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SKUNK CABBAGE CREEK:  
An Evaluation of 1980 Rehabilitation  
Training Sites and Techniques

Annette M. Parsons  
Robert B. Rohde

Redwood Community Development Council  
Forest Improvement Center  
Eureka, California  
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SKUNK CABBAGE CREEK:  
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SUMMARY

This report presents a brief background of Redwood Community Development Council's Skunk Cabbage Creek rehabilitation training project in Redwood National Park. It also presents an initial evaluation of the results of the rehabilitation techniques applied. This evaluation follows the first winter season. Future evaluations should be made following several full years to more completely determine the effectiveness of the techniques.

The primary goal of rehabilitation efforts in the Park is to decrease logging-related erosion problems, and to hasten revegetation and stabilization of disturbed Park lands. The primary goal of the Rehabilitation Training Program was to provide on-the-job experience for people interested in this field, so as to contribute to individual and community job skills. The combination of these two compatible goals has resulted in a successful training and rehabilitation program.

In 1980, labor intensive techniques and heavy equipment tasks were combined to demonstrate and apply rehabilitation in three major areas within the Skunk Cabbage Creek Planning Unit. The most intensive rehabilitation efforts involved treatment of a recent logging activity-related landslide in one of the Units. Training crew participants did the labor intensive work, and heavy equipment work was contracted locally. Varying degrees of success were attained following the first season's rains. Generally speaking, rehabilitation efforts have so far aided the area in returning to a stable, vegetated condition.

## INTRODUCTION

On March 1, 1980, the National Park Service (Redwood National Park) and Redwood Community Development Council (RCDC) agreed to cooperate in the development and implementation of a long-range model demonstration training and employment program in the fields of watershed and forest rehabilitation. RCDC is a not-for-profit corporation formed exclusively for charitable, educational, and scientific purposes. This program is designed to provide training and employment to workers in the skills required for the rehabilitation of cut-over lands within Redwood National Park. The program is also intended to contribute to the economic, educational, and social levels of Humboldt and Del Norte County residents who are substantially unemployed, underemployed, or whose income is below federal poverty guidelines. The Skunk Cabbage Creek Unit in Redwood National Park was selected as the first rehabilitation and employment worksite (Figure 1).

This report will describe briefly the area and specific worksites in the Skunk Cabbage Creek Unit. For a more detailed explanation and description, refer to the Cooperative Agreement (1980), the Skunk Cabbage Creek Management Plan (1981), and subsequent Amendments I, II, and III. These documents describe in detail the Skunk Cabbage Creek Unit and specific worksites within the Unit.

In the summer of 1980, ten participants began their training in rehabilitation techniques in various planning units within the Skunk Cabbage Creek Unit (Figure 2). These planning units represent a variety of geologic, hydrologic, vegetative, and soil conditions on logged over lands. Criteria used in selecting the specific project sites within the planning units included severity of stability and revegetation problems, opportunity for application of a variety of techniques, and cost effectiveness.

The general approach to rehabilitation included geomorphic/erosional mapping, use of heavy equipment for major earthmoving tasks, and use of work crews to refine heavy equipment work, construct erosion control devices, and replant disturbed areas. Also included

were several methods of documenting rehabilitation efforts and their effectiveness; documentation included photographs, journals, and vegetative and hydrologic monitoring procedures.

The work in Unit B constituted an intensive effort to essentially reconstruct an entire drainage. Slopes were very steep, usually over 50%. Equipment operators were required to maneuver the equipment with very limited working space; at times, working clearance was less than a foot.

## GENERAL DESCRIPTION OF THE AREA

The Skunk Cabbage Creek Unit is located in Humboldt County, California, approximately 2.5 miles north of Orick, off Pacific Coast Highway 101 (Figure 1). The unit encompasses roughly 1800 acres of redwood forest lands in the coastal mountains of Northern California.

The climate in the area of the Skunk Cabbage Unit is characterized by cool wet winters, during which most of the average annual rainfall of about 70 inches is delivered. Summers are warmer and drier, and coastal fog has significant influence on plant-soil moisture relationships. Storms are generally of moderate intensity, with winds from the south-southeast. Prevailing winds are from the northwest.

The main drainage within the unit is Skunk Cabbage Creek, flowing southeast from a narrow ridge above Goldbluff Beach into Prairie Creek northeast of Orick. The underlying rock type dominant in this area is meta-sedimentary, and mostly highly sheared and faulted micaceous schist. This rock unit is characterized by deep-seated slope instability, especially when traversed by roads. The soils formed from this rock type tend to be gravelly and moderately deep to deep, with loam surfaces and heavy clay loam to clay subsoils. They are moderately erodible, and generally moderately to highly productive for timber. Slopes in this part of the Unit range from about 30 to 70 percent. In the valley formed by the creek, a freshwater marsh supports a variety of plant and animal species.

The northern portion of the Unit consists of a gently sloping plateau, draining to the north. The soil parent material in this area consists of recent unconsolidated sediments. The soils are deep and non-gravelly with loam surfaces over fine sandy clay loam subsoils. These soils tend to be highly erodible and are highly productive for timber. Slopes in this part of the Unit range between 20 and 50 percent.

A great diversity of plant and animal species can be found in the various types of ecosystems within the Skunk Cabbage Creek Unit. Various conifers such as spruce, redwood, Douglas Fir, or hemlock dominate

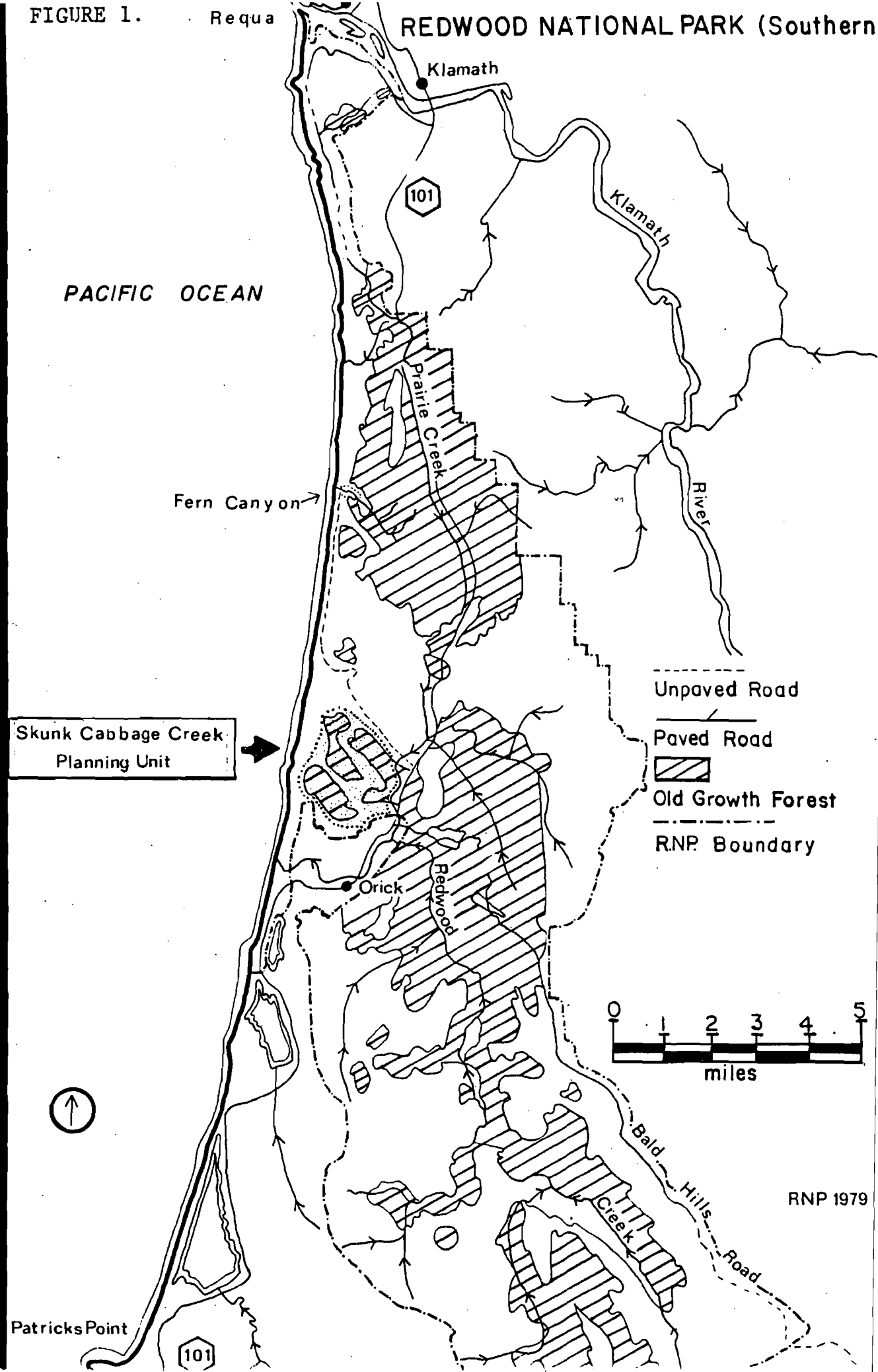
the canopy in parts of the Unit, and in some areas, red alder is the dominant cover species.

Approximately 600 acres of the Unit were tractor logged between 1972 and 1977. These logging activities and associated roads, skid trails, and landings have altered such features as water runoff, groundwater flow, soil character, and plant communities. Rehabilitation efforts are aimed at decreasing locally accelerated erosion caused by logging activities, and at aiding the land in rapid recovery to a relatively stable vegetated condition approximating that prior to logging.

FIGURE 1.

Requa

# REDWOOD NATIONAL PARK (Southern



RNP 1979

## 1980 TRAINING AND REHABILITATION PROJECTS

The planning units selected for the bulk of the 1980 rehabilitation projects were planning units A, B1, and G (Figure 2). Criteria for selecting specific sites within these planning units were discussed in the introduction.

The first step in the selection of the Skunk Cabbage Creek rehabilitation sites was preparation of a geomorphic map of each planning unit. These maps were made on aerial photograph enlargements at a scale of approximately 1:2000. The specialists mapped such features as surface drainage patterns (natural and altered), areas of rill and gully development, sheet erosion, slope failure (potential and existing), nick points, water bars (operable and breached), fill crossings in drainages, debris jams, and sediment traps.

Following mapping, the planning units were then broken up into manageable units, and priority sites were identified for initial work.

UNIT A  
SKUNK CABBAGE CREEK SOUTH

Site Description

Unit A consists of a 35-acre clear cut on the south side of Skunk Cabbage Creek, tractor-logged in 1977 (Figure 3). The underlying rock type is fractured micaceous schist. The soils in the Unit tend to be gravelly and consist mostly of brown to grayish brown, moderately deep to deep loam over heavy clay loam. They are well to moderately well drained, moderately to strongly acid, have moderate permeability, moderate erosion hazard, and are highly productive for timber. Slopes average 30 to 50 percent, on a northeast aspect. Few well-defined drainages occur in the Unit. A main haul road crosses the Unit near the bottom and at mid-slope. Land areas undisturbed by tractors are growing remnant old-growth forest understory vegetation, and alder and spruce are revegetating skid trails and haul roads.

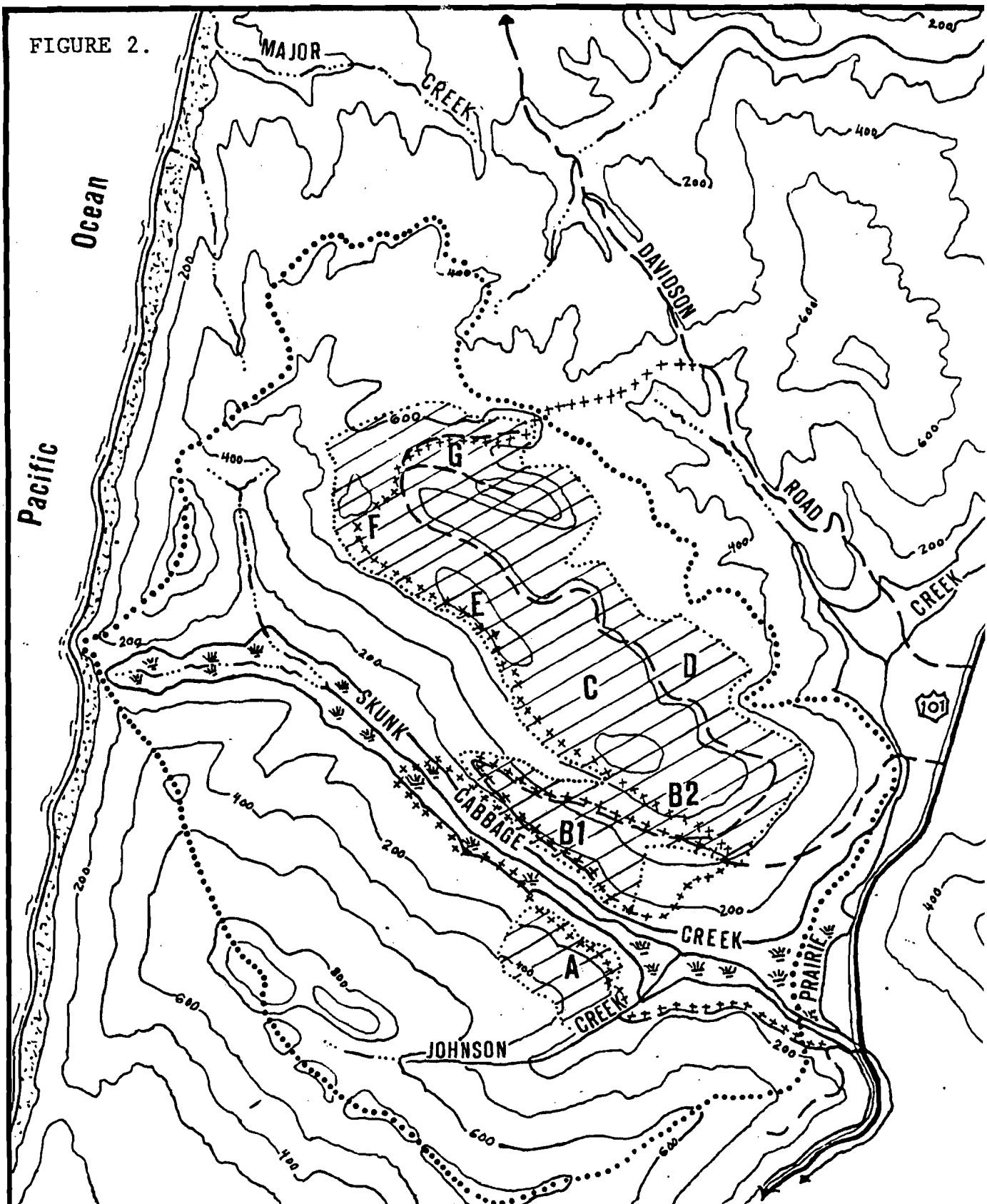
Surface erosion in the Unit is minimal. One gully and five breached water bars needed treatment. Several culverts along the main haul road presented potential problems due to clogging by debris, ponding of sediment and water, breaching of debris dams and potential dam failure.

Approach

Unit A was geomorphically mapped during the winter of 1980. Three culvert locations and three tractor constructed fill crossings were determined to be problems of highest priority in the Unit. Figure 3 shows locations of areas treated in Unit A.

Unit A was scheduled into the 1981 project when heavy equipment work on the Unit B1 slide advanced one week ahead of schedule. Unit A was added to the heavy equipment schedule with no additional time or budget modifications.

FIGURE 2.



SKUNK CABBAGE CREEK REHABILITATION PLANNING UNIT

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- ..... Planning Boundary
- Improved Road
- ++++ Proposed Trail

 Major Rehabilitation Area

Source USGS 7.5 Quad.

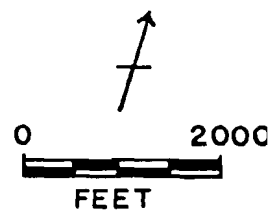
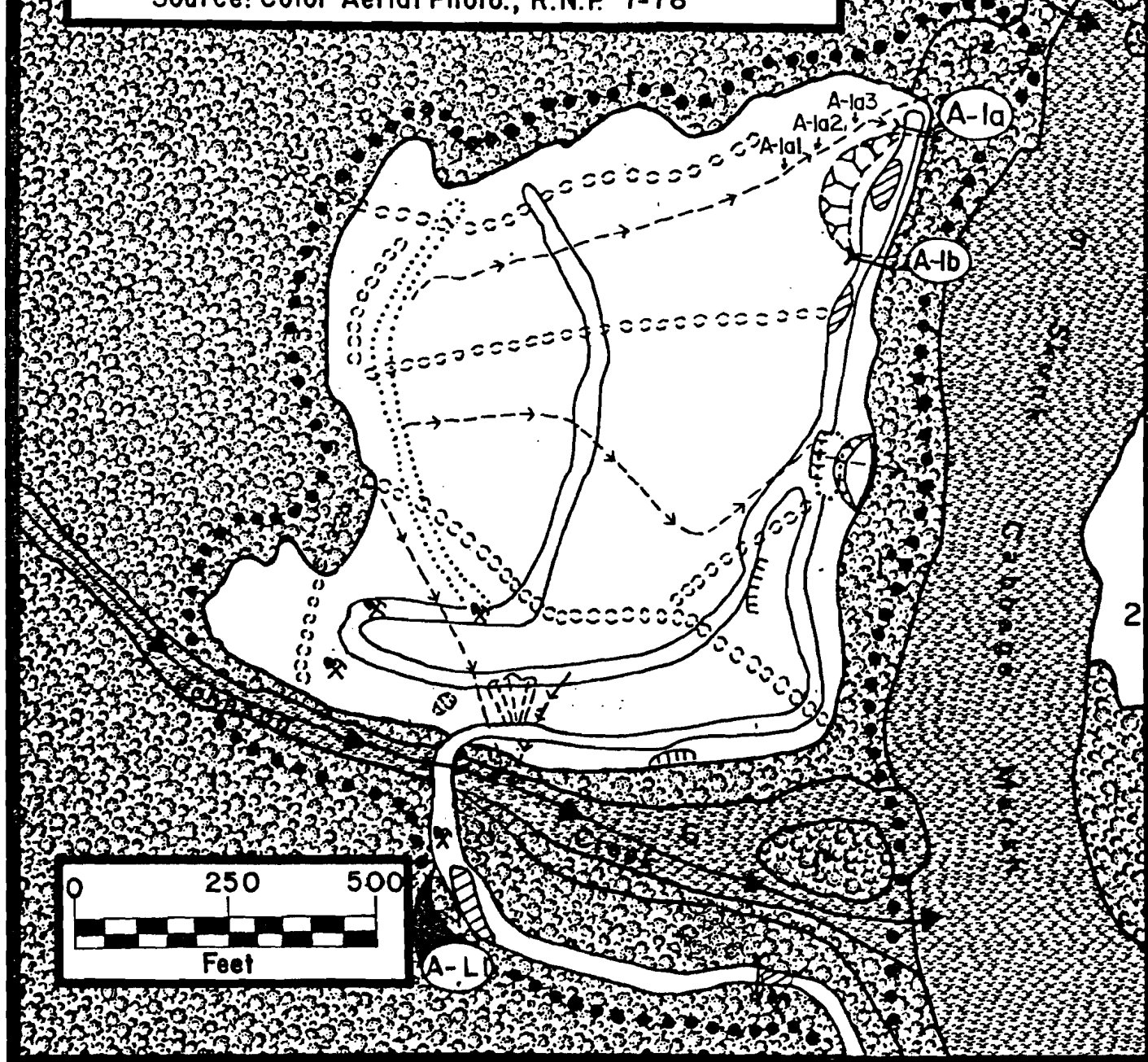


FIGURE 3.

# SKUNK CABBAGE CREEK REHABILITATION PLANNING UNIT A

Source: Color Aerial Photo., R.N.P. 7-78



# LEGEND

## Land Rehabilitation

- |                                                                                                                                       |                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
|  Ridge                                               |  Perennial Stream    |
|  Seasonal Stream                                     |  Natural Drainage    |
|  Gravel Road                                         |  Skid Trail, Landing |
|  Culvert                                             |  Nick Point          |
|  Tension or fill fracture cracks                     |                                                                                                       |
|  Active Slump                                        |  Inactive Slump      |
|  Manual Labor Site not requiring Heavy Equipment Use |                                                                                                       |
|  Debris Slide Site                                   |                                                                                                       |
| ●●● Rehab. Planning Unit Boundary                                                                                                     |                                                                                                       |

## Vegetation #s

- |                                                                                        |                                              |
|----------------------------------------------------------------------------------------|----------------------------------------------|
|  1  | Old Growth Redwood Forest                    |
|  1* | Old Growth Redwood, Spruce, & Hemlock Forest |
|  2  | Recently Harvested Redwood Forest            |
|  3  | Second Growth Conifer Forest                 |
|  4  | Pasture / Prairie                            |
|  6  | Riparian Vegetation                          |
|  8  | Coastal Spruce & Alder Forest                |
|  9  | Freshwater Marsh                             |

The major tasks in this Unit involved removal of two culverts (Sites A-1a and A-1b), and removal of three tractor-constructed fill crossings upslope from Site A-1a (Sites A-1a1, A-1a2, and A-1a3). In accordance with Park policy, the culverts were removed to reestablish the pre-existing natural drainage patterns. Following heavy equipment work, revegetation of each site was done to encourage vegetative regrowth on newly exposed soil areas.

