

UNITED STATES DEPARTMENT OF THE INTERIOR  
NATIONAL PARK SERVICE

WATERSHED REHABILITATION PLAN

ENVIRONMENTAL ASSESSMENT

REDWOOD NATIONAL PARK

DEL NORTE AND HUMBOLDT COUNTIES  
CALIFORNIA

The long-term objective of the rehabilitation program at Redwood National Park is to minimize man-induced erosion within the park while encouraging the return of the area to a mature redwood forest ecosystem. The program will consist of several interrelated projects to be carried out over 15 years. The projects include erosion control, planting of forest vegetation, and removal of roads not needed for access to rehabilitation sites or for future park management. Where necessary, stream channels disrupted by logging activities will be reconditioned, and restoration activities along the main stem of Redwood Creek will be undertaken to protect downstream redwood groves and aquatic communities. A monitoring program will be implemented to determine the effectiveness of rehabilitation techniques, with conclusions recorded for the benefit of other governmental and private agencies with similar tasks. Accelerated recovery rates of disturbed slopes are considered beneficial for the watershed on a cumulative basis. Overall, localized environmental impacts of the plan may be adverse, short term, and insignificant.

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Comments must be received at the above address by

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## I. PURPOSE AND NEED

Public Law 95-250 directed that a rehabilitation program be developed for some 48,000 acres in the Redwood Creek basin of Redwood National Park. Before these lands were added to the park in 1978, timber harvesting and related road construction had adversely influenced erosion rates, sediment deposition, and water quality within the entire basin. It is these problems that are to be addressed in the rehabilitation program. PL 95-250 also established a 33,000-acre park protection zone (PPZ) upstream of the park boundary where the secretary of the Department of the Interior was given responsibility for ensuring that logging does not adversely affect park resources and for generally protecting the park from adverse impacts caused by activities occurring beyond the park boundary. The act authorized appropriations of \$33 million for rehabilitation work (see appendix A).

The purpose of this document is to present proposals to minimize man-induced erosion within Redwood National Park and to encourage the return of a natural pattern of vegetation, pursuant to PL 95-250. Ultimately the efforts should result in the restoration of natural ecosystems to a condition similar to what would have existed without disturbance by man. The program will also seek to minimize or eliminate man-induced erosion within the PPZ through the review of timber harvest plans and ongoing sediment source studies, while still fostering the productivity of commercial forestland.

## II. AFFECTED ENVIRONMENT

### A. Natural Resources

#### 1. Overview

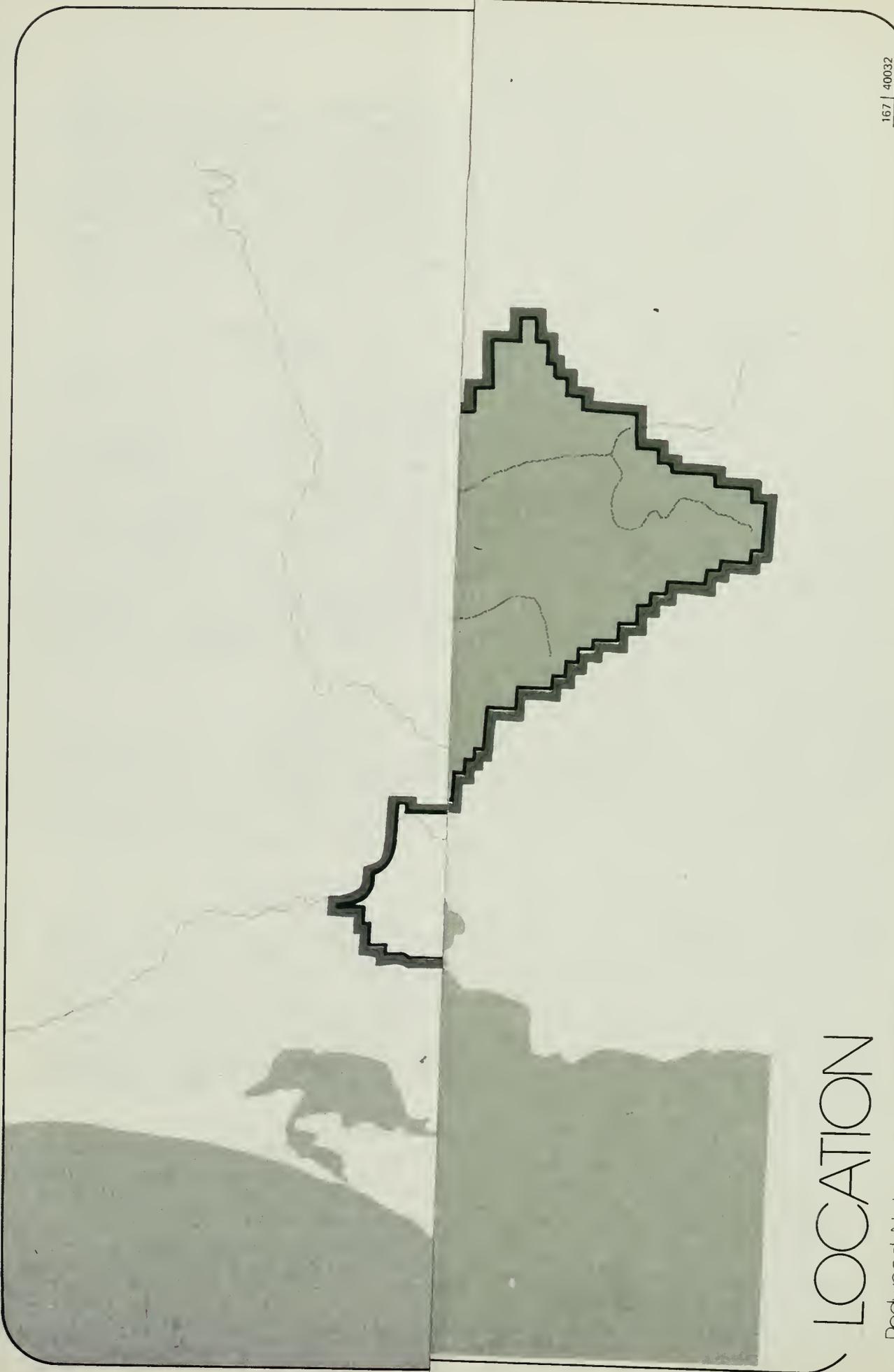
Redwood Creek drains a 280-square-mile watershed in the mountainous, coastal region of northwestern California. The creek begins near an elevation of 5,000 feet and flows northwest for 55 miles until it empties into the Pacific Ocean near Orick. The watershed is characterized by high relief, steep unstable slopes, and narrow valley bottoms. Average hillslope gradients range from 31 to 34 percent, and over a third of the basin shows evidence of past or present mass movement (U.S. Department of the Interior, Geological Survey [USDI, GS] 1976b).

Redwood Creek and its tributary streams are subject to frequent flooding from winter storms, and basin soils are naturally unstable and highly erodible. Landslides and earthflows are widespread, and even under natural conditions streams swelled by winter rains transport large volumes of sediment. Mean annual erosion rates for the north-coast area in general result in sediment yields in excess of 4,000 tons per square mile per year (Janda and Nolan 1979). For Redwood Creek, with over 90 percent of the forests in the basin harvested, the sediment yields are in excess of 8,000 tons per square mile per year (U.S. Congress, House, Committee on Government Operations 1976).

The existence of over 300 miles of truck roads and 3,500 miles of tractor trails has created the greatest erosion problems in the watershed. The cutting of logging roads into steep slopes has often resulted in massive slope failures, causing sediment to be delivered directly into perennial and intermittent stream channels. Surface runoff is intercepted and concentrated by inboard ditches along these roads, and it often empties onto slopes that have no natural drainage channels, resulting in severe gullying. During major storms, culverts and inboard ditches often become blocked, and water is diverted onto road surfaces, causing new gullies and saturating road fills, which in turn leads to slope failures.

Many natural deep-seated mass movements in the prairies in the watershed have also been aggravated by logging. Road construction across unstable prairie grasslands has altered the natural drainage patterns, resulting in deep gullies and slumping as the prairie slopes adjust to changing hydrologic conditions.

Altered drainage patterns, loss of topsoil, soil compaction, destruction of ground cover and subsequent decreased evapotranspiration, increased runoff rates, increased soil temperature, and decreased soil moisture are among the results of the logging activities. Downstream from the cutover lands, the



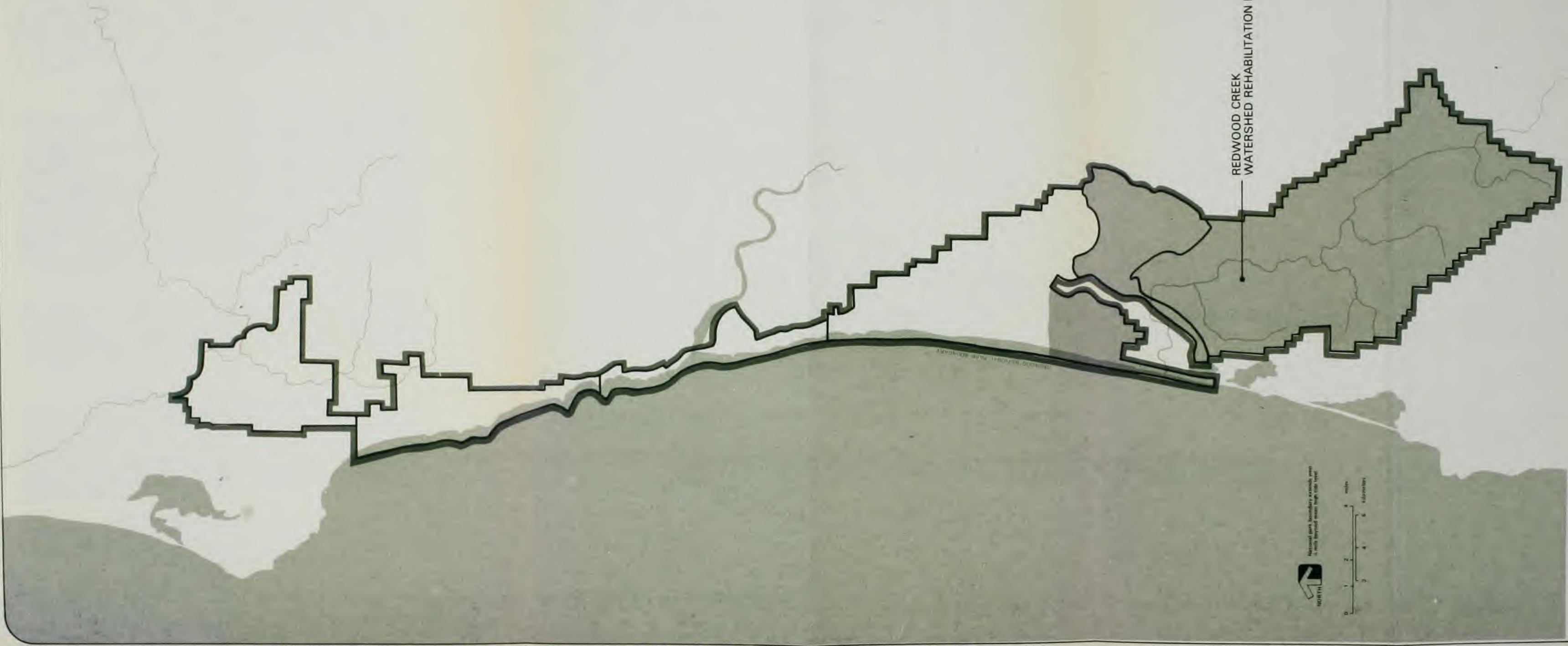
# LOCATION

Redwood National Park

US Department of the Interior

National Park Service

167 | 40032  
DSC | JUL 80



North arrow and legend: National park boundary extends approximately 1 mile beyond mean high tide level.



REDWOOD CREEK WATERSHED REHABILITATION EFFORT

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effects include the aggradation of streambeds, the loss of anadromous fish-spawning habitat due to increased sedimentation, increased streamside slope failures, greater bank erosion, loss of streamside vegetation, higher winter stream discharge, lower summer discharge (accompanied by higher water temperatures), and altered flow patterns and sediment quantities in the estuary. Changes wrought by these events have led to general degradation of the watershed, including damage to the aquatic and riparian environments of the Redwood Creek corridor.

## 2. Vegetation

Historically, the Redwood Creek basin supported a dense mosaic of forest, prairie, and woodland. Forest types ranged from Sitka spruce (Picea sitchensis) on slopes and valleys adjacent to the ocean, to the redwood/Douglas-fir (Sequoia sempervirens/Pseudotsuga menziesii) associations in the more upland areas approximately 10 miles from the coast. Redwoods dominate the alluvial forests and reach their greatest height here. California-laurel (Umbellularia californica) and bigleaf maple (Acer macrophyllum) are common associated species on alluvial flats. Elsewhere associated species of importance include hemlock (Tsuga heterophylla), grand fir (Abies grandis), madrone (Arbutus menziesii), tanoak (Lithocarpus densiflorus), and red alder (Alnus rubra). In the upper basin, redwoods are absent or are confined to valley bottoms. At higher elevations, true firs (Abies sp.) replace Douglas-fir.

Approximately 65 percent of the basin within the park has been cutover or otherwise disturbed by activities associated with logging (i.e., construction of roads, skid trails, and landings). Only 29 percent remains in old-growth and/or advanced second-growth stands, while the remaining 6 percent consists of prairies, woodlands, valley, and riparian bottomlands (see table 1 in section III.A.).

## 3. Wildlife

A wide range of wildlife habitats for a variety of species are found in Redwood National Park, the three state parks, and surrounding areas. In addition to the habitats coinciding with various vegetation types, there are marine, intertidal zone, sand and gravel beach, rocky seashore, saltwater marsh, and offshore rock habitats. The species associated with these various habitat types are listed in appendix F-7 of the Draft Environmental Statement for the General Management Plan (DES 79-55; see USDI, NPS, DSC 1979).

Common mammals within the Redwood Creek basin include the Roosevelt elk, black-tailed deer, black bear, and various small mammals. Bobcat, gray fox, coyote, and mountain lion also occur in the area. Mink, otter, and beaver are more closely associated with Redwood Creek and its tributaries.

Birds in the watershed include larger species such as hawks, waterfowl, and turkey vultures, as well as smaller species such as sparrows and warblers. Occasionally, eagles, falcons, and osprey are observed, but only the osprey is known to nest in the immediate area.

Sightings of endangered or threatened birds have been made primarily along the coast of Redwood National Park, and peregrine falcons, brown pelicans, and the Aleutian Canada goose have been seen. No endangered or threatened mammals inhabit the project area.

Additional information pertaining to the affected environment may be found in DES 79-55. More detailed discussions on the natural environment of the Redwood Creek watershed can be found in Kolipinski 1975; USDI, NPS 1975; USDI, GS 1975b; and U.S. Congress 1976.

## B. Cultural Resources

### 1. Archeology/Ethnography

Archeological sites identified in the Redwood Creek basin are situated within the ethnographic territory of the Chilula peoples, also known as the Redwood Creek or Bald Hills Indians. The last Chilula family left Redwood Creek early in the 1900s, but prior to that date, the Chilula occupied most of the lower portion of Redwood Creek.

The Chilula were inland oriented, since they had no direct access to the ocean without going through the "danger zone" that separated them from the Coast Yurok, their traditional enemies. Because coastal and riverine resources were less abundant or accessible for the Chilula than for their Yurok and Wiyot neighbors, the Chilula probably placed greater emphasis on vegetable foods and game than on fish. In addition, their subsistence effort was probably more mobile and not necessarily oriented around Redwood Creek itself, except during the limited period of the creek's yearly salmon run.

Within their territory, the Chilula could use the creek for salmon and eel, the forests for acorns and elk, the prairies for bulbs, grasses, and game, and the forest/prairie ecotone for the diversity of plant species it offered. During the year, various resources would be utilized at the appropriate season, and temporary camps or procurement sites would be occupied away from permanent Chilula villages.

Information about the settlement patterns and early lifeways of the Chilula is contained at archeological sites in the proposed Bald Hills archeological district. This resource information is valuable to anthropological research, to local Chilula

descendants, and to the interpretation of events and changes in the Redwood Creek basin.

The earliest European knowledge of northwestern California dates from the Spanish and Russian sea explorations between 1542 and 1800, but they did not reach the Redwood Creek area. After 1800, however, Chilula territory was traversed by fur traders and gold miners, and permanent homesteads were established during the 1850s and 1860s. The Trinidad Trail, a primary pack trail from the coast to the Trinity River goldfields, crossed Redwood Creek at the Tall Trees and then ascended the Bald Hills ridge. During this period, the Chilula people resisted the incursions of white settlers and their population was greatly reduced, resulting in near extinction.

Today there are not more than two or three Chilula descendants with direct ties to the Redwood Creek basin. The living Native Americans of Chilula ancestry represent a cultural continuum and are actively following traditional beliefs and customs.

## 2. History

Historic properties within the Redwood Creek basin are primarily associated with homesteading and ranching, a result of the broad expansionist movements encouraged by the initiation of trade and commerce with the interior mining regions at the head of the Sacramento Valley. By the end of the 19th century, the ranchers of the Redwood Creek valley and Bald Hills had laid the foundations of a thriving lifestyle based on agriculture, horticulture, and livestock raising. These pursuits lasted well into the 20th century, when they were finally disrupted, and almost entirely destroyed, by the arrival of the lumber industry.

Pursuant to executive order 11593, two surveys were initiated within the Redwood Creek basin to ascertain sites and structures of historic and architectural significance (USDI, NPS 1969; USDI, NPS, DSC 1978 and 1980b). The Lyons ranch homestead site and remnants of the Tall Trees/Trinidad Trail were identified as possessing intrinsic historic importance and are being nominated to the National Register of Historic Places. Two other properties, the Lane barn at Elk Camp and the Dolason half-barn in Dolason Prairie, possess exemplary architectural significance and are recognized for their local value, although they are not of national register calibre. Ongoing archeological surveys and a proposed oral history program may identify additional historic sites, which would be added to the cultural resources data base for the park. Their significance would be evaluated against the criteria for inclusion on the National Register of Historic Places (36 CFR 1202). Actions specific to the management of the Lyons Ranch site, the Dolason barn, and the Lane barn are found in the cultural resources

management portion of the General Management Plan (USDI, NPS 1980).

### C. Socioeconomic Conditions

#### 1. The Regional Economy

Until the 1980 census results become available, current socioeconomic data on Humboldt County will not be known. The following discussion is based primarily on projections and observations published in the Socio-Economic Base Study on Six Rivers National Forest (TerraScan 1979). Additional economic information may be found in DES 79-55 and in the 1980 report to Congress on the status of the implementation of the park expansion act (USDI, NPS 1980).

The population of Humboldt County has increased slightly since 1970. In 1976 Humboldt County's population was estimated by the state to be 106,000, reflecting a growth rate of 6.5 percent between 1970 and 1976. The 1980 census is likely to reveal an additional net migratory inflow.

Employment in forest products industries has declined, while agriculture, commercial fishing, tourism, and government have all expanded. The decline in forest products has been accompanied by a substantial increase in unemployment rates. Between 1970 and 1980, the unemployment rate for Humboldt County has increased from 10.1 percent to an estimated 12.9 percent (USDI, NPS 1980). Concurrently, taxable transactions, personal income, and residentiary employment have increased. The total Humboldt County income in 1980 is estimated at \$523,800,000 and residentiary employment is approximately 19,100 (Jewett). These increases may be partially due to the Redwood Employment Protection Program, which was set up to maintain the incomes of those persons who lost jobs because of the expansion of Redwood National Park. The increases may also partially result from an increase in professional and white collar occupations, as well as unskilled and semiskilled positions. In addition, the decrease in forest products manufacturing has resulted in an increase in the cost of wood products, a leveling of productivity, and possibly the adoption of more labor-intensive methods (TerraScan 1979).

#### 2. Visitor Characteristics and Trends

The information in this section was collected in a visitor survey conducted during the summer and winter of 1977 at Redwood National Park. Additional information concerning visitation can be found in DES 79-55 and in the "Redwood National Park Tourism Study: Economic Impacts of Alternative Park Development Plans" (Grobey and others 1979).

The survey revealed that 60 percent of the Redwood visitors are California residents, 75 percent travel more than 200

miles to reach the park, and 70 percent visit the park for recreation. The majority of visitors come in private automobiles, and one-third travel in some type of recreation vehicle. The majority spend more than eight nights away from home, and only 8 percent cited Redwood National Park as the primary destination of their trip. Only 27 percent of the visitors surveyed were in the park for the first time, and 29 percent had previously visited seven or more times. Ninety percent planned to spend less than eight hours in the region.

The number of park visits is projected to increase from slightly more than 600,000 in 1970 to almost 2 million by 1990. This represents an annual increase of 5.9 percent and is approximately four times as large as the growth in recreation demand projected for the nation over a similar time period. In 1970, 62 percent of all the visits were during July, August, and September. This is projected to decline to 38 percent by 1990, with the winter and fall seasons absorbing larger numbers of visitors.

### III. ALTERNATIVES, INCLUDING PROPOSED ACTIONS

#### A. No-Action Alternative

The no-action alternative is a "natural process" alternative whereby revegetation and eventual soil stabilization would occur without direct assistance from mechanized equipment or labor. Disturbed slopes would be permitted to seek their own level of stability, the existing road system would remain, and altered and blocked stream channels would be left. The actions under this alternative would be the opposite of the proposed actions.

