30	.03/ft ²	
H-7	Excavator 1150C 1150C (w)	9 2 2	580.50 120.00 120.00	820.50	45 61	5 18"	904	.91	NONE	—	—	
~~H-8~~	~~Excavator~~	~~8~~	~~516.00~~		~~60~~	~~7~~	~~417~~	~~1.67~~	~~NONE~~			

H-8	Excavator 1150C	8 3	516.00 180.00	696.00	60	7	417	1.67	NONE	—	—
H-9	Backhoe D-6 Backhoe (Rx)	12 12.5 3	360.00 412.50 90.00	862.50	52	5	785	1.10	NONE	—	—
H-10	1450 Backhoe D-6	.5 6.5 5	32.50 195.00 165.00	392.50	42	5	138	2.84	Check Dams (4)	352.72	88.18/co
H-10½	Backhoe D-6	7¾ 1	232.50 33.00	265.50	44	4	310	.86	NONE	—	—
H-11	1450 Backhoe D-6	6 6 3	390.00 180.00 99.00	669.00	42	5	356	1.88	Check Dams (5)	433.80	86.76/co
H-12	1150C Backhoe D-6 Backhoe (Rx)	5 8.5 9.5 2	300.00 255.00 313.50 60.00	928.50	50	6	319	2.91	Rock: Adjust	95.64	.32/ft²
H-13	1150C Backhoe D-6 Backhoe (Rx)	11.5 19.5 4.5 4.5	690.00 585.00 148.50 135.00	1558.50	67	6	1303	1.20	NONE	—	—

	Backhoe	19.5	585.00					NONE	—	—
	D-6	4.5	148.50							
	Backhoe (Rx)	4.5	135.00	1558.50						
H-14	Backhoe	24	720.00		54	4	724	2.33	NONE	—
	D-6	26 1/2	874.50							
	Backhoe (Rx)	3	90.00	1684.50						
H-15	Backhoe	16.5	495.00		45	5	930	1.16	NONE	—
	D-6	15.5	511.50							
	Backhoe (Rx)	2.5	75.00	1081.50						
H-16	Excavator	3	193.50		65	6			Check (7) Dams and Rocks	592.88
	1150C	2	120.00	313.50						84.70/co
H-19	Excavator	9	580.50		65	6	1392	.50	NONE	—
	1150C	2	120.00	700.50						
H-20	Excavator	14	903.00		105	8	996	1.27	NONE	—
	1150C	6	360.00	1263.00						
H-21	Excavator	4	258.00		83	8	295	1.60	NONE	—
	1150C	3	180.00							
	Loader (Rx)	1	35.00	473.00						

H-22	Excavator	10.5	677.25	1307.25	57	7	2430	.54	Rock: Adjust	32.48	.08/ft ²
	1150 C	10.5	630.00								
H-23	1150C	2	120.00	345.00	50	5	422	.82	NONE	-	-
	Backhoe	4	120.00								
	Backhoe(Rx)	3.5	105.00								
Dolason Channel	Excavator	20.5	1322.25	3396.25	250	7	3813	.89	Rock: Adjust	162.40	.09/ft ²
	1150 C	19.5	1170.00								
	1150 C (W)	2	120.00								
	Loader (Rx)	9.5	332.50								
	Excav. (Rx)	7	451.50								

Total 18036.25

DECKS and LANDING	PRAIRIE (P) FOREST (F)	RIPPING EQUIP- MENT	EQUIPMENT	HRS	COST	TOTAL COST	AREA (ft²)	LABOR INTENSIVE TREATMENT	COMMENTS :
D-1	F	TD 25	Crane 1150C	3.5 6.5	271.25 390.00	661.25	17,500	Plots	
D-2	F	TD 25	Excavator 850C	2 2	129.00 120.00	249.00	12,500	Plots	
D-3	F	TD 25	Excavator 1150C	23 23	1483.50 1380.00	2863.50	15,000	Plots	1150C constructed a drain and pushed a small section of the edge down slope.
D-4 (switch- backs)	P	TD 25	Crane Excavator 1150C	27 ³ / ₄ 12 21	2150.65 774.00 1260.00	4184.65	10,000	Straw, Seed	Buried Douglas Fir in IBD. 1150C outsloped and walked the Straw in.
D-5 (switch- backs)	P	TD 25	Crane Excavator 1150C	15 20 24	1162.50 1290.00 1440.00	3892.50	12,500	Straw, seed	Constructed a French Drain in the IBD and filled a 100 ft. long by 12' 7" Gully below the deck.
D-5 (lower W-Line)	F	TD 25	1150C Excavator	5 7	300.00 451.50	751.60	5,000	Plots	
D-6	F	1150C 6-way blade	Excavator 1150C	2 4	129.00 240.00	369.00	5,000	Plots	Filled ponds and IBD with fill from C-8 (150 yd³). Swale constructy

D-5 (Line)	F	TD 25	1150C Excavator	5 7	300.00 451.50	751.60	5,000	Plots	
D-6	F	1150C 6-way blade	Excavator 1150C	2 4	129.00 240.00	369.00	5,000	Plots	Filled ponds and IBD with fill from C-8 (150 yd ³). Swale construct between D-6 and D-7.
D-7	F	TD 25	1150C	2	120.00	120.00	5,000	Plots	
D-8	F	TD 25	Excavator	11	709.50	709.50	7,500	Plots	Swale between D-8 and R-18.
L-1	F	TD 25	1150C Excavator	10½ 7	630.00 451.50	1081.50	9,375	NONE	
L-2	F	NOT RIPPED	1150C Excavator	3 10½	180.00 677.25	857.25	15,000	NONE	
L-3	F	TD 25	1150C Excavator	7 5.5	420.00 354.75	774.75	7,500	Straw, Seed	Swale mid-landing and logs left on the surface.

L. Johnson

Addendum To:
WORK SUMMARY AND COST ANALYSIS REPORT
Site 80-5
W-Line and Dolason Prairie

T. Spreiter and L. Johnson

By
L. Johnson
1983

Site Description

The Dolason Rehabilitation Unit, Site 80-5, is eight miles east of the Pacific Ocean and encompasses the north side of the Dolason Creek drainage. The unit is bounded on the north by the K & K Road; the south by Redwood Creek; the east by the main stem of Dolason Creek; and the west by the Dolason Creek/Emerald Creek drainage divide. The boundaries encompass 845 acres; mapping was concentrated in the 152 acres of tractor-logged and 73 acres of cable-yarded hillslope and the 200 acres of Dolason Prairie. Old-growth redwood covers the 420 acres remaining between lower W-Line and Redwood Creek (Figure 1). Two haul roads switchbacked across the Dolason unit. The Harding Road extended from Bald Hills Road downslope to W-Line on Dolason Prairie, and the terminal section of W-Line continued from the middle of the lower slope. Rehabilitation activities concentrated on the removal of all 4.3 miles of haul roads, and .5 mile of a skid road spur off D-Line near Dolason Creek.

The site is underlain by the Redwood Creek Schist and interbedded sandstone and mudstone of the Franciscan assemblage (Harden, et al., 1982) which are separated by the northwest-trending Grogan Fault. The fault diverges eastward from Redwood Creek one mile upstream of Dolason Creek, and intersects Dolason Creek at the 250-foot elevation and the north spur of Dolason/Emerald Creek divide at 1000 feet. An isolated unit of metamorphosed sandstone and mudstone is located adjacent to the east side of the Grogan Fault (Harden, et al., 1982). The Redwood Creek schist is a well-foliated, highly fractured and sheared, fine-grained quartz-mica schist. It is predominantly in old growth redwood forest on this site. The character of the mudstone and sandstone changes downslope from Bald Hills ridge towards Redwood Creek. More coherent sandstone occurs from the ridge to the 1750-foot elevation ending

near the spur road that connects D-Line to Harding Road. Sandstone bed thicknesses are up to 10 m but most are .1 to 3 m with thinner mudstone interbeds (Harden, et al, 1982). The incoherent sandstone and mudstone unit covers the midslope to the Grogan Fault. The sandstone/mudstone ratio is lower than the coherent unit; massive sandstone beds are less common, and rocks are more brecciated and sheared (Harden, et al, 1982). Landslide deposits of an old complex earthflow cover the upper third of Dolason Hill and overlie both sandstone and mudstone units.

Soils in the area are predominately in the Atwell soil series, and a Hugo-like soil series along the ridges. Prairies and adjacent oak woodlands contain the Kneeland soil series. The Atwell series consists of deep, poorly drained clay rich soils, which are subject to active mass wasting. Most Atwell soils exist on broadly amphitheater-shaped concave slopes with high densities of small first order shallow-incised streams. There are also an unusual number of windthrows, fallen, and tilting trees. The Hugo-like ridge soils are well-drained, with a gravelly loam surface and a clay loam subsurface, which are more stable and less erodible than the nearby slopes. The Kneeland series found a rolling, earthflow slopes, and benches can range from moderately well drained to somewhat poorly drained, and consist of a loam to clay loam surface with a clay loam to gravelly clay loam subsurface.

Elevation on the site range from 140 feet at Redwood Creek to 2,476 feet on Bald Hills Ridge. Hillslopes range in gradient from 15 to 80 percent. The steepest slopes occur adjacent to the tributary streams to Dolason Creek and to Redwood Creek. The broader, gentler bench areas are near the Bald Hills ridgetop and along the Dolason Prairie ridge. Coherent sandstone beds form these benches in the topography. Ridges are rounded, and tributary drainages are well incised. The hillslope, including the Dolason/Emerald Creek divide below Dolason Prairie, steepens downslope of the contact between the coherent

and incoherent sandstone and mudstone units. Stream channels in this zone are more poorly defined and less incised than upslope. In the lowest one-quarter of the hillslope, coinciding with the schist and the remnant old growth redwood, slopes increase, streams are more incised, and unstable areas are present.

Land-Use History

Harding Road was a major logging haul road built in the early 1950's. It started at the Bald Hills Road and switchbacked down, mostly through grasslands to the base of Dolason Prairie. Two units totalling 68 acres south of the road were selectively logged and tractor-yarded by the Harding Lumber Company. In 1971 and 1972 a 37 acre unit was clearcut and tractor-yarded by Simpson Timber Company with a spur road built in 1971 connecting D-Line with Harding Road. W-Line was a major haul road built by Arcata Redwood Company in 1976. It starts at the Bald Hills Road on the northern boundary of Elk Camp Prairie and enters the Dolason Creek drainage at the switchbacks of Harding Road. This .6 mile of switchbacks was upgraded by widening and rocking the road and then incorporated into the W-Line road system. W-Line then switchbacked another 1.5 miles through forest to Dolason Creek. In 1977 a 47 acre unit was tractor clearcut and two units totalling 73 acres were cable clearcut from W-Line by Arcata Redwood Company.