A large mass of logging debris and loose soil material had been piled at the end of the Unit A access road. A Caterpillar tractor and excavator worked together to remove logging debris and reslope excess fill material to an approximation of the original slope contour.

Within six working days, these tasks were completed, and waterbars were reconstructed on the access road as the equipment retreated from the Site. Finally, the Caterpillar shaped and recontoured the landing (AL-1) for future use as a trail head parking area.

The cost for heavy equipment work in Unit A was \$7,649.50. A total volume of approximately 35,000 cubic yards of materials were excavated and reshaped. Cost and time details for heavy equipment work in Unit A are presented in Table 1.

Following completion of heavy equipment work in Unit A, training program participants installed several waterbars and planted tree seedlings.

Manual work primarily involved planting of seedlings on exposed soil areas at a 4-foot spacing. Channel bottoms at excavated sites were planted with alder tube stock in two rows at 1-foot spacing. Upslope from these alder rows, on the sideslopes at each excavation site, a mix of alder and conifer seedlings was planted. These seedlings were planted at 2-foot intervals. The conifer stock consisted of about 80 percent redwood and 20 percent spruce. The workers also constructed temporary foot bridges and trails at culvert removal sites A-1a and A-1b.

## Documentation

Permanent photo points were established to provide before-and-after treatment photographic records of work done. These photo points can also be used for collecting future follow-up records of treatment effectiveness and site recovery. The photo points were marked with red and yellow flagging on undisturbed trees and stumps adjacent to each rehabilitation site. The following photos illustrate the heavy equipment work done in Unit A (Figures 4 through 9).

To document and help understand natural revegetation following disturbance, an intensive vegetation survey was conducted on four plots within the Skunk Cabbage Creek Unit. Two of these plots were located at the culvert removal sites in Unit A. Prior to any heavy equipment work, the plots were inventoried using the releve vegetation monitoring system. A square area surrounding each culvert removal site was flagged with yellow flagging, forming the boundaries of the monitoring plot at each location. The vegetation was then classified into four categories as follows:

- a) the moss layer, comprising the first few centimeters above the ground surface;
- b) the herb layer of the lesser vegetation;
- c) the shrub layer; and
- d) the tree layer.

Then, within each category, each plant type was rated according to its "cover degree" and "sociability". Appendix D provides an explanation of ratings, and ratings obtained from the study plots. The Park Service established several releve plots in Unit A and other parts of the Skunk Cabbage Creek Unit.

## Effectiveness of Rehabilitation Work in Unit A

Culvert removal sites have undergone minimal adjustment since heavy equipment work. Little channel downcutting is evident. Planted seedlings appear healthy, except for a few trampled by elk. Fill crossing removal sites also appear stable. Seedling plantings are successful, and natural vegetation is good.



FIGURE 6. Fill crossing removal Site A-1a2  
after heavy equipment.



FIGURE 7. Fill crossing removal Site A-1a3  
after heavy equipment.



FIGURE 8. Culvert removal Site A-1b after heavy equipment.



FIGURE 9. Culvert removal Site A-1b after heavy equipment.

UNIT B  
SKUNK CABBAGE CREEK NORTH

Site Description

Unit B consists of 65 acres of cutover land on the north side of Skunk Cabbage Creek (Figure 10). The upper portion of the area was clearcut logged in 1972, and the lower portion in 1976. Old growth redwood forest bounds the Unit on the east and west, and the Skunk Cabbage Creek marsh forms the southern downslope boundary. Fractured micaceous schist underlies the Unit, predisposing the area to mass slope failures. Soil characteristics are similar to those of Unit A. Most slopes range between 50 and 70 percent, on a southwest aspect. A number of small drainages dissect the area, dominantly trending north-south. One main access road traverses the Unit at midslope and switches back to run along the base of the Unit, near the marsh. Numerous tractor skid trails trend up and down slope, with many trails branching along the contour.

Revegetation in the Unit is good. The primary erosion problems in this Unit are due to alteration of drainage patterns by roads and to mass slope failures. A landslide occurred in a drainage channel (Site B1-8k) in this Unit during the mapping phase of site investigation (March, 1980) (Figures 10 and 11). The slide was probably triggered by ground saturation resulting from water ponding behind tractor-constructed fill crossings. As the mass of soil and debris slid down the channel, it scoured the channel bed and banks severely. The bulk of the material came to rest on and below the main haul road. This completely blocked the road and created potential for road failure and continued movement of the material downslope.

Moderate to heavy concentrations of logging slash and debris were scattered about the slopes throughout the Unit, presenting potential fire hazards.

Approach

Unit B was mapped during the winter of 1980. The

# SKUNK CABBAGE CREEK REHABILITATION

## PLANNING UNIT BI

Source: Color Aerial Photo., R.N.P. 7-78

FIGURE 10.

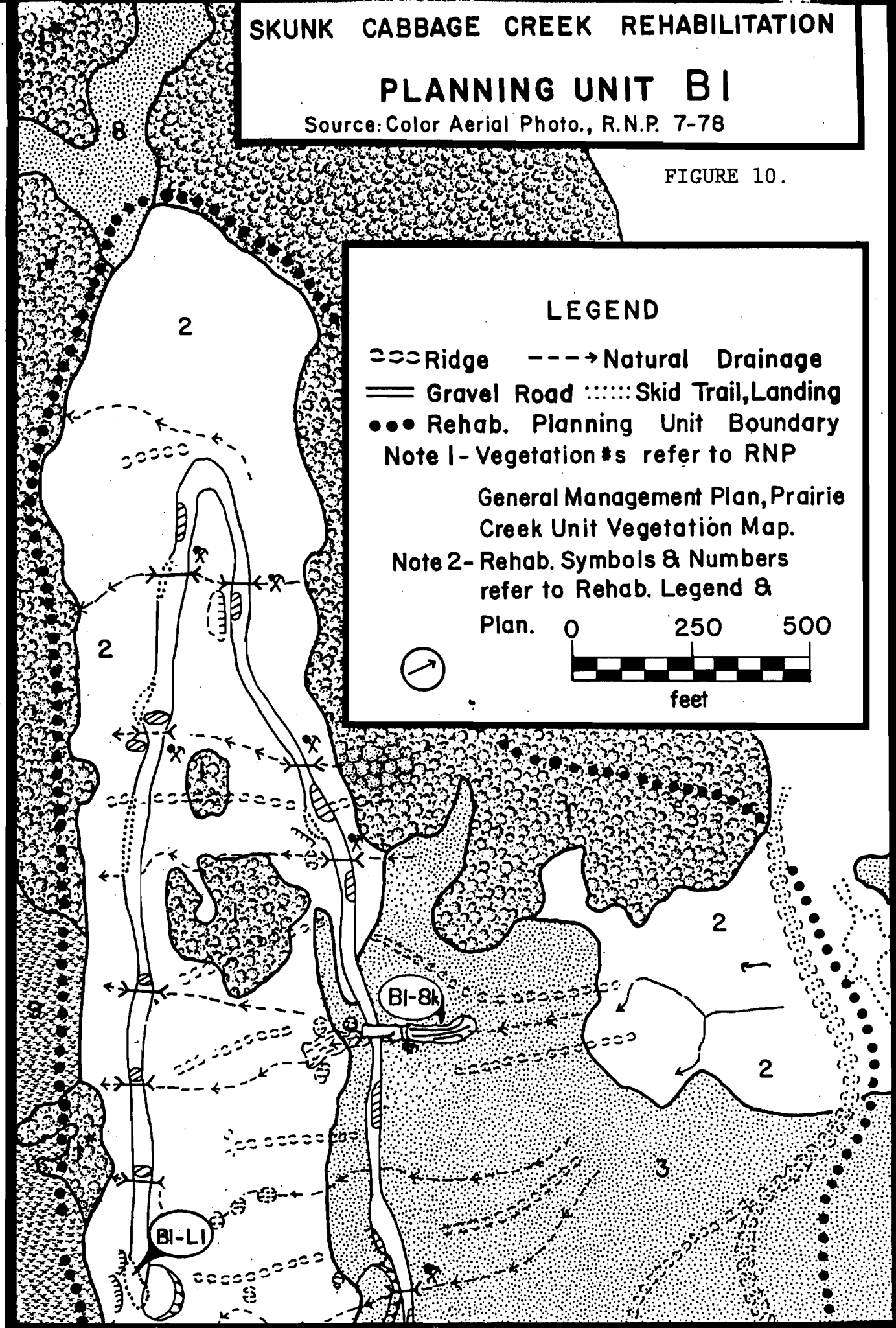
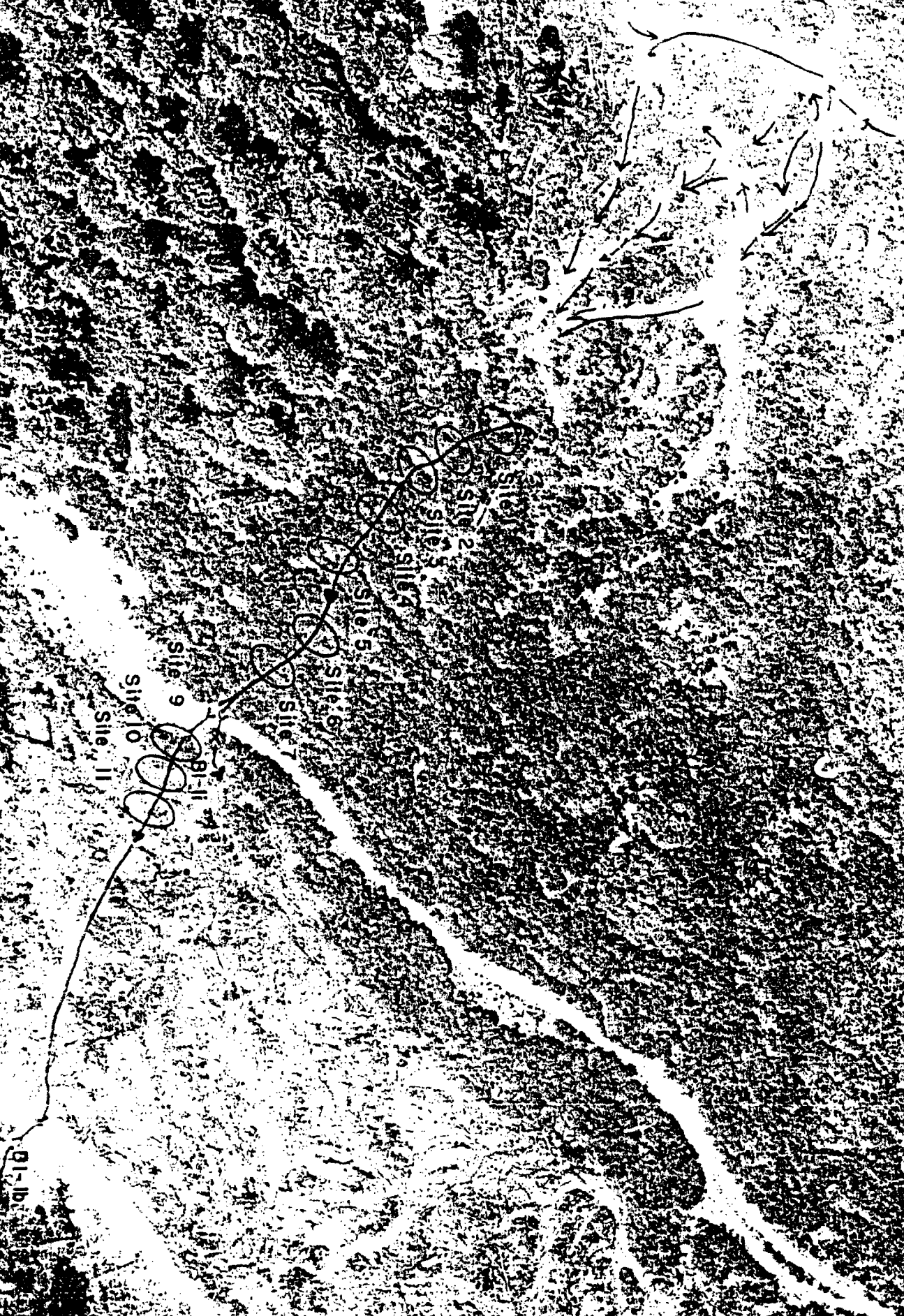


FIGURE 11.

(A)



slide at site B1-8k and logging debris on landings L1 and L3 were the primary treatments in Unit B. The landslide was the focus of intensive rehabilitation efforts in the Unit. The drainage in which the slide occurred is approximately 1650 feet in length, from the ridge top to the channel mouth at Skunk Cabbage Creek. The channel trends nearly due north-south, and has an average gradient of 45 percent. The scarp headwall of the slide is located about 700 feet down from the ridge. Approximately 1000 cubic yards of material moved 600 feet down the channel, completely scouring the channel. The exposed raw, unvegetated stream channel presented potential for severe downcutting and bank sloughing as the drainage returned to its own dynamic equilibrium. The blockage of the channel by the displaced material set the stage for future sliding resulting from ground saturation at that point and the unstable nature of the material itself.

In compliance with National Park Service objectives, each remaining skid trail crossing was removed in an effort to treat the drainage as one integral watershed unit boundary. The decision was made, therefore, to completely remove and reslope the remaining fill crossings above the slide headwall, remove excess material from failed crossings, and reslope channel banks. This plan included repair of culvert damage on the main haul road, using heavy equipment. This work was then followed with a combination of labor-intensive techniques to stabilize the stream channel and revegetate the bare slopes. The fill crossings were assigned site numbers, beginning at the top of the drainage with site 1 and ending just below the main haul road with site 11 (Figure 11). Preliminary data gathering at these eleven sites included recording such information as best route of access, percent slope, stability, and other site-specific factors necessary for development of adequate treatment prescriptions (Appendix A).

Heavy equipment work on Site 81-8k began on Sept. 8, 1980. An excavator and a D-5 Caterpillar tractor worked to remove slide debris and fill material. When-even possible, fill was removed down to the estimated natural stream channel level. This was not possible at a few of the crossings (Sites 2, 4 and 7) due to soft loose soil conditions or inaccessibility to the equipment. The crossings were excavated and resloped beginning at the top of the drainage channel and working down. Skid trails at the crossings were outsloped using fill material removed from the channel crossings.

The former haul road surface was decompacted prior to fill placement using the blade of the Caterpillar.

At the main haul road, Site 8, the old culvert was not functioning, and water was flowing down the road's inboard ditch. The existing culvert was cleaned out, and a ditch at the downhill end was dug to divert the flow into a small natural drainage channel to the east of the slide. This culvert will probably not conduct water except at very high flows, and thus will act as an overflow water channel. A larger culvert was installed at Site 8, redirecting normal flows into an energy dissipation system below the road in the newly excavated stream channel. This channel runs along a small fault zone, and has sufficient capacity to contain high flows. Heavy equipment work on the slide (Site 8l-8k) was completed by September 22, 1980.

Large volumes of logging debris were left piled or scattered on landing B1-L1 following logging. Rehabilitation work with heavy equipment involved winching and pulling apart the logs for future milling and splitting.

Landing B2-L3 on the haul road was inadequately drained, creating potential saturation and stability problems. The Caterpillar was used to construct a drainage at this site to help avoid these potential problems.

During the period from September 22nd to the 30th, 1980, a self-loader flatbed truck hauled straw to mulch sites, and check dam materials to sites where needed. Loads of millable material were transported to Site B2-L3 for future milling and use in Park structures.

Total cost for heavy equipment work in Unit B was \$23,127. A total of approximately 5,000 cubic yards of fill material were excavated and reshaped. Table 2 gives a breakdown of cost and time for heavy equipment work in Unit B.

Following heavy equipment work, training program participants began construction of a variety of channel control and energy dissipation structures, and applied revegetation techniques to newly exposed bare slopes. Such techniques as water ladders, riffle boxes, check

dams, submerged spillways, rock armoring, mulching, jute netting, wooded terraces, and terraced plantings were among those used.

The excavated fill crossings in the drainage where the landslide occurred presented a variety of unique problems. This opportunity was used to encourage creativity on the part of the program participants in developing rehabilitation prescriptions. Each separate crossing was identified as a rehabilitation site and delegated to a trainee for labor-intensive rehabilitation. This also provided the workers with an opportunity to obtain experience in designing, constructing, and supervising construction of a variety of rehabilitation structures.

#### SITE SPECIFIC DESCRIPTIONS AND EVALUATIONS

##### Site Bl-8k-1

Site 1 necessitated little hand work, as stream channel gradient was relatively gentle and consistent. Some swordferns and rushes (Juncus) were successfully transplanted onto excavated slopes. Streamflow emerges from the slope at the head of the excavated channel. No head cutting or bank sloughing has occurred, although some channel downcutting is evident.

Figure 12 illustrates the cross-section monitoring station between Sites 1 and 2. Figure 13 diagrams the channel cross-sectional shape before and after treatment.

##### Site Bl-8k-2

At Site 2, where heavy equipment was unable to completely excavate to the original channel level, a slug of approximately 3200 cubic yards of material remained in the channel. This created a potential flow barrier and/or potentially unstable mass which would be likely to fail in the future, endangering downstream structures. A riffle box about six feet in length was installed to conduct flow over a 5-foot drop-off and prevent downcutting at this point. The check dam at the head of the riffle box has filled with sediment and

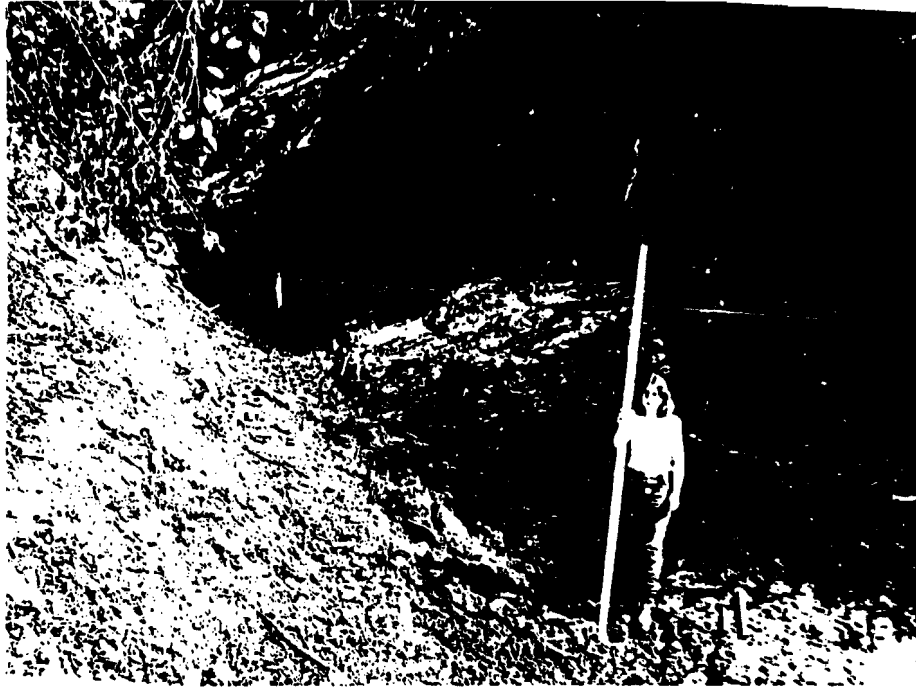
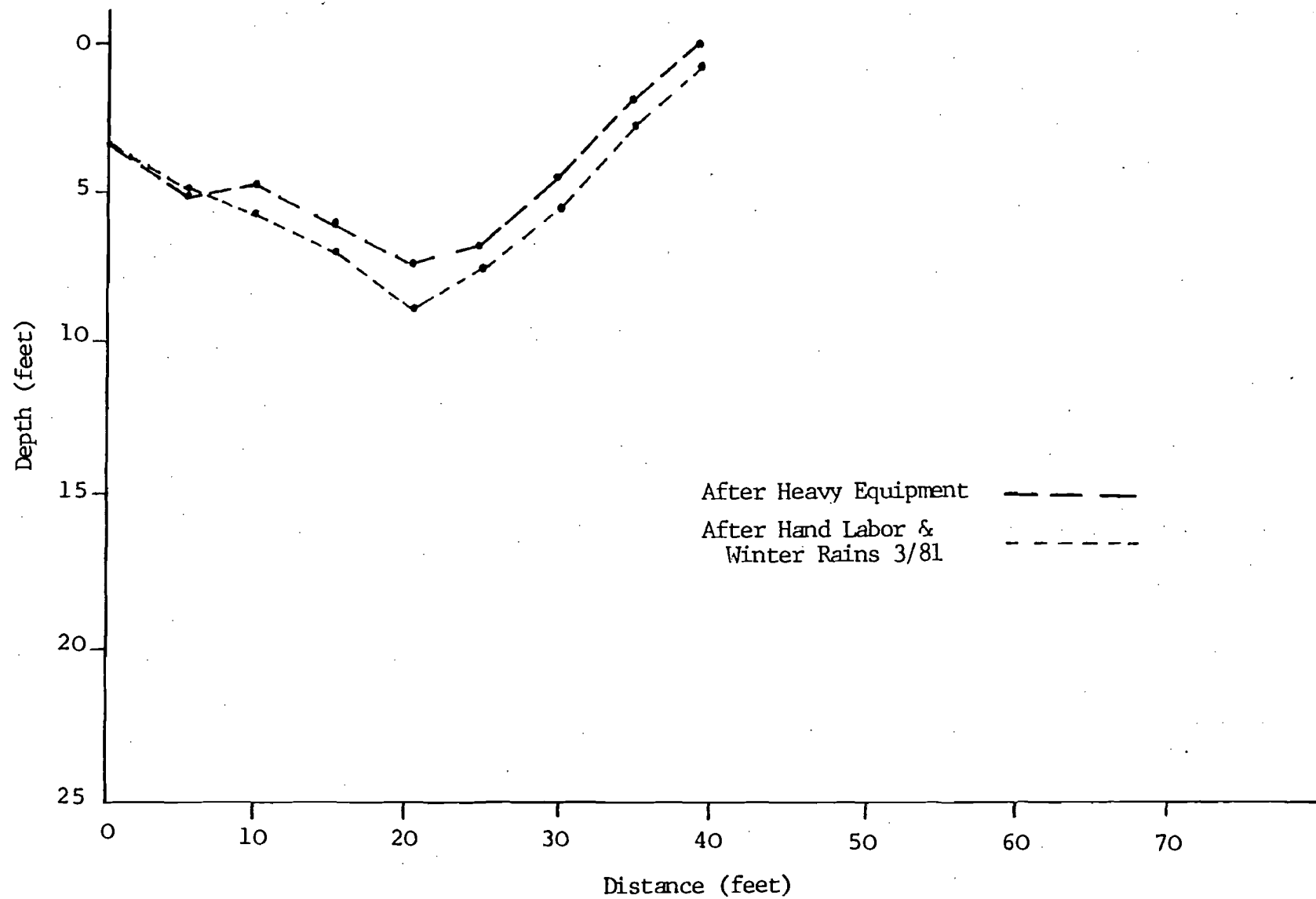


FIGURE 12. Cross section monitoring station between Sites 1 and 2.