Even without a comprehensive rehabilitation program for the Redwood Creek watershed, some efforts would undoubtedly be undertaken as part of the natural resources management plan to address the most critical erosion problems and to restore natural processes. Such efforts would be undertaken pursuant to the NPS "Management Policies" (USDI, NPS 1978), which require the abatement of erosion induced by human activities and vegetative manipulation. The effectiveness of something less than a full-scale program, however, is nearly impossible to evaluate because the actions undertaken would depend on the money and personnel available, and additional park staff would probably not be assigned exclusively to watershed rehabilitation efforts, owing to other park priorities. Because the development of this approach, along with a detailed impact analysis, would be contrary to the congressional mandate to restore the watershed, this alternative has not been considered in detail.

#### B. The Proposal

The proposed actions define an approach to the rehabilitation of the Redwood Creek basin. Many sitespecific actions will not be prescribed until various surveys and inventories have been completed, and until pilot rehabilitation activities have been evaluated for effectiveness.

The most important objectives of the overall effort include the rehabilitation of logged hillslopes, the restoration of ephemeral, intermittent, and perennial stream channels, and the revegetation and restoration of denuded forestland. These objectives will be accomplished by controlling gully, rill, and slope erosion; by rediverting streams back into their natural, prelogging channels; by excavating fills placed in road and skid trail stream crossings; by removing organic debris and stored sediment in natural stream channels where necessary; and by stabilizing mass movement features where feasible. Vegetation will be planted to directly control erosion, to reestablish forest vegetation, and to restore disturbed prairie vegetation.

Additional proposals include the removal of unnecessary roads and the maintenance of roads considered to be essential.

Monitoring for effectiveness of treatment techniques will assist in evaluating the relative success of efforts. A basinwide inventory of sediment sources and the habitat quality of tributaries will provide information relative to the rehabilitation of aquatic communities and streamside vegetation. Timber harvest plans in the PPZ and cooperative agreements with federal, state, and local governments, and also with private landowners, will continue to be evaluated.

The programs and specific actions that are being proposed to achieve these objectives are described below. The erosion control program is the focus of initial rehabilitation efforts and is discussed first. Other programs include revegetation and the rehabilitation of prairies, riparian resources, and the Redwood Creek estuary. The management of cultural resources and the program budget and staffing are also discussed.

1. Watershed Rehabilitation

- a. Erosion Control Program

- (1) Existing Conditions Evaluation

- A Ground Disturbance and Erosional Landforms map has been prepared to indicate the degree of ground disturbance within the park for the Redwood Creek watershed (see map in pocket at back of report). Major erosional features such as large earthflows and debris slides are also identified on the map. Information for the map comes from photo interpretation of 1:6000 color vertical aerial photos, taken in June and July of 1978. Ground reconnaissance for the mapping took place at various locations throughout the area during the past two years.

This map is being used along with additional scientific data and NPS policies to determine rehabilitation priorities for disturbed sites throughout the basin. The map does not show the order in which sites will be treated because these priorities must be decided by applying all of the criteria discussed in the following section (III.B.1.a.(2)). The map does show the conditions at the various sites, which can then be evaluated according to the criteria to determine treatment priorities--site proximity to a perennial stream, relative age of logging, logging method, accessibility of the site in terms of the road network, and the size of the drainage area above the site. However, other conditions, such as relative sediment yield, site-specific erosion problems, and the comparative condition of roads, can only be determined by onsite inspection.

The map also delineates both the active and inactive major erosional landforms that are clearly visible on the aerial photographs. These include forested earthflows that are either dormant or slow-moving; relict, bowl-shaped avalanche scars; large slope hollows that may be prehistoric landslides; and erosion-cut terraces that now form flat ridgetops. These natural

features of the landscape indicate the degree of erodibility of the terrain, but they are not the sole basis for any rehabilitation treatment.

The lands shown on the map have been categorized according to the condition of the resource and the vegetation type, and the aggregate acreage for each category has been calculated. This information is shown in table 1. For disturbed lands within a particular category, the type of general treatment that may be considered is also shown in the table.

## (2) Site Selection Criteria

The primary aim of rehabilitation work will be to minimize the delivery of sediment from logged hillsides into perennial stream channels in the Redwood Creek watershed. In general, the tributary basins with the highest sediment yields will be treated first, but other factors will also be considered before final decisions about treatment sites and schedules are made. Critical areas include sites of major disturbances, such as logging roads and/or tractor-logged slopes, that are close to perennial streams. Disturbed areas at the ends of logging roads and the end portions of logging roads themselves may be treated before other equally critical areas are treated because once roads are pulled, disturbed slopes are no longer easily accessible and other road sections cannot be pulled until dead-end sections have been treated.

The following criteria, listed in order of importance, are to be considered in determining priorities in the scheduling of sites for treatment. The most critical areas, as measured by these criteria, will have the highest priorities for treatment.

The amount of sediment yield from the tributary basin in which the site occurs: The higher the estimated sediment yield, the higher the priorities for the treatment of sites in the tributary basin.

The proximity of sites to perennial stream channels: The closer the sites to perennial streams, the higher the priorities.

The condition of logging roads: The more serious the state of disrepair of roads within or adjacent to a site, the higher the priorities.

The date of logging: Recently logged areas are more accessible, and the erosional problems are easier to detect and are not as well developed, therefore these areas should be treated before conditions worsen.

Table 1: Land Disturbance Categories  
(from Land Disturbance and Erosional Landforms map)

Land Category	Land Description	Estimated Total Acres	Expected Treatment	
			Heavy-Equipment Work	Labor-Intensive Work
1	Old-growth stands and advanced second growth	18,590	None	None
2	Older cut units with dense regrowth and few remaining tractor trails; includes well-established second growth	10,665	None	Upgrade water bar network on any existing haul roads
3	Tractor-yarded unit with dense regrowth and minimal bare tractor trails	5,735	None	Upgrade water bar network on any existing haul roads
4	Tractor-yarded unit with adequate regrowth but extensive bare tractor trails; drainage disturbance present	10,450	Rip trails to disaggregate surface; reroute drainage runoff to original water-courses; remove debris from channels to prevent bank erosion; excavate fill material and debris from road crossings; and divert inboard ditch runoff to natural channels	Construct check dams; line stream channel crossings with rock; apply mulches and seed bare trails and landings with grasses and shrubs; if regeneration on slopes insufficient, plant redwood and/or Douglas-fir seedlings
5	Recent tractor-yarded unit with minimal regrowth; drainage disturbance prominent, with obvious erosion due to haul roads/landings and tractor trails	4,600	Disaggregate trails; reroute drainage to original water-courses; remove debris from channels and excavate crossings; divert inboard ditch runoff from roads and landings	Construct check dams; line stream channel crossings with rock; add mulches and consider other soil amendments on bare trails and landings; replant slopes if regeneration insufficient
6	Recent tractor-yarded unit on flat to moderate slopes with negligible erosion problems and minimal regrowth	295	Confirm and upgrade water bar network	If regeneration on slopes insufficient, plant redwood and Douglas-fir seedlings; plant grasses and shrubs on bare roads/trails and landings
7	Recent cable-yarded/high lead unit with no serious erosion; minimal regrowth; drainage problems associated with landings/decks	2,395	Outslope landings and decks where close to streams; improve drainage on wet landings by diverting inboard ditch runoff	Apply mulches and consider other soil amendments on landings/decks; plant grasses and shrubs for ground cover on landings/decks; restock slope if regeneration insufficient
8	Dense alder growth on wet slopes, including midslope seepage zones and recently vegetated landslides	585	None	On unstable slopes where seepage may be contributing to slope failures, possibly improve drainage and route water onto more stable slopes
9	Older cable-yarded unit with negligible erosion; good regrowth; no obvious drainage disturbance and no cuts by tractor trails	400	None	None

Land Category	Land Description	Estimated Total Acres	Expected Treatment	
			Heavy-Equipment Work	Labor-Intensive Work
10	Quarry sites; bare rock with no vegetative cover	40	None	None
11	Large logging decks		Rip surface to disaggregate compacted soil; improve drainage if needed	Apply mulches and plant with grasses, shrubs, and conifers, if desirable
12	Low-gradient valley bottomland with lush riparian growth		None	None
13	Prairie grasslands and oak woodlands; severe local gully erosion associated with roads across prairie	2,275	Remove unnecessary roads; in other cases divert inboard ditch runoff to prevent concentrated flows onto unstable prairie slopes	Remove conifers that have seeded onto disturbed cut-and-fill slopes along road to prevent further encroachment on the prairie; seed native perennial grasses on disturbed sites
14	Flat ridgetop area representing an older erosional surface; currently few erosion problems, regardless of land use history; may include some old-growth forest and tractor-logged units	2,030	Divert problem drainages in headwater areas if feasible	None
15	Highly erosive unit confined to southeast corner of park; most sites have been logged, but have moderate to extensive regrowth; because of naturally erosive soil and highly sheared bedrock, numerous complex slope drainage problems still need treatment	1,720	Conduct extensive slope work because of the area's unstable nature; reroute drainages where slope failure and gulying exist; divert surface runoff to natural channels; remove and outslope all roads; disaggregate trails; remove debris from channels; excavate fill material and debris from road crossings	Same as categories 4, 5, and 7
16	Active earthflows, landslides, debris avalanches, and recent slumps; may or may not be vegetated	50	To be determined	

The past logging method: Tractor-yarding results in greater ground disturbance than does cable-yarding, so the former areas will have higher priorities.

The accessibility of the site: Sites at the ends of dead-end logging roads must be treated first because road removal precludes reasonably easy access to the site for rehabilitation.

The amount of drainage area upslope from the site: If a certain site is selected for treatment, all the drainage area immediately upslope to the watershed divide must be treated at the same time so that small watersheds on the slope are rehabilitated as a physiographic unit.

Three other factors will be considered in determining work priorities. Addressing these factors will fulfill the legislative mandates outlined in PL 95-250.

Selecting sites for training labor-intensive rehabilitation groups: In many instances, training should be conducted at noncritical sites. Whenever practical, labor-intensive rehabilitation groups will employ people from Del Norte and Humboldt counties. At these sites, technique development and improvement can be used to increase the effectiveness of rehabilitation efforts at more critical sites. Noncritical sites are those that do not have the potential to yield large volumes of sediment directly to perennial streams. An adequate buffer of old-growth redwood between the site and a major tributary, or between the site and Redwood Creek, will also qualify a site as being noncritical.

Selecting demonstration sites: In some cases it may be desirable to illustrate rehabilitation techniques for general park interpretation purposes by treating a site adjacent to a visitor use area. Such a site might not be considered a critical area as defined by the criteria above.

Selecting sites for experimental or innovative erosion control work: Experimental erosion control work will be done in noncritical areas because the results of such work are unknown. Included as part of the experimental work will be request-for-proposal (RFP) type contracts, which will require bidders to submit proposals for treating specific problem areas. These proposals will be evaluated by NPS personnel for their anticipated effectiveness before contracts are awarded.

### (3) Sequence of Activities

The following sequence of events outlines the critical steps that must be completed for each rehabilitation site

after the treatment priority has been established. The most important procedural steps, or those with the greatest potential time requirements, are listed first. (See the Action Sequence flow chart for implementation sequencing.)

(a) Cultural Resources Survey

Pursuant to executive order 11593, "Procedures for the Protection and Enhancement of the Cultural Environment," all sites will be surveyed for cultural resources that may be affected by the rehabilitation effort. This survey must be made early so that if significant cultural resources are found, a method for avoidance of effect or plan for mitigation can be developed and implemented well before active rehabilitation work begins. Requisite compliance actions must be approved as outlined in the "Regulations for the Protection of Historic and Cultural Properties" (36 CFR 800). Specific cultural resources management actions are discussed in section III.B.2.

(b) Endangered Species Survey

Pursuant to PL 93-205, the Endangered Species Act of 1973, as amended 1978, all sites will be surveyed to ensure that no threatened or endangered species of plants or animals will be adversely affected by rehabilitation work. If a sensitive species is found at or near an activity site, then an early determination will be made as to what negative impacts may occur and what mitigation or abatement measures may be employed to reduce the degree of impact.

(c) Premapping and Inventory Preparation

Complete aerial photo coverage at an acceptable scale will be obtained for each site, and enlarged photo-mylars from each negative will be produced for the actual mapping of the site. Field inspections of erosional features identified on the aerial photos will be conducted to establish the degree of disturbance and rehabilitation priorities.

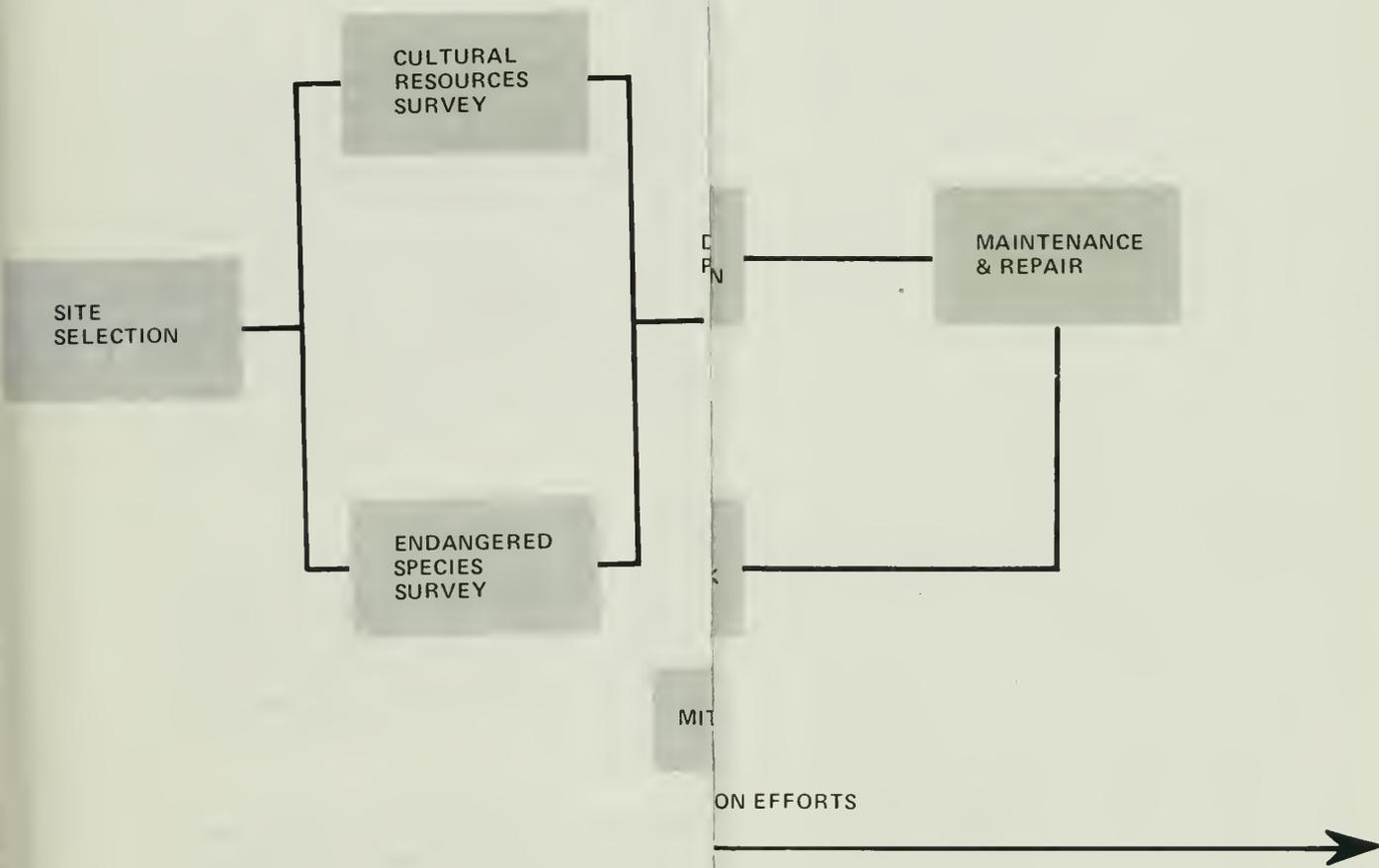
(d) Mapping and Erosional Features Inventory

Sites in the basin that are selected for rehabilitation will be inspected and fully mapped to determine the original natural geomorphic configuration of the slope, and also the extent and nature of erosion on logged slopes, haul roads, and severely disturbed or compacted areas. Determinations will be made about which erosional processes are at work in each area and about whether rehabilitation efforts will improve conditions. Some sites may have already recovered naturally to a point that physical rehabilitation activities will actually increase sediment transport; therefore, these sites may be considered for rehabilitation only through revegetation and not through major physical treatment.

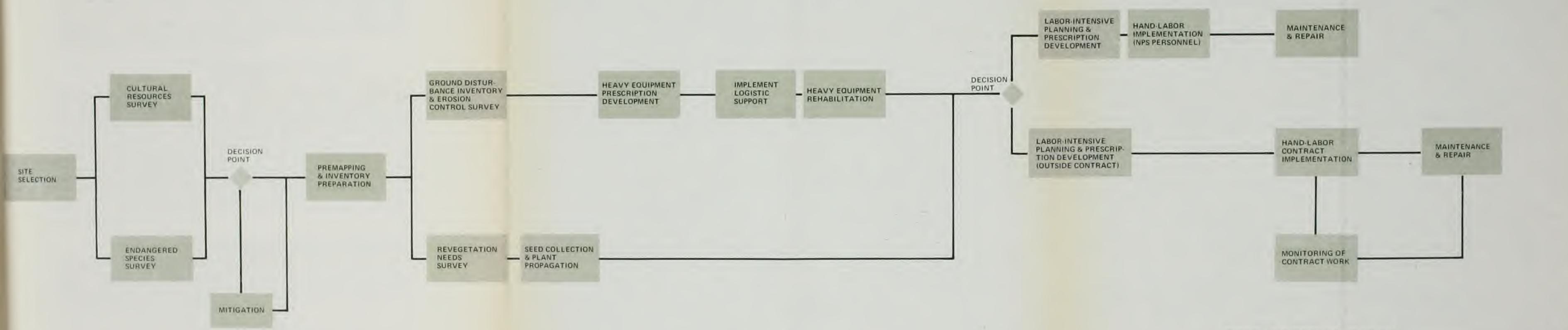
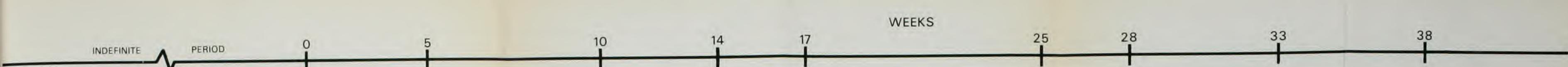
INDEFINITE

PERIOD

38



# ION SEQUENCE (flow chart) WOOD REHABILITATION PLAN



MONITORING OF REHABILITATION EFFORTS FOR EFFECTIVENESS →

**ACTION SEQUENCE**  
(flow chart)  
REDWOOD REHABILITATION PLAN

(e) Revegetation Needs Survey

Each rehabilitation site will be inventoried to determine soil types, moisture-holding capacity, nutrients present, slope, aspect, and naturally occurring plant species. This will help in selecting vegetation types best suited to the unit. The survey will be undertaken at the same time as the mapping and inventory of erosional features.

Studies of early plant succession will guide the use of plant species for erosion control and revegetation. In addition, a broad survey of conditions will guide a tree-planting program designed to speed the reestablishment of forests on cutover and understocked land. Generally all sites disturbed by rehabilitation activities will be replanted with appropriate vegetation. Studies of long-term vegetation management needs will be conducted as rehabilitation progresses.

(f) Heavy-Equipment Prescription Development

Work sites where rehabilitation will require heavy equipment will be identified, the type of treatment will be prescribed, and access routes will be determined. All requirements in terms of deciding what personnel and equipment are needed, where camp facilities should be located, and which materials must be purchased or can be provided by the park should be completed by this time. Potential sources of materials such as rocks, redwood boards, and mulches will be identified and storage areas defined. Equipment rental agreements will be prepared for review and authorization. Heavy-equipment work will take into account concurrent work and equipment needs at other rehabilitation units, and work will be scheduled so as to minimize equipment time and cost. Tours of the units for prospective contractors will also be conducted.

(g) Seed Collection and Plant Propagation

The collection of native seeds and the propagation of native plants, as determined by the revegetation needs survey, will be undertaken at the same time as the previous step. Native seed stocks from commercial outlets may be utilized when available. These operations will probably be contracted out, but they can also be carried out by NPS staff.

(h) Logistic Support

The equipment operators selected for the heavy-machinery rehabilitation work will be contracted. All equipment needed to accomplish rehabilitation work will be gathered, inventoried, and transported to the site. Campsites will be set up at the selected locations.

(i) Rehabilitation by Heavy Equipment

Efforts to be undertaken with heavy equipment will focus on stream channel clearance, road removal, fill crossing excavation, cut-and-fill bank stabilization, restoration of predisturbance drainage patterns where feasible, gully stabilization and/or diversions, debris removal (including salvage, milling, and end hauling), and mulch production and transportation. Heavy-equipment work will be supervised by park personnel, including an archeologist when so designated by the clearance document, to provide for continuous onsite monitoring of contractor activities.

(j) Labor-Intensive Erosion Control and Revegetation Prescriptions

This phase will involve the development and supervision of contract work; or if appropriate, all work can be performed by NPS staff. Decisions will be made about intensive work sites, the type of treatment necessary at each site (such as constructing of check dams, water ladders, or water bars; rocking of channels; willow wattling; and mulching) and monitoring techniques for the work sites. A specific vegetative prescription will also be prepared to detail the type and quantity of each species to be used, planting rates, soil bolstering efforts, and any other steps necessary to ensure successful germination and growth. If work is not to be performed by NPS personnel, work contracts--including statements of work, technical specifications, special considerations (for example, conditions for archeological clearance), field maps, drawings, sketches, figures, and/or diagrams of prescribed techniques or structures--will be prepared by NPS personnel. After NPS approval of contracts, they will be advertised and awarded according to federal procurement regulations. After contracts for bidding are released, prospective contractors will be given tours of the work sites.