Erosional Problems

The Dolason unit was chosen for rehabilitation because of the recent road construction and tractor logging, and to test treatments for roads and erosional features on prairies. The terminal 1.5 miles of W-Line downslope of the switchbacks was a relatively intact, all-season haul road. Ten of eleven culverts were intact and properly placed with only minor fluvial erosion. A cutbank slump occurred in March 1980, blocking the channel and culvert inlet at RX-7, thus diverting flow across the road prism and causing gullying and

failure of the outboard edge of the road. There were numerous areas where road stability was questionable, indicated by the presence of ponded water, seeping cutbanks, tension cracks and small scarps. A 400-foot section of road had failed, debris avalanche style, down an 80-90 percent, logged, right-of-way slope causing small mudflows to reach several hundred feet into the old growth. Several decks had logs and slash perched around their edges and against old growth redwood, with one deck located above an intermittent stream channel.

Harding Road crossed fifteen ephemeral and intermittent streams with only three stream crossings that remained intact with no erosional problems. The rest had either failed or were plugged and were diverting flow down approximately 1,250 feet of inboard ditch, causing gullying of the ditch and the slope or channel below where the flow finally broke through the road. At one crossing (RX-14) approximately 100 cubic yards had eroded due to the flow diversions. Special problems arise in prairies due to road construction. Subsurface flow in the prairie soils (at least those underlain by interbedded sandstone and shale) is confined to the lower part of the A horizon by a less permeable clayey B horizon. This means that road cuts or gullies intercept subsurface flow at an unusually shallow depth, and the continuous seepage increases bank sloughing. A major consideration in deciding to totally outslope prairie roads and gullies was to attempt to bury the seeping A/B horizon boundary and allow subsurface flow to remain in the soil. Also total outslowing eliminates road scars on the prairies which have a high aesthetic value in the park.

Tractor yarding activities severely impacted the streams in the 1971-72 and 1977 units. Large organic debris and soil were used to construct tractor skid trail stream crossings at ten distinct locations on poorly incised stream channels. In several of these regions, intersecting skid trail

networks obliterated the former channels. Several crossings had also plugged, forming large diversion gullies downslope and on skid trails. The two cable-yarded units had minimal erosional problems.

Approach to Rehabilitation

Detailed geomorphic mapping of the Dolason unit began in April 1980, and lasted into June 1980. This time period was also used to prescribe specific erosion control treatments. Heavy equipment work at the site commenced on June 30 and finished September 16, 1980 (Table ____). Labor intensive work occurred during the heavy equipment phase and finished in November 1980. Table 1 summarizes costs and general categories for heavy equipment and labor intensive treatments.

Heavy Equipment Work

Fifteen pieces of heavy equipment were used on the Dolason site including five bulldozers, a drag-line crane, a backhoe, an excavator, three loaders, and four dump trucks. A list of equipment types, with hourly rates is contained in Appendix 1. The heavy equipment work can be separated into four categories: 1) hillslope work above W-Line, and on the D-Line spur road; 2) the removal of 2.2 miles of road across Dolason Prairie named Harding Road; 3) the removal of the lower 2.1 miles of W-Line haul road; and 4) miscellaneous heavy equipment costs. Table 1 summarizes these cost categories. Total heavy equipment expenditure on the Dolason site was \$82,443.40.

Equipment work began with opening the D-Line spur road and Harding Road. At the same time, dump trucks delivered rock to stream crossing locations on the entire site. Once these tasks were completed the roads were then ripped, and work began at the lower end of W-Line near Dolason Creek.

Removal of the lower 2.1 miles of W-Line road was by far the most important and expensive aspect of the Dolason Rehabilitation Site. The emphasis of work on the removal of W-Line can be divided into three categories: 1) the excavation of thirteen stream crossings; 2) outsloping of road; and 3) removing the fill edge along landings and decks.

Excavation of the thirteen stream crossings on W-Line Road was accomplished primarily by a bulldozer and excavator, with minimal work being done by a drag-line crane. The amount of fill removed from the crossings varied from 39 to 400 cubic yards, averaging 175 cubic yards. Cost varied from \$60.00 to \$2,898.75, for an average of \$858.00 per stream crossing or \$4.55 per cubic yard of material removed. Total excavation cost was \$10,332.50.

Seven of the excavated stream crossings were armored using 380 cubic yards of quarried rock from the W-Line rock pit, for an average of \$117 per stream crossing or \$2.15 per cubic yard of rock placed by heavy equipment. Total rocking cost was \$818.25. Equipment hours, costs, excavated volumes, and unit costs for each road crossing treated are listed in Appendix 2.

The total cost to treat the W-line road prism was \$27,391.65 of which \$16,514.40 was spent on removing the fill edge from landings and decks, with an average cost of \$13,043.65 per mile of haul road. Outsloping the W-Line Road involved three pieces of equipment, primarily an excavator and bulldozer, with minimal use of a drag-line crane on landing and deck fill edges. The entire length of W-Line was ripped using a ripper bulldozer prior to outsloping. The lowermost 1.5 mile of W-Line road, mostly through old growth redwood was outsloped to a slight to moderate degree at an average cost of \$1.78 per linear foot. The 0.6 mile of W-Line that traversed Dolason Prairie was outsloped completely, at an average cost of \$4.20 per linear foot. Equipment hours, costs, outsloped road lengths, and unit costs for each road reach treated are listed in Appendix 3.

There were six decks along W-Line that had slash and logs perched around their edges, and in some places debris was shoved up against the old growth redwood below. The crane was utilized on three of the six decks, and the excavator and bulldozer on all six decks. The edge material was pulled back and then sloped against the road cutbank at a total cost of \$16,514.40, averaging \$.18 per square foot of area affected. These costs are included in Appendix 3.

Removal of Harding Road was the second most expensive phase of the Dolason Rehabilitation Site. The emphasis of work can be divided into two categories: 1) the excavation of seventeen stream crossings; and 2) outsloping 2.2 miles of prairie road.

Excavation of the seventeen stream crossings on Harding Road was accomplished by two sets of equipment; a backhoe and D-6 bulldozer combination completed the upper nine crossings and an excavator and bulldozer combination completed the lower eight crossings. The amount of fill removed from the crossings varied from 75 to 317 cubic yards, averaging 157 cubic yards. Costs varied from \$94.50 to \$1,684.50, for an average of \$666.00 per stream crossing or \$4.01 per cubic yard of material removed. Total excavation cost was \$10,714.75. Twelve of the stream crossings excavations were armored using 310 cubic yards of quarried rock from the W-Line rock pit, for an average rock placement cost of \$88 per stream crossing or \$1.98 per cubic yard. Total rocking cost was \$615.00. Equipment hours, costs, excavated volumes, and unit costs for each road crossing treated are listed in Appendix 4.

An interesting comparison can be made between the use of a backhoe and bulldozer, versus the greater efficiency of an excavator and bulldozer in excavating stream crossings. The backhoe/dozer combination excavated nine stream crossings, totalling \$7,232.50 and consisting of 1,370 cubic yards removed, at an average cost of \$5.28 per cubic yard of material removed. Whereas, the excavator/dozer combination excavated eight stream crossings, totalling \$3,582.25 and consisting of 1,303 cubic yards, at an average cost of only \$2.67 per cubic yard of material removed.

Outsloping Harding Road involved the same two sets of equipment mentioned above. The entire 2.2 miles of road was outsloped completely, except in sections that traversed second growth forests. These areas were moderately to slightly outsloped. Almost the entire length of Harding Road was ripped using the TD-25 ripper Caterpillar. The total cost to remove Harding Road was \$9,076.25, with an average cost of \$4,125.57 per mile. Complete outsloping of 1.4 miles of Harding Road across Dolason Prairie cost \$7,836.00, with an average cost of \$5,597 per mile or \$1.07 per linear foot. Slight to moderate outsloping of 0.8 mile of Harding Road through the forest cost \$1,240.25, with an average cost of \$1,550.00 per mile or \$.29 per linear foot of road reach. Equipment hours, costs, outsloped road lengths, and unit costs for each road reach treated are listed in Appendix 5.

The emphasis of work on the hillslopes was the treatment of ten skid trail stream crossings and the removal of 0.5 mile of skid road. Two different areas were treated, the slope just above Rx-3 on W-Line, and the D-Line spur skid road and slope. Skid trail crossing excavations on the D-Line spur road utilized a bulldozer and excavator, with a loader delivering rock to the finished channel from a rock stockpile located on D-Line. The skid trail crossings above W-Line were done by an excavator, and a loader delivering rock to the finished channels, and a bulldozer placing waterbars on the access skid trail.

The amount of fill excavated from each worksite varies from 30 to 816 cubic yards, averaging 241 cubic yards. Total cost for the excavation of the ten skid trail crossings was \$7,648.50, with an average of \$765 per stream crossing or \$3.17 per cubic yard of material removed. Eight out of the ten crossings were armored using 290 cubic yards of quarried rock from the W-Line rock pit. The cost for placement of the rock was \$1,227.75, with an average of \$153 per stream crossing, or \$4.23 per cubic yard placed.

The half mile of skid road removed cost \$2,701.25, and included slightly outsloping the road, pulling the fill edge back on a deck, and constructing three water-bars on the D-Line to divert inboard ditch flow off the rehabilitation site. Appendix 6 itemizes equipment hours, excavated volumes, outsloped road reaches, and unit costs for each hillslope treatment.

Miscellaneous heavy equipment costs on the Dolason site totalled \$11,917.50. They included channel armoring below two culverts on the K & K (\$1,423.50), ripping and opening all roads (\$2,591.00), travel time between worksites \$1,796.00), and standby expenses (\$6,107.00).

Labor Intensive Work

Labor intensive work was completed by a staff of Redwood National Park laborers, site geologist, and technicians. Redwoods United, Inc.'s employees applied straw mulch. The primary purpose of labor intensive work on the Dolason site was to reduce bare ground surface erosion and excavated stream channel erosion, and to re-establish vegetation at the freshly disturbed worksites. A complete list of the tasks, including the quantity, cost and unit cost for each is given in Table 2.