Figure 13. Channel Cross-Section, Sites 1 & 2.



no sidecutting has occurred. The riffle box is effectively conducting flow and slowing water velocity with no significant leakage, but at the base of the energy dissipator below the riffle box, a plunge pool has developed. This is undermining the stakes which secure the rocks, and eventual failure is inevitable unless maintenance takes place. Some overall channel downcutting has occurred.

The channel banks were contour terraced to trap moving soil, slow runoff velocity, and provide a level base for plantings. Alder poles and redwood slabs were used to construct wooded terraces, and both types are functioning well. No pronounced rill development has occurred, nor has development of nick points at outside edges. The alder terraces, however, are expected to last only 2 to 3 years before rotting away, while the redwood slab terraces are expected to last much longer. A variety of planted species and propagation techniques was used to experiment with revegetation on the terraced slopes. Transplants and freshly acquired cuttings from nearby evergreen huckleberry plants (Vaccinium ovatum) were planted. Both are showing excellent survival rates. Cuttings were dipped in a compound to stimulate root development. Cuttings of coyote brush (Baccharis) which had been nursery rooted were also planted, but survival rate of this species is only about 25 percent. Sword ferns and rushes were successfully transplanted to moist areas adjacent to the stream channel. Natural revegetation is progressing well on the terraced slopes; various species of herbs, forbs, and Ribes are seeding in.

The outsloped skid road surface was straw-mulched and planted with alder, spruce, and Douglas fir. Survival rate is high and browse damage is minimal. Straw mulch was applied to the surface of the former skid trail at a rate of approximately 4,000 lbs. per acre, and is successfully protecting the soil from raindrop impact. The straw mulch also promotes infiltration and reduces rill development by reducing runoff velocity. A possible side effect of the straw mulch may be an initial upsetting of the carbon-nitrogen ratio (C:N) in the soil, resulting in a nitrogen deficiency. However, if the mulch is successful in preventing surface erosion, and if alder seedlings grow as rapidly as expected, this negative effect may be short-lived and insignificant in relation to the benefits derived.

Figures 14, 15, and 16 illustrate structures used, and before-and-after labor intensive treatment of the site.

#### Site Bl-8k-3

At Site 3, channel and bank degradation were determined to be potential problems due to channel shape and gradient. A first effort involved building rock armor along the sides of the channel, but not the bottom. This technique was rendered non-functional after the first period of heavy rains by stream flow cutting around the outside of the armor, creating a gully alongside the excavated channel bottom rather than in it. Work crews rebuilt the channel and constructed a series of rock and stake check dams, most of which were anchored against bedrock. These are effective in trapping some sediment, but plunge pools are forming at the bases of those dams not on bedrock. If undermining continues, these check dams will eventually fail, taking some sections of the stream bank with them.

Near the lower end of this stream section, slab check dams were installed. They have all filled with sediment, and no sidecutting or plunge pool development has occurred. The lowermost check dam at Site 3 is the largest check dam built on the drainage; it too is functioning well. The next dam down from the uppermost check dam at this site should be watched closely. It appears to be retaining a disproportionately large volume of sediment and is exhibiting signs of stress; the slab is slightly bowed and is developing cracks. Higher flows than have occurred to date may side cut this dam.

Channel slopes were contour terraced using alder poles and redwood slabs. As at Site 2, terraces are functioning well. Some surface erosion, as evidenced by erosion pedestals, is occurring between the terraces, but eroded material is then trapped by the next terraced downslope. Huckleberry cuttings were planted on the terraces and exhibit a high survival rate. Natural revegetation is also progressing rapidly at this site. Transplanted ferns and rushes are doing well, as are planted tree seedlings. The skid trail was mulched with straw, which is successfully protecting the soil surface.



FIGURE 14. Site 2 after heavy equipment, before manual labor.



FIGURE 15. Site 2 after manual labor.



FIGURE 16. Riffle box at Site 2.

An incised skid trail parallels the drainage channel about 150 feet to the east, running almost straight downslope. It was used as the main access for heavy equipment from the top of the ridge. This skid trail is especially a problem, as it creates an erodible channel in which water can gain volume and velocity as it proceeds down the trail. Since the trail is incised, there is no way to effectively divert water out of it. Wherever possible, water bars were constructed. One of these water bars diverts the flow to an area where it disperses and infiltrates. Downslope at the next outsloped skid trail, where the demonstration trail crosses, a seep has developed which may be a result of the water bar. At this seep area the outsloped fill material is saturated. This saturation may inhibit seedling growth, creates poor trail conditions, and may contribute to slope instability. If the seep is determined to be caused by the water bar diversion, steps should be taken to remedy the situation.

Figures 17 and 18 show before-and-after treatment for Site 3.

#### Site B1-8k-4

Large pieces of logging debris prevented complete excavation of the stream channel at Site 4. After as much of the fill material as possible was removed, streamflow went underground into a hole in the remaining fill. This created potential for instability due to soil piping and subsurface saturation. The structures built at this site were designed to keep streamflow above ground to minimize this hazard. The uppermost structure is a riffle box approximately eight feet long. The slabs which support this and other riffle boxes and water ladders are expected to act as check dams. These dams act as a foundation for the other structures. In case of significant leakage beneath the structures, a V-notch has been cut into these slabs to discharge any water that may build up behind them (Figure 19).

The riffle box at Site 4 functions as designed, with no significant leakage. Cotton fiber caulking was used to seal joints in flow-conducting structures and has proven to be effective. Below the riffle box, a series of slab dams and rock and stake dams help to

prevent channel downcutting and trap sediment (Figure 19). The dams appear to be large enough to handle most high flows, and little or no plunge pool development can be observed. A foot bridge was constructed across the stream channel at Site 4 for the observation trail. Below this bridge, steepness of slope and depth of excavation, beyond the limits of the equipment, prevented complete channel excavation. Streamflow began to flow subsurface at the top of the scarp headwall created by the slide of March 1980; saturation and piping here would greatly increase potential for further sloughing of the oversteepened scarp. To avoid this, a slab check dam and riffle box series was built to conduct flow above ground and into the water ladder at Site 5. Some water flow is creeping back through the V-notch under the riffle box and saturating the ground beneath the box. The degree of saturation does not appear great, and the problem can be easily treated by nailing a small bat under the lip of the riffle box, or by closing off the V-notch under the riffle box altogether.

Straw mulch was applied to the outsloped former skid trail, with successful results. The tree seedlings planted here are doing well, as are the fern and rushes transplanted.

Figures 20 through 22 show before-and-after treatment site characteristics.

#### Site B1-8k-5

This reach of channel consists of the March 1980 slide headwall area. A water ladder about thirty feet long conducts water from the above riffle box, over the oversteepened scarp, and onto an extensive area of shingle-lapped rock armor. No significant leakage from the wooden structures is evident. Regular inspection and maintenance of the water ladder will be necessary to insure against serious leakage and malfunction, as ground saturation at this point could result in another deep-seated failure, destroying all structures downstream. The rock armor, which is anchored firmly into bedrock at the base, is functioning well to prevent channel and bank degradation. A small amount of side cutting at the base of the armor does not appear to be undermining the support base. The steep area on both



FIGURE 17. Site 3 before treatment.



FIGURE 18. Site 3 after treatment  
and first winter's rains.

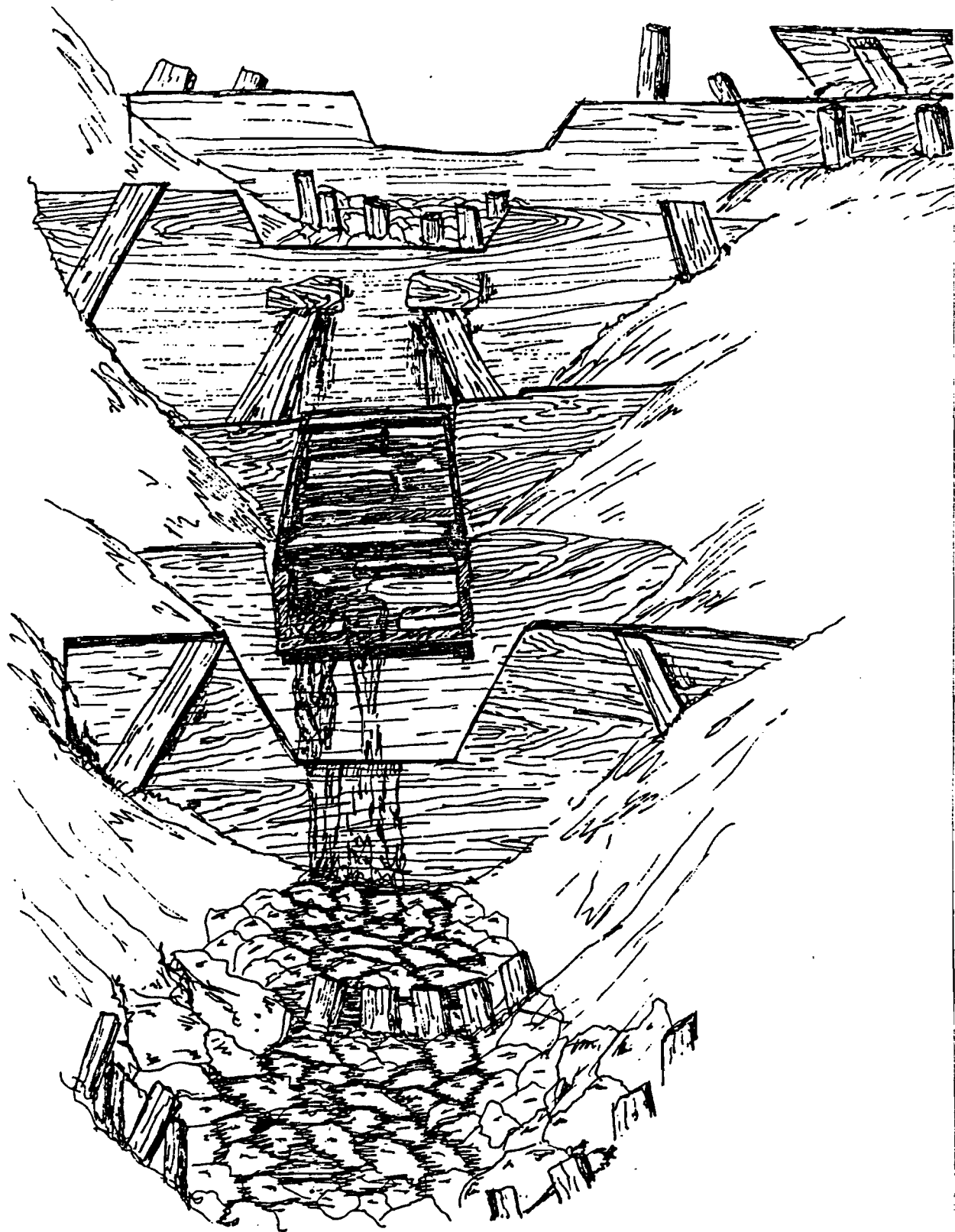


FIGURE 19. Erosion control structures at the lower end of Site 3, upper end of Site 4.

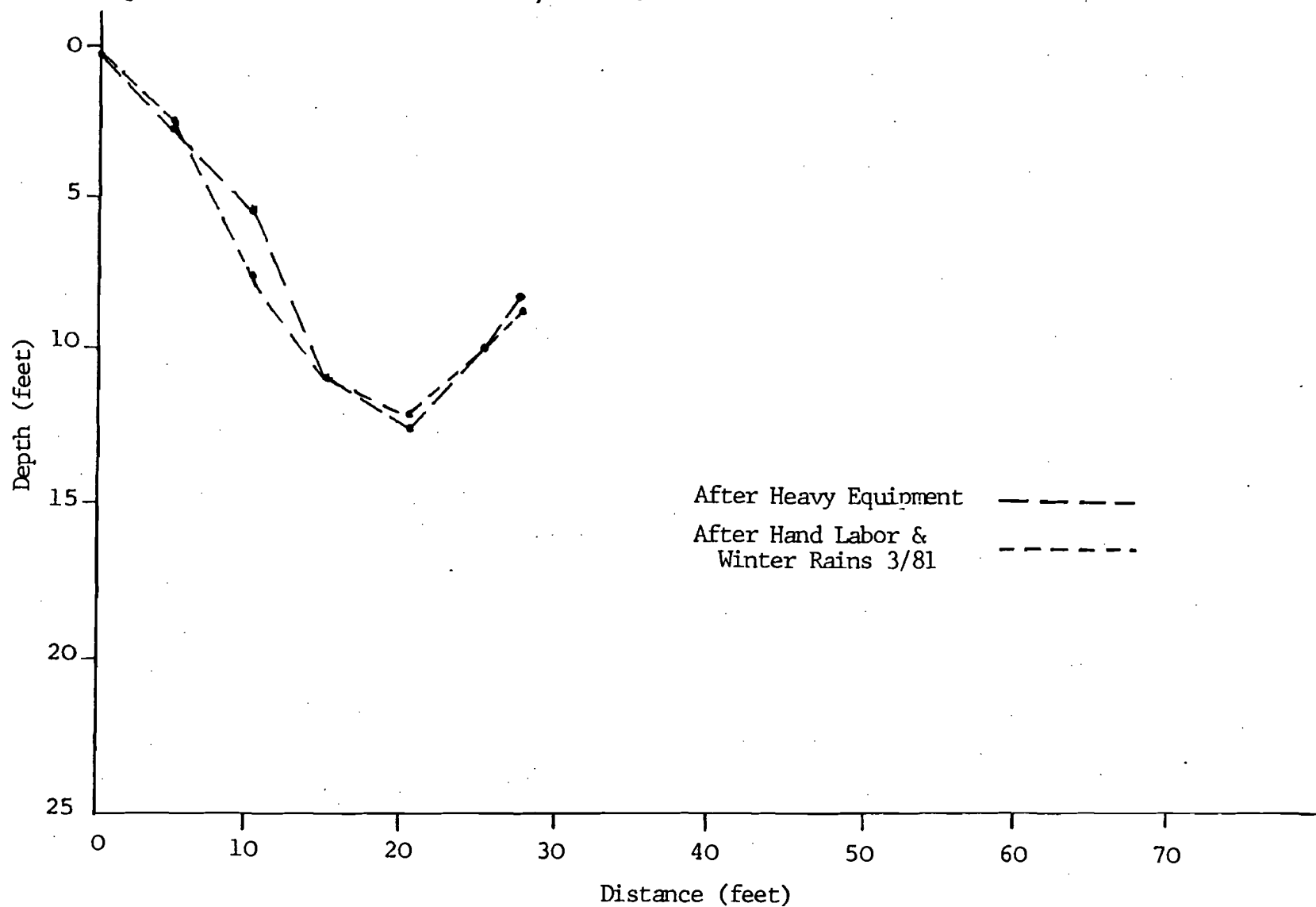


FIGURE 20. Site 4 after heavy equipment, before manual labor.



FIGURE 21. Site 4 after manual labor and after first season's rains.

Figure 22. Channel Cross-Section, Site 4.



sides of the water ladder and rock armor was mulched with straw secured with jute netting. These areas are natural seep areas; therefore, alder and rushes were planted to rapidly establish a good vegetative cover with adequate root strength to help stabilize the area. The former skid trail was treated as previous sites, with straw mulch and planted tree seedlings.

Figures 23 through 26 illustrate the management sequence at Site 5.

#### Site B1-8k-6

Manual labor prescriptions for Site 6 involved a series of submerged spillways, spaced about 15 feet apart toward the top of the reach, and nearing 30 feet apart at the lower end of the reach. They were intended to channelize flow and prevent downcutting and nick point development. In every case, a plunge pool has developed below the energy dissipator at each spillway. In some cases, the structures themselves have been undermined (Figure 27). These structures will probably eventually be completely undermined and fail. This area merits careful observation; it may be deemed beneficial to remove some or all of the structures, depending on the progress of channel degradation and stability of the structures.

On the skid trail to the west of the channel at Site 6, natural mulch was applied rather than straw, using forest litter collected from adjacent areas. In terms of providing soil protection, slowing runoff velocity, and promoting infiltration, the natural mulch is at least as effective as the straw mulch used at other sites. If the litter used is rich in alder litter, there may be an advantage over straw from less serious disruption of the soil C:N ratio. This was an initial attempt at applying natural mulch to a disturbed site. Problems in collecting the leaves and duff were experienced which discouraged the continuation of this technique. A more extensive experiment utilizing available natural mulch should consider the labor time required for natural mulch vs. the purchase, transportation and labor involved in straw application.

Seedlings and transplants at Site 6, as at the other sites, look healthy, and survival rate is high.



FIGURE 23. Site 5, before treatment.

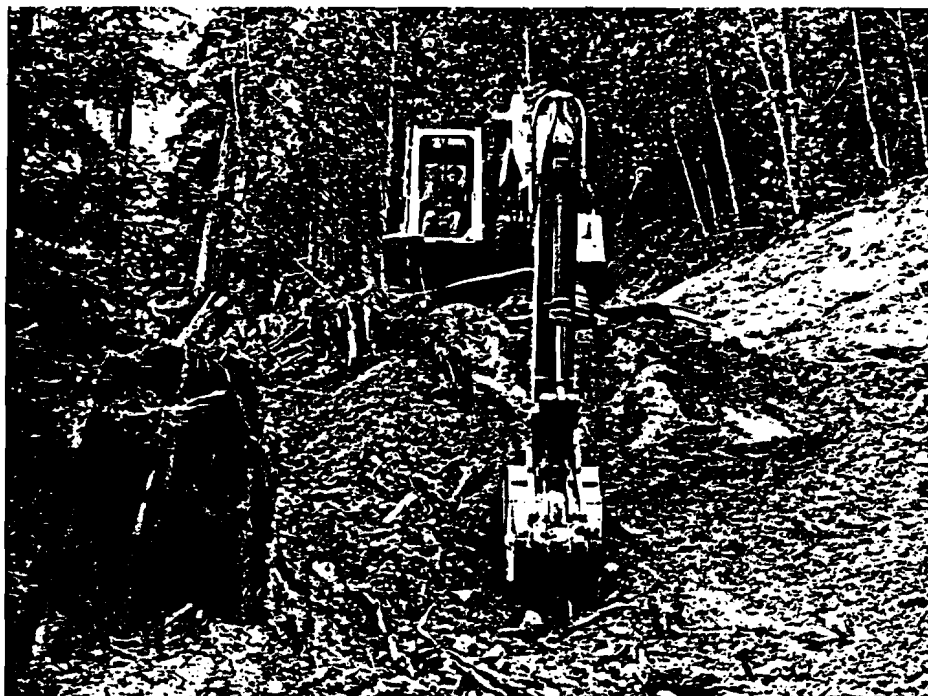


FIGURE 24. Site 5 during heavy equipment.



FIGURE 25. Site 5 after heavy equipment and manual labor.