(k) Implementation of Labor-Intensive Work

This step will include NPS monitoring of contracted activities. A determination will be made as early as possible whether the rehabilitation techniques prescribed for the sites are effective, and recommendations will be made for changes in techniques where necessary. Contracted personnel will be monitored to ensure compliance with contract stipulations.

(l) Maintenance and Repair

Winter storms will almost immediately test the structural integrity of the erosion control measures implemented at each site. (Normally, the first winter is considered critical.) Periodic inspections will be made by NPS personnel to ensure that these control measures remain effective. In areas where they have failed, emergency repairs will be undertaken. The

(e) Revegetation Needs Survey

Each rehabilitation site will be inventoried to determine soil types, moisture-holding capacity, nutrients present, slope, aspect, and naturally occurring plant species. This will help in selecting vegetation types best suited to the unit. The survey will be undertaken at the same time as the mapping and inventory of erosional features.

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(h) Logistic Support

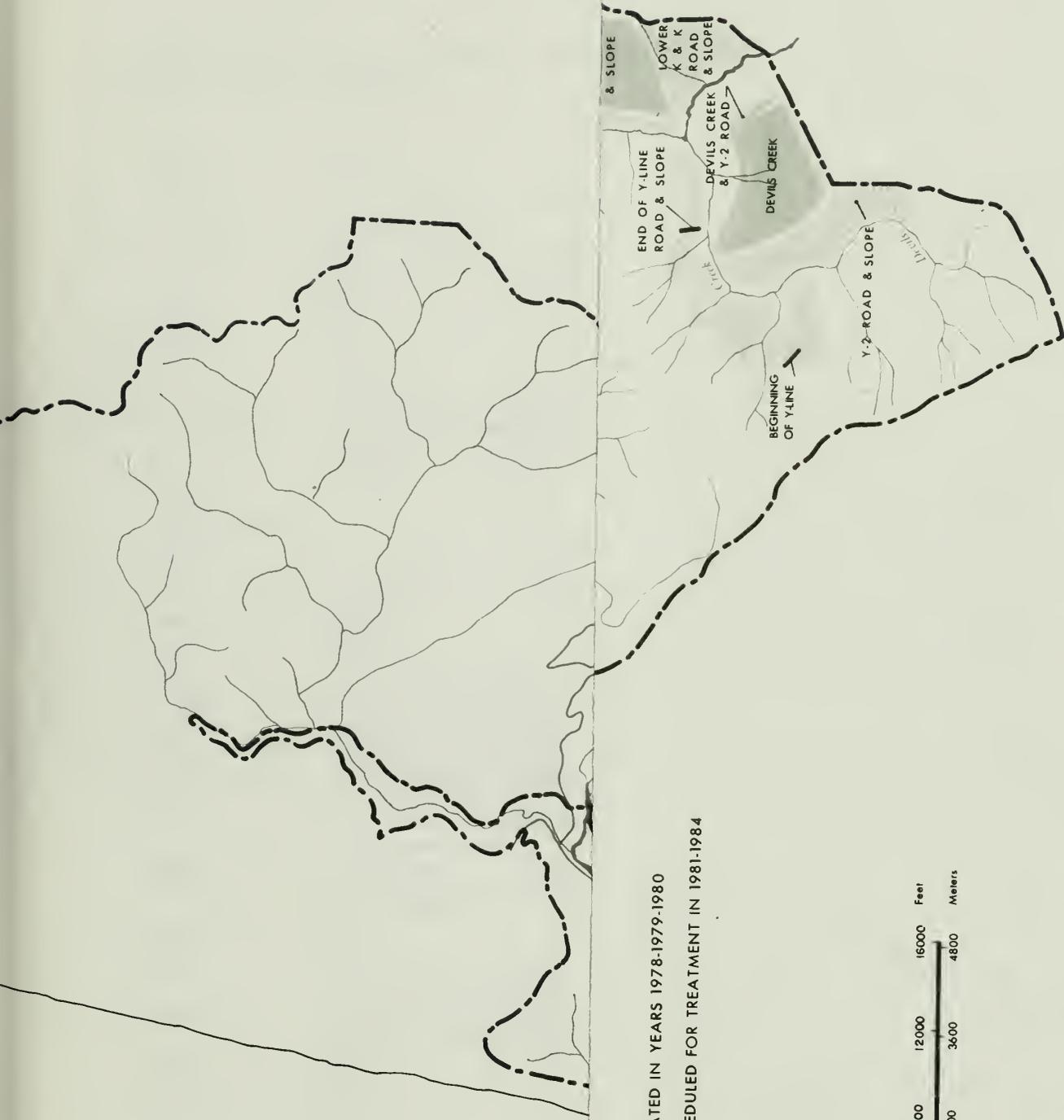
The equipment operators selected for the heavy-machinery rehabilitation work will be contracted. All equipment needed to accomplish rehabilitation work will be gathered, inventoried, and transported to the site. Campsites will be set up at the selected locations.

Table 2: Critical Areas Site Schedule

<u>Site</u>	<u>Year for Treatment</u>
W-line road and slope	1980
1920 road and slope	1980
Nose of Bridge Creek	1980
Devils Creek and Y-2 road	1980
M-6-2 road and slope	1980
Maneze Creek	1980
Lower K&K road and slope	*
Ingomar slope (including K&K and 1800 roads)	*
Y-2 road and slope	1981
M-7-5-2 road and slope	1981
M-7-5-1 (0.5 mi. segment not finished)	1981
Copper Creek (north side)	1981
Upper Slide Creek	1982
Lower Slide Creek	1982
M-6-1/M-6-2 roads and slope	1982
W-line/C-30 roads and slope	1982
End of Y-line; road and slope	1982
Y-line/M-2 road and slope	1983
D-line road and slope	1983
M-11-1-1 road and slope	1983
Maneze Prairie	1983
Complete critical areas	1984

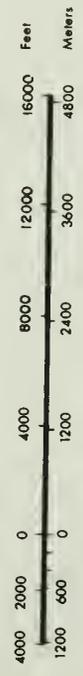
Note: Treatment of the following areas has already been completed: upper Bond Creek, lower Bond Creek, upper Miller Creek, lower Weir Creek, M-7-5-1 road & slope, Copper Creek (south side), Airstrip Creek, C-line landing, and end of C-line road. (See appendix B for a description of early rehabilitation efforts.)

\*These sites will be treated as soon as possible; however, treatment is contingent on the removal of the K&K road.



SITES TREATED IN YEARS 1978-1979-1980

SITES SCHEDULED FOR TREATMENT IN 1981-1984



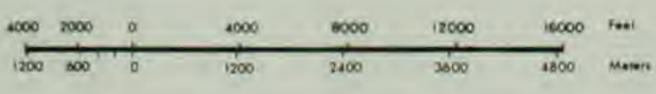
# CRITICAL AREAS REHABILITATION SCHEDULE

## REDWOOD NATIONAL PARK/CALIFORNIA

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE



SITES TREATED IN YEARS 1978-1979-1980  
 SITES SCHEDULED FOR TREATMENT IN 1981-1984



# CRITICAL AREAS REHABILITATION SCHEDULE

REDWOOD NATIONAL PARK/CALIFORNIA

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

Table 3: Road Removal Schedule and Priorities

West Side Road System: Devils Creek-Bridge Creek  
(exclusive of critical areas)

<u>Road</u>	<u>Section</u>	<u>Length</u>	<u>Number of Drainage Crossings</u>	<u>Priority</u>	<u>Year of Projected Start-Up</u>
Y-2	From Y-line rock pit #2 to critical area	3.0	3	1	85-87
Y Line	From M-line to Y-2 road	2.2	4	3	90-92
1320	Entire (to park boundary)	1.0	3	1	85-87
M-2-1	Entire	2.4	6	1	85-87
M-2½	Entire (on ridge)	2.2	0	3	90-92
M-2-4	Entire	0.8	3	3	90-92
M-2-2	From Y-line to M-2, including spurs	2.6	11	2	88-90
M-2	From M-line to M-2/Y-line road & slope critical area	1.3	3	3	90-92
M-2-1-1	From M-2 to Devils Creek divide	2.4	9	1	85-87
M-2-1-1 (remaining) and M-3-1-2	From M-3-1 to M-2-1-1	8.3	17	2	88-90
M-3-1	Entire portion back to M-3-2	3.2	13	1	85-87
M-3	Terminal section of M-3 to M-3-2	1.6	4	1	85-87
M-3-2	Entire	0.6	1	2	88-90
M-3-1	Remainder	0.5	3	2	88-90
M-3	From M-line to M-3-2	1.5	10	3	90-92
1800-2	Entire road network on tractor-logged slope	2.1	2	1	85-87
1800-1	Entire road network on tractor-logged slope	2.3	4	1	85-87
1800	From Redwood Cr. crossing to 1840 road	1.3	5	1	85-87
1840	Entire road network and associated spurs	3.6	22	1	85-87
1850	Entire road	1.1	9	1	85-87
M-7-5	From 1800 road to Bridge Cr. bridge	5.1	20	2	88-90
M-7-1	Entire	0.8	0	2	88-90
M-7-2	Entire	0.6	2	2	88-90
M-7	Entire road from M-line to Bridge at Bridge Cr.	1.3	4	2	88-90
M-line	Entire road from Tall Trees Grove to M-line deck	6.2	9	3	90-92
M-4	Entire	2.5	11	1	85-87
B-5-1	Entire	3.2	12	2	88-90
B-5-1-1	Entire	2.6	7	3	90-92

West Side Road System: McArthur Creek-Elam Creek-Bond Creek-Fortyfour Creek-Tom McDonald Creek (exclusive of critical areas)

<u>Road</u>	<u>Section</u>	<u>Length</u>	<u>Number of Drainage Crossings</u>	<u>Priority</u>	<u>Year of Projected Start-Up</u>
A-9-7-3	Entire, including spurs	2.8	7	1	85-87
A-9-7	Work access route to end	2.4	3	2	88-90
A-9-7-2	Entire	1.5	11	2	88-90
L-line	Terminus, including spurs	2.5	9	1	85-87
L-line	Middle segment (to L-1 Road) including spurs	0.9	3	2	88-90
L-2	Entire	2.7	8	2	88-90
L-2-2-1	Entire	2.5	2	2	88-90
L-1-1	Entire	3.0	2	2	88-90
L-1-5	Terminal portion	0.4	5	1	85-87
L-1-5	Remaining portion back to L-1	1.1	6	2	88-90
L-1-4	Entire	0.7	0	2	88-90
L-1	Entire	2.4	11	3	90-92
A-9-7-1	Entire, including spurs	7.4	17	2	88-90
L-1-2	Entire	0.6	7	2	88-90
M-11	From critical area to A-9 road	1.6	1	2	88-90
A-9	From A-9 deck to end	2.7	4	3	90-92
L-line	L-1 to A-9 deck #2, upper segment	1.1	0	3	90-92
C-line	Terminal portion below A-9-9 road	2.5	11	1	85-87
C-13	Entire	2.0	13	1	85-87
C-12-1	Terminus	0.5	4	1	85-87
C-12-1	Upper segment	0.6	0	2	88-90
G-6-1	Entire	1.6	7	2	88-90
A-9-9	Entire road from A-9 deck #2 to C-line	2.6	7	3	90-92
C-6-1	Entire road plus spur	0.9	1	3	90-92
C-6-2-1	Entire	1.0	0	3	90-92
A-9-6-1	Entire road plus spur	1.7	5	3	90-92
A-9-6	Entire road back to work access road	1.8	8	3	90-92
G-2	Entire	0.5	3	3	90-92
G-4	Entire road network plus spurs	2.6	6	2	88-90
C-9	Entire road from junction with G-6	1.0	4	1	85-87

East Side Road System (exclusive of critical areas)

<u>Road</u>	<u>Section</u>	<u>Length</u>	<u>Number of Drainage Crossings</u>	<u>Priority</u>	<u>Year of Projected Start-Up</u>
C-20	Entire	2.5	6	1	85-87
C-10	Entire	0.8	4	3	90-92
C-40	Entire	1.5	4	2	88-90
C-30	From C-line to C-30/W-line critical unit	1.2	0	3	90-92
C-50 and end of C-line	Entire length of each section	1.5	2	1	85-87
Maneze Road	Entire	2.1	4	1	85-87

Projected start-up years are when actual labor-intensive and/or heavy-equipment work should begin at a given site, although preplanning, erosion mapping, and prescription development may actually take place earlier than the year indicated.

b. Other Ecosystem Rehabilitation Programs

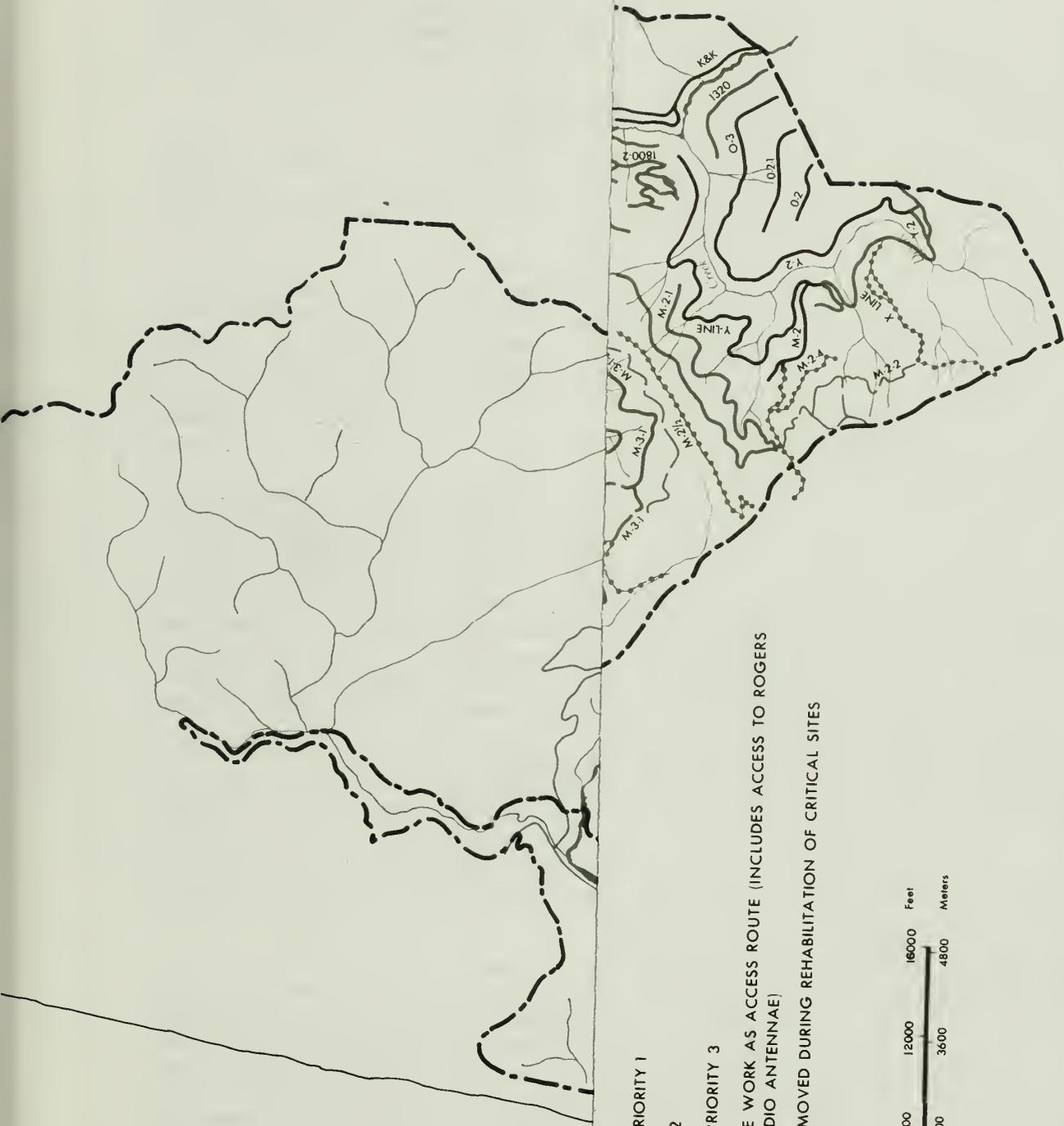
Initial measures to control and diminish man-induced rates of erosion in the watershed also represent the first steps in the rehabilitation of the ecosystem. The long-term ecosystem rehabilitation efforts are so closely related to overall management of park resources that these efforts would best be considered in the natural resources management plan. However, many of the rehabilitation activities can be most efficiently accomplished at the same time as erosion control activities that must be pursued immediately. These activities will be addressed in this document. Decisions regarding such activities will be made by the park staff and should become part of the erosion control/revegetation prescription for each site.

(1) Revegetation

Revegetation will be conducted in portions of the watershed to restore the Redwood Creek basin to a more natural successional stage. This program will be directed toward the eventual return to an old-growth redwood forest. In many cases this will mean only revegetation for erosion control, as previously explained. Work will also be directed toward replanting Douglas-fir and redwood on cutover lands that show unusually slow progress in natural recovery. However, not all cutover lands will be treated. Some sites will recover naturally without any human interference, other sites lack access and are neither physically nor economically feasible to reclaim, and small sites where revegetation is not necessary for erosion control may be left to reseed naturally.

Exotic trees, which are now maturing, were planted on cutover lands as part of the reforestation efforts taken before the park was established. The exotic trees of primary concern are Monterey pine (Pinus radiata), Lombardy poplar (Populus nigra italica), and Port Orford cedar (Chamaecyparis lawsoniana). To a limited extent, these trees were planted to provide a quick-growing screen near highways. These exotics will be located and may be removed as a part of the effort to reestablish native vegetation patterns in the park wherever active erosion control is also being carried out. Large plantation plantings of exotic trees will be studied for future removal. Control will be accomplished by cutting or girdling sprouting species.

Other exotic plant species established within the park, mainly at disturbed sites, will be identified. Their distribution will be determined, and their present and future



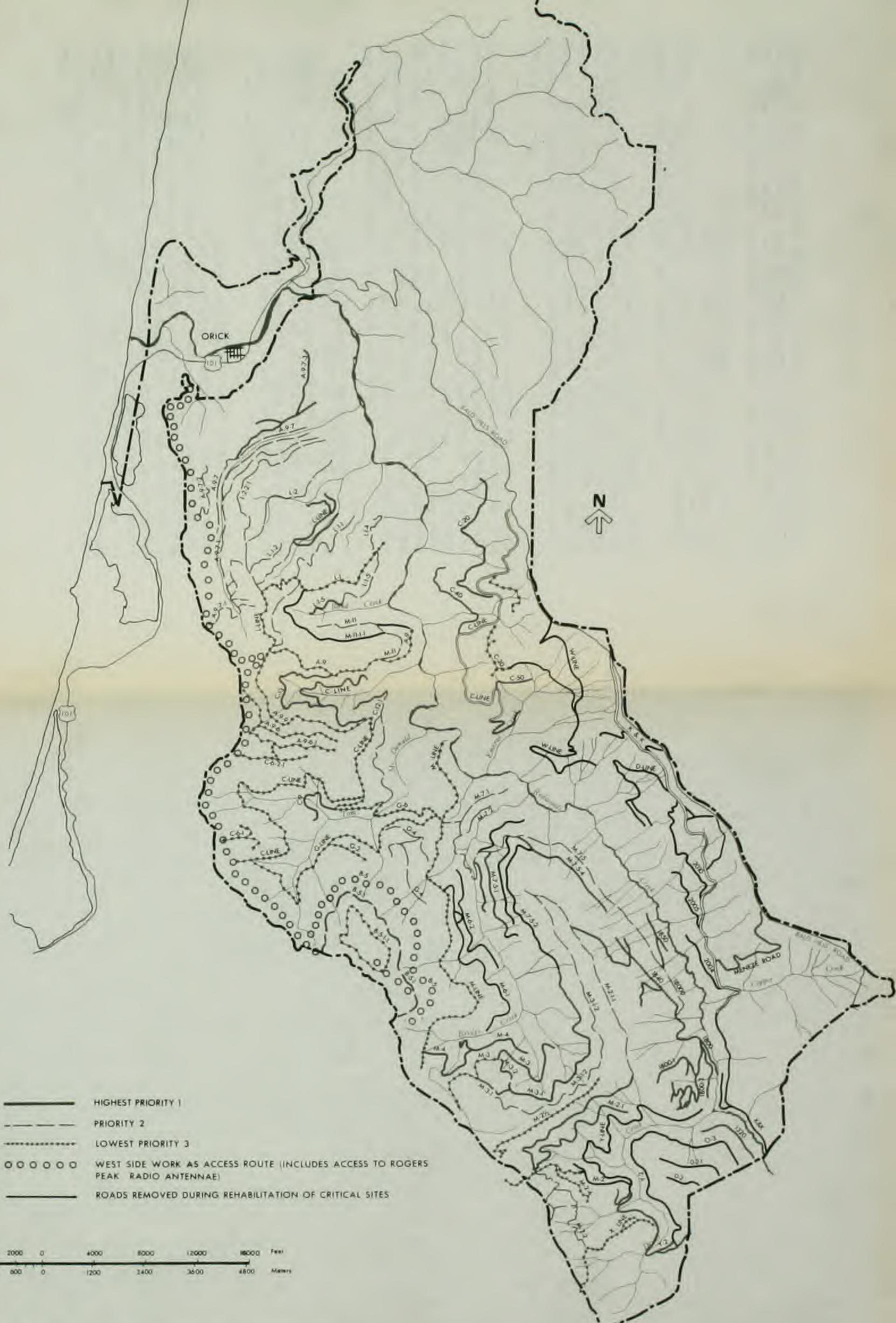
- HIGHEST PRIORITY 1
- - - - PRIORITY 2
- · - · - · LOWEST PRIORITY 3
- ○ ○ ○ WEST SIDE WORK AS ACCESS ROUTE (INCLUDES ACCESS TO ROGERS PEAK RADIO ANTENNAE)
- ROADS REMOVED DURING REHABILITATION OF CRITICAL SITES



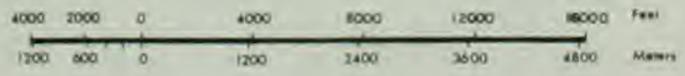
# ROAD REMOVAL PRIORITIES

## REDWOOD NATIONAL PARK/CALIFORNIA

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE



- HIGHEST PRIORITY 1
- - - - PRIORITY 2
- ..... LOWEST PRIORITY 3
- ○ ○ ○ ○ WEST SIDE WORK AS ACCESS ROUTE (INCLUDES ACCESS TO ROGERS PEAK RADIO ANTENNAE)
- ROADS REMOVED DURING REHABILITATION OF CRITICAL SITES



**ROAD REMOVAL PRIORITIES**  
 REDWOOD NATIONAL PARK/CALIFORNIA  
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impacts on park resources will be evaluated. Control of the more prominent exotic species will be emphasized because many exotics have become naturalized at disturbed sites, such as roads and trails, and are generally established throughout the region.