Labor intensive work started one week before heavy equipment rehabilitation work began, and the first task was the delivery of straw bales and checkdam materials. As the heavy equipment work progressed, labor intensive tasks such as checkdam construction and channel rocking followed. All labor intensive treatments were completed by mid-November 1980.

The most expensive labor intensive treatment and technique to prevent erosion in excavated stream channels (downcutting and bankcutting) was checkdams. A total of 41 checkdams were placed in seven stream channel excavations, for a total cost of \$4,109.89 (excluding material costs), or \$100.24 per check dam. Unit cost is comparatively high because stream excavations were made to match the natural side slopes above and below and required construction of wide check dams. All the checkdams were either one or two boards high, and had wooden energy dissipators installed at their bases. Rock was also used as channel armor where possible both between dams and at the lower end of the channel reach where the rock was staked into place below the last dam.

Channels were rocked initially by heavy equipment. Labor intensive work included placement and adjustment of rocks in each channel, and locally gathering smaller rock (4-12 inches in diameter) to fill the gaps. Thirteen channels needed major rock adjustment and several other channels needed

Table 2
80-5 Dolboon Site
LABOR INTENSIVE TREATMENT COSTS

Category	Number of Worksites	Total Person-Hours	Total Cost	Quantity	Unit Cost	Percent of Total Labor Intensive Cost
1. Check Dam Construction	7	538	*4109.89	41 check dams	*100.24 / check dam	35 1/2 %
2. Rocking of Channels	13	185	1247.02	5514 ft ²	.23 / ft ² or *95.92 / channel	11 %
3. Jute Netting and Curlex	5	123 1/2	801.13	2828 ft ²	.28 / ft ²	7 %
4. Straw Mulch Implying and Application	23 acres	247 1/2	1502.38	23 acres	65.32 / acre	13 %
5. Douglas-Fir Shed Removal	2	58 1/2	410.85	—	—	3.5 %
6. Chicken Wire Slope Support Fence	1	8	43.20	1 fence 40 ft ²	43.20 / site or 1.08 / ft ²	.4 %
7. Skid Sled	—	14	75.60	1	—	.6 %
8. Miscellaneous Tasks	—	470	3332.44	—	—	29 %
TOTALS: 8	—	<u>1644 1/2</u>	<u>*11,522.51</u>	—	~~see above~~	100 %

minor adjustments after heavy equipment, and labor totalled \$1,247.02.

The most expensive labor intensive treatment and technique to prevent erosion on bare ground was the application of straw mulch. Total cost for distribution and application of straw mulch was \$1,502.38 (excluding straw purchase cost), of which 46 percent was spent moving the straw and 54 percent on spreading the straw. Approximately 23 acres were treated, with a unit cost of \$65.32 per acre.

Jute netting and curlex were applied to five worksites, which included three channel bottoms, one channel sideslope, and one steep reach of outsloped prairie. Total area covered is 2,828 square feet, with a total cost of \$801.13 (excluding material cost), or \$.28 per square foot.

The removal of young Douglas-fir trees on Dolason Prairie was suggested by the Research Biologist as part of the prairie restoration program. These trees are among the first to invade disturbed ground (cutbanks and road side cast) and result in "unnatural" lines of trees across the grasslands. Also, a metal lean-to shed on upper Dolason Prairie (located on an archeological site) was disassembled and removed in response to the Park Archaeologist's recommendation. Total cost for both projects was \$410.85.

A chicken wire (slope support) fence was installed on the left bank of skid trail stream crossings 3 to protect the excavated stream channel from being obstructed by falling slope debris, and to allow overland flow to pass freely through. Total cost was \$43.20. A wooden skid sled (designed to be pulled by a bulldozer) was constructed to transport straw to areas inaccessible by truck, at a cost of \$75.60 (excluding material costs).

Miscellaneous labor intensive costs totalled \$3,332.44, and included standby time while assisting the heavy equipment, choker setting, travel to and from worksites, training, and discussion time.

Winter Maintenance

Maintenance during the winter immediately following rehabilitation at the Dolason site consisted of repairing 76 percent of the checkdams (\$235.70), adjusting channel rock to prevent streambank erosion in four stream crossings (\$173.12), and the application of grass seed to several prairie outslope failures (\$11.80). Total winter maintenance cost was \$420.62.

The type of checkdam failures included: spliceboard leaks; splashboards became suspended due to downcutting below them; and the fill packing around the bases washed out (see diagram 1).

Evaluation of Heavy Equipment Used

The use of heavy equipment at the Dolason site was effective at excavating introduced debris from stream channels, removing potential road failure material and improving drainage on the site. However, the cost-effectiveness could have been improved by changes in the types of equipment used. Many road removal tasks that were completed by the crane or backhoe could have been accomplished more efficiently with a hydraulic excavator. The backhoe's lower cost effectiveness has already been stated in the heavy equipment cost section. On worksites where the crane initially worked, the end product was of poor quality and the cost efficiency was extremely poor. Therefore, many of these worksites were later completed to a higher standard using the excavator.

Table 1. SUMMARY OF HEAVY EQUIPMENT AND LABOR INTENSIVE TASKS AND COSTS TO REHABILITATE THE DOUGLASS UNIT (80-5)

HEAVY EQUIPMENT COSTS

Hillslope Worksites

Excavation of ¹⁰ skid trail stream crossings	8,876.25
Outsloping and waterbarring ^{5 miles of} skid road access	<u>2,701.25</u>
Sub-Total	\$ 11,577.50

Harding Road Removal

Excavation of 17 stream crossings	11,329.75
Outsloping 6.2 miles of road	<u>9,076.25</u>
Sub-Total	\$ 20,406.00

(lower)

W-LINE Road Removal

Excavation of 13 stream crossings	11,150.75
Outsloping 2.1 miles of road (includes landings (2) and decks (9))	<u>27,391.65</u>
Sub-Total	38,542.40

Miscellaneous Costs

K&K culvert improvement	1,423.50
Ripping and opening roads	2,592.00
Travel between worksites	1,796.00
Standby and "other"	<u>6,107.00</u>
? Move in/out Costs ? lowering	Sub-Total \$ 11,917.50

TOTAL HEAVY EQUIPMENT COSTS

\$ 82,443.40

TABLE 1 continued

LABOR INTENSIVE COSTS

Check dam construction	4,109.89
Rocking of channels	1,247.02
Jute netting and curlex	801.13
Straw	1,502.38
Douglas-fir and sled removal	410.85
Chicken wire slope support fence	43.20
Skid sled	75.60
Miscellaneous	3,332.44

needed
vegetation

TOTAL COSTS \$11,522.51

Total Cost For Rehabilitation Treatments \$ 93,965.91

What costs for I on another table?

Appendix 1.

EQUIPMENT USED ON DOLANSON SITE 80-5

<u>Equipment Description</u>	<u>Cost/Hour*</u>
850 C Case Bulldozer with 4 in 1 bucket and rippers.	60.00
1150 C Case Bulldozer with 8 way blade and winch	60.00
1450 Case Bulldozer with 8 way blade and winch	65.00
CAT D6B 44A Bulldozer with 4 way blade and winch	33.00
CAT TD25 Bulldozer with 4 way blade and rippers	73.50
John Deere 690 B Excavator with $\frac{3}{4}$ yd ³ bucket	64.50
580 C Case Extendahoe with $\frac{1}{4}$ yd ² bucket	30.00
Erie 22 B Drag-Line Crane, track mounted	77.50
Case W18 Loader, rubber tired	45.00
CAT 955 Loader, rubber-tired, $2\frac{1}{2}$ yd ³ bucket	55.00
Loader, rubber tired	35.00
10-yd dump trucks (four utilized)	ave. 32.00/hr/truck

* All hourly rates include operator

New Numbering System

ads

W-LineHarding Road

New:	Old:	New:	Old:
R-1	D-1, R-1	R-16	R-26
R-2	R-3	R-17	R-26 1/2
R-3	R-4	R-18	R-27
R-4	R/Q-5	R-19	R-28
R-5	D-2, R-6	R-20	R-28 1/2
R-6	D-3, R-7, 8, 9, 10, 11, 12; S-5, 6; C-6, L-1	R-21	R-29
R-7	None	R-22	R-30
R-8	R-13, 14; L-2	R-23	R-30 1/2
R-9	R-15, 16, 17, 18; C-10, 11; D-5, 6, 7, 8.	R-24	R-32
R-10	R-19	R-25	R-33
R-11	R-20, R/Q-21	R-26	R-33 1/2
R-12	no no.	R-27	R-34, C-13
R-13	R-22, 23; D-4	R-28	R-35
R-14	D-5	R-29	R-36
R-15	R-24, 25; S-11	R-30	R-37
		R-31	R-38
		R-32	R-41

Hill slope:

New:	Old:	New:	Old:
SR-1	R-31, 40; L-3	~~SX-1~~ SX6	H-19
SR-2	Quagmire Road	~~SX-2~~ SX7	H-20
~~SX-3A~~ SX2	S-2	~~SX-3~~ SX8	H-16
~~SX-2E~~ SX3	S-3	~~SX-4~~ SX9	H-22
~~SX-3C~~ SX4	S-4	~~SX-5~~ SX10	H-21
~~SX-3D~~ SX5	W-1	~~SX-6~~ SX11	Dolason Trench

(OVER)

New Numbering System

Stream Crossings

W-line

New:	Old:
Ry-1	C-1
Ry-2	C-2
Rx-3	C-3
Ry-4	C-4
Ry-5	C-5
Ry-6	C-7
Ry-7	C-8
Ry-8	C-9
Ry-9	H-1
Ry-10	H-2
Ry-11	S-7
Rx-12	S-8
Ry-13	S-10

Harding Road

New:	Old:
Ry-14	S-13
Rx-15	C-12
Ry-16	H-3
Ry-17	H-4
Ry-18	H-5
Ry-19	H-6
Ry-20	H-7
Rx-21	H-8
Rx-22	H-9
Rx-23	H-10
Ry-24	H-10½
Ry-25	H-11
Ry-26	H-12
Rx-27	H-13
Ry-28	H-14
Ry-29	H-15
Rx-30	H-23

K&K:

Camp Road Culvert
K&K road Culvert

K&K culvert improvement sites

80-5 DOLASON DRAINAGE AREAS (New^{Site} Numbers)