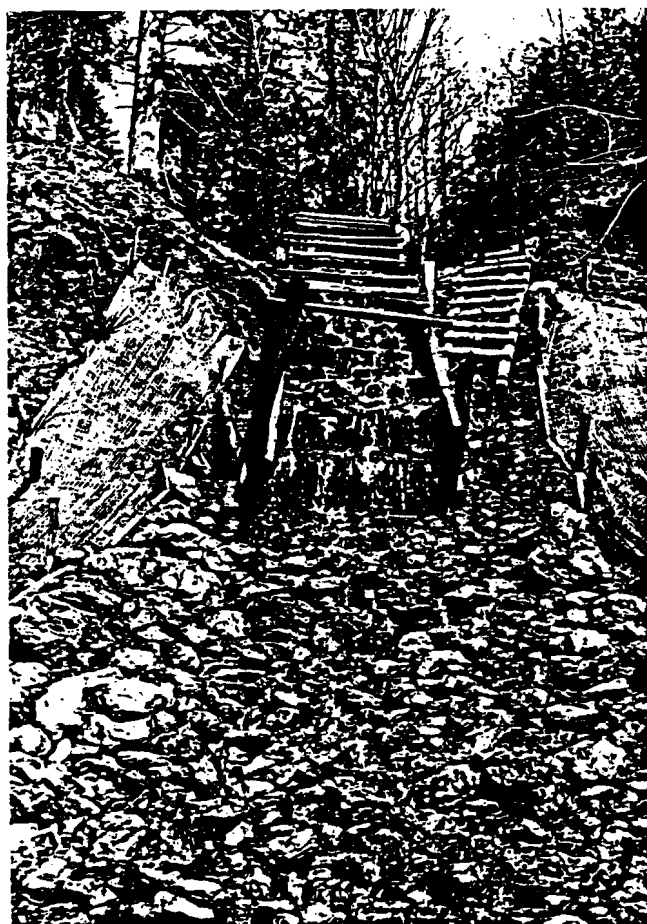


FIGURE 26. Water ladder, jute netting, and rocking at Site 5.



FIGURE 27. Undermining of submerged spillway from plunge pool development.

Figures 28 through 33 provide a record of changes at Site 6.

#### Site B1-8k-7

The stream reach at the upper end of Site 7 did not appear to present particular problems. For this reason no channel control structures were built. Some down-cutting has occurred, but it is not severe, and the channel appears to be stabilizing itself successfully. Perhaps Site 6 would have experienced as little adjustment as Site 7 if it had been left alone.

Near the middle of the Site 7 stream channel reach, a large log lying directly along the channel was immovable. A rotted center provided a natural channel for very low flows, and with chainsaws the workers cut out the center of the log to contain higher flows as well. At the outflow point of the log and at natural nick points in the channel, pronounced plunge pool development is occurring. (Figure 38).

At the lower end of Site 7, a series of slab check dams and adjoining boxes are effectively trapping sediment, and no sidecutting has taken place. These check dams utilize double spillways, for low and high flows, and are high enough to handle very high flows. This check dam system discharges onto a short and wide water ladder with sloping, wide treads. The entire system is functioning well, and no problems are evident.

Figures 34 and 35 show before and after labor intensive phase appearance of the Site.

#### Site B1-8k-8

Site 8 consists of the main haul road stream crossing. The original culvert was poorly placed and was ponding water below the road. Tension cracks indicated a large unstable mass of material below the road. A 24-inch culvert, removed from one of the Park's other rehabilitation sites, was installed in the newly excavated channel line. The original culvert was left in place and a ditch was constructed at its outlet below the road, to direct water into an adjacent small

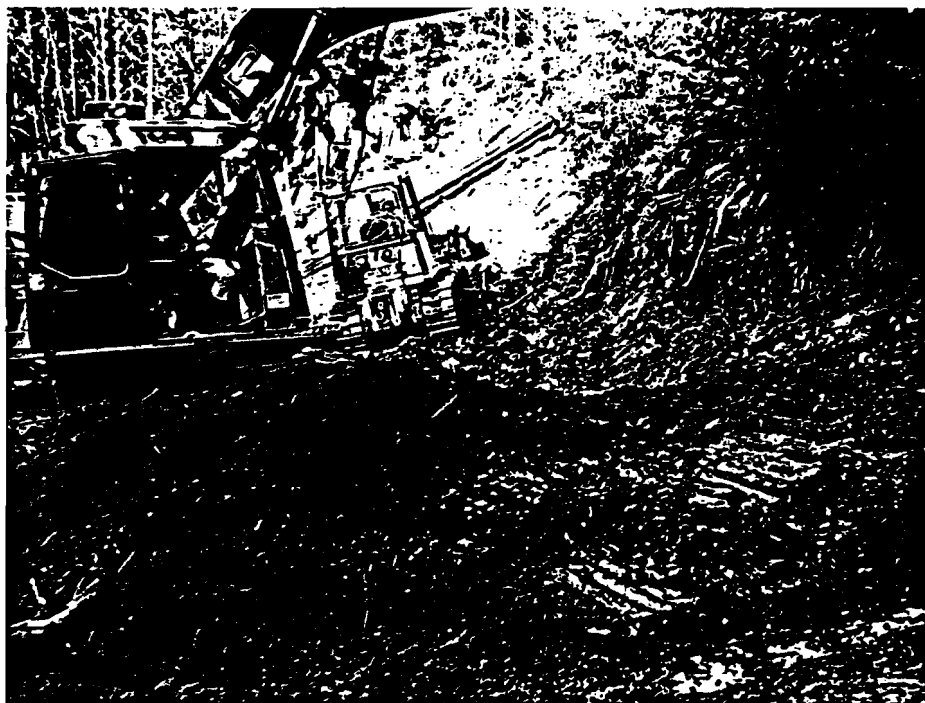


FIGURE 28, Heavy equipment at Site 6.



FIGURE 29. Site 6 after manual labor and first winter's rains.



FIGURE 30. Heavy equipment at Site 6.



FIGURE 31. Heavy equipment and manual labor work completed, Site 6.

FIGURE 32. Erosion control techniques  
at Sites 5 and 6.

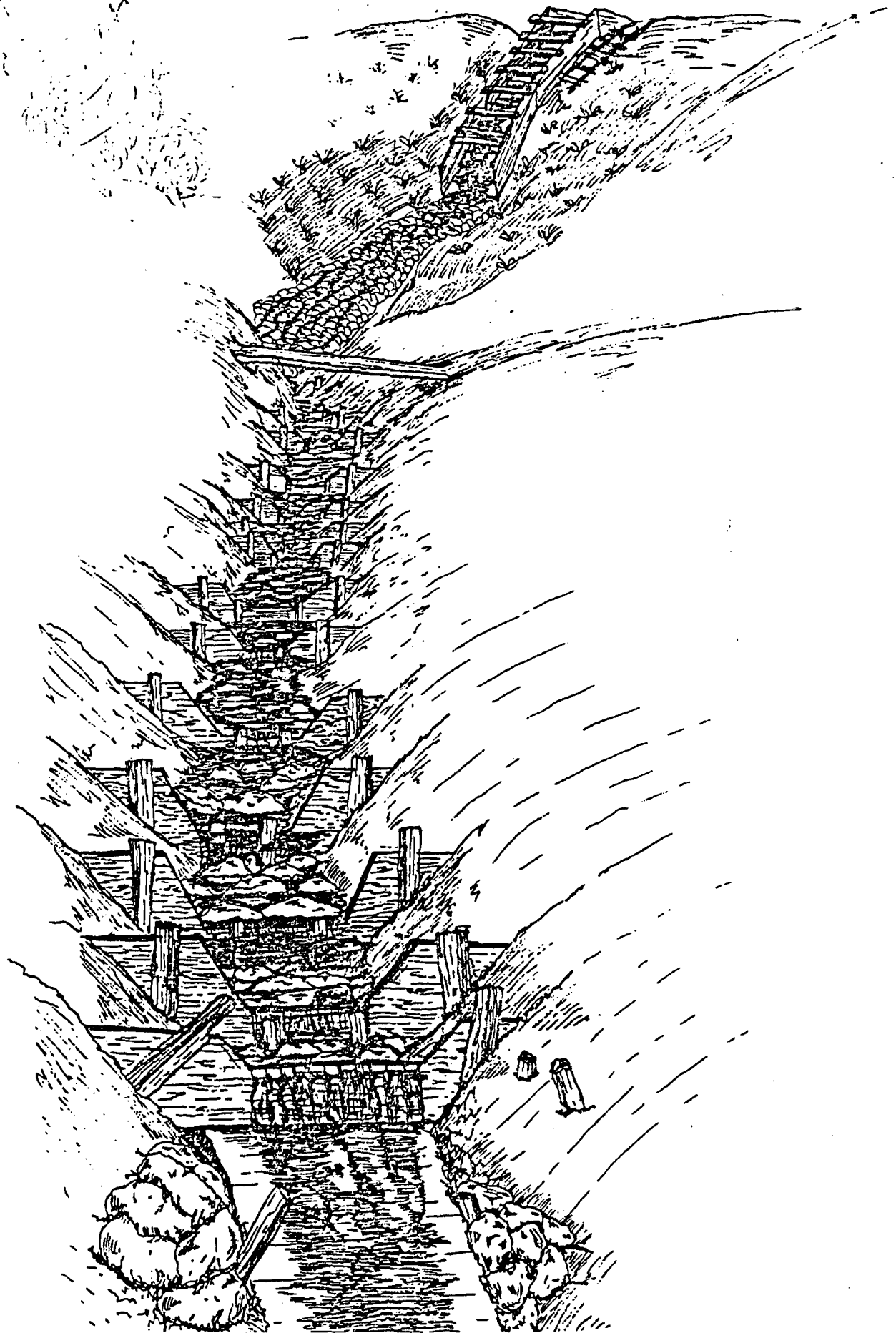


Figure 33. Channel Cross-Section, Site 6.

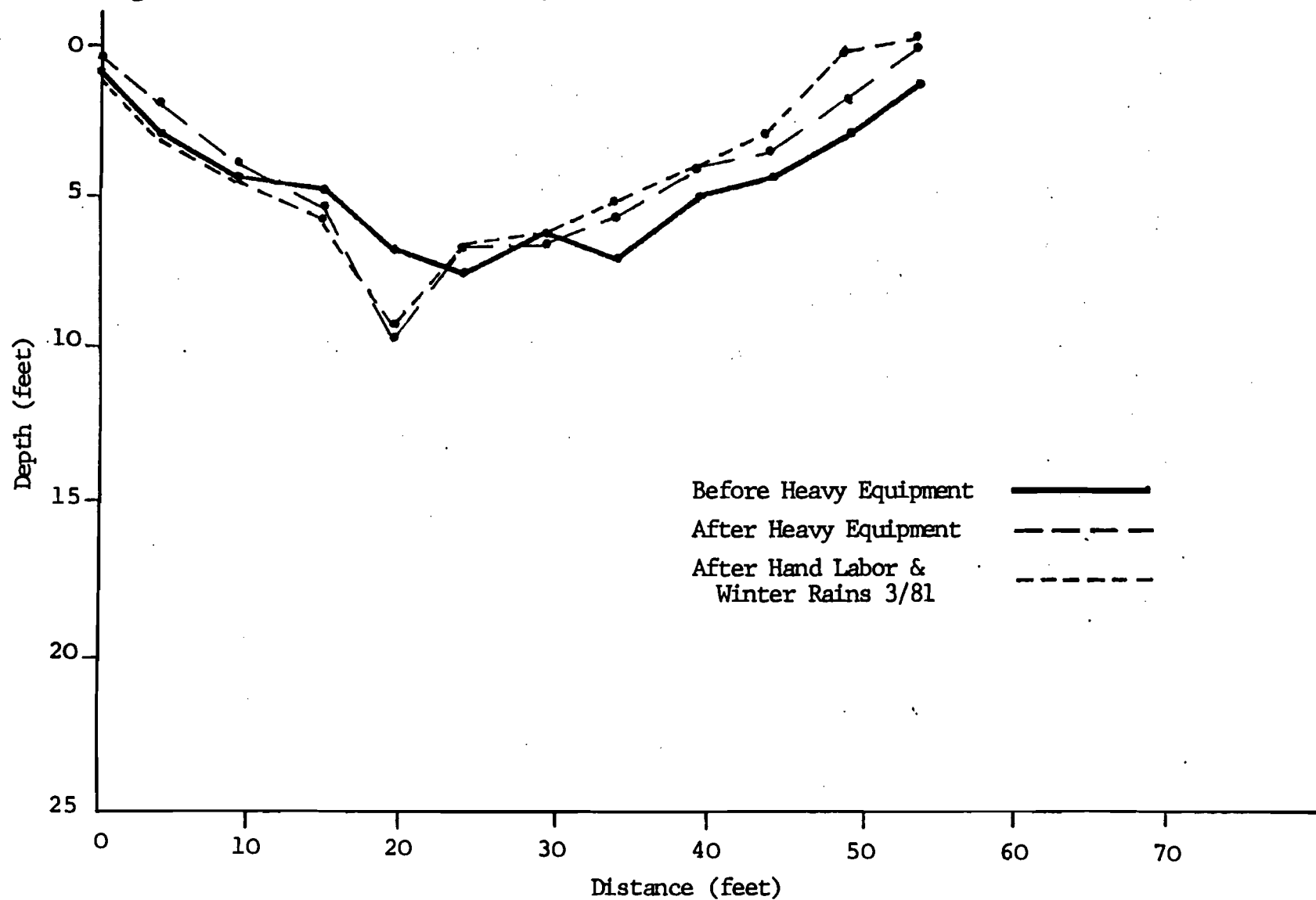




FIGURE 34. . Site 7 after heavy equipment, before manual labor.

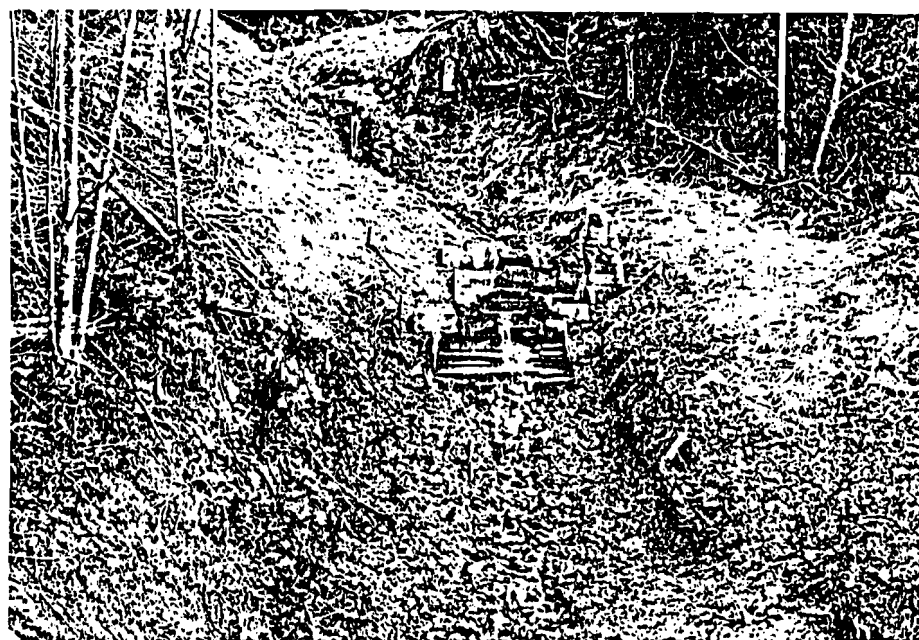


FIGURE 35. Site 7 after manual labor and first winter's rains.

drainage. The original culvert can act as an overflow water diversion if culvert blockage or streamflow exceeds the capacity of the newly-placed culvert.

Figure 36 diagrams changes in channel cross-section before and after treatment.

#### Site Bl-8k-9

The upper end of Site 9 required an energy dissipation system for outflow from the newly installed culvert. A trough was installed, constructed from a culvert cut longitudinally in half. This trough discharges into a box constructed of alder poles and filled with large rocks and wood debris, which is a temporary measure until road removal. This box traps sediment and dissipates flow onto a slab energy dissipator, which has been undercut. A small amount of runoff from the road surface was running under and parallel to the culvert trough and developing a small gully. Waterbars were built on the road to divert this runoff and prevent further gully development.

Channel downcutting is pronounced in the section below the trough-box system, in some places exceeding one foot in depth. Several rock and stake dams were installed, exhibiting varying degrees of success. The redwood slab dams installed are functioning with no apparent problems.

Steep slopes created where the skid trail had been were contour terraced using alder poles. Rill and gully development has undercut the poles in several places, necessitating maintenance and repair. Transplants and tree seedlings are doing well, and natural revegetation at this site is proceeding very rapidly.

Figures 37 through 39 provide a record of the changes at Site 9.

#### Site Bl-8k-10

At Site 10, a riffle box about 15 feet in length conducts flow over a steepened channel reach. The only apparent problem is a slight plunge pool developing at its base. A submerged spillway which was intended to

Figure 36. Channel Cross-Section, Site 8.

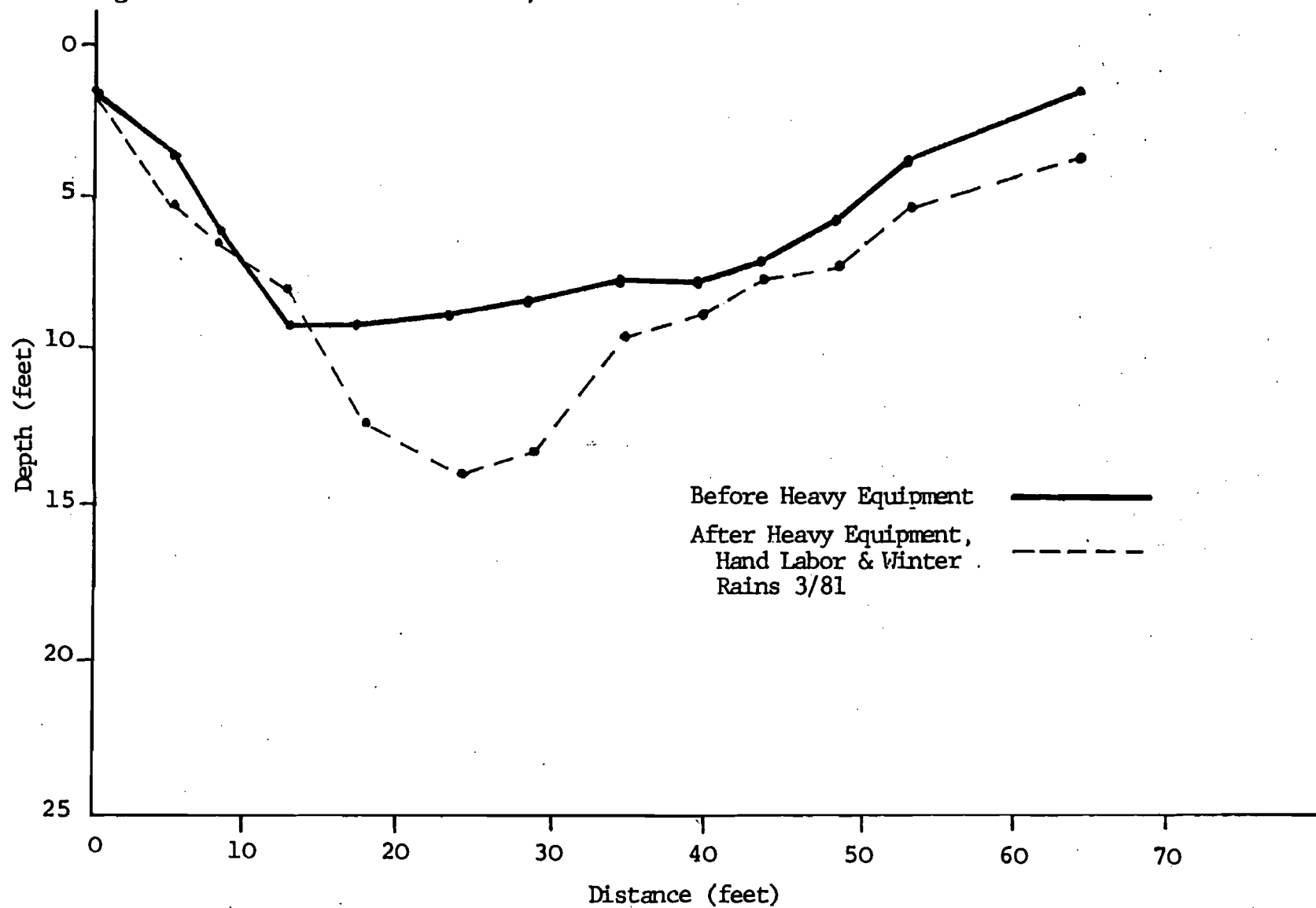


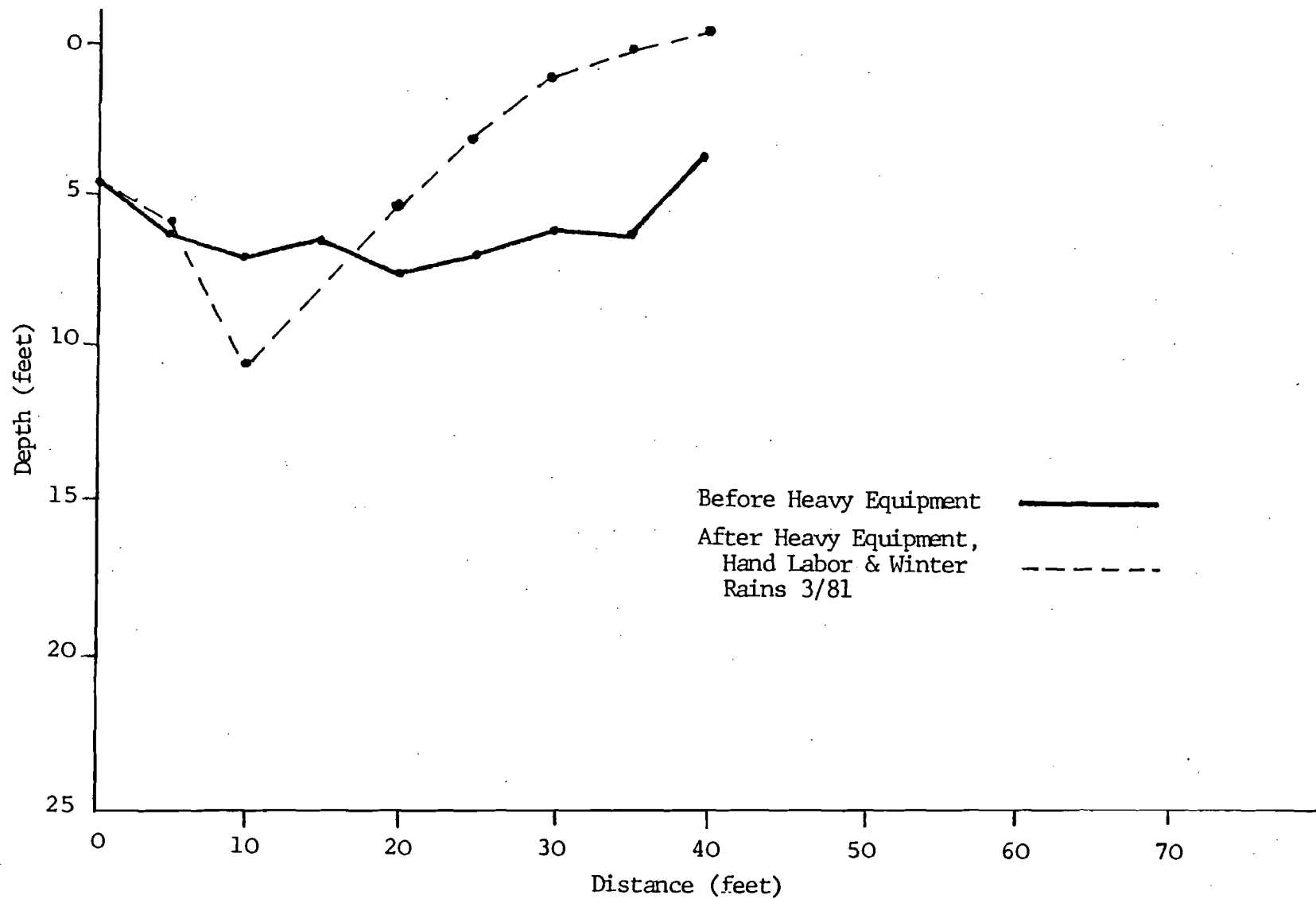


FIGURE 37. Heavy equipment at Sites 9 & 10.