## (2) Prairie Rehabilitation

About 3,000 acres of prairies along the eastern slopes of the Redwood Creek basin were added to the park in 1978. These prairies are usually on south- and west-facing slopes and are between 1,000 and 3,000 feet in elevation.

Many areas are deeply gullied where logging roads have concentrated runoff onto the prairie. A rehabilitation program will be developed to properly disperse road runoff, to remove unnecessary roads that traverse prairies, and to install gully plugs, check dams, and other erosion control techniques so as to stop gully down-cutting and to stabilize gully banks.

Cattle operations during the last century have resulted in the selective grazing of native perennial prairie grasses, thus favoring the spread of introduced nonnative annual grasses. Roads cut through prairies have also allowed conifers to become established along disturbed roadsides. Vegetation conversion to native species will be thoroughly studied, along with elk, fire, and other management issues, in the natural resources management plan. Initial rehabilitation efforts will focus on the removal of invading conifers while management techniques for reestablishing native grasses are being developed.

## (3) Riparian Resources Rehabilitation

The higher rate of sediment input to Redwood Creek has resulted in severe aggradation of the stream channel, bank undercutting, loss of streamside vegetation, and severe impacts to aquatic communities. These conditions may be expected to persist for years without active restoration efforts in the main stem of the creek.

Before restoration work begins, existing conditions will be evaluated, including streambank stability, water quality, amount of stored sediment, the quality of aquatic habitat, and an aquatic resources analysis. Research into the prelogging quality of habitat and aquatic populations will be conducted to determine the level of restoration desired. Once this determination has been made, specific actions may be recommended to restore habitats to prelogging quality. Such actions may include the removal of log jams, sediment traps, and reservoirs of stored sediment; the possible restocking of native fish species; and the active stabilization of streambanks.

A basinwide inventory of sediment sources along perennial tributaries to Redwood Creek and an assessment of stored sediment within the channels will be undertaken. Erosion control treatments will then be prescribed where feasible for specific erosion features within the park, the PPZ, and perhaps the remainder of the upstream basin.

A determination will also be made of the habitat quality of basin streams and the availability of food resources for native fish. Recommendations will be made where appropriate to facilitate the establishment of a healthy and diverse, self-perpetuating aquatic community.

#### (4) Redwood Creek Estuary Rehabilitation

The productivity of this estuary has been significantly impaired by logging in the watershed and by the channelization and construction of levees through the Orick valley to the mouth of the creek.

Following major floods in northern California between 1953 and 1965, levee construction and stream channelization began on the lower 3.4 miles of Redwood Creek. The project was completed in October 1968.

Logging activities upstream have further exacerbated the problems that originated with the levee system. The level of rehabilitation that is feasible in the estuary will have to be determined, based on practical, legal, and political considerations. Prior to making this determination, however, the existing productivity of the estuary will have to be assessed. Toward this end, studies will be conducted of water quality, aquatic organism community structure, the effective estuary area, existing sediment, and accumulated organic debris. Possible restoration activities may include the modification of levees and portions of levees to restore freshwater circulation, and the removal of sediment and organic debris.

#### c. Monitoring Activities

Monitoring activities will constitute a significant portion of the overall rehabilitation program. Monitoring at each unit will begin before and will continue immediately after rehabilitation work has been completed, and monitoring throughout the basin will continue after all major rehabilitation efforts have been finished. Control sites where rehabilitation programs have not been implemented will also be monitored so that results can be prepared. Both qualitative and quantitative monitoring techniques will help determine the effectiveness and relative benefits of the overall rehabilitation effort and will guide program modifications. Restoration activities will be monitored by installing erosion pins and sedimentation weirs and by establishing photo points from

where site changes can be documented through time-sequence photography and channel cross-sections. Other techniques may be developed to monitor the effectiveness of new erosion control and restoration measures.

Overall watershed monitoring will also be conducted to determine sediment transport trends. This will help determine the effectiveness of the rehabilitation measures and the direction of "management" activities for upper basin areas outside the park (see discussion under section III.b.1.d.(3)).

The effectiveness of revegetation will be monitored to determine the level of erosion control and ecosystem restoration achieved. This determination will be based upon an analysis of germination/survival ratios related to planting, fertilization, and seeding rates. The information collected will be used to modify and improve existing state-of-the-art knowledge pertaining to site-specific vegetation prescriptions.

Certain wildlife populations such as elk and deer may be monitored because they may have direct and significant impacts upon rehabilitation efforts. For example, the success of revegetation at a site may greatly depend upon the numbers of browsers (elk and deer) present.

d. Additional Considerations

(1) Access

During the course of the rehabilitation program, practically all the logging roads within the Redwood Creek unit of Redwood National Park will be removed (see the Road Removal Priorities map). Most of the roads will be removed either because they are not now functional and serve as constant sources of sediment, or because they require annual maintenance and do not serve park management needs. After eight to ten years of rehabilitation work, a limited number of roads that are useful and are on relatively stable terrain will remain. These roads are essentially the main arteries of the extensive, former logging road network. Park managers will be responsible for deciding whether to remove or maintain these stable roads.

On the east side of the basin, probably only the C-line road to the Tall Trees trailhead and the Klamath and Korbel (K&K) road to the Copper Creek divide will remain. (This assumes an alternate K&K road is opened sometime in the next eight to ten years. If the alternate road is not opened, then the entire K&K road will remain.) On the west side, however, a more extensive road system, including major segments of the L-line, the A-9 line, the G-line, the C-line, and the M-line will most likely remain for a longer period of time or until no longer needed for fire control purposes. The M-line is the only reasonably stable, rocked

road on the west side that goes from the ridgetop to Redwood Creek. The west side access road, which is described in the following section, may remain after rehabilitation work is finished.

Two primary considerations in determining the fate of a given road are access for rehabilitation maintenance and for fire control. Because access for maintenance should not be required for more than one or two years after the initial work is completed, road segments will be removed relatively soon after areas have been treated. A fire management program has not yet been developed. However, as the Road Removal Priorities map indicates, once all nonfunctional or erosion-sensitive roads are removed, no road access to the lower slopes of any of the tributary basins will exist, and most of Bridge Creek and Devils Creek will be totally inaccessible.

On the top of Rodgers Peak, a 2,790-foot-high broad-topped peak on the western park boundary, are several radio relay antennae used by Humboldt County and the Louisiana-Pacific Corporation. An all-weather access road off the B-5 road, which will become part of the west side access road, serves the site of the antennae, and this access road will be kept open indefinitely.

(a) West Side Access Road

An existing route along a ridge on the west side of the Redwood Creek basin will be improved in summer 1980 to allow all-weather access for rehabilitation work for the next seven to ten years. The present access route is through a private gate owned by the Louisiana-Pacific Corporation at Big Lagoon, 15 miles south of Orick. Although Louisiana-Pacific has allowed access for the Park Service since the expansion of the park, this route across private land does not provide the unlimited access needed for effective park management during after-hours and for weekend or holiday operations.

The proposed west side access route will start at the junction of Hilton Road and U.S. 101 in Orick and follow an existing county road, a logging haul road, and a pioneered tractor road for 15 miles to the junction of the B-5 and B-line roads near Rodgers Peak on the western park boundary. The route is geologically stable, well-drained, and involves minimal grades for the most part (steep grades are present in only two short segments). It will be improved to a two-lane, 20-foot-wide subgrade width where feasible and will be rock-surfaced for all-weather use. Significant new road construction will be required in only one place, for about 700 feet, to tie two segments of the route together. Moderate regrading will be necessary in two places, for about 1,000 feet, to achieve an acceptable road grade. Along a total of 4 miles, the road standard is already well above

that prescribed. For the remainder of the route, minor grading and widening will occur and adequate drainage will be provided. The road section, roadway grades, drainage measures, and alignment are designed for park management needs only and not for future public use.

The major cost component of access improvement will be the provision of rock surfacing. Alternative sources of rock for surfacing include the two existing Y-line road rock pits within the park, gravel extraction from Redwood Creek (probably on the floodplain near Orick), outside the park, and the sites of previous gravel operations upstream. Gravel could also be obtained from existing road surfaces that will eventually be removed.

(b) The K&K Road

The Redwood National Park expansion included approximately 12 miles of the K&K road, which is the major haul road for Simpson Timber Company's milling and logging operations. PL 95-250 states that the secretary of the Department of the Interior shall permit continued access and use of the acquired segment of road at levels and extent of use existing at the time of the expansion.

The acquired segment runs along the east bank of Redwood Creek for approximately 2.5 miles through some of the most unstable and erosive terrain in the entire park. The road provides a perennial source of sediment to Redwood Creek because the road fill frequently fails, the road drainage promotes gullying, and the road itself crosses several very active earthflows. One of the major goals of the rehabilitation program is the elimination of this especially erosive segment of the K&K road by rerouting it along an alternate alignment outside the park boundary.

Both Simpson and the National Park Service support the development of a replacement road outside the park. The selection of an alternate route should be accomplished immediately so as to reduce total costs, allow for park planning, and provide for immediate increased protection to the downstream resources.

An alternate route for the K&K road has been proposed along Coyote Creek, which is the farthest tributary downstream in the PPZ on the east side of the basin. This route, which was proposed by the National Park Service in May 1978, is acceptable to Simpson, and evaluations are now underway to ascertain the feasibility of the rerouting. A separate environmental assessment will be prepared for this project.

As long as the K&K road continues to be open for use by Simpson through Redwood National Park, a major erosion problem in the park cannot be treated. Were it not for the legislatively mandated usage of the K&K road, the road and adjacent slopes would be assigned the highest priority for rehabilitation because of the severity of slope stability problems along the road adjacent to Redwood Creek.

(c) The B-line and M-line Road

Just south of Rodgers Peak, along the western boundary of the park, is a 2.5-mile portion of the B-line and M-line road. This is a major Louisiana-Pacific Corporation logging haul road that passes just inside the Redwood Creek watershed and then crosses over the ridge and back out. PL 95-250 allows for this acquired road segment to continue to be used for timber harvesting and road maintenance.

Because Louisiana-Pacific must continue to use this logging haul road, a problem of conflicting use exists because a portion of the road within the park boundary will also be used by the Park Service for rehabilitation access and general park management. (The B-line and M-line road connects with the southern end of the west side access road previously discussed.) Both Louisiana-Pacific and the Park Service have expressed concerns about the long-term mutual use of this road segment in terms of the protection of lands from trespass, conflicting types of use, liability, and sufficient levels of maintenance.

The fact that the road segment lies along one of the park boundaries makes the issue a boundary problem as well as a conflicting use problem. The park boundary in this vicinity is such that an alternate logging haul road could be constructed along the ridge outside the park. Louisiana-Pacific has already surveyed such an alternate route that is suitable both to them and the Park Service. The road would entail 7,000 feet of new haul road construction and another 4,000 feet of road improvements, all of which would be undertaken by Louisiana-Pacific. In addition, the Park Service would have to build approximately 3,000 feet of new road along the ridge on park lands to connect the southern end of the west side access road to the M-line road for rehabilitation access.

(2) Sediment Source and Transport Studies

Two important facets of the rehabilitation proposal are the studies of sediment sources and sediment transport for the Redwood Creek basin. Sediment studies will be conducted concurrently with the first phases of the rehabilitation program. Their main focus will be to understand the sources and transport of sediment in the basin. The effectiveness of the current rehabilitation program within the park will also be assessed relative

to sediment-contributing areas throughout the Redwood Creek watershed. The studies will help answer the following questions:

Where are the major sediment sources that have resulted in a high amount of sedimentation in the main channel of Redwood Creek?

What land use practices particularly increase erosion rates from the major sediment source areas?

Based on the studies, what specific recommendations can be made concerning the management of watershed lands upstream from Redwood National Park?

How long will it take for the excessive amount of sediment now in the main channel of Redwood Creek within the park to be flushed downstream to the ocean?

How effective is the current rehabilitation program in controlling the major sources of sediment flowing into the main channel of Redwood Creek?

Given the demonstrated capability and capacity of the techniques used in the park's rehabilitation program, is it possible to effectively treat the most serious erosion problems in the watershed?

The above questions will be answered by means of detailed field mapping along the main channel of Redwood Creek and in the major tributaries. The mapping will be done in conjunction with aerial photo interpretation and the sediment sampling being conducted by the U.S. Geological Survey. The sediment study program outlined above succeeds the U.S. Geological Survey studies conducted in the basin starting in 1973, and preliminary answers to the above questions should be formed by November 1980. By 1981, these studies will provide specific recommendations for the management of lands within the Redwood Creek basin, both within and upstream from the park. This will help ensure the best protection of park resources, particularly those along the main channel of Redwood Creek, from excessive erosion and sedimentation.

### (3) Activities in the PPZ and Timber Harvest Plan Reviews

A major aspect of PPZ monitoring is an NPS review of timber harvest plans within this 33,000-acre area. These reviews allow NPS scientists to suggest alternatives in harvesting schedules and techniques to minimize logging-induced erosion. These recommendations are submitted to the California Department of Forestry, which must approve all plans. Little if any post-harvesting evaluation has occurred to determine whether

the timber harvest was consistent with the procedures and precautions outlined in the plan. In the future, the monitoring program will entail a thorough review of the condition of all roads within the PPZ, and an effort will be made to cooperate with landowners to properly maintain primary and secondary haul roads and those used for forest maintenance access and to eliminate dead-end and temporary roads within the zone.

Other monitoring activities in the PPZ are being carried out as part of the previously mentioned sediment source area studies. The two gaging stations installed in September 1979 by the U.S. Geological Survey on Coyote Creek and Panther Creek will provide data on sediment and water yields from these basins. The stations are on Simpson Timber Company lands and were installed with their concurrence and cooperation. Detailed mapping of selected reaches of all four tributaries in the PPZ (Coyote, Garrett, Lacks, and Panther creeks) will be done by NPS geologists to determine the amount of stored sediment that could be transported into the main channel. Mapping will also help determine the extent and activity of landsliding along the tributary channels that could cause further large introductions of sediment to Redwood Creek.

Both the timber harvest plan reviews and the sediment source studies in the PPZ are being done in cooperation with, or with the permission of, private landowners. The park's policy is to work with the landowners to make mutually agreeable management decisions about activities within the PPZ so as to minimize the possibility of excessive erosion that may damage park resources downstream. If activities in a portion of the PPZ can be demonstrated to be harming downstream park resources, PL 95-250 authorizes the Secretary of the Interior to acquire that portion of the PPZ.

(4) California Forest Improvement Program

On March 30, 1979, the National Park Service entered into a cooperative agreement with the California Department of Forestry and provided \$400,000 to the California forest resources improvement fund for the restoration of cutover lands within the Redwood Creek watershed. Forest resource improvement projects are limited by the California Forest Resources Improvement Act of 1978 to privately owned parcels with 5,000 acres or less of commercial forestland. Improvement projects include land conservation projects, forest improvement, and fish and wildlife habitat improvement.

(5) Composting

Logging activities such as road and trail building and log skidding remove much of the upper soil horizons. The remaining subsoil or parent material is low in nutrients and

does not support extensive plant growth. Soil amendments, such as compost material, can help reduce sheet erosion and facilitate plant growth in a rehabilitated area. To effectively reduce erosion and to help plant growth, amendments to soil parent-materials must dissipate rainfall, absorb and hold moisture, provide a good growing medium, and provide a timed release of plant nutrients. Compost for rehabilitation projects is available commercially in the vicinity of Redwood National Park, and it may be augmented by a static-pile composting project established jointly with local community organizations.

(6) Redwoods United, Inc.

PL 95-250 provides for the maintenance of Redwoods United, Inc., by stating "that it shall be a purpose of this act that the community services and employment opportunities provided by Redwoods United, Incorporated, a nonprofit corporation located in Manila, California, shall be maintained at the present rate of employment to the greatest degree practicable." Therefore, Redwoods United crews will be permitted to salvage raw material the park deems appropriate for removal. All such salvage work will be coordinated through the chief of resources management, and an accurate record of all wood removed will be kept by the park. The park may also contract with Redwoods United for projects such as tree planting, brush clearing, road maintenance, and exotic plant control. Details of each project and remuneration will be worked out at the time of the undertaking.

(7) Salvage of Down Timber

On cutover lands throughout Redwood Creek basin are large quantities of salvageable down timber (redwood, Douglas-fir, hemlock, etc.) that were left by timber companies at the time the park was expanded in 1978. These logs, stumps, and other cut pieces will only be salvaged if removal does not significantly damage old-growth and second-growth timber or result in excessive sedimentation in Redwood Creek or any of its major tributaries. Much of the salvage operation will be performed by tractors and cranes during the heavy-equipment phase of rehabilitation. Logs difficult to reach may be retrieved by using rental cable equipment. Logs will be hauled to a central location, usually a deck or landing, for future milling. Where feasible, however, raw material may be milled in place, and wood products may either be used at that location or transported from the site. Before milling, all logs and larger pieces will be professionally scaled and graded. Wood products will be disposed of as follows:

for rehabilitation erosion control--slabs for check dams, water ladders, planter boxes, stakes, trash racks, etc.

for other park needs--picnic tables, signs, exhibits, fences and stakes, dimensional lumber for shelters, decks, building repair, book shelves, etc.

for Redwoods United, Inc.--a wide variety of products produced at Redwoods United's workshop in Manila, California.

## 2. Cultural Resources Management

A cultural resources management plan for Redwood National Park was completed in 1980 as part of the General Management Plan (USDI, NPS 1980a). However, cultural resources in the Redwood Creek basin were addressed only superficially because surveys and data analysis were incomplete and the rehabilitation proposal was only partially defined, making resource evaluation and impact analysis impossible at that time. Therefore, cultural resources management for Redwood Creek basin is discussed more fully in this document.

### a. Research Design and Management Actions

The cultural resources in the Redwood Creek basin represent a wide range of human activities and land uses spanning at least 2,000 years. Such resources include archeological remains of prehistoric villages, temporary encampments, and trail sites; historic structures and trails; and religious sites significant to contemporary Native Americans. Cultural resources will be managed for preservation and protection to an extent that is compatible with the legislative directive to rehabilitate and protect the watershed.

Inventories, evaluations, and management recommendations for cultural resources in the Redwood Creek unit are guided by a research design that addresses general anthropological questions pertinent to northwestern California (King and Bickel 1980). In a broad sense, information is being sought about the prehistoric and historic human populations of Redwood Creek to learn more about settlement locations and variations of early land uses, the change in land uses over time, the interactions of various early populations, the interactions of these early human groups with their environment, and their influence upon the natural environment.

The methodology and approach needed to obtain answers to these general research questions are viewed in terms of management objectives and NPS policies. Management actions are detailed below, relative to both an anthropological research design and the prudent consideration of archeological, historical, and contemporary Native American values.

#### (1) Identification of Resources

Cultural resources will be identified through a combination of archival research, oral history, and field survey.

(a) Historical Survey

Several studies of historic resources in the Bald Hills/Redwood Creek area have been completed, and historic sites have been identified (USDI, NPS 1969; USDI, NPS, DSC 1978, 1980b). Two of the sites have been recommended for nomination to the National Register of Historic Places. Unidentified historical resources may still exist and may be discovered during ongoing archeological surveys. All historic sites identified during archeological surveys will be recorded and added to the existing historic data base.

(b) Archeological Survey

Archeological surveys of portions of the Redwood Creek drainage in 1978 and 1979 recorded 20 prehistoric sites, the majority of which are included in the proposed Bald Hills archeological district, now being considered for national register status (King and Bickel 1980; Hayes and others 1980; Salzman and Bickel 1979; Bickel 1979; Salzman 1979).

The immediate goal of survey efforts is to gain a representative sample of 10 to 15 percent of the lands planned for rehabilitation so that archeological site occurrence models and sensitivity criteria may be developed. Once predictive models have been established and tested, future survey needs will be reduced; intensive surveys will be necessary only in areas where high archeological sensitivity is predicted.