W-LINE				Harding Road			
Site No.	Acres	Cfs: Q 2yr	Q 25yr	Site No.	Acres	Cfs: Q 2yr	Q 25yr
Rx-1	4	1	2	Rx-14	2	1	2
Rx-2	25	13	19	Rx-15	5	3	5
Rx-3	14	7	11	Rx-16	5	3	5
Rx-4	20	10	15	Rx-17	15	9	14
Ry-5	12	5	8	Rx-18	5	3	5
Ry-6	4	2	2.5	Ry-19	19	11	17
Rx-7	2	.8	1.3	Ry-20	28	12	18
Rx-8	.6	.25	.4	Ry-21	1	.4	.6
Ry-9	headwaters	-	-	Rx-22	26	11	16
Rx-10	3	2	3	Ry-23	15	9	14
Rx-11	3	2	3	Ry-24	2	1	2
Ry-12	3	2	3	Rx-25	12	7	11
Rx-13	2	1	2	Rx-26	18	8	11
Hillslope Crossings:				Rx-27	8	3	5
				Rx-28	11	5	7
				Ry-29	13	6	9
				Rx-30	10	5	7
Sx-3A ^{Sx2}	13	7	11	Dolason	236	99	149
Sx-3B ^{Sx3}	11	6	9	Creek at			
Sx-3C ^{Sx4}	11	6	9	W-line			
Sx-3D ^{Sx5}	8	5	7				
Sx-1 ^{Sx6}	29	12	18				
Sx-2 ^{Sx7}	3	1	2				
Sx-3 ^{Sx8}	.8	.3	.5				
Sx-4 ^{Sx9}	33	14	21				
Sx-5 ^{Sx10}	34	14	21				
Sx-6 ^{Sx11}	49	21	31				

80-5

HEAVY EQUIPMENT SEQUENCING

Week Number	Dates Weekly	Work Locations	Type of EQUIPMENT
		✓ Old #1's	
1	June 30 - July 3	-- Open Roads; Harding and D-Line Spur Road	Cat TD 25 Ripper
		-- Rock Delivery; W-Line	Cat 955 Loader, five 10-yd dump trucks
		-- Straw Delivery; W-Line	one dump truck
2	July 7-11	-- No heavy equipment work this week.	
3	July 14-18	-- Ripping Roads; W-Line	Cat TD 25 Ripper
		-- Rock Delivery; W-Line, Harding Road	one 10-yd dump truck
		-- Straw Delivery	Flat Bed Truck
		-- W-LINE (C-1, C-8, D-1)	Crane, and 1150C
		-- W-LINE (C-2, S-2, S-3, S-4)	Excavator
4	July 21-25	-- W-LINE (D-4, D-5)	Crane, 1150C
		-- W-LINE (C-1, C-2, C-3, C-4, S-2, S-3, S-4, R/O-5)	Excavator 1120C, 850C, and Loader
		-- Rock Delivery; Harding Road, D-Line Spur Road	Dump Truck
5	July 28- August 1	-- W-LINE (C-4, C-5, D-2, D-3, L-1, R-7, R-8, R-9, R-10)	Excavator, 1150C, 850C

HEAVY EQUIPMENT SEQUENCING

Week Number	Dates Weekly	Work Locations	Type of EQUIPMENT
6	August 4-8	-- W-LINE (C-6, C-7, C-8, C-9, C-10, L-1, L-2, D-6, S-5, R-10, R-11, R-12, R-13, R-14, R-17)	Excavator, 1150C
		-- Harding Road (H-14, H-15, H-23)	Backhoe, D-6
7	August 11-15	-- W-LINE (C-11; L-2; D-5, 7, 8; W-1; R-13, 14, 15, 16, 17, 18, 19, 20; R/Q-21; H-1, 2)	Excavator, 1150C
		-- Harding Road (H-12, 13, 14, 23; R-26, 27)	Backhoe, D-6
		-- Ripping Roads (Harding Road through the prairie)	TD 25 Ripper
8	August 18-22	-- W-LINE (S-7, 8, 10, 11; D-4, 5; R/Q-21, R-22, 23, 24, 25)	Excavator, 1150C
		-- Harding Road (H-9, 10, 10½, 11, 12, 13, 23; R-32; Camp Road and K&K Channel)	Backhoe, D-6
9	August 25-29	-- Harding Road (R-25, 26, 27, 28, 28½, 29; H-3, 4, 5, 6; S-13; C-12)	Excavator, 1150C
		-- Harding Road (H-10, 10½, 11; C-13; R-34, 35, 41)	Backhoe, 1450

HEAVY EQUIPMENT SEQUENCING

Week Number	Dates Weekly	Work Locations	Type of EQUIPMENT
10	September 2-5	-- Harding Road (R-34, 41) -- Harding Road (H-7, 8; R-30, 30½). -- D-LINE Spur Road (R-31, 40; H-16, 19, 20, 22; Dolanon Trench).	1450 only Excavator, 1150C Excavator, 1150C
11	September 8-12	-- D-LINE Spur Rd (R-40; H-21, 22; L-3; Dolan Trench; Quaminc Rd).	Excavator, 1150C, loader
12	September 15-16	-- Camp Road (R-37).	1150C

SUMMARY OF AVERAGE COSTS OF ROAD TREATMENT

Type of Worksite	# of Work-Sites	Range: L.F.	Equipment	Range: Equip. Hours	Total Sites Cost	Average: Cost/ Worksite	Range: Cost	Total L.F.	Average: Cost/ L.F.	Range: Cost/ L.F.
I. Wooded Roads:										
[Complete -- none]										
Moderate	12	125' - 4100'	Excav. 2-60 Crane 3 1/2 H50C 2-55 1/2 BH 1 1/2 - 5 1450 5		\$10,119.75	\$843	\$165-7200	9600'	\$1.05/LF	\$.12 - 2.06 LF
Slight	6	225' - 1725'	Excav. 5-46 H50C 2-31 D-6 3 1450 1 1/4 Loader 1		\$7,598.25	\$1316	\$81-3027	5950'	\$1.33/LF	\$.20 - 1.90 LF
II. Prairie Roads										
(Complete)										
Moderate 15-25%	16	125' - 2100'	Excav. 2-24 H50C 1-27 BH 2 1/4 - 10 1450 5-25 1/4 Crane 15-27 1/4		\$21,151.15	\$1322	\$120-4996	9575'	\$2.21/LF	\$.40 - 31.14 LF
[Steep over 25% -- none]										
TOTALS:	34	125' - 4100'	Excav. 2-60 Crane 3 1/2 - 27 1/4 BH 1 1/2 - 10 H50C 1-55 1/2 1450 5-25 1/4 D-6 3 Loader 1		\$39,169.15	\$1152	\$81-4996	25,125' 4.8 miles	\$1.56/LF \$160/miles	\$.12 - 31.44 LF

TABLE
HAUL ROAD AND SKID TRAIL CROSSING EXCAVATION COSTS

80-5 ^{excluding Rock Costs}

Type of Worksite	# of Worksites	Range: vol. fill yd ³	Equipment	Range: Hours	Total Sites Cost ²	Average Cost/Worksite	Range: Cost	Total yd ³	Average: Cost/yd ³	Range: Cost/yd ³
EXTRA-SMALL 0-100 yd ³	15	10 - 100 cy	Excav. 1 1150C backhoe D-6 1450 Loader	2-12 1-3.5 6.5-7.5 1-4.5 1-5 1-5	\$4993.00	\$333	\$60-724	901 cy	\$5.54	\$1.60 - 11.25
SMALL 100-400 yd ³	23	102 - 400 cy	Excav. 1150C BH D-6 1450	1-23 .5-17.5 2-24 1-26.5 6	19,173.25	860	65-2279	5147	3.84	.63 - 12.54
MEDIUM 400-800 yd ³	1	500 cy	Excav. 1150C	10.5 10.5	1207.25	1207	1207	500	2.61	2.61
LARGE 800-2000 yd ³	1	816 cy	Excav. 1150C Loader	27.5 21.5 9.5	2612.25	2612	2612	816	3.20	3.20
EXTRA-LARGE >2000 yd ³	0									
TOTALS:	40	10-816 ave. 184/site	Excav. 1150C Crane BH D-6 1450 Loader	1-27.5 .5-21.5 1-15 2-24 1-26.5 .5-6 1-9.5	\$28,645.75*	\$717	\$60-2899	7364 cy	\$3.90/cy	

*Only excavation cost, ~~excavation~~ ~~cost~~ ~~to~~ ~~excluded~~.

SKID TRAIL and HAUL ROAD CROSSING ROCK COSTS - 80-5

Work Site	Quantity yd ³	Quarry Cost/yd ³	Transport Cost/yd ³	Placement Cost/yd ³	Total Cost/yd ³	Total Rock Cost	Total Excav. Cost	Rock - Labor Int. Cost	Total Site Cost
Rx-1	60	14.60		2.08	16.68	1000.80	1770.75	—	2771.55
Rx-2	80	14.60		4.43	19.03	1522.40	1763.75	—	3286.15
Rx-3	80	14.60		N.R	14.60	1168.00	924.00	—	2092.00
Rx-4	30	14.60		NR	14.60	438.00	661.50	55.01	1154.51
Rx-5	30	14.60		8.30	22.90	687.00	675.00	152.72	1514.72
Rx-7	70	14.60		1.29	15.89	1112.30	2808.75	204.83	4125.88
Rx-10	30	14.60		NR	14.60	438.00	129.00	—	567.00
Rx-14	80	14.60		2.00	16.60	498.00	760.50	27.00	1285.50
Rx-17	30	14.60		NR	14.60	438.00	285.75	—	723.75
Rx-18	25	14.60		NR	14.60	365.00	252.50	24.30	642.80
Rx-19	20	14.60		NR	14.60	292.00	451.50	24.30	767.80
Rx-20	20	14.60		NR	14.60	292.00	820.50	—	1112.50
Rx-21	25	14.60		NR	14.60	365.00	696.00	—	1061.00
Rx-22	20	14.60		4.50	19.10	382.00	772.50	—	1154.50
Rx-26	20	14.60		3.00	17.60	322.00	868.50	95.64	1316.14
Rx-27	30	14.60		4.50	19.10	382.00	1423.50	—	1805.50
Rx-28	30	14.60		3.00	17.60	352.00	1594.50	—	1946.50