FIGURE 38. After manual labor and first winter's rains Sites 9 & 10.

Figure 39. Channel Cross-Section, Sites 9 & 10.



halt development of a nick point has been severely undercut, threatening the structure and adjacent channel banks. From this point on down, no further channel structures were built. The stream flows onto bedrock, to a drop of about 15 feet. The contour terraces constructed on raw exposed slopes at this site were constructed of shorter poles, and are not continuous across a terrace level. Rills and gullies are developing where gaps in a terrace occur. These terraces need some repair, and perhaps should be replaced with longer poles to form a continuous terrace at each level. Planted seedlings look good, and horsetails (Equisetum sp.) are returning to the slopes in abundance.

A diagram of structures at this site, and before-and-after treatment of Site 10 are shown in Figures 40 and 41.

#### Site B1-8k-11

The channel at this final treatment site on the drainage was excavated to carry water above ground. A large volume of logging debris was pulled out of the former stream crossing. At the base of the fifteen-foot drop (bottom of Site 10), chicken wire was used to secure rocks to the channel in an attempt to dissipate energy from the fall. Edge cutting is occurring around this, and bank sloughing has occurred around several large plunge pools. Seedling planting was the only other hand work done at Site 11. The seedlings are doing well, as is natural vegetation.

Figures 42 through 44 show changes at Site 11.

From this point on down to the confluence with Skunk Cabbage Creek, the channel underwent no further treatment. The total number of redwood seedlings planted in Unit B1 was approximately 1085. Roughly 975 spruce, 765 alder, and 500 Douglas fir seedlings were also planted, as were approximately 1000 rushes (Juncus sp.) and 250 ferns with other transplants. Labor intensive work was essentially completed by October 30, 1980, except for a few subsequent plantings of tree seedlings and some maintenance work.

FIGURE 40. Riffle box at Site 10.

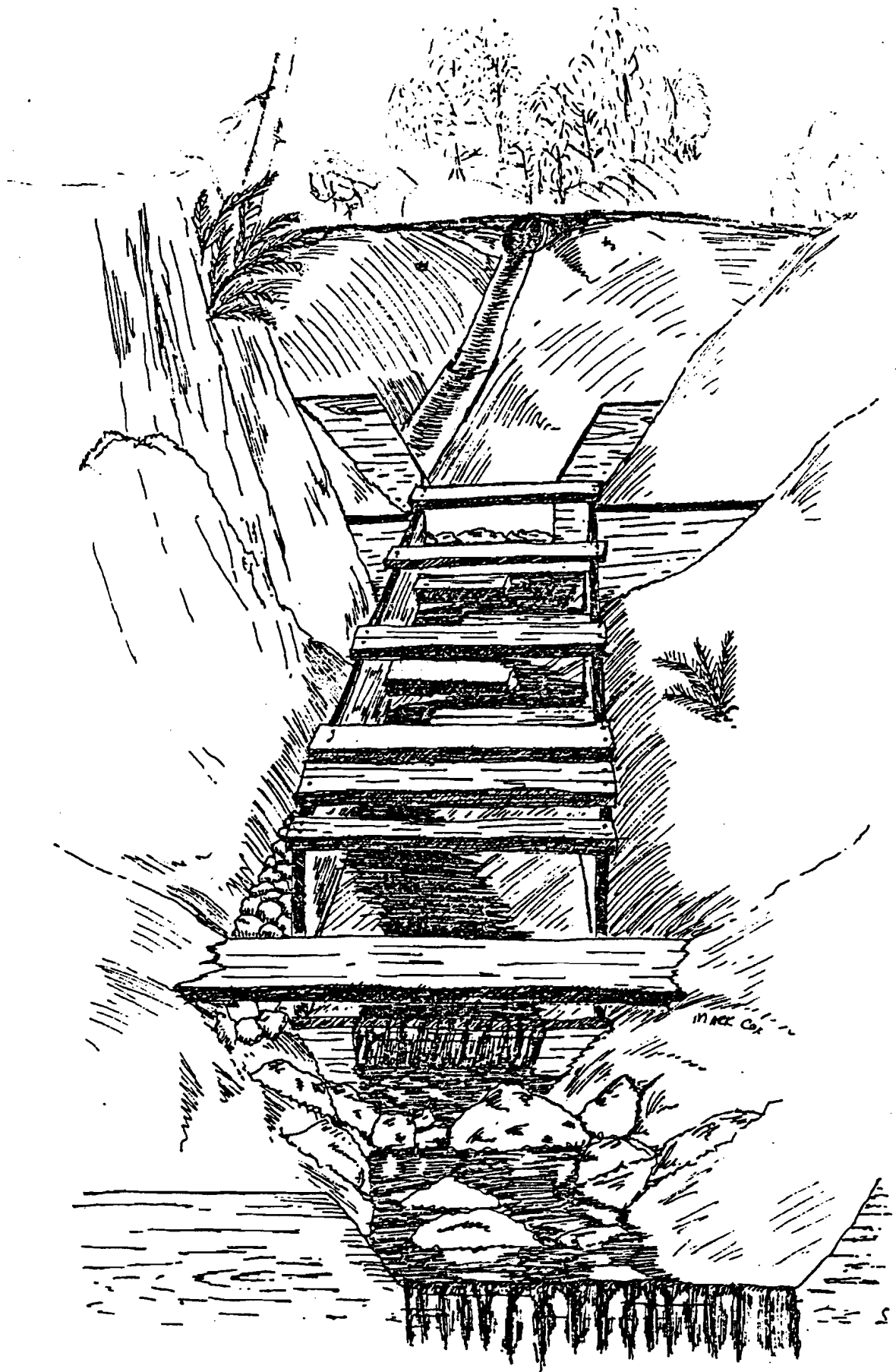


Figure 41. Channel Cross-Section, Site 10.

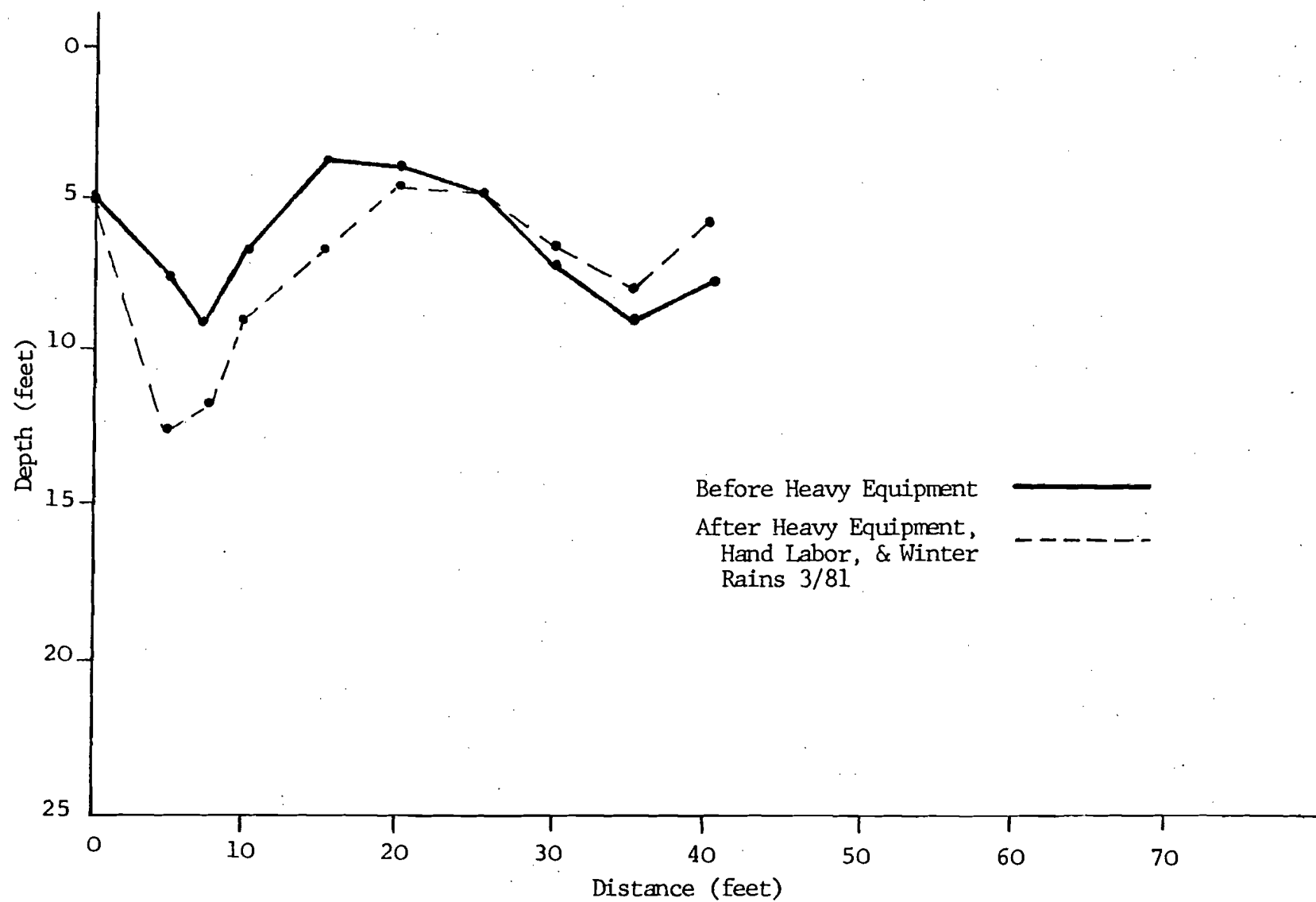


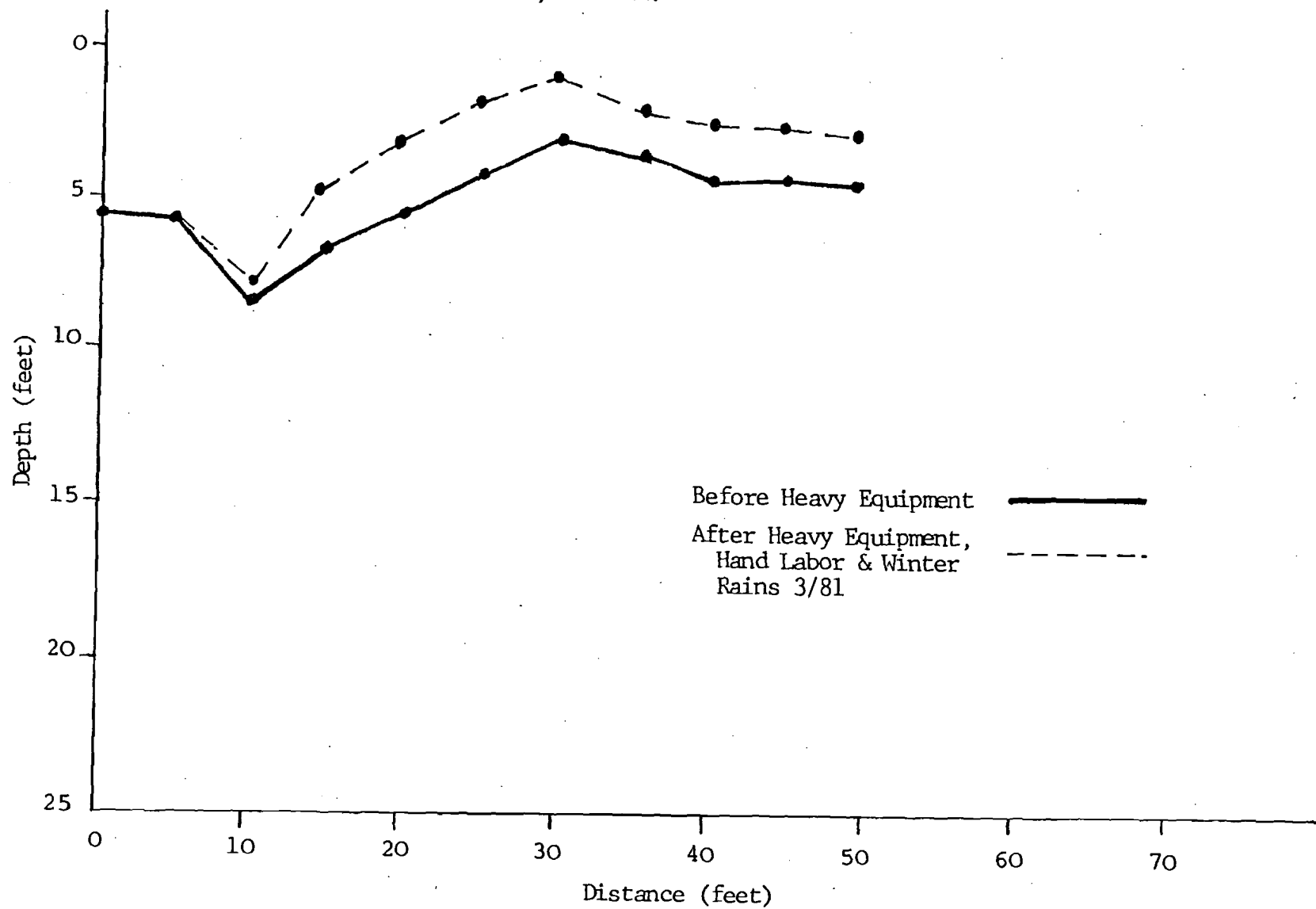


FIGURE 42. Site 11 before treatment.



FIGURE 43. Site 11 after heavy equipment.

Figure 44. Channel Cross-Section, Site 11.



## Documentation

Three methods of documenting changes through time have been established in Unit B. Prior to work by heavy equipment, permanent photo points were established at each fill crossing, and flagged with red and yellow flagging, before treatment. Also established at seven of the crossings were permanent stream channel cross-section monitoring stations. Figure 11 shows the locations of these points. These stations were marked by stakes placed at a distance from the stream channel adequate to avoid disturbance during rehabilitation procedures. Compass bearings and distances from other stakes were recorded to provide a means of relocating a point in the event a stake was disturbed. The monitoring procedure used was adapted from that used by Redwood National Park personnel in its own monitoring projects. Cross sections were monitored before heavy equipment, after heavy equipment, and after hand labor work following the first winter's rains, March 1981. Appendix C shows a sample cross-section data collection page.

An intensive vegetation survey was conducted in two areas in Unit B, near the end of the main haul road. The releve monitoring system was used, as on the two plots in Unit A. The plots selected were proposed culvert removal sites, to document the vegetation currently established on the sites prior to any rehabilitation practices. This helps to understand natural vegetative succession following disturbance, as the sites have had 5 years following logging to revegetate. Culverts were not removed from the Unit B releve plots; these plots can be used as controls for comparison with the two treated releve plots in Unit A.

## UNIT G GOLDBLUFF

### Site Description

Unit G is a 55-acre clearcut at the northernmost end of the Skunk Cabbage Creek Rehabilitation Unit (Figure 2). The area was tractor-logged to the edge of a series of earlier cuts, which are in various stages of forest regrowth. Revegetation consists of old-growth redwood understory species, and spruce and redwood seedlings. Slopes are relatively gentle in this area, ranging mostly from 20 to 50 percent. Soils are derived from recent unconsolidated sediments and tend to be non-gravelly with loam surface horizons over fine sandy clay loam subsoils. The soils are moderately to strongly acid, are well drained, and have moderate to slow permeability. Surface horizons exhibit good structural development, and undisturbed areas are relatively erosion-resistant. However, disturbed areas with exposed subsoils are highly erodible. These soils, when intact, are highly productive for vegetation, but exposed and compacted areas of subsoil may require considerable time or management to regain productivity.

One main access road extends to a landing and ridge top at the end of the Skunk Cabbage Creek Rehabilitation Planning Unit. Many tractor constructed skid trails dissect the slopes, both on the contour and up and down slope. These skid trails are frequently cut five to ten feet deep into the slope, causing channelized surface drainage, intercepted subsurface drainage, and increased runoff from the decreased infiltration on the road surfaces. This concentrates runoff into the highly erodible channels, increasing volume and velocity of channelized runoff, and contributes significant amounts of sediment to drainages downslope. Areas of primary concern, therefore, are centered around exposed road surfaces, skid trails, and log landings.

### Approach

Unit G was geomorphically mapped during March of

1980. A number of sites within the unit were determined to present excellent opportunities for hands-on learning experiences for the training program participants. Opportunities for experience in milling and preparation of wood products for use in erosion control structures, and in design and construction of various types of such structures were considered. No heavy equipment work was done in Unit G.

A milling site was established on the main landing at the end of the access road (G-L3). The crews learned milling and splitting techniques for wood products, using available on-site logging debris as a source of wood.

Several gully systems were treated using a variety of techniques (Sites 4, 10, and 12). These included slab check-dams, submerged spillways, riffle boxes, and pine bough check dams. The slab dams were used in the areas of steeper slopes (40 to 70 percent slopes), and most of the bough dams were installed in gullies on gentler slopes (20 to 50 percent slope). The bough dams utilized boughs from non-native Monterey pines which had been planted following logging. These non-native species are inconsistent with Park Service goals of re-establishing natural vegetation communities, and so their removal and use in such erosion control structures is an effective and productive way of dealing with them.

In addition to providing a learning site for RCDC's participants, this area was used as an education and demonstration area for other crews. A visiting crew from the TREE program in Sonoma County also gained valuable hands-on experience in these various techniques.

Alder, redwood, and spruce seedlings were planted in areas slow to revegetate naturally.