Until an adequate survey sample is attained, archeological surveys in the Redwood Creek unit will be based on the mixed-strategy approach adopted by Salzman and Bickel (1979). Briefly, this strategy uses surface visibility as the primary criterion for conducting a survey; steepness is a secondary criterion. That is, all areas that have adequate ground visibility, except those with slopes exceeding 50 percent, should be surveyed. In addition, areas that are judged "likely" for prehistoric occupation should also be surveyed, regardless of whether or not there is adequate ground visibility. The latter situation might require the clearing of vegetation. This approach permits less-than-complete surveys of rehabilitation units, but it requires a field inspection of each unit and a field evaluation to determine which portions of the unit will be intensively surveyed. Any areas not surveyed will be indicated on surveyors' maps, and reasons for the lack of a survey noted. In a high sensitivity area where ground visibility is poor, intermittent hand-clearing of duff and vegetation may be necessary to accomplish an intensive survey.

Archeological surveys will precede planned rehabilitation activity by at least two years so that adequate time is allowed for resource evaluation, assessment of potential impacts, and the necessary consultations with the

California Historic Preservation Office and the Advisory Council on Historic Preservation if sites of national register significance are identified.

Initial site records will include detailed descriptions of environmental and locational factors as one set of attributes and archeological surface characteristics as another. Coding of environmental and archeological attributes will provide information necessary to prepare site occurrence models and to make site significance evaluations. All archeological sites and isolated finds will become part of the park's cumulative cultural resource data base.

### (2) Contemporary Native American Sites

Areas within park boundaries that have continuing significance to living Native Americans who hold traditional ties to Redwood Creek have been identified (Bickel 1978). These areas remain important to present-day Native Americans and constitute continuing land use practices in the "ethnographic present." As new information is obtained through consultations with the park's Native American heritage advisory committees, it will be added to the confidential inventory of contemporary Native American sites.

Mutually acceptable methods of protection and preservation will be developed by the park and the advisory committee for Redwood Creek basin.

### (3) Evaluation of Resources

All cultural resource sites identified will be evaluated according to significance criteria of the National Register of Historic Places. Adequate site records and analyses will be necessary to make informed evaluations. In addition to the initial recording of a site, a return visit to the site will be made to gather more site-specific information if further evaluation is warranted.

Controlled surface analysis, as described by King and Bickel (1980), and/or limited subsurface testing may be required to fully evaluate a site's significance. Artifacts will not be collected from a site surface unless certain diagnostic forms, such as projectile points, are to be used for comparative analysis. The location of any item collected will be mapped with reference to the site datum. Augering is the preferred method of subsurface testing, but shovel testing may be necessary to further define the depth and extent of a site and to make an informed evaluation of site content and significance. Native Americans' consent will be sought prior to any subsurface disturbance of an archeological site.

The value of oral testimony and tradition from Native Americans and others will be utilized in making site

evaluations. Interviews and consultations with knowledgeable old-time residents may support the importance of certain historic and prehistoric sites.

#### (4) Archeological Clearance

All cultural resources eligible for the National Register of Historic Places will be protected in accordance with the Advisory Council's "Regulations for the Protection of Historic and Cultural Properties" (36 CFR 800). Archeological clearance must officially be issued prior to heavy equipment usage or any activity that disturbs the earth. Archeological clearance procedures established by NPS policies and the Western Archeological Center will be followed, and clearance for each rehabilitation project or unit will be issued only if all requirements of 36 CFR 800 are met. Clearance conditions may include avoidance of certain areas, archeological monitoring of heavy-equipment work, or other measures designed to protect cultural resources.

If the loss or alteration of cultural resources is necessary to accomplish watershed protection goals, and if there is no prudent or feasible alternative, professionally designed salvage of data will be conducted pursuant to standards described in "Recovery of Scientific, Prehistoric, Historic, and Archeological Data: Methods, Standards, and Reporting Requirements," as proposed, January 28, 1977 (36 CFR 1210).

#### b. Five-Year Plan and Action Sequence

##### (1) Overview

By the end of fiscal year 1980, 10 to 15 percent of the rehabilitation lands will have been surveyed. During FY 1981, site occurrence models and archeological sensitivity criteria will be constructed and tested, with the ultimate goal of reducing future survey expenditures. The lands included for FY 1980 survey work consist of rehabilitation units scheduled for treatment from 1981 to 1984. Surveys of these lands during 1980 should provide the two-year "lead" time necessary for adequate consideration of cultural resources. The park archeologist will maintain close interaction with rehabilitation staff and will be made aware of any changes or modifications in scheduled rehabilitation plans. The rehabilitation staff and field crews will be briefed on the importance of certain cultural resource sites and the procedures for reporting new discoveries if archeological remains are encountered during field operations (see table 4).

##### (2) Coordination with Rehabilitation Plan

###### (a) Erosion Control

Cultural resource inventories, evaluations, and compliance actions will be completed well before active rehabilitation work is started in those units selected for priority treatment. (The lands included in the 10 to 15 percent archeological survey sample are priority treatment areas.)

Archeological clearances must officially be issued before heavy-equipment rehabilitation takes place in each unit. The rehabilitation unit supervisor and the chief of natural resources management will be responsible for seeing that their field crews are familiar with any special conditions that may be part of the official archeological clearance. The park archeologist will be responsible for notifying the above managerial staff and for monitoring the progress of operations to ensure compliance.

(b) Revegetation

The hand planting of trees and shrubs and the application of mulches and fertilizers on cutover lands normally will not require archeological clearance procedures. Other revegetation techniques that may adversely affect cultural resources will require compliance action. Tree thinning and the removal of exotics will be monitored by the park archeologist to ensure the protection of recorded archeological and historic sites.

(c) Prairie Rehabilitation

A large portion of the proposed Bald Hills archeological district is in a prairie setting. A previous cultural resources survey has shown that the prairies and prairie ecotones are archeologically "sensitive" areas where evidence of prehistoric usage is very likely to be found. Rehabilitation and fire management activities that may affect archeological sites in the district will be coordinated with the provisions of section 106 of the Historic Preservation Act.

(d) Riparian Resources Rehabilitation

The restoration of Redwood Creek and its tributaries may include removing log jams and reservoirs of stored sediment. If these activities are planned for areas determined to be archeologically sensitive, compliance with the procedures in 36 CFR 800 will be sought.

(e) Redwood Creek Estuary Rehabilitation

The mouth of Redwood Creek is considered a "sensitive" area in terms of its archeological significance and Native American heritage values. The protection of cultural resources in this area by preservation and monitoring is the recommended action.

(f) West Side Access Road and Road Maintenance

Archeological survey and clearance procedures have been completed for the west side access road. Although no national register properties were discovered, isolated archeological objects were observed and recorded. The road work will be monitored by the park archeologist in the event that ground-disturbing activities uncover archeological resources. The

Table 4: Five-Year Plan and Action Sequence  
for Archeological Clearances

<u>Season</u>	<u>Project or Unit</u>	<u>Action</u>	<u>Archeological Clearance</u>
<u>FY 1980</u>			
Spring	Bridge Creek M-6-2	Survey completed	Unconditional clearance*
Spring	End of W-line road	Test excavations of HUM-484 completed	Conditional clearance
Spring	1920 road slope	Survey completed	Unconditional clearance*
Spring	2004 road/Maneze Creek	Survey completed	Conditional clearance
Spring	Nose of Bridge Creek	Survey completed	Unconditional clearance*
Spring	Devils Creek Y-2 road slope	Survey completed	Unconditional clearance*
Summer	West side access road	Monitor	Conditional clearance
Summer	15% representation sample (3,000 acres)	Survey and evaluate	Pending survey results
	Other rehabilitation activities	Survey, evaluate, monitor on case-by-case basis	
<u>FY 1981</u>			
Fall/winter	15% representation sample	Further evaluations; develop site occurrence models	
Spring/summer	Scheduled rehabilitation projects	Monitor; design mitigation measures if necessary	
	Other rehabilitation activities	Survey, evaluate, monitor on a case-by-case basis	

FY 1982-1985

Test and refine site occurrence models and sensitivity criteria.  
Evaluate need to survey project areas on case-by-case basis.

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\*With an unconditional clearance, activities will still be halted and a park archeologist will be consulted if cultural resources are encountered during rehabilitation work.

park archeologist will coordinate with the road engineer to ensure that routine maintenance throughout Redwood Creek basin will not necessarily damage cultural resources situated nearby or under road surfaces.

(g) Park Protection Zone

Significant cultural resources exist in the PPZ. Information about traditional and historical uses of the upper Redwood Creek basin will be sought as part of the effort to understand the cultural and natural history of park lands. All federally assisted or permitted projects must comply with federal cultural resources legislation and Advisory Council regulations (36 CFR 800). The park will continue its support of private citizens' concerns for the protection of archeological, historical, and contemporary Native American heritage values on nonfederal lands.

3. Operations Management, Program Budget, and Staffing

a. Operations Center

Field personnel engaged in watershed rehabilitation will operate from a center in Orick. A staff of up to 70 will use the center for offices, laboratories, storage, and equipment maintenance. A 1-acre site at the north end of Orick along U.S. Highway 101 has been temporarily leased to function as the center. Facilities there include a garage for storage and chain saw maintenance, and four park-owned trailers and a small house for office space. Authority exists for acquiring up to 8.5 acres of land from a willing seller for a permanent site. The feasibility of establishing such a site will continually be evaluated as suitable parcels of land become available in the Orick area.

b. Equipment Needs

Most of the heavy-equipment needs for erosion control will be acquired through short-term equipment rental agreements. Park-owned equipment will be kept to a minimum. On hand or on order are a mobile multidimension sawmill, three brush clippers, and a 2½-ton truck for transporting chips and wood material. Some park-owned road maintenance equipment such as trucks and graders may periodically be used.

c. Camp Plans for Workers

Spike camps will be established at suitable sites within or adjacent to rehabilitation project locations as needed, but mainly during the summer and fall. Environmental, archeological, and sanitation factors will be considered when selecting sites. Each camp will be completely removed when no longer needed. To prevent harm to animals or other related problems, all refuse will be put in containers and removed regularly.

d. Program Budget and Staffing

The FY 1980 budget for the rehabilitation team breaks down as follows: \$1 million in personnel services and benefits, \$700,000 in support costs (equipment, supplies, other park staff, some monitoring activities, vehicles, services, etc.), and \$800,000 in contracts and cooperative agreements for rehabilitation work (heavy-equipment rental and labor-intensive work). This last amount is over and above rehabilitation work accomplished by park staff. The total FY 1980 budget is about \$2.5 million.

FY 1980 staffing allowances include 10 permanent full-time staff, 17 permanent less than full-time personnel, and 65 temporary positions. Several supporting positions are carried under other division rosters, for example, a contracting specialist, an interpretive specialist, and a budget and procurement specialist. Budget and staffing reflect program implementation, technique development and testing, rehabilitation and erosion monitoring, cultural resources protection and policy compliance, environmental policy compliance, PPZ monitoring of timber harvests, rehabilitation and resources management planning, and environmental and resource monitoring and studies. Other activities include any that are required to effectively develop, implement, support, monitor, and maintain the rehabilitation program.

Rehabilitation program plans call for treating the most critical erosion-prone and high-sediment-yield areas from FY 1980 through FY 1984. By early FY 1981, the rehabilitation team will be fully staffed and operating at a maximum effective level to accomplish identified objectives, including an expansion of activities on cutover land in the watershed above the park addition. An estimated budget for FY 1983 of \$4.9 million includes \$1.4 million in personnel services and benefits for the rehabilitation team (the additional \$0.4 million will cover estimated pay increases and possible conversions from less than full-time to full-time positions), \$900,000 in support costs, \$1.5 million for in-park rehabilitation contracts and cooperative agreements, and \$1.1 million in matching funds for rehabilitation in the watershed above the park (to be carried out by private landholders under cooperative agreements with Redwood National Park).

Following 1984, the primary emphasis of the rehabilitation program will be on road pulling. Beginning in 1985, the budget may begin to decrease by about 10 percent per year. By FY 1990, the total budget is expected to be approximately \$2,604,000. This is projected to include \$744,000 for personnel services and benefits for the park rehabilitation team, \$478,000 in support costs, \$797,000 for in-park rehabilitation contracts and cooperative agreements, and \$585,000 in matching funds for rehabilitation in the watershed above the park. During the remainder of the 15-year rehabilitation program, the budget will decrease further, although it is not yet known by how much.

#### IV. ENVIRONMENTAL CONSEQUENCES

This section evaluates the major elements of the proposed actions in terms of their effect on natural resources, cultural resources, and local socioeconomic conditions. The discussion of impacts is necessarily general because much of the specific information on erosional processes in the basin is still being collected and evaluated. The complex geomorphic processes that operate naturally in the basin add to the difficulty of projecting the effects of rehabilitation proposals.

To help in evaluating the impacts of the proposal, existing conditions and their impacts, as related to past silvicultural activities, are discussed. If no direct action was taken to rehabilitate the watershed, it is expected that these conditions would continue until natural processes became reestablished--an indeterminate amount of time.

Further environmental documentation may be required if there are major changes in rehabilitation techniques, or if there is a shift in the primary direction of the proposal. In addition, the monitoring program of the proposal should in time indicate if environmental impacts are significantly different from those anticipated. If this occurs, a further assessment of the proposal will be made.

##### A. Impacts on Natural Resources

###### 1. Soils and Geology

###### a. Impacts of No Action

Although high erosion rates occur naturally in the Redwood Creek basin, they have been accelerated by land use changes during the last few decades. The high sediment yields result from complex natural processes involving the interaction of climate, geology, and land use. Recent studies indicate that sediment discharges from harvested basins are twice as high as discharges from basins that drain relatively undisturbed terrain (USDI, GS 1980). A map of the geological features in the Redwood Creek basin has been prepared by the Geological Survey, and publication is pending.

The basin is underlain by an assemblage of rocks that are pervasively sheared and highly susceptible to deep-seated mass movements (USDI, GS 1975b). The most apparent erosional features are active earthflows and debris slides. On the eastern side of the basin alone there are over 122 active earthflows. Other apparent erosional features include gullies and side-cast slope failures associated with extensive road building in the basin. (See Ground Disturbance and Erosional Landforms map.)

Over 210 miles of primary and secondary logging haul roads have also been constructed in the main basin, excluding those roads in the Skunk Cabbage and Lost Man Creek drainages. Most of these roads are low standard roads and represent significant sources of sediment. In addition, 7.6 miles of these roads cross major prairies on the east side of the basin, further complicating natural erosion processes in these areas.

Approximately 17,065 acres within the park have been severely disturbed, either by large-scale tractor-yarded logging activities or logging on naturally unstable slopes (see table 1, categories 4, 5, 6, and 15). Approximately 18,590 acres remain in old-growth or well-advanced second-growth status (table 1, category 1), while the rest of the acreage is currently in various stages of recovery from past logging activities (table 1, remaining categories).

Timber-harvesting activities have significantly accelerated erosion in the basin. The impacts of this higher erosion rate are most evident along the main channel of Redwood Creek and its major tributaries, where damage to streamside vegetation has occurred as a result of accelerated bank erosion and overbank deposition of sediments. In addition, sedimentation has resulted in the loss of low-flow aquatic habitats and the destruction of suitable spawning gravels for anadromous fishes.

On the hillslopes, severe gullying and subsequent drainage disturbance have triggered new mass-movement activity and aggravated older existing features. This activity has resulted in the movement of significant quantities of soil, rock, and debris downslope and into tributary stream channels. The processes involved in mass movement are complex, and the impacts caused by logging are not clearly understood. Generally mass-movement features within the basin exist in a state of dynamic equilibrium, where movement is periodic in response to either lateral channel erosion along the toe or excessively high-pore pressure and seepage caused by major rainfalls (USDI, NPS 1975).

How the activities of man have specifically increased and/or disturbed earthflow erosion rates is unknown. However, road building generally accelerates mass-movement processes in a number of ways. Roads built across the toes of these features remove lateral support, creating an increase in the pull of downslope gravity and seepage forces, causing the feature to grow upslope. In addition, road construction accelerates fluvial erosion (the downslope, down-channel movement of surface rock and soil caused by running water) by increasing surface runoff and by diverting and/or concentrating surface runoff across recently exposed materials, which are more susceptible to sheet and gully erosion (USDI, NPS 1975).

Any soil loss as a result of erosion or any other reason diminishes the productivity of the remaining soil and affects the rate of natural recovery. Until erosion rates return to prelogging levels, the effects of logging would continue to be realized in all components of the natural system for an indeterminate time.

b. Impacts of the Proposal

(1) Erosion Control Program

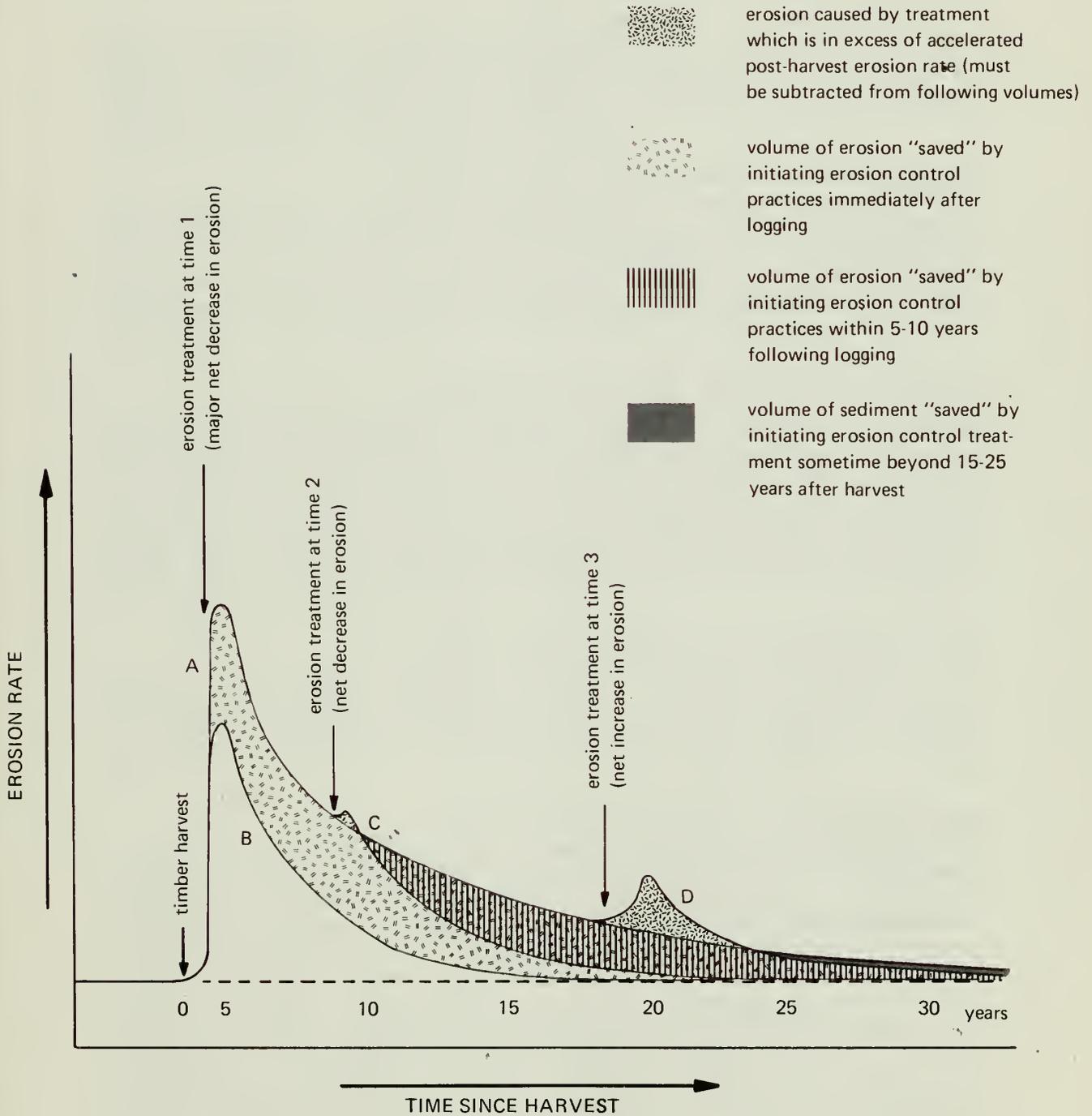
Generally, adverse impacts resulting from rehabilitation activities will be minor in comparison to the impacts already occurring in the watershed as the result of silvicultural activities.

Heavy equipment work will result in the greatest impact. New disturbance caused by treatment activities will result in small, currently unquantifiable, soil losses from each rehabilitation site. Excavation of selected perennial stream crossings will result in short-term increases in stream turbidity during the work periods. Some channel downcutting will occur during the first winter storms at these excavated stream crossings. Constructing check dams or rocking channel crossings, and planting and mulching side slopes, should reduce the erosion from newly treated sites, while proposed monitoring programs will help determine final soil losses caused by rehabilitation. The use of mulches and the planting of grasses and legumes will aid in short-term erosion control and will help to keep the soil from recompacting, thus aiding natural revegetation.

Studies of logging impacts show that erosion rates increase dramatically in the first 2-5 years after timber harvesting. Then the rates begin to decrease slowly as vegetation becomes reestablished, and as localized slope failures become stabilized. The graph of erosion rates is a qualitative representation of erosion rates, as affected by rehabilitation activities, on a hypothetical hillslope site in Redwood Creek. Curve A is the generalized erosion rate for logged areas in the northwest California region (Swanson 1979). The area beneath the curve represents the amount of accelerated soil loss resulting from logging activities at a given site. Rehabilitation efforts begun immediately following logging (see erosion treatment at time 1) should significantly reduce erosion rates over natural recovery rates without contributing any additional impact to the system (curve B). The amount of soil that is potentially saved by initiating rehabilitation measures early is thus represented by the area between curves A and B.