PAGE TWO

SKID TRAIL and HAUL ROAD CROSSING ROCK COSTS - 80-5

Work Site	Quantity yd ³	combined Quarry Cost/yd ³ Transport Cost/yd ³		Placemnt Cost/yd ³	Total Cost/yd ³	Total Rock Cost	Total Excav. Cost	Rock - Labor Int. Cost	Total Site Cost
Rx-29	30	14.60		2.50	17.10	513.00	1006.50	—	1519.50
Rx-30	30	14.60		3.50	18.10	543.00	240.00	—	783.00
Sx-X 6	20	14.60		NR	14.60	292.00	700.50	—	992.50
Sx-27	20	14.60		NR	14.60	292.00	1263.00	—	1555.00
Sx-49	40	14.60		NR	14.60	584.00	1307.25	32.48	1923.73
Sx-# 10	20	14.60		1.75	16.35	327.00	438.00	—	765.00
Sx-6 11	160	14.60		4.90	19.50	3120.00	2612.25	162.40	5894.65
Sx-3A, B, C SX 2, 3, 4	30	14.60		13.63	28.23	846.90	845.00	123.38	1865.28
Totals 25	980cy	*14.60/cy	Ave.	*4.24/cy	*16.92/cy	*16,602.40	*25,112.00	*912.06	*42,626.46

Hillslope Work: Ski Trail Crossing Excavation Cost est - estimate

SITE number	Equipment	Cost	Total Cost	Volume yd ³	Unit Cost	LI Treatment	Unit Cost	Total ~~EST~~ SITE COST	Remark
Sx-3A, 3B, 3C 7, 8, 9	Excav. 1150C Rocking Excav. Loader	\$645.00 240.00 141.25 247.50	\$885.00 408.75	est. 100 30 (100 est)	\$8.85 13.63	Rocking \$133.36	.17/ft ²	\$1427.13	Rocked channel Access Rd Cost included in excavation
Sx-3B 10	Excav.	129.00	129.00	est. 30	4.30	✓ dams (6) \$372.60 Curlex 16.20	62.10/dam .41/ft ²	517.80	double channel excavation
Sx-1	Excav. 1150C	580.50 120.00	700.50	383 Rx 20	1.83 N.C.	None	None	700.50	double channel at Top.
Sx-2	Excav. 1150C	903.00 360.00	1263.00	260 Rx - 20	4.86 N.C.	None	None	1263.00	
Sx-3	Excav. 1150C	193.50 120.00	313.50	246	1.27	✓ dams (7) \$592.98	84.70/dec.	906.38	
Sx-4	Excav. 1150C	677.25 630.00	1307.25	500 Rx 40	2.61 N.C.	Rocking 32.48	.08/ft ²	1339.73	
Sx-5	Excav. 1150C Rocking Loader	258.00 180.00 35.00	438.00 35.00	76 20	5.76 1.75	None	None	473.00	
Sx-6A & 6B Dolason Creek	Excav 1150C Rocking Excav. Loader	1322.25 1290.00 451.50 332.50	2612.25 784.00	816 160	3.20 4.90	Rocking 162.40	.09/ft ²	3558.65	
TOTALS: 10	Excav. 62.5 1150C 49 Loader 17 1/2 Hours	5321.25 2940.00 615.00 8876.25	Excav: \$7648.50 Rocking: \$1227.75 \$8876.25	2411 cy 290 cy	\$3.17/cy \$4.23/cy	Rocking 322.26 ✓ dams (2) 965.48 Curlex 16.20	✓ 74 27/100 Total \$1309.94	\$10,186.19	

Appendix 2

W-LINE

SITE Number	Equipment	Cost	Total Cost	Volume yd ³	Unit Cost	L.I. Treatment	Unit LI. Cost	Total Site Cost	Remarks
Rx-1	Excav. Crane 1150C Rock: — Excav. 1150C	64.50 1046.25 660.00 — 64.50 60.00	1770.75 124.50	233 60	# 7.60 2.08	Minor Rock Adjustment	—	1895.25	
Rx-2	Excav. Crane 1150C Rock: — Excav.	1128.75 155.00 480.00 — 354.75	1763.75 354.75	318 80	5.55 4.43	Minor Rock Adjustment	—	2118.50	
Rx-3	Excav. 1150C Rock: —	774.00 150.00 —	924.00	400 80	2.31 —	"	—	924.00	
Rx-4	Excav. 1150C Rock: —	451.50 210.00 —	661.50	85 30	7.78 —	Rocking adjustment	55.01 .12/ft ²	716.51 ~~661.50~~	
Rx-5	Excav. 1150C Rock: — Excav. 1150C	645.00 30.00 — 129.00 120.00	675.00 249.00	60 30	11.25 8.30	Rocking 152.72 Chisel & pry (6) 72.50	.51/ft ² 12.05/dm	924.00 1149.02	

SITE Number	Equipment	Cost	Total Cost	Volume yd ³	Unit Cost	L.I. Treatment	Unit L.I. Cost	Total W.L. Site Cost	Remarks
Rx-6 ●	Excav. 1150C	\$ 419.25 180.00	\$ 599.25	54 ⁹	\$ 11.10	Straw	—	599.25	
Rx-7 ●	Excav. 1150C Crane Rocking Backhoe plus	1290.00 1170.00 348.75 90.00 ⁺	2808.75	224	12.54	Rock 204.83 Jute Net: 540.02	.52/Ft ² .56/Ft ²	~~2898.45~~ 3643.60	
Rx-8 ●	1150C	60.00	60.00	swale ~10	—	—	—	60.00	Remove culvert
Rx-9 ●	Excav.	64.50	64.50	103	.63	straw seed	—	64.50	headwaters bowl
Rx-10 ●	Excav. Rock Incl.	129.00	129.00	39 Rx 30	3.31	—	—	129.00	
Rx-11 ●	Excav. 1150C	258.00 120.00	378.00	97	3.90	Vdams 8 605.12 Jute Netting 48.60	75.64/1 dam .12/Ft ²	~~378.00~~ 1031.72	
Rx-12 ●	Excav. 1150C	129.00 120.00	249.00	396 200	.63 1.20	Jute Netting 163.91	.18/Ft ²	~~249.00~~ 412.91	
Rx-13 ●	Excav. 1150C	129.00 120.00	249.00	261	.95	straw, seed	—	249.00	
stake 13 Excavation Rocking	Excav 93 1/2 Crane 20 1150C 58 BH 3 174 1/2	6030.75 1550.00 3480.00 90.00	\$ 10,372.50 Rx 818.25 \$ 11,150.75	2084 2240 yd ³ Rx 380 yd ³	4.62 4.52/y 2.15/cy	Rx 412.56 Vd 677.42 JN 752.50 1842.51	\$ 137.52/chaire 48.39/1 dam —	\$ 12,993.26 ~~11,150.75~~	

SITE Number	Equipment	Cost	Total Cost	Volume yd ³	Unit Cost	L.I. Treatment	Unit L.I. Cost	TOTAL SITE COST	Remarks
Rx-23	Backhoe D-6 1450	\$ 195.00 165.00 32.50	\$ 392.50	Mining 24 ft rest 100	3.93	✓ dam (4) 352.72	82.18	~~745.22~~ 745.22	✓ dam channel
Rx-24	BH D-6	232.50 33.00	265.50	110	2.41	—	—	265.50	unprotected channel
Rx-25	BH D-6 1450	180.00 99.00 390.00	669.00	118	5.67	✓ dam (5) 432.80	86.76	~~669.00~~ 1102.80	✓ dam channel
Rx-26	BH D-6 1150C Rocking BH	255.00 313.50 300.00 60.00	868.50 60.00	130 20	6.68 3.00	Rocking 15.64	.32/ft ²	~~928.50~~ 1024.14	Rocked channel w/ log spillway
Rx-27	BH D-6 1150C Rocking BH	585.00 148.50 690.00 135.00	1423.50	317 30	4.49 4.50	—	—	1558.50	Rocked channel
Rx-28	BH D-6 Rocking BH	720.00 874.50 90.00	1594.50 90.00	212 30	7.52 3.00	None	—	1684.50	ditto

SITE Number	Equipment	Cost	Total Cost	Volume yd ³	Unit Cost	L.I. Treatment	Unit L.I. Cost	TOTAL SITE COSTS	Remarks
Rx-29	BH	495.00		136	7.40	None	—	1081.50	Rocked channel
	D-6	511.50	1006.50						
	Rocking BH	75.00	75.00	30	2.50				
Rx-30	BH	120.00	240.00	94	2.55	None	—	345.00	Rocked channel
	1150C	120.00							
	Rocking BH	105.00	105.00	30	3.50				
TOTALS 17	Excav. 40 1/2	2612.25	Excavation:		Ave.	Rocking: 4	\$42.81/clem	13,300.15	—
	BH 12 1/4	3757.50	\$10,714.75	2673 yd ³	\$4.01/cy	\$171.24		~~\$11,329.75~~	
	1150C 33	1980.00	Rocking:			check dam (14)			
	1150 6 1/2	422.50	\$615.00	310 cy	\$1.98/cy	\$1799.16	\$128.51/10		
	D-6 7 1/2 hrs.	2557.50	\$11,329.75			\$1970.40			
	282 3/4 Hrs.								
				4,757 yd ³					

Appendix 4

Harding Road

SITE Number	Equipment	Cost	Total Cost	Volume yd ³	Unit Cost/yd ³	L.I: Treatment COST	Unit COST	Total site COST	Remarks
Rx-14	Excav. 1150C Rocking Backhoe ⁺	\$580.50 180.00 60.00	\$760.50 60.00	Not Measured Est. 200 30	3.80 2.00	Rocking: 27.00	.07/ft ²	~~820.50~~ 847.50	double crossing channel: Rocked
Rx-15	1150C	120.00	120.00	Est. 75	1.60	straw	—	120.00	unprotected channel
Rx-16	Excav 1150C	64.50 30.00	94.50	102	.93	ev dams(5) 1012.64	202.53	~~94.50~~ 1107.14	check dam channel
Rx-17	Excav 1150C	225.75 60.00	285.75 incl. Rx \$	81 → 30	3.53 —	—	—	285.75	Rocked channel
Rx-18	Excav 1150C	193.50 60.00	253.50 incl Rx \$	149 → 25	1.70 —	Rocking 24.30	.08/ft ²	~~253.50~~ 277.80	Rocked channel
Rx-19	Excav.	451.50	451.50 incl. Rx \$	278 → 20	1.62 —	Rocking 24.30	.03/ft ²	~~451.50~~ 475.80	Rocked channel
Rx-20	Excav. 1150C	580.50 240.00	820.50 (incl. Rx) Rx	272 20 yd ³	3.02 —	—	—	820.50	double channel 1 rocked 1 unprotected
Rx-21	Excav. 1150C	516.00 180.00	696.00 (incl. Rx) Rx	146 25	4.77 —	—	—	696.00	Rocked channel
Rx-22	BH D-6 Rocking BH	360.00 412.50 90.00	772.50 90.00	153 20	5.05 4.50	—	—	862.50	Rocked channel