#### Documentation

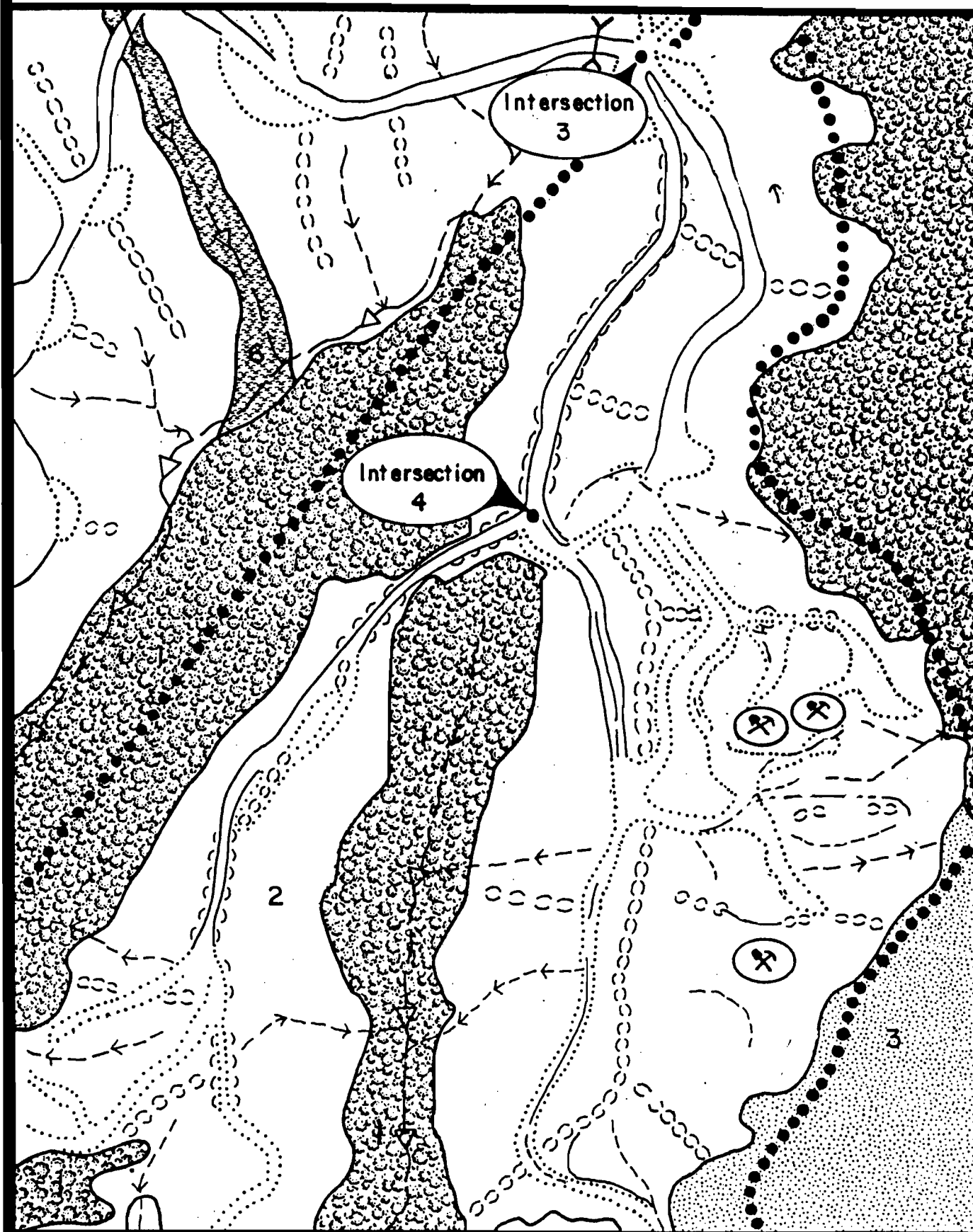
Permanent photo points were established in this Unit to provide a photographic record of the various training sites and techniques applied. These photo points were flagged with red and yellow flagging.

FIGURE 2.

# SKUNK CABBAGE CREEK REHABILITATION

## PLANNING UNIT G

Source: Color Aerial Photo., R.N.P. 7-78



## Effectiveness of Rehabilitation Work in Unit G

Overall, the rehabilitation sites appear to be stabilizing as a result of rehabilitation efforts. Many of the structures functioned very well through the rains to date, while some others failed for a variety of reasons. These successes and failures are invaluable learning aids for training crews as the trainees analyze the cause of the failures. Some follow-up maintenance and repair work was done, and will require further rains before they can be evaluated for effectiveness.

The successful structures are working well to trap sediment and arrest gully development, while providing a stable substrate in which plants can become established.

Most failures occurred in slab check dams and can be attributed to inadequate design or installation. Sidecutting and undercutting of dams seemed to be the major problems. Where these problems occurred, they may have been avoided by constructing wing-walls, higher dams, larger spillways, better splash protection, keying slabs further into banks, or obtaining a tighter fit at points where two slabs joined together. On some of the steeper stretches where problems occurred, spacing between dams may have been too great.

Nearly all the pine bough dams have held up very well so far. These structures appear to be functioning even better than had been expected. Further follow-up through more rains is needed to fully evaluate their success. The bough dams have a much shorter effective life, but if they continue to exhibit similar success, the results may have promising implications for gullied areas of lower slope requiring a short-term, efficient, and inexpensive boost in stabilization.

A riffle box was designed and constructed to conduct concentrated runoff over an oversteepened section where a nick point was developing. The structure is functioning very well, acting to slow water velocity, trap sediment, and disperse flow onto a more stable area. A simple energy dissipation system consisting of a few shingle boards and some slash was installed at the base of the riffle box and is functioning very well.

A number of breached water bars were repaired, and some new water bars were constructed to channelize or divert runoff flow from skid trails.

Revegetation efforts in Unit G were not intensive. Seedlings of alder, redwood, and spruce were planted on skid trails and landings. The alder and the spruce are doing well, with a low mortality rate. Redwood seedlings are not doing as well; a number have died, and many appear unhealthy.

Most of the redwood seedlings that are still healthy are those which were planted in cool, moist, or shaded areas. Since the alders grow faster on disturbed sites than the other species, and since they can have a positive effect on soil fertility through nitrogen fixation, they should be one of the dominant species of tree seedlings planted in such areas. With in a relatively short time, they will develop root systems which improve soil stability. The alders will also contribute large quantities of relatively nitrogen-rich leaf litter to surface soil, and provide a shaded environment which will then be hospitable to redwood seedlings.

## EFFECTIVENESS OF EROSION CONTROL TECHNIQUES

As indicated in the site-specific discussions, numerous erosion control techniques were applied following heavy equipment work in the Skunk Cabbage Creek Unit. Available on-site materials were used whenever possible. Construction specifications followed were similar to those described in National Park Service Technical Specifications (U.S.D.I., N.P.S., 1978). The following section is a discussion of the effectiveness of the various techniques following the first winter season after implementation.

### Check Dams

Check dams were one of the most frequently used techniques in the Skunk Cabbage Creek Unit. Check dams are structures built into a drainage channel or gully. Their usual function is to return a channel bed to a semblance of its uneroded level, and to arrest channel downcutting. In Skunk Cabbage Creek, they were used in situations of newly excavated channels primarily for the purpose of reducing water velocity, thus decreasing the energy of the flowing water. Ideally, this promotes stabilization of banks, thus aiding in revegetation at a site. The structures themselves are temporary, but the intent is to help establish sufficient vegetative cover and root strength so that even after the structures have decomposed the channel will remain stable. A detailed explanation of check dam design and placement is given in Technical Paper 1 (R.N.P., 1980). In the process of designing, installing, and observing check dams, RCDC personnel developed some variations in design and installation techniques. In hopes that these findings may be of value to other watershed managers, a discussion follows.

The problem of soil piping was encountered following installation of slab check dams. This occurred in the non-cohesive soil material that back-filled the trench which keyed the slab into the channel. The result was undercutting of the slab, rendering the dam non-functional. To avoid this problem, back-filling was done using a layering technique; a 2-inch

layer of the soil material was tamped and followed by a layer of rocks approximately golf-ball sized, then another layer of dirt was placed and tamped. This procedure was repeated two to three times, and resulted in a more competent back-fill, less susceptible to undercutting.

In addition to the redwood slab dams, two other types of check dams were installed at some of the sites. These were the pine bough check dams primarily used in Unit G, and the rock-and-stake check dams installed at various sites on the Unit B slide. The pine bough dams were largely experimental and were installed in smaller gullies on slopes of lower gradient. As discussed in the section on Unit G, these dams are exhibiting a high degree of success and may prove effective and inexpensive in some situations.

A number of rock-and-stake check dams were used at Site B1-81. Rock and stake check dams are an intermediate step between bough dams and slab check dams. They are used where the containment of soil moving downslope is not a primary goal. Stakes driven into the ground in an arch along the bottom of the stream channel act to retain the fist-sized rocks placed upslope of the stakes. Overlapping rocks placed at intervals up the stream channel between stakes provide a staircase effect similar to slab check dams. Rock and stake check dams seem to be most effective where stream velocity is relatively slow. Rock and stake dams are effective in inhibiting channel downcutting and bank scouring.

### Waterbars

Waterbars are linear depressions dug into a gullying road or trail to divert waterflow off the road or trail. Ideally, they are placed so as to conduct the water onto a more stable slope or drainage channel. Technical Report 1 (R.N.P., 1908) discusses in detail waterbar design and construction. Waterbars were commonly used on skid trails and roads in the Skunk Cabbage Creek Unit. They are a relatively quick, inexpensive, and simple solution to gully problems in some situations. Most waterbars in the Skunk Cabbage Creek Unit were constructed by the Cat tractor -- a quick and efficient method of construction; but in inaccessible areas, waterbars must be hand-constructed.

## Water Ladders and Riffle Boxes

The function of water ladders and riffle boxes (referred to respectively as water ladders and water flumes in Technical Report 1, R.N.P., 1980, and described in detail) is to conduct streamflow over a nick point or a steepened section of channel while preventing downcutting. These structures were installed in a number of locations, primarily in Unit B. The decision as to whether to use a water ladder or a riffle box was based mainly upon channel gradient. On areas of lower gradient, the riffle boxes work well, and are much quicker and easier to construct. However, in oversteepened reaches, a riffle box would tend to act more as a flume, and water velocities would not be effectively reduced. A water ladder usually works better in these situations to conduct water while helping to slow velocity.

Design and construction of water ladders and riffle boxes were basically the same as those described in Technical Report 1. However, a fundamental difference in construction and installation technique innovated by the RCDC staff was implemented in several of the Skunk Cabbage Creek Unit structures. This involved the following steps:

1. Necessary length of box was determined;
2. Slab check-dam type foundations or supports were installed at the upper and lower ends of the intended box placement, with a cut-out to fit the sides and bottom of the box; and
3. The riffle box was installed directly into the cut-out in the slabs.

This technique results in a very sturdy box and minimized dependence on metal fasteners such as screws and nails for structural support. This is desirable since the metal fasteners tend to rust out and weaken the structure at that point. In addition, the slab support technique serves to help channelize flow directly into the riffle box at the upper end, since the upper support acts in a manner similar to a check dam.

An experimental technique was the addition of a

V-notch in the center of the lower support slab. This would theoretically serve as a spillway in the event that water collected behind the lower support slab, thus preventing ground saturation.

These notched slab supports are functioning excellently in all cases to firmly support structures. No significant leakage or overflow has occurred at any of the structures, thus preventing an accurate evaluation of the function of the V-notches. At one site, a small amount of leakage thru the notch from backward creep of water flowing over the lip of the riffle box has resulted in saturation of the ground beneath the box.

The problem can be easily remedied, however, by either closing off the V-notch entirely, or by nailing a small slat of wood under the lip of the outflow point of the riffle box to prevent the backward creep of the water flow. Extension of the lip of the box farther beyond the support slab may also eliminate the problem.

Another technique was the use of cotton fiber calking where necessary to seal cracks and joints in structures where leakage was likely to be a problem. This material swells upon wetting, thereby creating a tightly fitting seal. Leakage was effectively prevented in this manner. The material is expected to endure long enough to prevent severe problems until the site has revegetated.

In all cases, water ladders and riffle boxes are fully functional. Flow capacity has been more than adequate thus far, and no serious secondary problems have arisen because of the structures. The major problems with nearly every water ladder or riffle box system are with the energy dissipators at the outlet of the structures. These are discussed in the section on energy dissipators. Water ladders and riffle boxes are obviously a temporary measure, as are most rehabilitation techniques used in the

Park. The minimum life expectancy of such structures is estimated to be approximately 10 years. Ideally, by this time the channel system will have returned to a vegetated condition, will have regained a relative equilibrium, and will be less susceptible to damage from erosion and channel and bank scour. Some sites may prove to be particular trouble spots, and may require regular inspection and maintenance of the structures to prolong their life.

### Submerged Spillways

A submerged spillway is a structure built into a drainage channel similar to a check dam, and constructed of milled slabs. The primary structural difference is in the height of the spillway above the channel bottom; a submerged spillway is installed flush with the channel bottom rather than installed at a height to create a dam. The theoretical purpose of a submerged spillway is not to trap sediment, as is the case with check dams, but to contain and direct stream flow, and to arrest channel downcutting by maintaining a stable base level. Unfortunately, where submerged spillways were used in the Skunk Cabbage Creek Unit (Site B1-8k-6), severe plunge pool development occurred below energy dissipators, causing bank cutting and in some cases undermining of the spillways themselves. Failure of these faulty structures in the near future is inevitable, and no constructing purpose will have been served, other than to demonstrate the inability of such structures to control the force of water moving downstream.

Analysis of the situation at Site 6 yields several possible causes for the lack of success of the submerged spillways:

1. Many of the spillway levels were actually slightly higher than the channel bottom rather than flush with it. Therefore these structures acted as small check dams. The velocity of water over the spillways was probably greater than it would have been if

spillways were flush, due to the distance of the fall. This may cause increased energy at the point of impact below the energy dissipators, hence formation of plunge pools;

2. Energy dissipators (splash boards) were not installed at stream grade level, thus creating a nick point at the bottom edge of the splash-board and resulting in undercutting of the structure;
3. Some downcutting is likely in any newly excavated channel, and this site was one where it was especially severe. The channel may not have been excavated completely to grade level due to the highly saturated nature; and,
4. The large particle size range of the material caused small local falls and plunge pool points as water flowed over larger rocks onto small material, making plunge pool development more likely to occur.

#### Notched Log

This technique was used to channelize streamflow where an immovable log was encountered in the stream channel. The log was simply notched using chain saws, to provide a flow outlet for water that would otherwise pond behind the log, or side cut around it. As was the case in Redwood National Park's own rehabilitation sites, this technique was little used. It is an important one to point out, however, since it can provide a simple solution to an otherwise major problem.

#### Channel Armor (Rocking)

Local rock was used to create protective armor in the stream channel at some sites in the Skunk

Cabbage Creek Unit. This technique was most effective when installation of the rock was done carefully and methodically, beginning at the bottom of the section to be armored with a firmly supported toe, and working upward, overlapping the rocks in a shingle-like manner. When this method was followed, and when the armored area covered sufficient area of the channel bottom and sides, sidecutting and downcutting were essentially prevented. In where the channel sides were not sufficiently protected, side cutting around the armor occurred, undermining the armor, and creating a gully parallel to the intended channel, thereby defeating the original purpose. The technique of shingle-lapped rock armor can be very effective and long-lasting when properly installed. It is quite labor consumptive, but less so than a rock-and-stake technique.

Rock armoring which is not started at the toe and shingle-lapped has a tendency to allow water to infiltrate beneath the placed rock and undermine portions of the rock area. Rock placement which begins at the top and works downslope eliminates the assets of shingle-lapped rock armoring, and makes the placement of rocks on slopes more difficult.

### Energy Dissipators

Energy dissipators are constructed at the outflow base of structures such as check dams and water ladders. The intent is to dissipate the impact of falling water and thereby decrease the amount of channel scour at that point. Energy dissipators may be constructed of rock, slash, or milled or split wood. The order of effectiveness of these various types is similar to that found by Redwood National Park as stated in Technical Report 1 (R.N.P., 1980); that is, rock being most effective (and longest lasting if firmly secured), slash being intermediate, and milled or split wood being least effective.

A common secondary problem resulting from energy dissipators was the occurrence of channel scour

below the energy dissipators. In essence, the problem of scour was simply transferred slightly farther downstream. This seemed to be most pronounced where the milled or split wood was used, and occurred to a lesser degree where the other materials were used. It is critical that energy dissipators be installed at grade level, flush with the stream channel bed to minimize this problem. Those locations where this was not a problem were usually directly on solid bedrock. It seems, therefore, that wherever possible, waterfall should be directed onto bedrock. In cases where this is not feasible, solidly secured rock energy dissipators should work best.

### Contour Terraces

Contour terracing was a commonly used technique in Unit B. Steep, newly exposed slopes which were highly susceptible to rill and gully development, sheet erosion, and ravel were given a boost in stabilization and revegetation using this technique. Alder poles or milled redwood boards were anchored firmly into the slope by stakes. The redwood terraces are expected to last much longer than the alder poles, but if sufficient vegetation becomes established before the poles decompose, both types should prove effective in erosion reduction. The terraces act to trap soil material moved from upslope and provide a stable base for revegetation. Combined with plantings, the process should prove very effective. The only terraced slopes exhibiting serious problems were those at Site B1-81-10. Shorter poles were used at this site to construct the terraces, and the terraces were not made continuous across a contour level. Rills and gullies have developed in the gaps between poles or boards composing each terrace, and undercutting of the terraces downslope has occurred. The undercut terraces are no longer functional as a result. These terraces should be repaired using longer poles and making the terraces continuous across a level. Tamping or compacting accumulated material behind pole terraces can also minimize undercutting due to piping.

In situations where poles are more available

than boards, alternating terraces of poles and boards can often be more effective and longer lasting than using poles alone.

### Mulches

A mulch acts to protect susceptible soil surfaces from raindrop impact, thereby reducing surface erosion and preventing puddling of surface soil structure. In addition, the mulch slows and disperses runoff, promotes infiltration, and helps retain soil moisture. Two types of mulches were used in the Skunk Cabbage Creek Unit. These were straw mulch, generally applied at the rate of 4,000 lbs/acre, and natural forest litter collected from nearby areas and spread over the susceptible area. Both types of mulch are very effective. The straw mulch is more practical, as the amount of time required to collect and distribute the native mulch appears prohibitive to large-scale application of the practice. As discussed earlier in this report, the disadvantage of an initial soil fertility imbalance which may result from the use of straw mulch may be compensated by the reduction of surface erosion and the establishment of natural vegetation.

On very steep slopes, or in areas subject to high winds, jute netting staked over the straw served well to secure the mulch in place.

### Revegetation Techniques

Nearly all of the various revegetation techniques used in the Skunk Cabbage Creek Unit are exhibiting success to date. Tube stock nursery seedlings, transplants of ferns, rushes, and huckleberries, and cuttings of huckleberries all show high survival rates. New spring growth is visible on nearly all of these, and browse damage is very slight. The only revegetation effort exhibiting a low success rate are the plantings of rooted coyote brush cuttings. A low

survival rate among these plantings may be a function of inadequate root to crown ratio, resulting in decreased ability to withstand moisture stress. Further investigation of a variety of propagation techniques is necessary to develop more effective revegetation practices.

#### Heavy Equipment Use

As in other Redwood National Park projects, heavy equipment use was an important component of rehabilitation in the Skunk Cabbage Creek Unit. Four separate pieces of heavy machinery were used during the heavy equipment phase of the project. (A copy of the heavy equipment daily log is in Appendix D.) Heavy equipment was used to remove logging debris, construct waterbars, and remove stream crossings in Units A and B1.

In order to avoid excessive complications, a heavy equipment supervisor who had previous machinery experience was appointed to the project. In cooperation with the project director, the excavator and Cat operators were walked through the entire project prior to commencement of work. With an understanding of the entire project and with few alterations of the work sequence, equipment work was completed in Unit B1 one week ahead of schedule.

## APPROPRIATE USE OF MACHINERY

In hopes of minimizing problems and increasing efficient use of time for others working in the field of watershed rehabilitation and dealing with heavy equipment, the following step-by-step discussion is presented.

(1) Select pieces of machinery which are most suited for the job. There are all types of Cats, back-hoes, trucks and draglines. It is not specific enough to merely say you want a D-5 Cat to do the job. Some D-5 models have tilting blades. Some have a power shift. Other models are older and simply cannot keep up with various other types of machinery (i.e., draglines and excavators) they may be required to work with.

(2) Identify contractors who have a good record in using various types of machinery in tandem. Ask these contractors what types of machinery can best be used for the jobs that you have prescribed.

You should ask for quotes. Bid quotes can be for all or portions of the equipment work prescribed.

Equipment operators should be able to explain what types of machinery will be used and in what combination. Experienced and qualified equipment contractors can estimate both the approximate amount of time the job will take and the appropriate combination of applicable equipment.

(3) If you have an idea of how much time the job should take or how much money you have to spend, try to avoid granting the contractor solely on a low-bid basis. By evaluating the contractor's bid proposal, you should be certain:

A. That all equipment operators have an experienced record with the pieces of machinery they will be operating. A list of references is desirable.

B. That their prescribed pieces of machinery are best suited for the job and not simply the only pieces of equipment they have available to them.

C. That they are able to justify to you why one type of machinery is superior to another for a particular job.

D. That they know how to perform such jobs as placing rock and removing large quantities of earth and debris.

E. That they feel confident with working their equipment in tight or steep places

Not all contractors qualify under these parameters. Only experienced people who operate heavy equipment themselves or have worked around heavy equipment for several years are most qualified to evaluate the skills of contractors and decide if they are adequate to perform the job.

In most cases, the experienced equipment contractor is best qualified to position the equipment and establish the pace in which equipment will work in tandem.

It is advisable that an experienced heavy equipment supervisor be assigned to the job. Without any idea as to the production capabilities of various pieces of machinery in combination, an inexperienced supervisor can simply be overwhelmed with the operation itself.

It is important to be conscious of an operator's apprehension in dangerous places. Working with, rather than simply observing or directing equipment through working situations provides an appreciation of the logistical problems which each operator faces. Learning to respect an operator's opinions and apprehensions is the key to achieving the maximum level of safety and production in each site specific situation.