If rehabilitation efforts are initiated after erosion rates have already begun to decline naturally, then the surface disturbance resulting from rehabilitation activities may

# QUALITATIVE REPRESENTATION OF EROSION RATES AS AFFECTED BY REHABILITATION





initially increase erosion rates locally for a short time (see erosion treatment at time 2). After the initial increase in erosion at the work site, the erosion rate should begin to decline more rapidly than if the site had not been treated. Consequently, a net benefit in soil/sediment loss would be expected from the program.

Rehabilitation treatment on some sites that may have stabilized naturally could result in a net increase in the erosion rate (see erosion treatment at time 3). The proposal recognizes this phenomenon and allows for extensive review of these situations during site selection procedures.

During the first three to four years of rehabilitation work, 3,000 to 5,000 acres will be rehabilitated. Most of this acreage is severely disturbed and represents a significant portion of the erosion problem in the basin. If rehabilitation efforts can be effective in reducing the sediment yields from these drainages, then the overall benefit to the watershed will be significant.

Following the first three to four years work on the critical areas, rehabilitation efforts will shift emphasis and focus on the removal of roads throughout the basin. Studies on logging methods conducted in steep mountainous terrain in western Oregon indicate that roads and skid trails are the principal sources of sediment--as much as 96 percent more sediment may result from tractor-yarded areas than from the same size area logged by a system requiring few roads and no skid trails (U.S. Environmental Protection Agency 1973b).

Under the proposal, approximately 178 miles of roads will be removed from the basin. Although it is difficult to project specific figures, associated treatment of hillslopes, drainages, and skid trails should account for a significant reduction in the accelerated erosion rates for these sites.

In the southeast section of the park, road construction across large deep-seated earthflows presents a complex problem. These earthflows are natural geomorphic features and represent a dynamic process that has shaped a significant component of Redwood National Park. Therefore, total stabilization of these features is not the objective of the rehabilitation plan. However, in most cases roads continue to contribute to a higher rate of movement in the earthflow than would occur naturally. The removal of roads, although not expected to immediately result in a decrease in earthflow movement rates, should result in a net decrease in movement over the long run. With the removal of roads, earthflow movement could accelerate, resulting in temporary increases in sediment transport as the feature adjusts to changes in

slope configuration and moisture conditions. This phenomenon is not, however, generally accepted and may not occur. Because this aspect of behavior for large-scale erosional features is not clearly understood, programs to treat such features will be carefully analyzed before action is taken.

Although a quantitative soil savings cannot be calculated at this time, rehabilitation treatment of erosion problems within the basin will have a positive impact upon the overall recovery of the watershed. Since rehabilitation activities will result in a net soil savings as outlined above, the severity of long-term impacts should be lessened proportionately because of the increased rate of recovery for basin erosion rates. In addition, information gained during implementation, and particularly during the monitoring program, should significantly add to the scientific knowledge about watershed rehabilitation. This will provide an important and beneficial service to other federal and state agencies faced with similar land use and rehabilitation problems.

## (2) Revegetation Program

The major impact of the revegetation program will be the reduction in sediment loss on planted hillslopes, roads, landings, and other disturbed sites by the reduction in rill and rainsplash erosion. Grasses and legumes seeded onto roadbeds, cuts, and fills can effectively reduce sediment loss from such sites by 67 percent in the first year (US EPA 1973b). An overall benefit to the basin will occur and result in savings of total sediment lost.

Grasses and shrubs planted on disturbed slopes are generally more effective in reducing erosion than trees within the first few years following treatment. Trees have little direct effect in controlling erosion until good canopy and root development occurs. In terms of erosion control, trees are most effective in increasing infiltration rates.

High water-demanding plants, such as willows, can be effective in partially dewatering wet slopes where seepage has led to slope failures, or where excessively wet soils are retarding conifer regeneration. However, these plants are only effective during summer, and not during winter when they are dormant and when wet slopes are the greatest problems.

The application of mulches and other soil protection materials should reduce surface rill and rainsplash erosion. These materials should help dissipate the erosive energy of raindrops, rills, or overland sheet flow, while generally helping conserve soil moisture and acting as insulators against intense solar radiation.

The removal of scattered concentrations of exotic species, such as the Monterey pine, may temporarily increase sediment yields from slopes and drainages. This phenomenon should be short-term and relatively insignificant in terms of basinwide sediment yields. Introduced exotic species are generally incompatible with a natural redwood forest ecosystem and may compete against the natural regeneration of redwood. The benefit of removing these species should outweigh the small additional increase in soil loss caused by removal. If the large plantation planting of Monterey pine on the west side of the basin is clear-cut, then the impacts may be significantly higher in terms of accelerated erosion rates. Further analysis will be necessary before this large tract of exotics can be removed. Indications are that some species, such as the Monterey pine, may eventually be naturally eliminated through competition with native fir and redwood.

Proposed second-growth stand manipulation programs, such as thinning, are expected to have little significant impact on soils and geology as long as no additional access is constructed and existing roads are removed following stand management activities. No overall adverse impact on soils and geology is expected to result from implementing the revegetation program.

### (3) Prairie Rehabilitation Program

One reason for the persistence of prairies on the east side of the basin may be the inherent instability of the soils. These soils generally have more clay and more cohesion, making them more susceptible to plastic deformation (Janda 1979). This aspect, combined with other soil characteristics and hydrologic conditions unique to grassland areas, apparently inhibits coniferous trees from becoming more widely established.

When roads are built across these prairies, instability is aggravated. Altered drainage patterns caused by road construction increase concentrations of surface flows, resulting in major gully erosion. These gullies in turn transport large quantities of sediment downslope to streams. The removal of unnecessary roads and the dispersing or redirecting of surface runoff to natural channels will reduce sediment loss but will not entirely stop it. Natural gully networks on the prairie grasslands will continue to transport significant quantities of sediment through bank sloughing and other geomorphic processes.

The use of heavy equipment to remove roads and excavate channel crossings will result in temporarily higher erosion rates, locally increasing sediment yields. This impact should be partially mitigated with the installation of gully plugs, check dams, and other physical structures as called for in

the proposal. Where roads are pulled on slopes greater than 10 to 15 percent, gullying will most likely still occur. However, replanting pulled road surfaces with selected grasses and legumes will further reduce the loss of soil.

(4) Riparian Resources Rehabilitation Program

Data collected by James M. Knott (USDI, GS 1975a) suggest that approximately 37 percent of the "coarse sediment" load for Redwood Creek remains in storage in the upper reaches of the channel within the park. Although some of this material is broken up and transported out of the basin as suspended load, severe aggradation has still occurred, partly because of upstream and upslope land uses. This condition has caused elevated channels and an increase in streambank erosion, severely affecting riparian vegetation through bank erosion and higher water tables.

The physical removal of stored sediment in the channel could effectively reduce higher bank erosion rates and the continued damage to riparian vegetation. However, until further data are collected, it is unknown what effect a sudden removal of stored bed load would have on stream-channel morphology.

Recent data on channel cross sections indicate that stream channels are generally degraded in the upper two-thirds of the Redwood Creek watershed. However, along the main channel of Redwood Creek within the park, aggradation is still occurring in most reaches (USDI, GS 1979). The data, however, do not indicate that general channel degradation has begun within the park. Sediment stored behind debris jams in tributary channels could be suddenly released as debris rots. However, qualitative estimates on the total volume of this sediment indicate that it is probably not significant compared to the volume of material already in the main channel. In the meantime, the extremely high volumes of bed load already in the channel will continue to move downstream, possibly causing additional damage to riparian vegetation, regardless of the treatment activities taking place upstream. The continued exploitation of timber resources within the PPZ and further upstream from the park will also continue to influence sediment loads of Redwood Creek within the park.

(5) Composting

The addition of composted material will be beneficial to soil and parent material of low fertility by acting as a mulching agent and by providing organic matter and nutrients. As an erosion control device, compost can be used like a mulching agent to reduce rilling and gullying and also erosion from rain. Compost will also improve the ability of the soil to absorb water directly by slowing runoff and by reducing crusting and soil sealing.

The addition of organic matter to disturbed soil will accelerate the development of new top soil through mechanical, chemical, and biological action. The overall result of the composting program will be to enhance the potential productivity of the soil.

Depending on the nature of the composted material used, water quality in the basin should not be affected by runoff from composted areas where soils may have higher bacteria levels as a result of the compost. If, however, domestic sludge is used from local sewage treatment plants, care will have to be exercised to ensure that heavy metals are not present, which could contaminate the surface waters of the basin.

## 2. Vegetation

### a. Impacts of No Action

Within the park addition, most of the cutover lands have largely been artificially reforested. Generally logging companies have either aerielly seeded Douglas-fir or planted bare-root or container nursery stock. As a result much of the watershed has an artificial structure and an artificial mixture of densities. For example, aerielly seeded areas may have 15 to 25 year-old stands of Douglas-fir, with densities as high as 3,000 to 20,000 trees per acre. These conditions can lead to stand stagnation and seriously inhibit redwood growth. Not until the stands begin to break-up (as long as 100 to 200 years) do redwoods start reaching canopy dominance.

Besides causing the direct losses of vegetation as a result of logging, man's activities have indirectly affected downstream vegetation. Damage to or the destruction of streamside vegetation has occurred from accelerated bank erosion, overbank deposition of sediments around the base of the trees, elevated water tables, and edge effects that have caused canopy damage/die-off and increased windthrow.

Prairie vegetation has been altered by the introduction of exotic grasses, cultivation, and domestic livestock grazing. In addition, road construction and gulying have resulted in the invasion of prairie vegetation by conifers, which readily seed on road cuts and fills. Grazing by domestic stock has selectively favored introduced annuals over native bunch grasses to a point where native perennials have been greatly reduced. The subsequent alteration of prairie vegetation has affected wildlife species that are heavily dependent on the availability and quality of grasslands.

### b. Impacts of the Proposal

#### (1) Erosion Control Program

Qualitative assessments of harvested lands show that natural regeneration is slowed or prevented on naturally

unstable slopes, which could take hundreds of years to stabilize so that forest cover can become established. Consequently, the reduction of erosion and the stabilization of slopes will enhance the recovery or natural regeneration of forest cover.

The most direct adverse impact that the erosion control program will have on vegetation will be the removal of reestablished vegetation at specific work sites. Heavy equipment work will in most cases destroy some vegetation that has become reestablished following timber harvest. Replanting afterwards will help to replace the lost vegetation.

At some work sites, vegetation may have become reestablished to a point that the negative effects of physical rehabilitation (heavy-equipment work in particular) may outweigh the benefits. To mitigate these potential adverse effects, the disturbance of such sites will be avoided, and only minimal erosion control activities will occur.

The removal of debris jams in drainage channels during the course of rehabilitation will positively affect downstream vegetation. It will reduce further bank erosion, prevent damage to streamside trees, and diminish the breeding habitats for potentially damaging insect populations.

No threatened or endangered, or proposed threatened or endangered, plant species will be destroyed by rehabilitation programs.

## (2) Revegetation Program

The principal impacts of revegetation will be associated with the removal of exotics and with activities to naturalize second-growth stands.

Following additional study, second-growth stands may be thinned to adjust species composition and to speed the reestablishment of a more nearly natural redwood/Douglas-fir forest. Other impacts associated with thinning include increased fire danger, possible vector points for insect infestation and breeding (with subsequent damage to living trees), and undesirable or unnatural visual results that could affect some park visitors.

Active management of exotics in the park can have a variety of impacts, depending upon the management technique chosen. Some exotics, such as Monterey pine, may be slowly replaced by endemic species through natural succession. In the meantime, however, competition by exotics will likely hinder the regeneration of native redwood and Douglas-fir, delaying the return of a natural forest.

Clear-cutting large tracts of exotics (primarily Monterey pine) will leave visually unattractive open areas, similar to those left by timber companies, and the National Park Service could be criticized by the public and other land management agencies for inconsistencies in stated resource management goals. Immediate staged removal of these exotics, while visitor access is still restricted, could reduce potential public criticism. Cleared areas would be subject to increased erosion, which could be mitigated by leaving some pines onsite and planting redwood and Douglas-fir seedlings.

Girdling exotic trees will leave large unsightly areas of standing dead trees. This could cause a fire hazard and provide an environment conducive to insect infestation.

Management strategies for the Port Orford cedar (Chamaecyparis lawsoniana), which was seeded extensively with Douglas-fir in several areas of the park, have not yet been determined. The long-term significance of planting this species is still being evaluated. For now the Port Orford cedar will continue to occupy a competitive niche within the park until management strategies can be recommended.

No management of exotics other than trees on second-growth forestlands is anticipated. Exotics such as pampas grass (Cortaderia selloana) and Scotch broom (Cytisus scoparius) are expected to be shaded out by second-growth forest canopy. Some exotics may be removed in prairie areas.

Under the proposal, fertilization may also be used to speed growth where grasses, shrubs, and trees have been planted for erosion control purposes. Widespread fertilizer application is not proposed on understocked slopes where seedlings are planted to augment natural regeneration.

### (3) Prairie Rehabilitation Program

The prairie rehabilitation program will be beneficial in maintaining this ecosystem. Although the mechanisms that sustain prairies in the park are not fully understood, the replacement of invading conifers with native perennial grasses and shrubs will at least reduce the threat of artificial invasion resulting from man's activities. Removing these young trees from roadsides and recently formed gully banks, followed by revegetation techniques where appropriate, will also restore the natural appearance of prairies, while generally encouraging native species to become reestablished.

The effectiveness of any prairie rehabilitation program will be limited until other impacts on the prairie ecosystem, such as the role of fire and the effects of domestic livestock grazing, are addressed.

#### (4) Riparian Resources Rehabilitation Program

Implementing the riparian resources program will cause few direct impacts on vegetation. Streamside vegetation will be indirectly benefited by stopping aggradation in the main channel and by potentially removing high bed loads, which in the past have damaged or destroyed vegetation by bank undercutting and overtopping.

By controlling upstream erosion, reversing stream aggradation, lowering elevated alluvial water tables, and reducing the threat of continued bank erosion and overbank deposition of coarse stream sediments, the vigor and health of the Tall Trees Grove should be ensured. This will also protect one of the park's most significant resources.

Some existing vegetation may be damaged or destroyed during bank stabilization activities. However, the species affected will most likely be those seral species that readily become reestablished after disturbance. No proposed or officially listed threatened or endangered species will be impacted.

#### (5) Composting

The primary impact of composting on vegetation will be the addition of nutrients to the soil. These nutrients will provide existing and newly planted vegetation with the necessary elements for developing a healthy and vigorous plant community, besides enhancing the potential productivity of soil and improving the quality and quantity of revegetation.

### 3. Aquatic Resources

#### a. Impacts of No Action

Logging has had particularly long-term effects on aquatic resources in the Redwood Creek basin. Upstream silvicultural activities have reduced the overall productivity in both the main stem of Redwood Creek and the estuary. The California Division of Ecological Service (1975) reviewed Redwood Creek as a fish habitat and concluded that current anadromous fish runs are far below those of 70 to 80 years ago.

This reduction is not entirely due to commercial fishing. The state found that the existing aquatic habitat conditions have precluded a significant recovery of the anadromous fishery. During spawning, salmonids deposit their eggs in gravel streambeds where they remain until hatching. The porosity of these gravel beds is key to the successful development of eggs and newly hatched fish or alevins, because they require well-oxygenated water relatively free of contaminants. Sedimentation alters the intragravel bed porosity so that this interchange of water does not occur, and eggs and alevins may be killed or their development altered.

After hatching, young salmonids (depending on the species) spend varying amounts of time in pools that offer protection from predators, provide an adequate food supply, and meet the environmental requirements of optimal growth. Increased sedimentation fills these pools, decreases the area available for such habitat, and reduces food resources there. Much of this sediment will remain until debris jams fail for one reason or another and wash the sediment downstream. These alterations in the availability and quality of nursery areas can significantly lower the survival rate of young fish because they are affected at the most critical stages in their development.

Water quality parameters directly affected by siltation are sediment load and turbidity. These conditions lower primary productivity by reducing light penetration, abrade fish and invertebrate gill tissues, and impair the sight and ability of fish to detect food.

Changes in water and habitat quality have also altered benthic invertebrate populations, primarily in types of organisms rather than in reduction of total abundance or biomass. Changes in the composition of benthic invertebrate fauna in turn seriously affect higher organisms by forcing changes in feeding habits (Hynes 1970).

The construction of levees at the mouth of Redwood Creek, and the channelization of the lower 3.4 miles of the creek, have disturbed the normal patterns of water circulation, inundation, and deposition. Coupled with increased sedimentation generated by upstream timber harvesting, this has resulted in a significant loss in the productive area of the estuary.

b. Impacts of the Proposal

(1) Erosion Control Program

The recovery of a viable, self-propagating aquatic community depends on the reduction of high erosion rates in the watershed. The various rehabilitation programs will all help aquatic systems to recover more rapidly. As erosion control techniques are taken on slopes, less sediment will enter surface waters, and stream turbidity should decrease more rapidly after major storms.

The major impacts on aquatic ecosystems will be on fish spawning and feeding. Decreased deposition of fine sediments and organic debris within the streams and on the gravel beds should generally enhance spawning and feeding opportunities for anadromous fish.

Rehabilitation efforts will positively affect benthic invertebrate populations by restoring the aquatic habitats to

a more natural, undisturbed state. As a result, localized perturbations in higher order fauna can be expected as natural food chains become reestablished. The degree of the impacts is not completely known at this time.

Tributaries that drain recently harvested areas usually contain numerous blockages made up of coarse organic debris, including sawed logs that have accumulated on older channel obstructions (USDI, GS 1975b). The removal of these debris jams may impact aquatic systems in diverse ways. If the jams are higher than 5 or 6 feet, they prevent the upstream migration of fish, so their removal will increase the available spawning habitat of anadromous fish. However, the removal of the debris will destroy stable niches for certain aquatic organisms, temporarily reducing the productivity of tributary streams. The removal of the jams will also allow the sediment trapped behind these barriers to move downstream, resulting in localized impacts along tributary channels.

Pools in the tributary streams of the basin that have been filled by sediment and debris washed down from harvested slopes will gradually reform if rehabilitation methods are effective in reducing erosion upslope. Pools should also eventually form behind natural barriers in the streambed. Without additional sediment input, the pools will become productive habitats similar to those that existed before logging. This will improve rearing habitats for anadromous fish.

Generally, the erosion control program will benefit aquatic resources by enhancing stream recovery potential over the long-run. Short-term impacts, however, may be significant in local areas.

#### (2) Revegetation Program

With the use of fertilizers, ammonia and nitrate concentrations in adjacent streams could increase to damaging levels. However, application rates are expected to be low and the areas small enough that no adverse impacts on water quality should occur. Careful monitoring of selected streams below fertilized sites will be conducted to determine the effects of fertilization on water quality. The types and application rates of fertilizers may be modified based on the results of this monitoring. However, basinwide fertilizer application rates should be insignificant, and water quality should remain unaffected in the main stem of Redwood Creek.

#### (3) Riparian Resources Rehabilitation Program

The water quality parameters that have been most directly affected by the destruction of streamside vegetation are temperature and dissolved oxygen. The absence of streamside vegetation results in more solar radiation striking the

surface of the water, resulting in higher instream temperatures. These temperatures may be lethal to aquatic organisms or exceed the temperatures at which growth and development is maximized. Therefore, significant alterations in community structure may have developed.

The increases in water temperature also directly affect levels of dissolved oxygen because the amount of a gas that can be dissolved in a liquid depends on that liquid's temperature. The higher the temperature of the liquid, the less dissolved gas it can hold. Higher temperatures also increase the rates of metabolism of oxygen-demanding organisms in the water, thereby further decreasing the level of dissolved oxygen. Although sufficient during most of the year to support a viable community of aquatic organisms, dissolved oxygen concentrations in pools and slack water areas may be reduced to critical levels during summer, when flows are low. Consequently, decreases in dissolved oxygen concentrations may have significantly adverse, long-term impacts upon aquatic organisms.

The rehabilitation of riparian vegetation along Redwood Creek should increase stream productivity. In an undisturbed forest system, streamside vegetation shades the stream, and primary productivity (that is, the direct conversion of sunlight into biomass by plants) contributes relatively little to the ecosystem in terms of energy that is available for aquatic organisms. The material that enters the stream from the terrestrial system (for example, leaves and twigs) is comparatively greater. The aquatic community reflects this condition in that organisms have adapted to use forest litter as an energy source. When streamside and slope vegetation is removed, the amount of terrestrially derived matter entering the stream is reduced, and more sunlight is available to instream primary producers. When this occurs, primary production becomes the major source of energy for the aquatic system, and the stream community restructures itself to process these other sources of energy. This major community restructuring is required before primary production occurring in the streams can be efficiently utilized, and it may require a great deal of time. In theory, therefore, stream productivity and diversity of desirable organisms may be significantly reduced by an absence of streamside vegetation.

The absence of streamside vegetation contributes to streambank instability, sloughing, and erosion, further exacerbating the effects of increased sedimentation. Programs to reestablish riparian vegetation will enhance streambank stability and help to alleviate these problems. Native plant species will be considered in rehabilitating riparian resources.

#### (4) Redwood Creek Estuary Rehabilitation Program

The type and degree of impacts of the rehabilitation program on the Redwood Creek estuary are unknown at this time. They will depend on the effectiveness of treatment methods in reducing upstream erosion and on the management decisions regarding allowable activities in the main channel of Redwood Creek.