Appendix 3

Road Rocks

SITE Number	Equipment	COST	TOTAL COST	Linear Feet	Unit COST	L.I. Treatment	Degree Outcropping	Prairie/Woods, etc. REMARKS
R-1 d1	Excav Crane 1150C	* 387.00 271.25 630.00	* 1288.25 -	625'	* 2.06	Straw, Plots	MOS	Includes removing deck edge by Rx-1. Woods. 30% Ex, 17% Crane 53% Cat.
R-2	-	-	-	125'	-	"	MOS	costs included in Rx-1 and Rx-2. woods
R-3	-	-	-	250'	-	"	MOS	ditto woods
R-4	Excav.	322.50	322.50	625'	.52	"	MOS	Woods 100% Excav.
R-5 D-2	Excav. 850C	129.00 120.00	249.00	250'	.99	"	MOS	woods 50% Excav 50% Cat
R-6 L-1 D-3	Excav. 1150C	3870.00 3330.00	7200.00	4100'	1.76	Plots, Straw Bare Ground	cos/mos/ cos	Woods, 4 WLB @ \$7.50 each Removed 1 culvert 52 % Excav. 48 % 1150 Cat
R-7	-	-	-	-	-	"	MOS	Cost included in R-6.
R-8 L-2	Excav. 1150C	999.75 930.00	1929.75	1075'	1.80	Plots	SOS	woods 50 % Exc. 50 % Cat.
R-9 L-4	Excav. 1150C	1677.00 1410.00	3087.00	1625'	1.90	Plots	SOS	woods 53% Ex 47% Cat removed 3 culverts, pulled etc on 4 decks.
R-10	Excav. 1150C	193.50 60.00	253.50	225'	1.13	Straw seeds	COS	75% Ex. 25% Cat.
R-11	Excav. 1150C	645.00 540.00	1185.00	475'	2.49	Straw seeds	COS	W/P 53% Ex 47% Cat

SITE Number	Equipment	COST	Total Cost	Linear Feet	Unit Cost	LI. Treatment	Degree Outsloping	Prairie/Woods % REMARKS
R-12	—	—	—	125'	—	straw, seed	COS	Cost included in Rx- and Rx-
R-13	Crane Excav. 1150C	\$2150.65 1225.50 1620.00	\$4996.15	750'	6.66	"	COS	Prairie, 1 switchback OS 38% Crane, 26% Exc, 36% Cat.
R-14	Crane Excav. 1150C	1162.50 1290.00 1440.00	3892.50	125'	31.14	"	COS	Prairie, switchback OS includes French Drain, and gully filling. 25% Crane, 34% Ex, 41% Cat
R-15	Excav. 1150C	1548.00 1440.00	2988.00	575'	5.20	"	COS	50% Cat 50% Excav. Prairie top switchbacks, includes one headwater region
TOTALS 15	Crane 46% Excav. 110% 1150C 192 428 3/4 hr	\$3584.40 12,287.25 11,520.00	\$27,391.65 13,315.15	10,950' 2.1 miles	AVG. 2.50/LF	Plot 5 straw - seed	—	11% Crane 44% Excav. 45% 1150C

SITE Number	Equipment	COST	Total COST	Linear Feet	unit Cost	L.I. Treatment	Degree Outslaping	Prairie / Woods, etc... REMARKS
R-16	Excav. 1150C	903.00 960.00	1863.00	1400'	1.33	chain seed	COS	Prairie 47% - Excav. 53% - Cat
R-17	1150C	120.00	120.00	300'	.40	"	COS	Prairie 100% - Cat
R-18	Excav. 1150C	322.50 390.00	712.50	500'	1.43	"	COS	Prairie 44% - Excav. 56% - Cat
R-19	Excav. 1150C	161.25 240.00	401.25	275'	1.46	"	COS	Prairie 38% Excav. 62% Cat
R-20	1150C	120.00	120.00	125'	.96	"	COS	Prairie 100% Cat
R-21	Excav. 1150C	129.00 540.00	669.00	375'	1.78	"	COS	Prairie 18% Excav. 82% Cat
R-22	Excav. 1150C	129.00 180.00	309.00	325'	.95	"	COS	40% Excav. 60% Cat 1/2 P 1/2 W
R-23	1150C	180.00	180.00	225'	.80	"	COS	woods 100% Cat
R-24	D-6	99.00	99.00	225'	.44	"	SOS	woods, 100% Cat.
R-25	1450	81.25	81.25	400'	.20	"	COS	1/2 W 1/2 P 100% Cat
R-26	BH 1450	105.00 325.00	430.00	175'	2.46	"	MOS	Prairie 41% BH 59% Cat

SITE Number	Equip.	COST	Total Cost	Linear Feet	Unit Cost	LI Treatment	Degree Out-sloping	Prairie/Woods, etc. REMARKS
R-27	BH 10 1450 10	\$300.00 1641.25	\$1941.25	1725'	*1.09	Straw/Hay Seed	MOS/cos	Prairie 28% BH 72% Cat
R-28	BH 1450	150.00 325.00	475.00	475'	1.00	Straw, Seed	COS/sos	1/2 P, 1/2 W 50% BH 50% Cat
R-29	BH 1150C	45.00 120.00	165.00	450'	.37	"	MOS	Woods 43% BH 57% Cat
R-30	1150C	240.00	240.00	1950'	.12	"	MOS	Woods, 100% Cat
R-31	—	—	—	525'	—	"	MOS	Woods: 1-WB constructed between 2 crossings
R-32	BH 1450	67.50 1202.50	1270.00	2100'	.60	"	COS	Prairie: 11% BH 89% Cat
TOTALS 17	BH 22 1/4 Excav. 25 1/2 1150C 51 1/2 1450 55 D-6 3 157 1/4 hr.	\$667.50 1644.75 3090.00 3575.00 99.00	\$9,076.25	11,550' 2.2 miles	Ave. *.78/LF	—	—	13% BH 16% Excav. 33% 1150 C 35% 1450 3% D-6

80-5 Dolson

Appendix C

SR -- Skid Road

Hillslope Work: D-LINE Spur Road Outsloping

SITE Number	Equipment	COST	Total COST	Linear Feet	Unit COST	L.I. Treatment	Degree Outsloping	REMARKS
SR-1 incl. L3	Excav ^{1 1/2} 1150C ³¹ Loader	\$483.75 1860.00 35.00	\$2378.75	1725'	\$1.38/LF	straw,	SOS	3 WB's included, 152' along with one fairly large deck.
SR-2	Excav.	322.50	322.50	900'	.36	straw d	SOS	Formerly Quigmore Rd.
2	Excav. Loader 1150C	806.25 35.00 1860.00 \$2701.25	\$2701.25	2625' .5 miles	\$1.03/LF	"	"	—

SKID TRAIL and HAUL ROAD CROSSING ROCK COSTS - 80-5

Cost of Loader	R	14	30	14.60	2.00	16.60	498.00	760.50	NR	1285.50
7000 7000 7000 7000 7000	R	17	30	21.4%	14.60	NR 166.92 L	438.00	285.75	0	723.75
	R	18	25	17.9%	14.60	NR 139.62 L E	365.00	253.50	24.30	642.80
	R	19	20	14.3%	14.60	NR 111.54 L	292.00	451.50	24.30	767.80
	R	20	20	14.3%	14.60	NR 111.54 L	292.00	820.50	0	1112.50
	R	21	25	17.9%	14.60	NR 139.62 L	365.00	696.00	NR	1061.00
	R	22	20	14.3%	14.60	4.50 111.54 L 90.00 B	382.00	772.50	0	1154.50
	R	26	20		14.60	3.00	17.60	352.00	868.50	95.64 1316.14
	R	27	30		14.60	4.50	19.10	382.00	1423.50	NR 1805.50
	R	28	30		14.60	3.00	17.60	352.00	1594.50	NR 1946.50

PAGE TWO

SND TRAIL and HAUL ROAD CROSSING ROCK COSTS - 80-5

Work Site	Quantity yd ³	Quarry Cost/yd ³	^{combined} Transport Cost/yd ³	Placement Cost/yd ³	Total Cost/yd ³	Total Rock Cost	Total Excav. Cost	Rock - Labor Int. Cost	Total Site Cost
R 29	30		14.60	2.50	17.10	513.00	1006.50	NR	1519.50
R 30	30		14.60	3.50	18.10	543.00	240.00	NR	783.00
S 1	20		14.60	NR	14.60	292.00	700.50	NR	992.50
S 2	20		14.60	NR	14.60	292.00	1263.00	NR	1555.00
S 4	40		14.60	NR	14.60	584.00	1307.25	NR 32.48	1923.73
S 5	20		14.60	1.75	16.35	327.00	438.00	NR	765.00
S 6	160		14.60	4.90	19.50	3120.00	2612.25	162.40	5894.65
~~\$ 7.8.9~~	30		14.60	13.63	28.23	846.90	895.00	133.38	1865.28
Totals 25	980cy 200cy 1180cy		\$ 14.60/cy ^{\$14,340} Avg. 4.24/cy 17,220		\$ 16.98/cy Avg.	\$ 16,602.40 ^{fill} cost not recorded.	\$ 25,112.00	\$ 912.06	\$ 42,626.46

80-5

W-line Rehabilitation Unit

Stream Crossing Treatments

Seed Mix : 50 lbs. / acre

1- Highland Bentgrass - 1.32 lbs/A = 11,220,000 seeds/A

(Agrostis - 8500,000 seeds / lb.)

2- Creeping Red Fescue - 28.05 lbs/A = 11,220,000 seeds/A

(Festuca - 400,000 seeds / lb.)