F. Before work begins, walk all heavy equipment operators and ground personnel through the work site. Explain:

1. The reason why the work has been prescribed;
2. The eventual desired result to be achieved;

3. The method in which each type of machinery will be used to accomplish the job;
4. The sequence of work tasks;
5. Each operator's individual responsibility;
6. The chain of supervision and decision-making responsibilities on and off the site;
7. Work day hours;
8. Expected completion time for specific and for overall projects;
9. Billing procedures.

NOTE TO EQUIPMENT SUPERVISORS:

Once you have identified to each operator what you want achieved and they have acknowledged to your satisfaction they they will perform the work to your specifications, allow them to proceed with no major interruptions.

An equipment operator is just like any other skilled individual who must feel out new situations, adapt to them, and then build up a momentum. Constant interruptions may show:

1. An inconsistency in the supervisor's perception in what ought to be accomplished;
2. Lack of confidence in the equipment operator's ability to perform the task as agreed upon with the project supervisor;
3. That the explanation provided for the work was not clear; or
4. That the operator's perception of the task is not consistent with that of the supervisor.

All of these are reasons for unsatisfactory work. It is advisable, if possible, to begin work on sites with less difficulty and work up to more complex projects. This is an important aspect that should be planned into the sequence of work tasks prior to the commencement of work.

Once an operator is confident that the work is being done to specification, then he/she is able to settle into a rhythm. With the knowledge of the

sequence of work projects to be performed, the operator can operate the machine in various combinations of motions to prepare for projects as they have been planned. It is not uncommon for the machinery to complete the job faster than expected, provided that the bid quote took into account normal delays (i.e., periodic breakdowns) and that the project supervision is not altering the work prescriptions and pace at random.

To avoid a misunderstanding between contractor and contract supervisor, an agreement to pay a prescribed minimum of hours or amount for completed work is justifiable. It is a common fact that there are delays and changes in work prescriptions in the course of a work contract. Neither party should feel cheated or over-committed due to such circumstances. Even though it is inevitable that unforeseen circumstances can occur, it is necessary to recognize the disadvantageous position in which a private contractor is placed if the previously arranged work or contract amount is reduced. Contractors typically operate on loans, leases, or borrowed time until payment for a job is reimbursed. The standard 30 day payment delays in any billing situation are figured into the operation of most businesses. The problems encountered by a service contractor when job or payment delays occur result in debt payments that weaken the company's ability to conduct business. It is not in the government's interest to weaken a business financially. Nor will professional businesses purposely sign into an agreement that prevents their ability to conduct normally scheduled business on a regular basis. Thus an agreed-upon minimum amount of time or money for work completed allows a contractor the security that his lease or loan agreements can be paid. The government would have to feel confident that the contractor would perform adequate work. The working relationship can be better controlled if the contracting agency knows what it wants and is openly willing to negotiate an equitable solution with a respectable contracting firm.

A general rule of thumb for payment and billing: It is advisable to have a regular method of documenting the time spent for each heavy machinery contractor. A review of starting time, work progress and shut-down time should be gone over with each contractor daily. The billing process can then reflect the actual work performed each day. There would then be no misunderstanding between the contractor and the employing agency.

## APPENDICES

APPENDIX A. Site Specific Information Collected at  
Tractor-Constructed Fill Crossings & Roads

STREAM CROSSINGS

Access (Flag)  
Slope %  
Slope stability  
Estimated cu. yds. of fill  
Where to place fill  
Seeps, emerging groundwater  
Revegetation of channel bank  
Salvage to be removed (Flag)  
Equipment notes  
Photo points (Flag)  
Subjective notes  
Map location (Blue line)

HAUL ROADS/SKID ROADS

Access  
Emerging groundwater, seeps  
Potential crossroad drain locations (Flag)  
Potential waterbar locations or failed waterbars  
(Flag)  
Need for outslipping or ripping  
Potential cutbank failure  
Problems with sidecast material  
Inboard ditches  
Water diverted to wrong drainage  
Gullies and prescriptions  
Quantity of vegetation to remove for access  
(Abundance, type, size, etc.)  
Equipment notes  
Photo points  
Subjective notes  
Map location (Blue line)

APPENDIX B. Sample Data Collection Form for Stream  
Channel Cross-Sections.

Project:

Date:

Surveyor:

Site Identification:

Site Condition:

Compass Bearing of Cross-section line:

Location Data:

Other Notes:

| Distance from<br>Starting Point (ft) | Height (ft.) |
|--------------------------------------|--------------|
|--------------------------------------|--------------|

TABLE 1. Cost and Time Expenditures for Heavy Equipment Work in Unit A.

| Date<br>(1981) | Task                                                           | Equipment                      | Approx.<br>Time<br>(hrs) | Approx.<br>Cu.Yds.<br>Moved | Cost     | Total<br>Cost of<br>Task |
|----------------|----------------------------------------------------------------|--------------------------------|--------------------------|-----------------------------|----------|--------------------------|
| 9/23           | Clear access into Unit A Sites, re-move logging debris         | D-5 Cat (Excavator on standby) | 10                       | -                           | \$550.   |                          |
|                |                                                                |                                | 10                       | -                           | \$400.   | \$ 950.00                |
| 9/24           | Remove fill crossings, outslope; A-1a1, A-1a2                  | D-5 Cat Excavator              | 10                       | 450                         | \$550.   |                          |
|                |                                                                |                                | 10                       |                             | \$950.   | \$1500.00                |
| 9/25           | Remove fill crossings, outslope, A-1a2, A-1a3                  | D-5 Cat Excavator              | 10                       | 600                         | \$550.   |                          |
|                |                                                                |                                | 10                       |                             | \$950.   | \$1500.00                |
| 9/26           | Finish Ala sites, contour end of access road                   | D-5 Cat Excavator              | 10                       | 1200                        | \$550.   |                          |
|                |                                                                |                                | 10                       |                             | \$950.   | \$1500.00                |
| 9/29           | Remove Culvert A-1b, construct water bars, pile logging debris | D-5 Cat Excavator              | 10                       | 500                         | \$550.   |                          |
|                |                                                                |                                | 6.5                      |                             | \$617.   | \$1167.00                |
| 9/30           | Pile logging debris                                            | D-5 Cat Excavator              | 11                       | -                           | \$605.   |                          |
|                |                                                                |                                | 4.5                      | -                           | \$427.50 | <u>\$1032.50</u>         |

TOTAL COST FOR HEAVY EQUIPMENT IN UNIT A: \$7649.50

TABLE 2. Cost and Time Expenditures for Heavy Equipment in Unit B.

| Date<br>(1981) | Task                                                   | Equipment                                        | Approx.<br>Time<br>(hrs) | Approx.<br>Cu.Yds.<br>Moved | Cost                 | Total<br>Cost of<br>Task |
|----------------|--------------------------------------------------------|--------------------------------------------------|--------------------------|-----------------------------|----------------------|--------------------------|
| 9/5            | Move into<br>job site                                  | D-5 Cat<br>Excavator                             | 5<br>5                   | -<br>-                      | \$275.<br>\$475.     | \$750.                   |
| 9/8            | Remove fill<br>outslope,<br>Site B1-8k-1               | D-5 Cat<br>Excavator                             | 7<br>7                   | 400                         | \$385.<br>\$665.     | \$1050.                  |
| 9/8,<br>9/9    | Remove fill<br>outslope,<br>Sites B1-8k-<br>1, B1-8k-2 | D-5 Cat<br>Excavator                             | 13<br>13                 | 750                         | \$715.<br>\$1235.    | \$1950.                  |
| 9/10           | Remove<br>fill, out-<br>slope, Site<br>B1-8k-3         | D-5 Cat<br>Excavator                             | 10<br>10                 | 500                         | \$550.<br>\$950.     | \$1500.                  |
| 9/11           | Remove fill,<br>outslope,<br>Site<br>B1-8k-4           | D-5 Cat<br>Excavator                             | 10<br>10                 | 500                         | \$550.<br>\$950.     | \$1500.                  |
| 9/12           | Remove<br>fill, out-<br>slope, Site<br>B1-8k-5         | D-5 Cat<br>Excavator                             | 10<br>10                 | 600                         | \$550.<br>\$950.     | \$1500.                  |
| 9/15           | Remove<br>fill, out-<br>slope, Site<br>B1-8k-6         | D-5 Cat<br>Excavator                             | 10<br>10                 | 550                         | \$550.<br>\$950.     | \$1500.                  |
| 9/16           | Remove<br>fill, out-<br>slope, Site<br>B1-8k-7         | D-5 Cat<br>Excavator                             | 10<br>10                 | 650                         | \$550.<br>\$950.     | \$1500.                  |
| 9/17           | Remove fill,<br>outslope,<br>Site B1-8K-8              | D-5 Cat<br>Excavator<br>(includes 1.5 hrs. stby) | 10<br>10                 | 500                         | \$508.75<br>\$878.75 | \$1387.50                |

TABLE 2 (Continued)

| Date                                     | Task                                                                                       | Equipment                                          | Approx.<br>Time<br>(hrs)    | Approx.<br>Cu.Yds.<br>Moved | Cost                           | Total<br>Cost of<br>Task |
|------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------|-----------------------------|--------------------------------|--------------------------|
| 9/18                                     | Remove fill,<br>outslope,<br>Sites<br>Bl-8k-9 & 10,<br>and channel<br>culvert out-<br>flow | D-5 Cat<br>Excavator                               | 10<br>10                    | 550                         | \$550.<br>\$950.               | \$1500.                  |
| 9/19                                     | Remove fill,<br>outslope,<br>Sites Bl-<br>8k-10 & 11                                       | D-5 Cat<br>Excavator                               | 10<br>10                    | 500                         | \$550.<br>\$950.               | \$1500.                  |
| 9/22                                     | Finish<br>Sites<br>Bl-8k-9, 10,<br>& 11                                                    | D-5 Cat<br>Excavator<br>(including 4 hrs. standby) | 11<br>11                    | -                           | \$605.<br>\$760.               | \$1365.                  |
| 9/22-<br>9/25                            | Haul straw<br>and milled<br>products to<br>rehab. sites                                    | Self-loading<br>truck                              | 50                          | -                           | \$3250.                        | \$3250.                  |
| 9/30                                     | Finish<br>Site<br>Bl-8k-7                                                                  | D-5 Cat<br>Excavator<br>Backhoe                    | 11<br>4.5<br>11             |                             | \$605.<br>\$427.50<br>\$384.50 | \$1417.                  |
| 10/1                                     | Backblade<br>fill, remove<br>debris, Site<br>Bl-8k-8, 9                                    | D-5 Cat                                            | 10                          | -                           | \$550.                         | \$550.                   |
| 10/2                                     | Waterbars<br>on Access<br>Road, Unit B                                                     | D-5 Cat<br>(includes 1.5 hrs. standby)             | 9                           | -                           | \$288.75                       | \$288.75                 |
| 10/3                                     | Standby                                                                                    | D-5 Cat                                            | 3                           | -                           | \$82.50                        | \$82.50                  |
| Transportation Costs:                    |                                                                                            |                                                    | Cat<br>Excavator<br>Backhoe |                             |                                | \$1286.40                |
| TOTAL COST FOR HEAVY EQUIPMENT IN UNIT B |                                                                                            |                                                    |                             |                             |                                | \$23,127.15              |

SUBJECT: Skunk Cabbage Creek Watershed Vegetation  
Report for Selected Sites

TO: Redwood Community Development Council, Inc.

FROM: Dotty Stout

DATE: May, 1980

The areas covered in this report are those of proposed rehabilitation sites where culverts are presently located. The purpose of this report is to document the vegetation currently established on these sites, before rehabilitation commences.

The method of vegetative monitoring used is the "releve'." A releve' is done by first selecting an area, or "plot" to be monitored. In this study the plots are square areas with the culverts located approximately in the center of the square so that vegetation occurring on the road and in the surrounding stream channel area may be monitored. The vegetation is then separated into four different layers to be considered. These layers are defined as:

- a. the moss layer, comprising the first few centimeters above the ground surface;
- b. the herb layer of the lesser vegetation;
- c. the shrub layer; and
- d. the tree layer.

Within each layer then, each individual plant type is rated according to its "cover degree" and "sociability." These terms and their rating symbols are defined as follows:

Combined Cover Degree and Abundance:

| <u>Symbol</u> | <u>Description</u>                                      |
|---------------|---------------------------------------------------------|
| r             | erratic occurrence                                      |
| +             | occasional and less than<br>5% cover of total plot area |

Combined Cover Degree and Abundance (continued)

| <u>Symbol</u> | <u>Description</u>                                                                    |
|---------------|---------------------------------------------------------------------------------------|
| 1             | abundant or common, but insignificant in cover, less than 5% cover of total plot area |
| 2             | very abundant or common but low in cover, 5 - 25% cover of total plot area            |
| 3             | 25 - 50% cover of total plot area                                                     |
| 4             | 50 - 75% cover of total plot area                                                     |
| 5             | 75 - 100% cover of total plot area                                                    |

Sociability

| <u>Symbol</u> | <u>Description</u>                                           |
|---------------|--------------------------------------------------------------|
| 1             | growing solitarily, singly                                   |
| 2             | growing in small groups of a few individuals                 |
| 3             | large group of many individuals, small scattered patches     |
| 4             | patches or a broken mat                                      |
| 5             | extensive mat almost completely covering the whole plot area |

Also included in this report is data from two land transects taken above the culverts at sites #3 and #4. The purpose of these transects is to show the variance of vegetation and sequence of occurrence going directly across the stream channel, from upper bank to upper bank.

Because I don't recommend the transect technique as a

practical method for continuous monitoring in this area, and also due to the complicated nature by which quantification of the vegetation was carried out, an explanation of technique is not given in this report. The data however, especially the "transect summary" given at the end of each transect data sheet, is comprehensible without explanation.

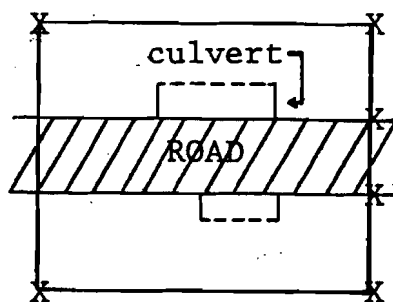
#### Plot Locations:

Location and site numbers are marked on the aerial photos.

All locations marked with yellow flagging.

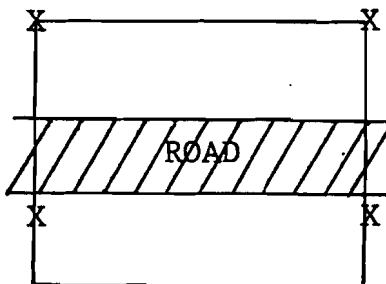
Sites #1 and #2: North cut-block, lowest cut-block. Both plots are at culvert sites at the end of the road which goes down to that cut area.

Site #1 is closest to the end of the road, site #2 being just above that and closest to the fallen tree in the road. Yellow flagging defines the plot area as shown by "X" in the diagram below:



Same flagging pattern for both plots.

Sites #3 and #4: South cut-block, at end of road on lower edge of cut. Flagged as shown below:



Site #3 at end of road. Site #4 just above.

Flags not at corners on lower edge below culvert.

Releve' Site #1: Northcut, nearest end of road.  
Plot split into two sections: 1) on road, 2) to  
either side of road (combined).

Road:

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| a. nothing            |                     |                    |
| b. <u>herb layer</u>  |                     |                    |
| wood rush             | 2                   | 3                  |
| rye grass             | 1                   | 1.5                |
| lotus                 | 1                   | 3                  |
| c. <u>shrub layer</u> |                     |                    |
| baccharis             | r                   | 1                  |
| d. <u>tree layer</u>  |                     |                    |
| red alder             | +                   | 1                  |
| spruce seedling       | r                   | 1                  |

Off Road, To Either Side:

|                      |   |     |
|----------------------|---|-----|
| a. moss              | 1 | 2   |
| b. <u>herb layer</u> |   |     |
| whipplea             | + | 1   |
| rushes               | 1 | 1.5 |
| rye grass            | 2 | 1   |
| fireweed             | 2 | 1   |
| sword fern           | + | 1   |
| deer fern            | + | 1   |

Off Road, To Either Side (continued)

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| composite             | 1                   | 1                  |
| thistle               | +                   | 1                  |
| horsetail             | +                   | 2                  |
| buttercup             | r                   | 1                  |
| lotus                 | 2                   | 3                  |
| c. <u>shrubs</u>      |                     |                    |
| baccharis             | 3                   | 1                  |
| berry                 | 2                   | 1                  |
| huckleberry           | +                   | 1                  |
| d. <u>trees</u>       |                     |                    |
| red alder             | 5                   | 1                  |
| spruce seedling       | r                   | 1                  |
| redwood seedling      | r                   | 1                  |

Releve' Site #2: North cut, just past fallen tree.  
Plot split into two sections; 1) road, 2) to either  
side of road (combined).

Road:

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| a. nothing            |                     |                    |
| b. <u>herb layer</u>  |                     |                    |
| rye grass             | 2                   | 1.5                |
| grass (Aira c.)       | 2                   | 1.5                |
| lotus                 | 2                   | 2.5                |
| Galium                | 2                   | 2                  |

Road (continued):

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| c. <u>shrubs</u>      |                     |                    |
| huckleberry           | +                   | 1                  |
| c. <u>trees</u>       |                     |                    |
| red alder             | +                   | 1                  |
| spruce seedling       | +                   | 1                  |
| redwood seedling      | +                   | 1                  |

Off Road, To Either Side:

|                      |   |     |
|----------------------|---|-----|
| a. moss              | + | 2   |
| b. <u>herb layer</u> |   |     |
| rushes               | 2 | 2   |
| fireweed             | 4 | 1.5 |
| whipplea             | + | 2   |
| thistle              | + | 1   |
| grass (Aira c.)      | 1 | 2.5 |
| grass (festucca)     | + | 1   |
| pearly everlasting   | + | 1   |
| sword fern           | + | 1   |
| lady fern            | + | 1   |
| rye grass            | 4 | 3   |
| willow-herb          | + | 1   |
| lotus                | 3 | 2.5 |
| c. <u>shrubs</u>     |   |     |
| baccharis            | 3 | 1.5 |

Off Road, To Either Side (continued):

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| huckleberry           | r                   | 1                  |
| d. <u>trees</u>       |                     |                    |
| redwood seedling      | +                   | 1                  |
| spruce seedling       | +                   | 1                  |

Releve' Site #3: South cut, end of road. Plot split into two sections; 1) road, 2) off road to either side (combined).

Road:

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| a. nothing            |                     |                    |
| b. <u>herb layer</u>  |                     |                    |
| wood rush             | +                   | 2                  |
| rushes                | +                   | 1                  |
| fireweed              | 1                   | 1                  |
| c. <u>shrubs</u>      |                     |                    |
| baccharis             | +                   | 1                  |
| berry                 | +                   | 1                  |
| d. <u>trees</u>       |                     |                    |
| red alder             | 3                   | 1                  |
| spruce seedlings      | +                   | 1                  |
| redwood seedlings     | +                   | 1                  |

Off Road, To Either Side:

|                       |   |   |
|-----------------------|---|---|
| a. moss               | + | 2 |
| b. <u>herb layers</u> |   |   |

Off Road, To Either Side (continued):

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| sedges                | 2                   | 2                  |
| skunk cabbage         | 1                   | 1                  |
| sword fern            | 2                   | 1                  |
| lady fern             | 2                   | 1                  |
| deer fern             | 2                   | 1                  |
| wood rush             | 1                   | 1                  |
| rushes                | 2                   | 2                  |
| grass (Festuca)       | 1                   | 1                  |
| sorrel                | +                   | 2                  |
| miners lettuce        | +                   | 2                  |
| stachys               | 1                   | 1                  |
| c. <u>shrubs</u>      |                     |                    |
| elderberry            | +                   | 1                  |
| berry                 | 3                   | 1                  |
| d. <u>trees</u>       |                     |                    |
| red alder             | 2.5                 | 1                  |
| hemlock (small)       | r                   | 1                  |
| spruce seedling       | +                   | 1                  |

Releve' Site #4: South cut, just above site #3. Plot split into three sections; 1) road, 2) above road, 3) below road.