As part of the rehabilitation program, physical, chemical, and biological data will be gathered to assess the existing productivity level in the estuary. This should provide information concerning historic profiles and estuarine configurations, seasonal and tidal changes in estuary and channel morphology, seasonal and tidal changes in physical/chemical parameters, the distribution of major concentrations of fish-food organisms, the distribution of areas of extensive macrophytic growth, and the level and distribution of use by salmonid and other fishes. The findings of the studies will provide the information necessary for making decisions about the management of the estuary.

In addition, each federal, state, or local governmental organization that has jurisdiction over activities in the estuary must be identified. This information will allow for a realistic set of alternatives to be developed concerning "restoration."

A variety of programs could be implemented to return the estuary to a level of productivity that more nearly represents its undisturbed state. These include modifying levees to improve circulation, removing sediment and organic debris, and revegetating damaged areas. Although any of these programs would increase turbidity, the associated impacts should be localized and short-term in nature when compared to the potential increase in productivity of the estuary.

Removing debris and sediment would allow the critical relationship between seawater tidal flow and freshwater inflow to become reestablished. Decayed wood material recovered during this operation could be used as composting material to enhance soil-bolstering projects upstream. Dredged material could also be disposed of at sea or on the beach north of Mussel Point. This possibility would be thoroughly studied before implementation.

If dredged material was disposed of at sea, the impact on marine systems would be insignificant compared to the amount of sediment naturally discharged from rivers along this portion of the coastline (Wahrhaftig 1976). However, a site-specific analysis of the disposal site would be conducted, and potential

impacts would be evaluated. Disposal of dredged material on the beach would be less desirable because it might leave an unpleasant odor and create a problem with flies. If properly placed, the sediment dredged from the estuary would enter the nearshore marine environment, where it would be available for longshore transport and normal seasonal beach deposition. Some additional dredging might be necessary every three to four years for an indefinite time, since higher than "normal" sediment movement from the upper watershed would probably continue until rehabilitation efforts began to take effect, possibly an interval of several years.

Initially, dredging might cause further degradation of the wetlands until the loose material was flushed out during winter rains. This impact could be mitigated by scheduling work in the late summer, when water levels are lower.

Removing the levee system could result in large amounts of sediment being deposited in the upper reaches of the existing wetlands, thus destroying or adversely impacting them. Sediment loads in the upper basin of Redwood Creek are substantial, and many untreatable subbasins would continue to release sediment into the main creek. With the levees removed, this material could produce large sediment load discharges to the wetlands for many years. In addition, the movement of bedload "slugs" is uncertain at this time, and active removal in the upper basin might be necessary to alleviate this sediment threat for downstream resources.

#### 4. Wildlife

##### a. Impacts of No Action

Wildlife has been significantly affected by logging in the upper and lower reaches of the watershed. Generally, population levels of those wildlife species specifically associated with mature old-growth redwood and Douglas-fir have been replaced by those more adapted to the open, brushy areas and new-growth forest. As portions of the watershed are stabilized and natural plant succession occurs, these populations will shift toward the original species composition and population sizes. The number of species will also change from a relatively high level during the recovery stage to a low level at more mature stages.

An additional effect of logging has been the alteration of the food chain. Degraded aquatic ecosystems reduce fish populations, which in turn affect river otters, king fishers, and similar species. This in turn affects large predators, such as the cougar, coyote, and black bear.

Park expansion, coupled with a subsequent reduction in poaching, has afforded opportunities for some wildlife populations (such as elk, deer, cougar, and bear) to increase.

Greater protection alone may allow for a sizable increase in these populations.

Elk and deer population changes are the most noticeable effect of logging. At least 150 elk have been observed in the general area of the rehabilitation sites, compared to a total park population of at least 580. The numbers of black-tailed deer, black bears, coyotes, and other wildlife species are unknown. Mandel and Kitchen (1979) stated that elk populations in heavily cutover areas should increase for 5 to 10 years and then begin to decline, reaching low levels 25 to 30 years after logging. Additional observations and studies indicate that the highest use of cutover areas occurs within 15 years of logging (Mandel and Kitchen 1979).

b. Impacts of the Proposal

Rehabilitation efforts will permit hillsides and roads to return more rapidly to forested conditions than they would otherwise because of the effects of continual earthslides, road failures, and abnormal drainage patterns. However, this accelerated loss of cutover habitat and the reduction of certain wildlife populations will be offset by an accelerated recovery in aquatic resources and dependent wildlife.

Decreases in elk and deer populations may be offset in two ways. First, elk may make more use of existing prairies and grassland. With reduced poaching and possibly some habitat manipulation, numbers may remain relatively high, and large, newly established herds may continue to occupy the Redwood Creek watershed. Second, elk and deer foraging in some areas may keep the recovery of some plant species to a minimum. Natural plant succession will eventually decrease forage quality, increasing pressure on remaining areas.

Impacts on wildlife populations and endangered or threatened species were previously discussed in detail in DES 79-55. No impacts on endangered or threatened species are anticipated as a result of the watershed rehabilitation program. If significant impacts do arise, they will be discussed in the natural resources management plan.

B. Impacts on Cultural Resources

1. Impacts of No Action

Archeological sites previously exposed by logging activities would continue to be subject to vandalism, weathering, and erosion. Eventually, natural revegetation would protect and stabilize the sites; however, some data would be irretrievably lost.

Because of the integration of archeological research and onsite investigation with the rehabilitation effort, it can be

hypothesized that certain losses would occur under a no-action alternative:

the opportunity to develop new methodologies for archeological survey and site evaluations in a logged slope setting

a better inventory and data base about cultural resources in the Redwood Creek basin, including information pertinent to the cultural heritage of Chilula descendants (the data base for northwestern California archeology is quite meager)

contributions to the understanding of land use patterns, past and present, in Redwood Creek, including knowledge of history and prehistory that is useful for interpretation and public education

The actions proposed for historic properties in the Redwood Creek basin, as delineated in the General Management Plan, will occur regardless of the rehabilitation effort. The Trinidad Trail will be recorded onsite and allowed to deteriorate; no additional investigation is warranted.

## 2. Impacts of the Proposal

The proposed action for the Trinidad Trail is monitoring to determine the effects of weathering and vandalism, recording, collecting oral history to increase the basic information about the trail, and allowing natural deterioration to continue. Compliance requirements for the ranch site and the two barns were documented pursuant to 36 CFR 800, and were incorporated in a memorandum of agreement on the General Management Plan. The agreement was approved by the California State Historic Preservation Office on July 7, 1980, and it was ratified by the Advisory Council on Historic Preservation on August 24, 1980.

It is essential to note that the impacts discussed below are potential impacts. The implementation of any one management action, or combination of actions, as described in the "Cultural Resources Management" section of the proposal (III.B.) should result in either avoidance or successful mitigation of adverse effects. Table 5 shows the numbers of sites potentially impacted and some general strategies for mitigation.

The use of heavy equipment, the excavation of stream channels, the contouring of landscapes, the removal of roads, trails, and scars, and the pulling of logs from stream channels for erosion control could result in the following potential effects on cultural resources:

disturbed site integrity caused by the removal of artifact locations (loss of provenience and stratigraphy)

damage to artifacts and features (housepits, hearths, etc.)

disruption of human burials

irretrievable loss of the record of human occupation and prehistory--a significant loss of Chilula heritage data

loss of surface identification of a site

Several sites are impacted by existing roads. Proposals to maintain these roads for rehabilitation work and/or access through the basin will continue to impact these sites.

The removal of mud slides, surface work (including rocking and grading), and the widening of roads could result in impacts similar to those outlined above.

To implement the prairie rehabilitation program, the use of equipment and personnel to remove roads, to reestablish drainage systems, and to construct check dams and water ladders could result in the same effects as discussed for erosion control. The replanting of grasses may be beneficial to preserving and protecting site integrity, depending on the method chosen. The method of fire control determined appropriate for prairie management could have significant impacts on cultural resources. These impacts will be addressed in the natural resources management plan.

The rehabilitation of the Redwood Creek estuary and of riparian resources will result in impacts in the affected areas similar to those described for the erosion control program.

General strategies for avoiding or mitigating potential adverse impacts are described in section III.B.2. Specific actions will depend on the rehabilitation prescription for a particular unit. Timely completion of surveys, so that cultural resource data can be incorporated at the decision-making stage, will usually result in the avoidance of impacts to sites.

A well-structured and closely coordinated monitoring program throughout the rehabilitation effort should allow for either the avoidance of impacts or the timely implementation of appropriate mitigation actions by qualified professionals.

Adverse effects may occur as the result of limited testing to determine the extent of a site or the deposition of materials. The long-range effect will be data presentation, design of an appropriate mitigation or avoidance of additional adverse impacts, and increased knowledge of the resource. Part or all of a site may lose its provenience.

Table 5: Impacts on Cultural Resources

Rehabilitation Program	Cultural Resources	Mitigation Strategy*
Erosion Control	HUM-442, Trinidad Trail	Monitor: All sites NAHAC consultations: HUM 442 Further evaluations: HUM 442, Trinidad Trail Oral history: Trinidad Trail
Prairie Rehabilitation	HUM-234, 439, 440, 442, 443, 444, 445H, 446, 447, 448, 449H, 450, 452, 453, 478, 480, 482, 490	Monitor: All sites NAHAC consultations: HUM 442, 444, 446, 447, 452, 490 Further evaluations: HUM 442, 444, 446, 490 Oral history: HUM 234, 445H, 447, 449H
Revegetation	All sites in Prairie Rehabilitation	Monitor: All sites NAHAC consultations: HUM 479, and all sites requiring further evaluation
Road Maintenance and/or Removal	HUM-442, 443, 444, 446, 448, 452, 479, 490	Monitor: All sites NAHAC consultations: HUM 442, 444, 446, 490 Further evaluation: HUM 442, 444, 446, 490

Note: The above information is pertinent to known historic and archeological sites within the rehabilitation area. Cultural resources listed are those that could be affected by some component of a rehabilitation effort. Mitigation strategies denote actions that would be undertaken to avoid impacts or to design specific mitigating measures. All cultural resources on the chart are being nominated to the National Register of Historic Places; all archeological sites are in the Bald Hills archeological district.

\*Definitions:

NAHAC--Native American heritage advisory committees  
HUM--Archeological site designation for Humboldt County  
Further evaluation--Subsurface testing to determine the extent of a site or the deposition of site materials. The sites designated for further evaluation on the chart represent exceptionally sensitive areas where this action may be necessary as a result of unavoidable rehabilitation actions.

Long-range beneficial effects accruing from the rehabilitation effort will be the preservation and protection of most cultural resources in the project area by stabilizing slopes, revegetating cutover areas, monitoring vandalism and weathering, and educating the public about the importance of these resources.

C. Impacts on Socioeconomic Conditions

1. Impacts of No Action

No economic impacts would be generated by the federal government under a no-action alternative. Any economic impacts would be independent of park actions. However, damage to park resources, such as the Tall Trees Grove, could significantly detract from visitor experiences and result in reduced park visitation. This would cause negative economic impacts in the region and local communities until the recreational value of the park was restored.

2. Impacts of the Proposal

a. Park Salaries and Expenditures

The rehabilitation budget expenditures are expected to have a relatively small but positive impact on Humboldt County and local communities. In 1983, when the rehabilitation team is fully staffed and operating at its maximum level of activity, rehabilitation projects are expected to generate \$2,361,990 (in 1980 dollars) in total income annually. This constitutes a 0.43 percent yearly increase in total income in Humboldt County. During this peak period, 92 park staff jobs and 51 residentiary sector jobs per year are projected to be generated by the program. This will increase total annual employment in Humboldt County by 0.33 percent and residentiary employment by 0.27 percent. These impacts are expected to be somewhat lower prior to 1983 and to decrease between 1984 and 1990, as shown in table 6.

Although 1980 census data are not available for accurately quantifying the economic impacts of the rehabilitation program on individual communities, such as Arcata, Trinidad, and Orick, these impacts will be relatively important. For example, some Orick residents have responded to the influx of NPS rehabilitation staff working in the area by initiating efforts to provide more and better housing. In addition, Orick representatives are working with Redwood National Park personnel on local land use and economic development planning.

b. Other Programs Associated With the Rehabilitation Plan

Several other programs associated with the rehabilitation program will increase local employment opportunities and provide direct and indirect social and economic benefits to the region and local communities. Specific numerical projections of

Table 6: Economic Impact of the Rehabilitation Proposal  
on Humboldt County  
(dollar figures in thousands, 1980 dollars)

Impact Category	1980	1983	1990
Taxable Transactions	\$507.24	\$1,021.39	\$ 571.21
Employment:			
Park	92	92	46
Residential	25	51	28
Income	\$982.73	\$2,361.99	\$1,735.74

Notes:

Personnel salaries are all presumed to be local (within Humboldt County).

Seventy percent of support costs are presumed to be spent locally.

Seventy percent of the contracts and cooperative agreements are presumed to be with local companies.

All matching funds are to be awarded to local landowners.

Contract, cooperative agreement, and matching fund expenditures are presumed to be 67 percent wages and salaries and 33 percent local purchases.

Gross wages and salaries  $\times$  0.312 (wage/taxable transaction coefficient) = taxable transactions.

Purchases  $\times$  0.2 (assumed proportion of expenditures subject to sales tax) = taxable transactions.

For every \$1,000 expended in taxable transactions, 0.05 job is generated in the residential sector.

The personal income multiplier is 1.2.

Indirect or tertiary impacts resulting from local purchases are ignored because of their insignificance at this budgetary level.

Only the impacts of local expenditures and salaries are calculated.

The multipliers, coefficients, economic models, and Humboldt County data utilized were derived from personal communications with Frank I. Jewett and John Henry Grobey; TerraScan, Socio-Economic Base Study on Six Rivers National Forest (Eureka, Calif., 1979); and Grobey and others, "Redwood National Park Tourism Study: Economic Impacts of Alternative Park Development Plans" (Humboldt State University, 1979).

people who will benefit from these programs are not known at this time. Therefore, the kinds of impacts that are expected will be discussed generally. The impacts to date will be reported as stated in the Second Annual Report to Congress (USDI, NPS 1980).

(1) Redwoods United, Inc.

Redwoods United, Inc., will be supported by specific portions of the rehabilitation program. The salvaging of wood from the watershed by Redwoods United crews and the awarding of rehabilitation work contracts to the organization will contribute to the continuation and economic viability of this important social service. In 1979, a total of 1,029 people in Humboldt County were impacted by Redwoods United's services and program (Redwoods United, Inc. 1980). It is hoped that the raw materials and work contracts provided by Redwood National Park will maintain the 1978 level of employment at Redwoods United to the greatest extent practicable.

(2) California Forest Improvement Program

Landowners with 5,000 acres or less of commercial forestland within the Redwoods Creek watershed may receive full funding by the National Park Service for land conservation projects, forest improvement, and fish and wildlife habitat improvements through the California Forest Improvement Program. During FY 1980, \$400,000 was provided by the Park Service for this program. These funds will allow many landowners to improve the value and productivity of their land as well as contribute to the rehabilitation of the watershed.

(3) Cooperative Agreements for Rehabilitation Training and Composting

The Redwood National Park staff is exploring two cooperative agreements that could aid in rehabilitation work and provide local employment.

First, Redwood National Park has approached Humboldt County with a proposal to fund a training and employment program for affected workers and other unemployed or underemployed persons. Enrollees would be selected by the county and progress through a curriculum, including on-the-job training, which would produce a work force that is competent to conduct rehabilitation programs on cutover lands. Upon completion of this formal training, these workers should be capable of contracting with not only the National Park Service, but also with the U.S. Forest Service and private timber companies to conduct desirable or required erosion control and planting projects. Thus, long-term benefits could be derived from this program by the trainees as well as by private companies and government watershed rehabilitation programs.

Second, Redwood National Park is working on a cooperative agreement with the Arcata Community Recycling Center, a nonprofit corporation, for a static-pile composting demonstration project. This may fill the park's compost needs and also provide social and economic benefits to the community by utilizing wood waste, sewer sludge, and other liquid wastes (for example, from portable toilets and fish processing). After the demonstration period, this may well evolve into a successful private enterprise, supplying composted materials for land and restoration projects being conducted not only by the National Park Service, but also by the U.S. Forest Service and private timber growers.

#### (4) Employment Programs

Since March 27, 1978, Redwood National Park has been giving "full consideration" and "preferential employment" to workers who have been adversely affected economically by the expansion of the park. Of 39 applications from displaced woodworkers during 1979, 3 career-conditional employees and 8 temporary employees were hired from those applicants who were certified as "affected workers." Additional qualified displaced woodworkers will be hired as needed during the rehabilitation program.

In addition, approximately 70 percent of the contracting and purchasing for rehabilitation work is from local firms. All requests for bids include the following statement:

To foster the economic revival of Del Norte and Humboldt Counties, the National Park Service will weigh considerations of prospective contractors and candidates for cooperative agreements, in favor of those whose businesses are conducted primarily in Del Norte and Humboldt Counties, and businesses that employ a majority of residents from Del Norte and Humboldt Counties.

All contractors are required to provide evidence of their giving "full consideration" to affected woodworkers. This is normally accomplished by clearing their hiring procedures through California's Employment Development Department, which reviews all Redwood Employee Protection Program workers who are eligible for such jobs.

#### c. Tourism

Visitor experiences will be enhanced by the rehabilitation of the Redwood Creek watershed. The preservation and restoration of natural processes in the watershed will improve the backcountry experiences provided through implementation of the Redwood National Park General Management Plan. Trail and campsite systems will be established following the development of

the backcountry use and management plan. Equestrian trails are being planned, and trips will be conducted by a private concessioner into the western drainages of the basin.

A shuttle-bus system beginning in Orick and operated by a Humboldt County resident carries more than 10,000 visitors each year to the 1½-mile trail leading to the Tall Trees Grove. (The grove was previously only accessible to the public via an 8½-mile hiking trail.) The interpretation of the rehabilitation program by park rangers on these shuttle buses, which will be supplemented by several interpretive stops, will help visitors to understand the goals and magnitude of the undertaking. The watershed as a whole will also serve as a living laboratory, demonstrating and fostering understanding and knowledge of erosion and rehabilitation processes.

The erosion control activities and estuarine rehabilitation resulting in positive impacts on aquatic resources will improve sportfishing, one of the major recreational attractions in the region.

The additional recreational and educational opportunities provided by the rehabilitation of the Redwood Creek watershed are likely to increase the time visitors spend in the region, and thus, the money they spend in local communities. The number of visitors attracted to the park by these activities or the time and money spent in the local communities as a result of the rehabilitation program are unknown. However, tourist expenditures for goods and services are expected to increase in Orick as a result of the shuttle-bus service. Any improvement to either the river or ocean sportfishing industry should have a positive effect upon tourism by attracting more fishing parties to the area, who will likely spend more time and money once they arrive (TerraScan 1979). Trailheads for hiking or horseback riding that are established in or near a community should also stimulate tourist expenditures at local gift shops, grocery stores, gas stations, restaurants, bars, hotels, and other establishments. In general, the rehabilitation of the watershed and the enhancement of tourist opportunities should increase local and regional tourist business, provided that no extreme gasoline shortages or price hikes occur.

## APPENDIXES

### A: LEGISLATION

#### Public Law 95-250 95th Congress

#### An Act

To amend the Act of October 2, 1968, an Act to establish a Redwood National Park in the State of California, and for other purposes.

Mar. 27, 1978  
[H.R. 3813]

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

Redwood  
National Park,  
expansion.  
Employment  
program.

#### TITLE I

SEC. 101. (a) In order to protect existing irreplaceable Redwood National Park resources from damaging upslope and upstream land uses, to provide a land base sufficient to insure preservation of significant examples of the coastal redwood in accordance with the original intent of Congress, and to establish a more meaningful Redwood National Park for the use and enjoyment of visitors, the Act entitled "An Act to establish a Redwood National Park in the State of California, and for other purposes", approved October 2, 1968 (82 Stat. 931), is amended as follows:

16 USC 79a.  
Boundaries.  
16 USC 79b.

(1) In subsection 2(a) after "September 1968," insert "and the area indicated as 'Proposed Additions' on the map entitled 'Additional Lands, Redwood National Park, California', numbered 167-S0005-D and dated March 1978."

(2) In section 2, subsection (a), delete "fifty-eight thousand" and substitute "one hundred and six thousand" and delete the period at the end of the subsection and add "and publicly owned highways and roads." In section 2, subsection (b), delete "by donation only". At the end of section 2, insert the following new subsection "(c)":

Park Protection  
Zone, land  
acquisition.

"(c) Within the area outside the boundaries of Redwood National Park indicated as the 'Park Protection Zone' on the map entitled 'Proposed Additions, Redwood National Park, California', numbered 167-S0005-D and dated March 1978, the Secretary is authorized to acquire lands and interests in land: *Provided*, That lands may be acquired from a willing seller or upon a finding by the Secretary that failure to acquire all or a portion of such lands could result in physical damage to park resources and following notice to the Committee on Energy and Natural Resources of the United States Senate and the Committee on Interior and Insular Affairs of the House of Representatives. Any lands so acquired shall be managed in a manner which will maximize the protection of the resources of Redwood National Park, and in accordance with the Act of October 21, 1976 (90 Stat. 2743). Acquisition of a parcel of land under the authority of this subsection shall not as a result of such acquisition diminish the right of owners of adjacent lands to the peaceful use and enjoyment of their land and shall not confer authority upon the Secretary to acquire additional lands except as provided in this subsection."

Notice to  
congressional  
committees.