3- Akaroa Orchard Grass - 20.78 lbs./A = 11,221,200 seeds/A

(Dactylis - 540,000 seeds / lb)

Straw : 2000 lbs. / A

70 lbs / bale = 28.5 bales / A

Fertilizer: 200 lbs. / A

20-16-0-13 (sulfur)

16-20-0

W-line Rehabilitation Unit

Stream Crossing Treatments Summary (see maps for areas treated)

Crossing #1

7/31 seeded & strawed ; 5lbs. seed, $3\frac{1}{2}$ bales straw, no fertilizer

(Quinn, Jason, Donna, Lois)

Crossing #2

7/31 seeded & strawed ; 5lbs. seed, 3 bales straw, no fertilizer

(Quinn, Jason)

Crossing #3

7/31 seeded & strawed ; 3lbs. seed, 3 bales straw, no fertilizer

(Quinn, Jason)

8/7 fertilized - 10lbs. fertilizer

(Jason, Steve)

Crossing #4

8/7 seeded, strawed, fertilized ; 4.5 lbs. seed, $2\frac{1}{2}$ bales straw, 17lbs. fertilizer

(Jason, Steve, Lois)

Crossing #5

8/7 seeded, strawed, fertilized ; 9.5lbs seed, $6\frac{1}{2}$ bales straw, 38 lbs. fertilizer

(Jason, Steve, Lois)

Crossing #6

8/7 seeded, strawed, fertilized ; 1.5 lbs. seed, 1 bale straw, 5 lbs. fertilizer

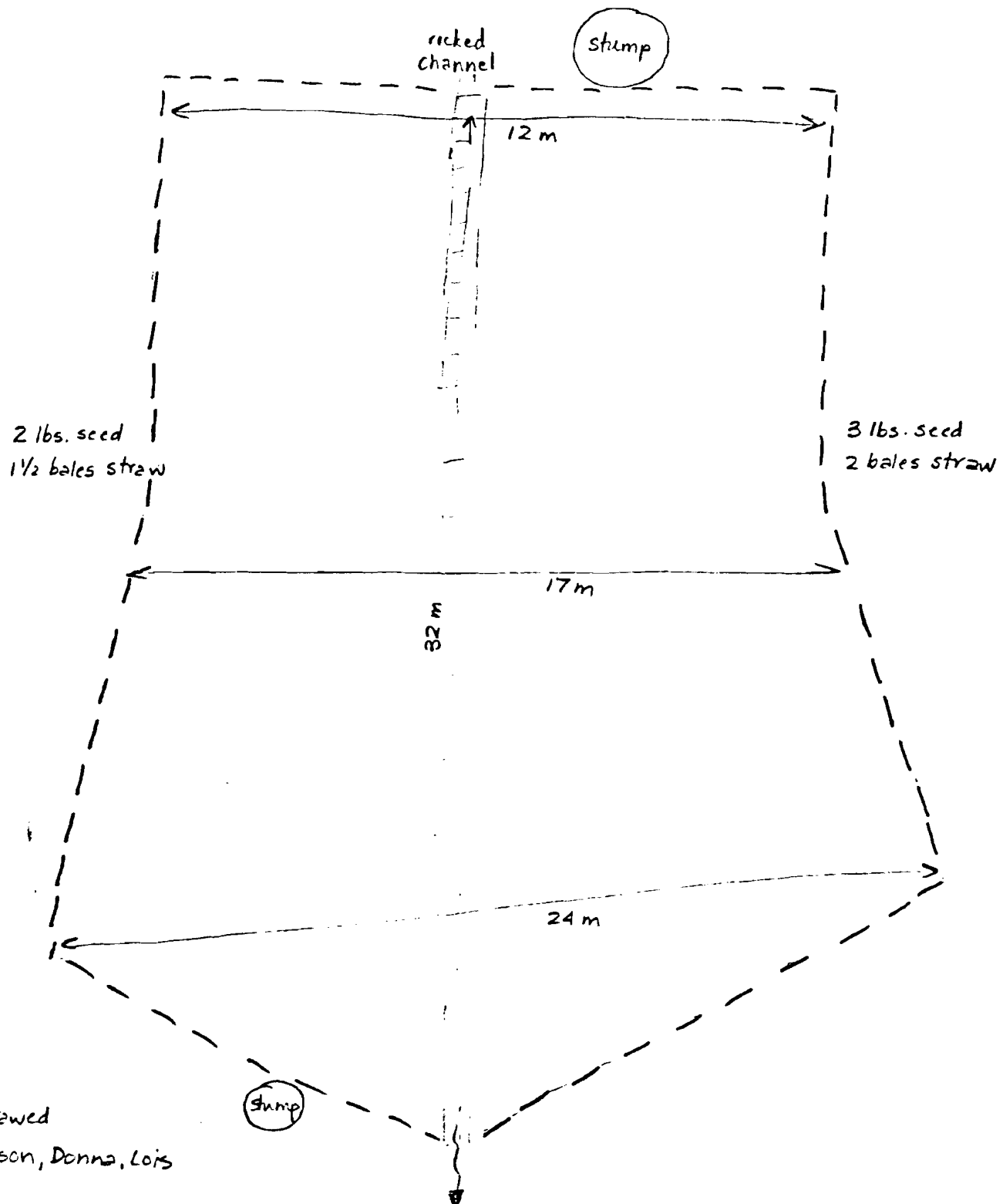
(Jason, Steve, Lois, Donna)

W-line Rehabilitation Unit

Stream Crossing Treatments

Crossing #1

~450 sq. feet
5 lbs. seed
3½ bales straw



31

W-line Rehabilitation Unit

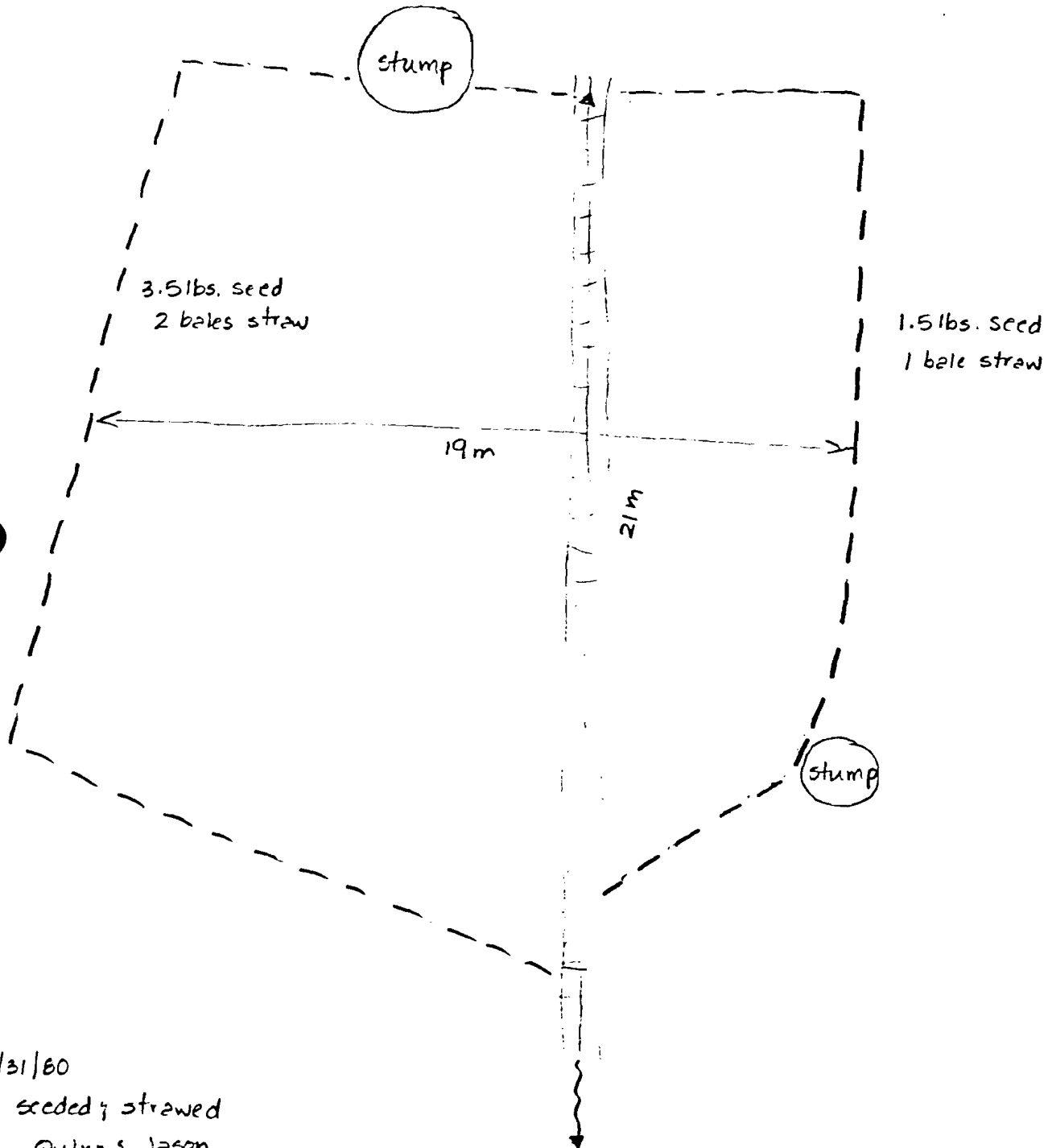
Stream Crossing Treatments

~ 400 sq. ft.