Road:

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| a. nothing            |                     |                    |

Road (continued):

| <u>Layer and Name</u> | <u>Cover Degree</u> | <u>Sociability</u> |
|-----------------------|---------------------|--------------------|
| b. <u>herb layer</u>  |                     |                    |
| grass                 | +                   | 1                  |
| willow-herb           | r                   | 1                  |
| wood rush (small)     | +                   | 2                  |
| wood rush (large)     | 1                   | 1                  |
| stachys               | r                   | 1                  |
| composite             | +                   | 1                  |
| c. <u>shrubs</u>      |                     |                    |
| baccharis             | +                   | 1                  |
| berry                 | r                   | 1                  |
| c. <u>trees</u>       |                     |                    |
| red alder             | 3                   | 1                  |
| spruce seedling       | +                   | 1                  |
| redwood seedling      | r                   | 1                  |
| hemlock seedling      | r                   | 1                  |
| cedar seedling        | r                   | 1                  |

Above Road:

|                      |   |     |
|----------------------|---|-----|
| a. moss              | + | 2   |
| b. <u>herb layer</u> |   |     |
| composite            | r | 1   |
| fireweed             | 2 | 2.5 |
| sedges               | 2 | 2.5 |
| skunk cabbage        | + | 1   |

Above Road (continued):

| <u>Layer and Name</u>   | <u>Cover Degree</u> | <u>Sociability</u> |
|-------------------------|---------------------|--------------------|
| rushes                  | +                   | 1                  |
| wood rush               | 1                   | 1                  |
| thistle                 | r                   | 1                  |
| miners lettuce          | 1                   | 2                  |
| lady fern               | 1                   | 1                  |
| c. <u>shrubs</u>        |                     |                    |
| berry                   | 1                   | 1                  |
| d. <u>trees</u>         |                     |                    |
| red alder               | 4.5                 | 1                  |
| redwood seedlings       | r                   | 1                  |
| douglas fir seedlings + |                     | 1                  |
| cedar seedlings         | r                   | 1                  |

Below Road:

- a. nothing
- b. nothing
- c. nothing
- d. trees

|           |   |   |
|-----------|---|---|
| red alder | 5 | 1 |
|-----------|---|---|

Transect, Site #3 (south cut-block)

| <u>Feet and Layer</u> | <u>Description</u>                                |
|-----------------------|---------------------------------------------------|
| 1 - 5                 | a. Bare ground (no mosses or forest litter) = 100 |
|                       | b. Fireweed = 5                                   |
|                       | c. Berry = 10                                     |

Transect, Site #3 (south cut-block) (continued):

| <u>Feet and Layer</u> | <u>Description</u>                                                                                                 |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|
|                       | d. Red Alder = 10 (all Alder < 10' tall)                                                                           |
| 5 - 10                | a. Bare ground = 50, litter = 50<br>b. Stachys = 5<br>d. Red Alder = 10                                            |
| 10 - 15               | a. Bare ground = 80<br>b. Grass = 20, Fireweed = 5, Deer Fern = 5<br>d. Douglas Fir seedling = 3                   |
| 15 - 20               | a. Bare ground = 100<br>b. Fireweed = 3<br>c. Berry = 10<br>d. Spruce seedling = 6                                 |
| 20 - 25               | a. Bare ground = 100<br>b. Stachys = 30, Fireweed = 10<br>c. Gooseberry = 15                                       |
| 25 - 30               | a. Bare ground = 80, debris (log) = 20<br>b. Grass = 5, Fireweed = 3, Lady Fern = 3<br>c. Berry (Salmonberry) = 50 |
| 30 - 35               | a. Bare ground = 100<br>b. Fireweed = 10                                                                           |

Transect, Site #3 (continued):

| <u>Feet and Layer</u> | <u>Description</u>                                                                                  |
|-----------------------|-----------------------------------------------------------------------------------------------------|
| 35 - 40               | a. Bare ground = 100<br>b. Deer Fern = 40, Fireweed = 15<br>c. Berry = 5<br>d. Spruce seedling = 10 |
| 40 - 45               | a. Moss = 50, Muddy ground throughout<br>b. Deer Fern = 90<br>c. Thimbleberry = 20, Berry = 3       |
| 45 - 50               | a. Marshy<br>b. Sedges = 60, Grass = 5<br>c. Berry = 15                                             |
| 50 - 55               | a. Marshy - wet<br>b. Skunk Cabbage = 45, Lady Fern = 40, Rushes = 20, Fireweed = 10                |
| 55 - 60               | a. Wet<br>b. Lady Fern = 35, Deer Fern = 20, Miners Lettuce = 20, Fireweed = 15, Sedge = 15         |
| 60 - 65               | a. Debris (slash) = 5<br>b. Deer Fern = 35, Lady Fern = 20, Fireweed = 15<br>c. Berry = 10          |
| 65 - 70               | a. Litter = 40                                                                                      |

Transect, Site #3 (continued):

| <u>Feet and Layer</u> | <u>Description</u>                                                                               |
|-----------------------|--------------------------------------------------------------------------------------------------|
|                       | b. Deer Fern = 20, Fireweed = 15<br>c. Berry = 55                                                |
| 70 - 75               | a. Slash = 80<br>b. Sword Fern = 90                                                              |
| 75 - 80               | a. Litter = 90<br>b. Sword Fern = 85, Grass = 15<br>c. Berry = 25                                |
| 80 - 85               | a. Debris = 50<br>b. Sword Fern = 40, Grass = 40<br>c. Berry = 35                                |
| 85 - 90               | a. Debris = 10<br>b. Sword Fern = 40, Fireweed = 20,<br>Stachys = 15, Grass = 10<br>c. Berry = 5 |
| 90 - 95               | a. Debris = 60<br>b. Fireweed = 10                                                               |
| 95 - 100              | a. Debris = 80<br>b. Fireweed = 20, Lady Fern = 15,<br>Azalea = 10<br>c. Blue Huckleberry = 20   |

End Transect.

Transect Summary, Site #3: Each plant given with the percent of the total transect length it occupies.

Layer A:

moss = 2.5%

Layer B: herbs

sword fern = 13%

deer fern = 10%

lady fern = 6%

fireweed = 6%

grasses = 5%

sedges = 4%

stachys = 2.5%

skunk cabbage = 2%

rushes = 1%

azalea = 1%

Layer C: shrubs

berry (unknown species) = 9%

salmonberry = 2.5%

gooseberry = 1%

thimbleberry = 1%

blue huckleberry = 1%

Layer D: trees

red alder (< 10'tall) = 1%

spruce seedlings = 1%

douglas fir = 0.5%

Transect, Site #4:

| <u>Feet and Layer</u> | <u>Description</u>                                                                                                         |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------|
| 1 - 5                 | a. Bare ground = 100<br>b. Miners Lettuce = 25, Lady Fern = 5<br>c. Berry = 10<br>d. Red Alder = 35 (all Alder < 10' tall) |
| 5 - 10                | a. Bare ground<br>b. Grass = 40, Deer Fern = 5<br>c. Berry = 20, Gooseberry = 5<br>d. Red Alder = 20                       |
| 10 - 15               | a. Bare ground<br>b. Grass = 15<br>c. Gooseberry = 10<br>d. Red Alder = 20, Spruce Seedling = 3                            |
| 15 - 20               | a. Moss = 20<br>d. Red Alder = 6, Redwood Seedling = 3                                                                     |
| 20 - 25               | a. Mucky<br>b. Grass = 40, Fireweed = 5, Deer Fern = 5<br>c. Berry = 10<br>d. Red Alder = 30                               |

Transect, Site #4: (continued):

| <u>Feet and Layer</u> | <u>Description</u>                       |
|-----------------------|------------------------------------------|
| 25 - 30               | a. Wet - Moss = 75%                      |
|                       | b. Fireweed = 35, Miners<br>Lettuce = 5  |
|                       | c. Berry = 25                            |
| 30 - 35               | a. Very wet                              |
|                       | b. Fireweed = 85, Miners<br>Lettuce = 20 |
|                       | d. Red Alder = 25                        |
| 35 - 40               | a. Very wet                              |
|                       | b. Miners Lettuce = 80,<br>Fireweed = 40 |
|                       | d. Willow = 10                           |
| 40 - 45               | a. Bare ground                           |
|                       | b. Rushes = 85                           |
|                       | c. Baccharis = 15                        |
|                       | d. Red Alder = 25                        |

End Transect.

Transect Summary, Site #4: Each plant given with the percentage of total transect length it occupies.

Layer A:

moss = 1%

Layer B: herbs

fireweed = 8%

miners lettuce = 6.5%

Transect Summary, Site #4 (continued):

|           |        |
|-----------|--------|
| grasses   | = 5%   |
| rushes    | = 6.5% |
| deer fern | = 0.5% |
| lady fern | = 0.5% |

Layer C: shrubs

|                         |      |
|-------------------------|------|
| berry (unknown species) | = 3% |
| gooseberry              | = 1% |
| baccharis               | = 1% |

Layer D: trees

|                   |        |
|-------------------|--------|
| red alder         | = 8%   |
| willow            | = 1%   |
| spruce seedlings  | = 0.5% |
| redwood seedlings | = 0.5% |

Plant List:

|          | <u>Genus and Species</u>      | <u>Common Name</u> |
|----------|-------------------------------|--------------------|
| Layer A: |                               |                    |
| 1.       | <u>Lycopodium</u> spp.        | Moss               |
| Layer B: |                               |                    |
| 1.       | <u>Aira Caryophylla</u>       | Grass (Aira c.)    |
| 2.       | <u>Anaphalus margaritacea</u> | Pearly Everlasting |
| 3.       | <u>Athyrium felix-femina</u>  | Lady Fern          |
| 4.       | <u>Belchnum spicant</u>       | Deer Fern          |
| 5.       | <u>Carex (simulata?)</u>      | Sedges             |
| 6.       | <u>Epilobium</u> spp.         | Willow-herb        |

## APPENDIX D. Heavy Equipment Daily Log

Monday, September 8

### Site 1: Stream Crossing #1

Start up time 7:00 A.M.

Access to site 7:45 A.M.

Equipment operator orientation 7:45 to 9:00 A.M.

Works beginning on Site 1, 9:10 A.M.

Site 1 is being removed from bottom up due to relatively tight access from above.

Slope above 25%.

Original drainage may exceed 45%

### Sequence of Work:

- 1) Excavator performs initial digging
- 2) Cat moves dirt to a predetermined location

Photos 1-6 on 64 exposure instead of a proper 125 black and white

Photo point on stump next to channel (to the right looking down stream)

Site 1 completed on Monday, at 2:00 P.M.

### Site 2: Stream Crossing #2

Excavation of Site #2 began at 2:10 P.M.

Work only partially started by the end of day 1, September 8.

Tuesday, September 9

Excavation began from bottom to top, depositing fill first on the North slope of Site #2, then moving the dirt along the access road.

Soft loose soil prevented the excavator from removing all the fill down to the natural drainage.

A Humboldt crossing was uncovered at the head of the stream crossing. The Humboldt crossing was apparently installed over a natural drainage waterfall. We attempted to remove the remaining fill by pushing dirt down to Site #3. Loose dirt and saturated stream sediment prevented the Cat from backing up slope. Thus a slug of material approximately 83 cubic yards, still remains in the stream channel at this site.

Photo point - Alder on left side of channel just downhill.  
Photos 6 & 7 taken at this site.

Site 2 completed on Tuesday.

#### Wednesday, September 10

##### Site 3: Stream Crossing

Work commenced on Wednesday, by first excavating up into Site 2 from the bottom. Only a portion of the material left from the previous day was accessible from this site. A water drop of five feet has been left because of inaccessibility.

Site #3 was excavated from the bottom up. The excavator and Cat worked in tandem. Removed fill was placed on the access road to Site 3.

It took the entire day to complete this site.

Photo point #1 - Stump on lower left side of access road. Photo #8.

Photo point #2 - Photo #9 & 10.

Work completed on Wednesday.

#### Thursday, September 11

##### Site 4: Stream Crossing at Head of Slide

Morning began with removing debris and fill material from between Sites 3 & 4. A heavy

concentration of loose organic debris was removed.

Site #4 was excavated from bottom to top. Fill material was placed on the Northern section of the access road until this road section was filled with excavated dirt. Dirt was then moved back toward the Southern portion of Site #4's access road until the stream channel was excavated to stream sediment.

Job was completed in one day. Equipment moved to access road to Site #5.

Photo point at stump below Site 4 on left side of stream channel.

Photo of Site #4 (nearly completed) Shot #4

#### Friday, September 12

##### Site 5: Remnants of Failed Stream Crossing at Head of Slide

Morning - Equipment moved to site and positioned one and one-half hours

Excavation began by pushing out a pad for the excavator to work on as the slide head was reshaped. Dirt was then excavated and placed behind the excavator where the Cat pushed the dirt to a side skid trail.

Excavation of Site 3 was completed by 3:00 P.M., Friday.

Photo site is the same as Site #4, Shot #3.

An additional photo point is below Site 5 on the left side of the channel. Several shots were taken there. Several shots of Ernie against the Redwoods were taken just above the additional photo point.

Monday, September 15

Site 6: Stream Crossing

The channel between Site 5 and 6 was excavated from the bottom up. The natural drainage configuration was easily defined on the east slope. The west slope leveled off and was back-filled to prevent a possible breach of channel into an existing skid trail.

Excavation continued down through stream crossing Site 6. The channel was allowed to level out a bit as it passed through the remains of the stream crossing skid trail.

The excavator was moved to a small skid trail just below Site 6. Excavation continued to re-establish the original stream channel configuration.

Work continued all the way to Site 7 in one day.

The Cat placed all the excavated fill material, winched wood debris and installed waterbars on its way out of Site 5 and 6.

Photo point - on left bank immediately across Site 6. Shot #5.

Photo point - on right bank in direct line with a stump downhill. Compass bearing N 10° W. Shot #6.

Work completed on Monday.

Tuesday, September 16

Site 7: Stream Crossing

Site 7 was excavated from the bottom up. Fill was deposited on the access road. During excavation of the uphill edge of the stream channel crossing, a seep was uncovered. Decomposing organic debris and well keyed-in logs prevented the machinery from performing a complete job at this site.

Equipment was relocated to the main haul road. Access to the channel between Site #7 and the main haul road was cleared by hand from 3:30 - 5:30. Heavy equipment was placed on stand-by for two hours.

Photo point - On a marked tree stump, left side of the stream channel.

#### Wednesday, September 17

By noon, the stream channel had been excavated to the main haul road. Fill material was deposited in the haul road's inboard ditch. Surface road material was loosened up before fill was deposited.

Water was channeled to the existing culvert for rain storms that occur before heavy equipment work is complete.

A culvert was partially excavated at Site B1-1J in an attempt to channel water under the haul road and then above ground. Currently, water percolates from a break in the culvert through loose material down-slope.

The Cat cleared access to Site 9 for the excavator. Equipment was asked to stand-by for two hours.

Photo point - A shot was taken from the center of the haul road directly up slope.

Preparation for Site 9 was completed by the end of the day.

Photo point - Stump on right downhill edge of drainage.

#### Thursday, September 18

The excavator began the day by installing a ditch at the downhill edge of the original culvert.

The remaining crossing was excavated as far downstream as the excavator could reach. Fill material was placed on the Site 11 access skid trail on a slight outslope gradient.

Equipment was removed downslope to the haul road below.

The project was concluded 3-1/2 days ahead of schedule with a feeling of accomplishment amongst us all.

#### Monday, September 22

While the excavator completed removal of fill from the access road to Site 9, the cat winched logging debris loose from the haul road's main landing (L1). The cat returned to its work on the access roads to Site 10 and 11 by winching loose organic debris and back-bladed fill material. Then while the excavator provided assistance, the cat completed compaction and debris removal at Site 9.

The excavator constructed a trench in the main haul road for a culvert placement and was then placed on stand-by for the rest of the day. The Cat constructed a drain on log landing B2-L3, then completed the day by hauling check dam materials to Sites 2, 3, 4 and 7 for subsequent hand labor work later in the week.

The cat was then hauled to Site A-1 for road clearance and site preparation. The excavator was given advance notice that a full day's stand-by the following day would be necessary.

Self-loader truck arrived with two tons of straw. It then hauled a full load of check dam materials previously milled out by training crews in Unit G.

#### Tuesday, September 23

The cat winched organic debris and provided level access into Site A-1a and A-1b.

The self-loader hauled 5 loads of millable logs to B2-L3.

Photo shots of Unit A sites and the log deck were taken for documentation.

Wednesday, September 24

The excavator was hauled in from Unit B1 and began work on Unit A, Sites A-1a1 and A-1a2. The Cat provided assistance to the excavator.

The self-loader continued its work of the previous day, but only worked 6-1/2 hours after delays in equipment breakdown.

Thursday, September 25

The excavator and Cat finished Site A-1a2 and A-1a3.

The self-loader worked 10-1/2 hours and provided five full loads to Landing B2-L3.

Friday, September 26

The excavator and D-5 contoured the end of the Unit A access road and completed culvert removal and outslope of Site A-1a.

The self-loader hauled five loads of logs to Landing B2-L3.

Monday, September 29

The excavator removed the culvert and outsloped stream crossing A-1b. The excavator was moved to

the entrance road until the lowboy could be arranged for transportation home. Excavator time completed.

The D-5 Cat re-established water bars on the access road to stream crossing A-1a and A-1b. Then for the rest of the day, logging debris at Landing A-L was placed for easy recovery next spring.

Tuesday, September 30

The lowboy arrived and moved the D-5 Cat to the northern Skunk Cabbage Creek access road. The lowboy then returned to Unit A and transported the excavator to Arcata.

The D-5 Cat was directed by Bob Rohde to remove logging debris from the first landing beyond the National Park Service gate. The landing was then shaped and contoured for future use as a parking area (this parking area is the site of a potential trail head into the old growth and down into the marsh).

The D-5 was moved to stream crossing Site 7 where soft clay and organic debris was separated. Loose fill was outsloped along the entrance access trail.

An attempt to haul straw to the rehabilitation Sites 4 and 7 was unsuccessful without appropriate hauling equipment.

The self-loader truck delivered culvert lengths to the B-1 access road. The self-loader had travelled to the W-Line and selected culverts that had been removed from other rehabilitation sites. The 24-inch culvert was placed in the culvert ditch, on the main haul road, and covered with previously excavated material by the D-5 Cat.

Wednesday, October 1

The D-5 Cat backbladed the access road to Site 9 and finished backblading the fill at access road Site 8. The D-5 moved to the bottom portion of the access road where logging debris (which had previously fallen across the road) was removed.

Thursday, October 2

The D-5 Cat work was completed today. Waterbars along the original access road to stream crossing Sites 1 through 7 were established.

An excellent job of Heavy Equipment has been completed.

## BIBLIOGRAPHY

- California Cooperative Soil Survey. 1961. Soil-Vegetation Survey, Orick quadrangle.
- Cooper, D.W. 1975. Upland Soils of Humboldt County. University of California, Agricultural Extension Service.
- Madej, M.A., Kelsey, H., and Weaver, W. 1980. Evaluation of 1978 Rehabilitation Sites and Erosion Control Techniques. Redwood National Park, Arcata, California. Technical Report #1.
- Redwood Community Development Council. 1980-1981. Skunk Cabbage Creek Unit Management Plan, and Amendments I, II, and III. RCDC report for U.S.D.I. National Park Service, Redwood National Park.
- Stout, Dotty. 1980. Skunk Cabbage Creek Watershed Vegetation Report for Selected Sites. Unpublished report to Redwood Community Development Council.
- U. S. Department of Interior, National Park Service. 1978. Technical Specifications for Watershed Rehabilitation for IFB 8480-78-2, 3, and 4. Unpublished, on-file, Redwood National Park.

Plant List (continued):

| <u>Genus and Species</u>            | <u>Common Name</u> |
|-------------------------------------|--------------------|
| 7. <u>Erechtites</u> spp.           | Fireweed           |
| 8. <u>Equisetum telmateia</u>       | Horsetail          |
| 9. <u>Festuca</u> spp.              | Grass (Festuca)    |
| 10. <u>Galium</u> spp.              | Galium             |
| 11. <u>Hypochoeris (radicata?)</u>  | Composite          |
| 12. <u>Juncus</u> spp.              | Rushes             |
| 13. <u>Lolium</u> spp.              | Rye Grass          |
| 14. <u>Lotus</u> spp.               | Lotus              |
| 15. <u>Luzula comosa</u>            | Wood Rush (large)  |
| 16. <u>Luzula parviflora</u>        | Wood Rush (small)  |
| 17. <u>Lysichiton americanum</u>    | Skunk Cabbage      |
| 18. <u>Monita</u> spp.              | Miners Lettuce     |
| 19. <u>Oxalis oregana</u>           | Sorrel             |
| 20. <u>Polystichum munitum</u>      | Sword Fern         |
| 21. <u>Ranunculus</u> spp.          | Buttercup          |
| 22. <u>Rhododendron occidentale</u> | Azalea             |
| 23. <u>Sonchus</u> spp.             | Thistle            |
| 24. <u>Stachys</u> spp.             | Stachys            |
| 25. <u>Whipplea modesta</u>         | Whipplea           |
| 26. Unknown grasses                 | Grass              |

Layer C:

|                               |            |
|-------------------------------|------------|
| 1. <u>Baccharis pilularis</u> | Baccharis  |
| 2. <u>Ribes menziesii</u>     | Gooseberry |

Plant List (continued):

|    | <u>Genus and Species</u>       | <u>Common Name</u> |
|----|--------------------------------|--------------------|
| 3. | <u>Rubus parviflorus</u>       | Thimbleberry       |
| 4. | <u>Rubus spectabilis</u>       | Salmonberry        |
| 5. | <u>Rubus</u> spp.              | Berry (unknown)    |
| 6. | <u>Sambucus callicarpa</u>     | Elderberry         |
| 7. | <u>Vaccinium</u> <u>ovatum</u> | Huckleberry        |
| 8. | <u>Vaccinium parviflorum</u>   | Blue Huckleberry   |

Layer D:

|    |                              |             |
|----|------------------------------|-------------|
| 1. | <u>Alnus rubra</u>           | Red Alder   |
| 2. | <u>Libocedrus decurrens</u>  | Cedar       |
| 3. | <u>Picea sitchensis</u>      | Spruce      |
| 4. | <u>Psuedotsuga menziesii</u> | Douglas Fir |
| 5. | <u>Salix</u> spp.            | Willow      |
| 6. | <u>Sequoia sempervirens</u>  | Redwood     |
| 7. | <u>Tsuga heterophylla</u>    | Hemlock     |