5 lbs. seed

3 bales straw

Crossing # 2



7/31/80

seeded & strawed

Quinn & Jason

W-line Rehabilitation Unit

stream Crossing Treatments

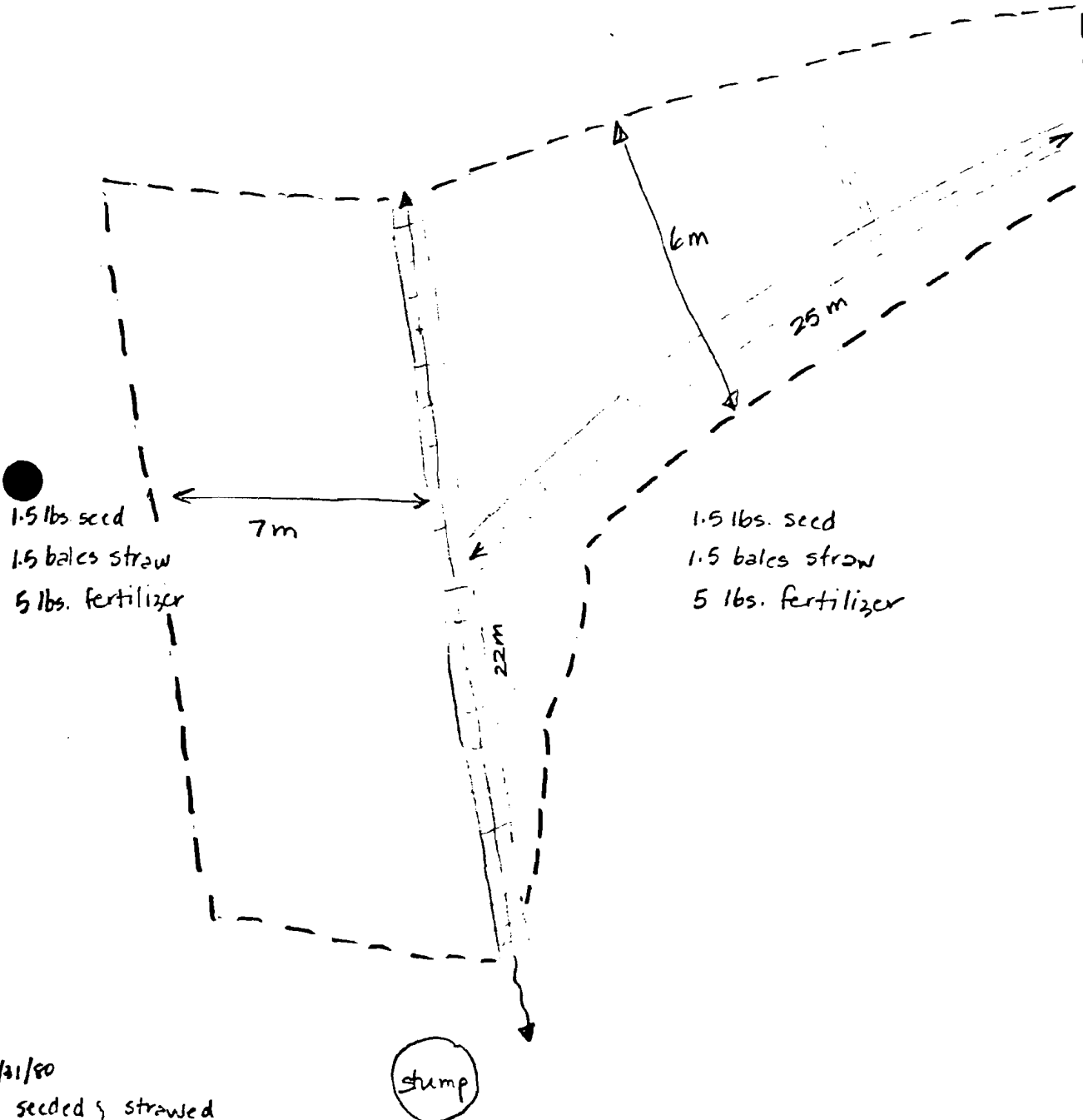
Crossing #3

~ 350 sq. ft.

3 lbs. seed

3 bales straw

10 lbs. fertilizer



7/31/80

seeded & strawed

Quinn's Jason

8/7/80

fertilized

Jason & Steve.

W-line Rehabilitation Unit

~ 350 sq. ft.

Stream Crossing Treatments

4.5 lbs. seed

2.5 bales straw

17 lbs. fertilizer

Crossing #4

1.5 lbs. seed

1 bale straw

5 lbs. fertilizer

20 m

5 m

7m

4m

2 lbs. seed

1 bale straw

8 lbs. fertilizer

1 lb. seed

1/2 bale straw

4 lbs. fertilizer

18m

8/7/80

seeded, strawed, fertilized

Jason, Steve, Lois

W-line Rehabilitation Unit

Stream Crossing Treatments

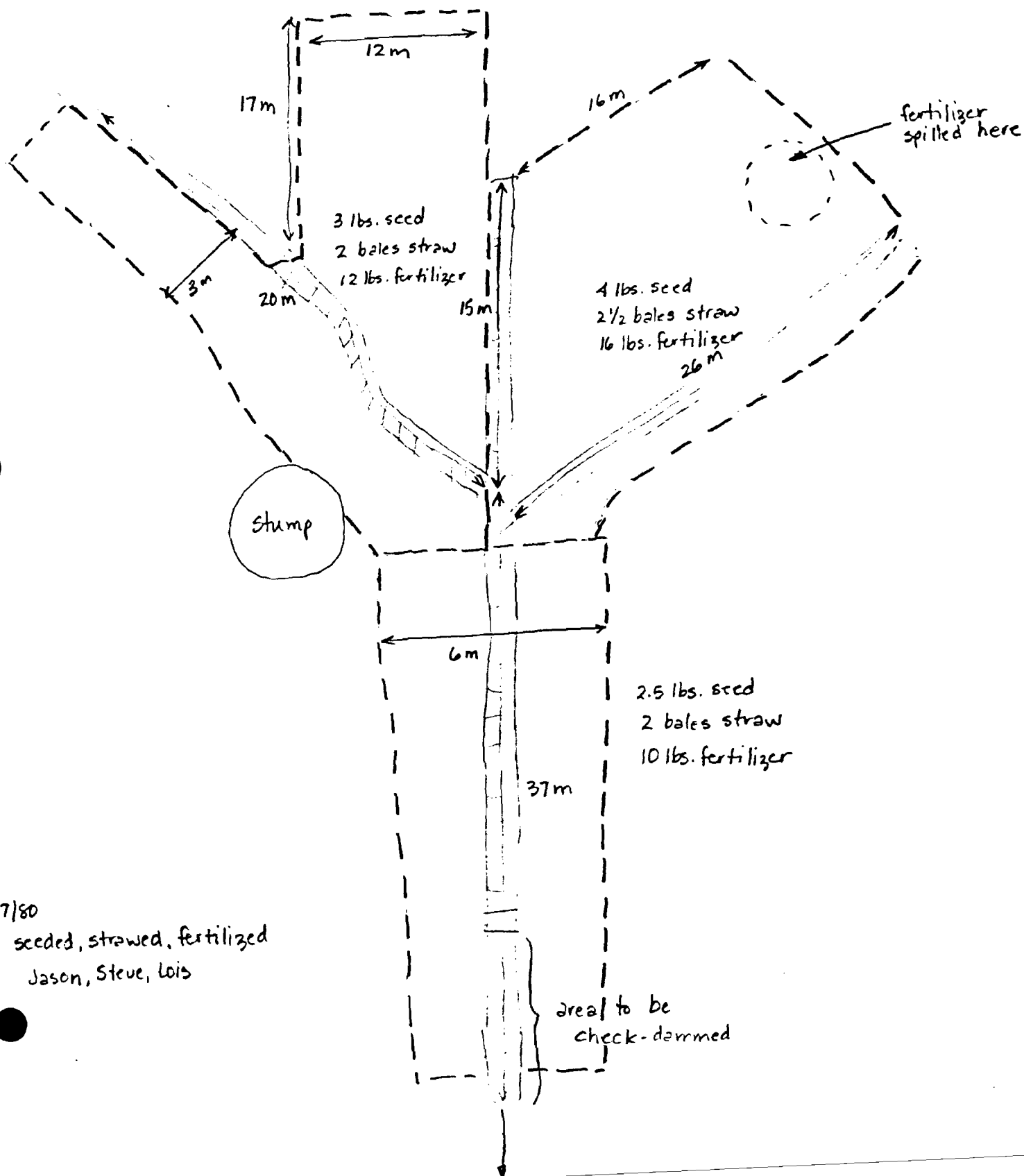
Crossing # 5

~ 800 sq. feet

9.5 lbs. seed

65 bales straw

38 lbs. fert.



8/7/80

seeded, strawed, fertilized
Jason, Steve, Lois

W-line Rehabilitation Unit

Stream Crossing Treatments

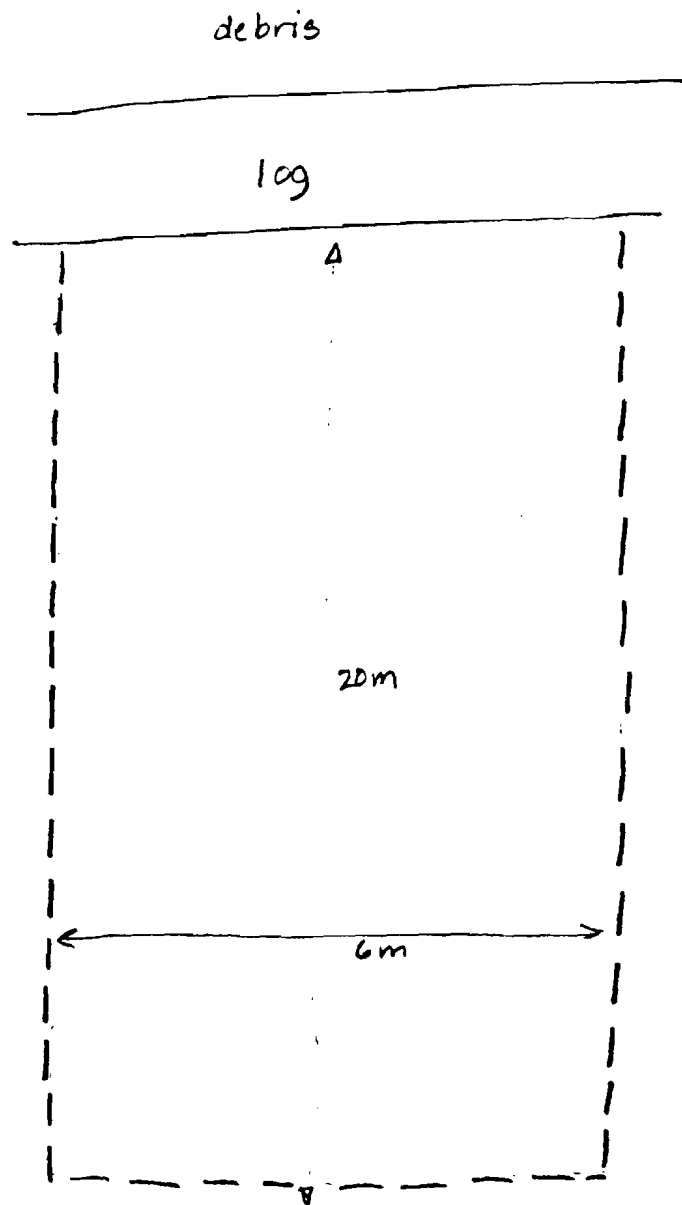
Crossing #6

~120 sq. feet

1.5 lbs. seed

1 bale straw

5 lbs. fertilizer



8/7/80

seeded, strawed, fertilized

Jason, Skue, Lois, Donna

possibly needs additional
treatment below



Unit: 80-5 1-A



Unit: 80-5 1-B



Unit: 80-5 1-C



Unit: 80-5 2-A



Unit: 80-5 2-B



Unit: 80-5 2-C



Unit: 80-5 2-D



Unit: 80-5 2-E