43 USC 1701.

(3) In subsection 3(a), delete the period at the end of the second sentence and add the following: "which donation of lands or interest in lands may be accepted in the discretion of the Secretary subject to such preexisting reverts and other conditions as may appear in the

16 USC 79c.

title to these lands held by the State of California, and such other reverters and conditions as may be consistent with the use and management of the donated lands as a portion of Redwood National Park. Notwithstanding any other provision of law, the Secretary may expend appropriated funds for the management of and for the construction, design, and maintenance of permanent improvements on such lands and interests in land as are donated by the State of California in a manner not inconsistent with such reverters and other conditions.”.

Vested and  
possessory rights  
in certain real  
property.  
16 USC 79c.

(4) In subsection 3(b)(1), after “NPS-RED-7114-B”, insert “and effective on the date of enactment of this phrase, there is hereby vested in the United States all right, title, and interest in, and the right to immediate possession of, all real property within the area indicated as ‘Proposed Additions’ on the map entitled ‘Additional Lands, Redwood National Park, California’, numbered 167-80005-D and dated March 1978, and all right, title, and interest in, and the right to immediate possession of the down tree personal property (trees severed from the ground by man) severed prior to January 1, 1975, or subsequent to January 31, 1978, within the area indicated as ‘Proposed Additions’ on the map entitled ‘Additional Lands, Redwood National Park, California’, numbered 167-80005-D and dated March 1978.”.

At the end of subsection 3(b)(1), insert the following new paragraphs: “Down tree personal property severed subsequent to December 31, 1974, and prior to February 1, 1978 may be removed in accordance with applicable State and Federal law, or other applicable licenses, permits, and existing agreements, unless the Secretary determines that the removal of such down timber would damage second growth resources or result in excessive sedimentation in Redwood Creek: *Provided, however*, That down timber lying in stream beds may not be removed without permission of the Secretary: *Provided*, That such removal shall also be subject to such reasonable conditions as may be required by the Secretary to insure the continued availability of raw materials to Redwoods United, Incorporated, a nonprofit corporation located in Manila, California.

“The Secretary shall permit, at existing levels and extent of access and use, continued access and use of each acquired segment of the B line, L line, M line, and K and K roads by each current affected woods employer or its successor in title and interest: *Provided*, That such use is limited to forest and land management and protection purposes, including timber harvesting and road maintenance. The Secretary shall permit, at existing levels and extent of access and use, continued access and use of acquired portions of the Bald Hills road by each current affected woods employer or its successor in title and interest: *Provided further*, That nothing in this sentence shall diminish the authority of the Secretary to otherwise regulate the use of the Bald Hills road.”.

Just  
compensation.  
Jurisdiction.  
16 USC 79c.

(5) In subsection 3(b)(2), delete the last sentence and add the following sentences at the end of the paragraph: “Any action against the United States with regard to the provisions of this Act and for the recovery of just compensation for the lands and interests therein taken by the United States, and for the down tree personal property taken, shall be brought in the United States district court for the district where the land is located without regard to the amount claimed. The United States may initiate proceedings at any time seeking a determination of just compensation in the district court in the manner provided by sections 1358 and 1403 of title 28, United States Code, and may deposit in the registry of the court the estimated just compensation, or a part thereof, in accordance with the procedure gen-

erally described by section 255a of title 40, United States Code. Interest shall not be allowed on such amounts as shall have been paid into the court. In the event that the Secretary determines that the fee simple title to any property (real or personal) taken under this section is not necessary for the purposes of this Act, he may, with particular attention to minimizing the payment of severance damages and to allow for the orderly removal of down timber, revest title to such property subject to such reservations, terms, and conditions, if any, as he deems appropriate to carry out the purposes of this Act, and may compensate the former owner for no more than the fair market value of the rights so reserved, except that the Secretary may not revest title to any property for which just compensation has been paid; or, the Secretary may sell at fair market value without regard to the requirements of the Federal Property and Administrative Services Act of 1949, as amended, such down timber as in his judgment may be removed without damage to the park, the proceeds from such sales being credited to the Treasury of the United States. If the State of California designates a right-of-way for a bypass highway around the eastern boundary of Prairie Creek Redwood State Park prior to October 1, 1984, the Secretary is authorized and directed to acquire such lands or interests in lands as may be necessary for such a highway and, subject to such conditions as the Secretary may determine are necessary to assure the adequate protection of Redwood National Park, shall thereupon donate the designated right-of-way to the State of California for a new bypass highway from a point south of Prairie Creek Redwood State Park through the drainage of May Creek and Boyes Creek to extend along the eastern boundary of Prairie Creek Redwood State Park within Humboldt County. Such acreage as may be necessary in the judgment of the Secretary for this conveyance, and for a buffer thereof, shall be deemed to be a publicly owned highway for purposes of section 101(a)(2) of this amendment effective on the date of enactment of this section."

(6) In subsection 3(e), delete "sixty days" in the last sentence and add the following sentences at the end of the subsection: "Effective on the date of enactment of this sentence, there are made available from the amounts provided in section 10 herein or as may be hereafter provided such sums as may be necessary for the acquisition of interests in land. Effective on October 1, 1978, there are authorized to be appropriated such sums as may be necessary for the implementation of contracts and cooperative agreements pursuant to this subsection: *Provided*, That it is the express intent of Congress that the Secretary shall to the greatest degree possible insure that such contracts and cooperative agreements provide for the maximum retention of senior employees by such owners and for their utilization in rehabilitation and other efforts. The Secretary, in consultation with the Secretary of Agriculture, is further authorized, pursuant to contract or cooperative agreement with agencies of the Federal Executive, the State of California, any political or governmental subdivision thereof, any corporation, not-for-profit corporation, private entity or person, to initiate, provide funds, equipment, and personnel for the development and implementation of a program for the rehabilitation of areas within and upstream from the park contributing significant sedimentation because of past logging disturbances and road conditions, and, to the extent feasible, to reduce risk of damage to streamside areas adjacent to Redwood Creek and for other reasons: *Provided further*, That authority to make payments under this subsection shall be effective only to such extent or in such amounts as are provided in advance in appro-

Interest  
Title revestment.

Down timber,  
sale.  
40 USC 471 note.

Highway right-of-  
way, land  
acquisition.

Land acquisition,  
availability of  
funds.  
16 USC 79c.  
16 USC 79j.

Contracts and  
agreements,  
appropriation  
authorization.  
Retention of  
senior employees.

Land  
rehabilitation,  
contracts and  
cooperative  
agreements.

Erosion and  
sedimentation  
study.

priation Acts. Such contracts or cooperative agreements shall be subject to such other conditions as the Secretary may determine necessary to assure the adequate protection of Redwood National Park generally, and to provide employment opportunities to those individuals affected by this taking and to contribute to the economic revival of Del Norte and Humboldt Counties in northern California. The Secretary shall undertake and publish studies on erosion and sedimentation originating within the hydrographic basin of Redwood Creek with particular effort to identify sources and causes, including differentiation between natural and man-aggravated conditions, and shall adapt his general management plan to benefit from the results of such studies. The Secretary, or the Secretary of Agriculture, where appropriate, shall also manage any additional Federal lands under his jurisdiction that are within the hydrographic basin of Redwood Creek in a manner which will minimize sedimentation which could affect the park, and in coordination with plans for sediment management within the basin. To effectuate the provisions of this subsection, and to further develop scientific and professional information and data concerning the Redwood Forest ecosystem, and the various factors that may affect it, the Secretary may authorize access to the area subject to this subsection by designated representatives of the United States.”.

16 USC 1a-1.

(b) The first section of the Act of August 18, 1970 (84 Stat. 825), is amended by adding the following: “Congress further reaffirms, declares, and directs that the promotion and regulation of the various areas of the National Park System, as defined in section 2 of this Act, shall be consistent with and founded in the purpose established by the first section of the Act of August 25, 1916, to the common benefit of all the people of the United States. The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress.”.

16 USC 1b, 1c.

16 USC 1.

(c) Notwithstanding any provision of the Act of October 2, 1968, *supra*, the vesting in the United States of all right, title, and interest in, and the right to immediate possession of, all real property and all down tree personal property within the area indicated as “Proposed Additions” on the map entitled “Additional Lands, Redwood National Park, California,” numbered 167-80005-D and dated March 1978, as established by subsection (a) (4) of the first section of this Act, shall be effective on the date of enactment of this section. The provisions of subsection 3(b) (3) of the Act of October 2, 1968, *supra*, shall also relate to the effective date of this section. From the appropriations authorized for fiscal year 1978 and succeeding fiscal years such sums as may be necessary may be expended for the acquisition of lands and interests in lands, and down tree personal property, authorized to be acquired, or acquired, pursuant to the provisions of this Act.

Effective date.  
16 USC 79c-1.  
16 USC 79a.

16 USC 79c.

Economic impact  
study.  
16 USC 79k.

SEC. 102. (a) The Secretary, in consultation with the Secretaries of Agriculture, Commerce, and Labor, shall conduct an analysis of appropriate Federal actions that may be necessary or desirable to mitigate any adverse economic impacts to public and private segments of the local economy, other than the owners of properties taken by this Act, as a result of the addition of property to Redwood National Park under the first section of this Act. The Secretaries shall also consider the benefits of making grants or entering into contracts or cooperative agreements with the State of California or Del Norte and Humboldt

Counties as provided by subsection (b) for the purpose of development and implementation of a program of forest resource improvement and utilization, including, but not limited to, reforestation, erosion control, and other forest land conservation measures, fisheries and fish and wildlife habitat improvements, and wood energy facilities. Not later than January 1, 1979, the Secretary shall submit to the Speaker of the House of Representatives and the President of the Senate a report of his analysis, including his recommendations with respect to actions that should be taken to mitigate any significant short-term and long-term adverse effects on the local economy caused by such addition.

Report, submittal to Congress.

(b) The Secretary of Commerce and the Secretary of Labor, in consultation with the Secretary, and pursuant to his study, shall apply such existing programs as are necessary and appropriate to further mitigate identified employment and other adverse economic impacts on public and private segments of the local economy, other than with regard to the payment of just compensation to the owners of properties taken by this Act and by the Act of October 2, 1968, *supra*. In addition to the land rehabilitation and employment provisions of this Act, which should have a substantial positive economic effect on the local economy, the Secretaries of Commerce and Labor are further authorized and directed to implement existing authorities to establish employment programs, pursuant to such grants, contracts and cooperative agreements with agencies of the Federal Executive, the State of California, any political or governmental subdivision thereof, any corporation, not-for-profit corporation, private entity or person, for the development and implementation of such programs, as, in the discretion of the Secretaries of Commerce and Labor, may be necessary to provide employment opportunities to those individuals affected by this taking and to contribute to the economic revival of Del Norte and Humboldt Counties, in northern California. Effective on October 1, 1978, there are authorized such sums as may be necessary to carry out the employment and economic mitigation provisions of this Act: *Provided*, That the authority to make payments under this section shall be effective only to such extent or in such amounts as are provided in advance in appropriation Acts.

Employment and economic mitigation programs.

16 USC 79a.

Appropriation authorization.

(c) The Secretary of Agriculture within one year after the date of enactment of this Act, shall prepare and transmit to Congress a study of timber harvest scheduling alternatives for the Six Rivers National Forest. Such alternatives shall exclude the timber inventories now standing on units of the Wilderness Preservation System and shall be consistent with laws applicable to management of the national forests. In developing the alternatives, the Secretary shall take into consideration economic, silvicultural, environmental, and social factors.

Timber harvest study, Six Rivers National Forest. 16 USC 79k note. Transmittal to Congress.

#### PREFERENTIAL HIRING

Sec. 103. (a) In order to utilize the skills of individuals presently working in the woods and in the mills to the greatest degree possible to both ease the personal economic effects of this taking, and to assist in the necessary rehabilitation, protection, and improvement of lands acquired by this Act through implementation of sound rehabilitation and land use practices, the Secretary shall have power to appoint and fix the compensation of seven full-time and thirty-one temporary personnel to assist in carrying out such programs necessary for the protection and enhancement of Redwood National Park. In filling these positions, preference shall be given to affected employees (as defined in title II of this Act) for a period ending on September 30, 1984, notwithstanding applicable civil service laws and regulations.

16 USC 79l.

(b) In order to effectively administer the expanded Redwood National Park created by this Act in a manner that will provide maximum protection to its resources and to provide for maximum visitor use and enjoyment to ease the local economic effects of this taking, the Secretary shall have power to appoint and fix the compensation of two full-time and twenty temporary employees in the competitive service. In filling these positions, preference shall be given to affected employees (as defined in title II) for a period ending on September 30, 1984, notwithstanding applicable civil service laws and regulations. The Secretary shall further have power to appoint and fix the compensation of an additional thirty-two full-time and forty temporary employees in the competitive service as provided by this subsection at the time of the donation of those park lands or interests in land owned by the State of California as are within the boundaries of Redwood National Park as provided herein. In filling these positions, preference shall be given to those State employees affected by this transfer for a period not to exceed six years from the date of transfer: permanent State civil service employees shall be provided the opportunity to transfer to a comparable Federal civil service classification notwithstanding applicable civil service laws and regulations.

Civilian jobs.

(c) An affected employee shall be given full consideration for certain civilian jobs as provided in this section both with the Federal Government and with those private employers that have certain undertakings or programs that involve Federal participation or approval for the period beginning on the date of enactment of this Act and ending September 30, 1984, if the positions will be primarily located in Humboldt or Del Norte Counties or other counties in California adjacent thereto, and if the employee is otherwise qualified under this section.

Notice, job availability.

(d)(1) Any Federal agency that is creating or filling a civilian Federal job that is within the scope of clause (2)(A) of this subsection, pursuant to contract, civil service merit system, or otherwise, that will be primarily located in Humboldt or Del Norte Counties, California, or other counties in California adjacent thereto, must provide notice in advance of the availability of that job and must provide qualified affected employee applicants for these positions with full consideration for these positions if the further conditions set forth in clause (2)(B) of this subsection are met. The notice required by this paragraph shall be as provided by applicable law and regulation through the offices of the Employment and Training Services located in Humboldt and Del Norte Counties, California, and through such other means as are likely to gain the attention of affected employees.

Consideration for employment, conditions.

(2) Consideration for employment under this section shall be provided under the following conditions:

(A) the job involves skills and training that could reasonably be expected to have been gained by individuals who have been employed as logging and related woods employees or sawmill, plywood, and other wood processing employees, or office employees, or that can reasonably be expected to be gained while so employed, or pursuant to retraining as provided herein; and

(B) the applicant has the ability, or can reasonably be expected to have the ability after appropriate training of reasonable duration as further provided herein, to perform the duties of the job: *Provided*, That the full consideration shall not be required with respect to those affected employee applicants requiring training

in a situation where the schedule for completion of the work is such that the period during which said employee can reasonably be expected to work following completion of training is determined by the Secretary to be incommensurate with the time and funds required to provide said employee with the necessary training.

(e) (1) Any Federal agency involved in the manner provided herein with a private employer responsible for filing an employment position that is within the scope of clause (2) (A) of subsection (d), above, that will be primarily located in Humboldt or Del Norte Counties, or other counties in California adjacent thereto, is directed to require that any Federal contracts, grants, subsidies, loans, or other forms of funding assistance, and any Federal lease, permit, license, certificate, or other entitlement for use, not constituting an existing property right as of the date of enactment of this Act, that is a condition to or a requirement of the conduct of harvesting and related activities or replanting and land rehabilitation or the conduct of wood processing and related activities or the conduct of highway construction and related activities shall be subject to and conditioned upon said private employer giving full consideration to affected employees as provided herein.

Private  
employers.

(2) Any private employer who participates with a Federal agency in the manner described above and who is, accordingly, subject to the requirements as provided herein, shall—

(A) provide notice of the availability of those jobs described in subsection (d) (2) (A) in the manner generally provided by subsection (d) (1); and

(B) provide full consideration to qualified affected employee applicants for these positions if the further conditions established by clause (2) (B) of subsection (d) are met.

(f) The Secretary is directed to seek and authorized to enter into agreements with affected employers and industry employers providing that full consideration shall be given with respect to the employment of affected employees who had been employed by affected employers in jobs that may become available in Humboldt and Del Norte Counties and other counties adjacent thereto. The execution and carrying out of such an agreement, or the giving of full consideration to the employment of affected employees under subsection (c) of this section, shall not subject an employer to any additional liability or obligations under any Federal or State equal employment law, rule, regulation, or order.

Employer  
agreements.

(g) (1) The Secretary, except as otherwise provided, shall be responsible for the implementation of this section and—

(A) is authorized and directed to make needed training available, upon application, to an affected employee applicant who, although not presently qualified for a position, can be reasonably expected to be qualified after appropriate training;

Training.

(B) is authorized to take such actions as may be necessary to ensure that an affected employee is not denied full consideration because of the need for training where there is no substantial reason to believe that the applicant would be unable to perform the duties of the job after proper training. If the job is one which must be filled while the affected employee would be in training, the Secretary shall encourage the employer to fill the job only on a temporary basis subject to the successful completion of the training by the affected employee;

(C) shall require that, in a case in which two or more affected

Greatest service  
preference.

- employee applicants have approximately equal qualifications for a job for which they are to receive full consideration, that applicant with the greatest creditable service shall be given preference among those applicants entitled to full consideration; and
- Noncompliance.** (D) upon the filing of a complaint by an employee who alleges that said employee's rights to full consideration were disregarded, the Secretary shall make a finding on the merits of such complaint. If it is determined that there has been noncompliance with this section, the Secretary shall take such action as may be appropriate to correct the situation.
- Job opening, agency notification.** (2) To assist in implementing this section, agencies shall notify the Secretary, in advance, of any job opening as provided for by subsection (d) and of any Federal commitment as provided for by subsection (e).
- (3) The Secretary shall—
- (A) seek the cooperation of the State of California and the county and local governments within Humboldt and Del Norte Counties in the implementation of the provisions of this section and in the adoption of similar provisions for full consideration of affected employees with regard to State, county, and local jobs and activities; and
- Union liaison.** (B) appoint, from among nominees proposed by certified or recognized unions representing employees, a person or persons who shall serve as the Secretary's liaison with employees and their union and as consultant to the Secretary with regard to the administration of those provisions of this Act for which the Secretary is responsible.
- Judicial review.** (h) An employee, a group of employees, a certified or recognized union, or an authorized representative of such employee or group, aggrieved by any determination by the Secretary under this Act shall be entitled to judicial review of such determination in the same manner and under the same conditions as provided by section 250 of The Trade Act of 1974 (88 Stat. 2029).
- 19 USC 2101.** (i) Nothing in this section shall be construed to affect any additional or alternative rights under a law, regulation, or contract (including, but not limited to, veteran preference and contracts between private employers and unions) in effect as of the date of enactment of this Act, and the implementation of this section shall be carried out in accord with applicable civil service laws and regulations except as otherwise provided for in this section. Employees appointed to Federal jobs pursuant to this section shall have their compensation fixed at rates not to exceed that now or hereafter prescribed for the highest rate of grade 15 of the General Schedule under section 5332 of title 5, United States Code.
- Annual report, submittal to Congress, 16 USC 79m.** SEC. 104. (a) The Secretary shall submit an annual written report to the Congress on January 1, 1979, and annually thereafter for ten years, reporting on the status of payment by the Secretary for real property acquired pursuant to section 101(a)(4) and section 101(a)(2) of this amendment; the status of the actions taken regarding land management practices and watershed rehabilitation efforts authorized by section 101(a)(6) and section 102(b) of this amendment; the status of the efforts to mitigate adverse economic impacts as directed by this Act; this status of National Park Service employment requirements as authorized by section 103 of this amendment; the status of the new bypass highway and of the agreement for the donation of the

State park lands as contemplated by section 101(a)(5) of this amendment; and, the status of the National Park Service general management plan for the park.

(b) No later than January 1, 1980, the Secretary shall submit to the Committee on Interior and Insular Affairs of the House of Representatives, and to the Committee on Energy and Natural Resources of the Senate, a comprehensive general management plan for Redwood National Park, to include but not be limited to the following:

(1) the objectives, goals, and proposed actions designed to assure the preservation and perpetuation of a natural redwood forest ecosystem;

(2) the type and level of visitor use to be accommodated by the park, by specific area, with specific indications of carrying capacities consistent with the protection of park resources;

(3) the type, extent, and estimated cost of development proposed to accommodate visitor use and to protect the resource, to include anticipated location of all major development areas, roads, and trails; and

(4) the specific locations and types of foot trail access to the Tall Trees Grove, of which one route shall, unless shown by the Secretary to be inadvisable, principally traverse the east side of Redwood Creek through the essentially virgin forest, connecting with the roadhead on the west side of the park east of Orick.

SEC. 105. Effective on October 1, 1978, there are hereby authorized to be appropriated \$33,000,000 to carry out the rehabilitation provisions of this Act.

SEC. 106. (a) Notwithstanding any contrary provision of the Act entitled "An Act to provide for certain payments to be made to local governments by the Secretary of the Interior based upon the amount of certain public lands within the boundaries of such locality", approved October 20, 1976 (90 Stat. 2662), the Secretary is authorized and directed to make payments on a fiscal year basis to each unit of local government, in the manner provided by the Act of October 20, 1976, in which lands owned by the United States within Redwood National Park are located. Such payments may be used for any governmental purpose. The amount of such payments shall be computed as provided in subsections (b) and (c).

(b) Payment made for any fiscal year to a unit of local government shall include that amount determined pursuant to the provisions of section 2 of the Act of October 20, 1976.

(c) Payment made for any fiscal year to a unit of local government shall also include that amount determined pursuant to the provisions of section 3 of the Act of October 20, 1976; *Provided, however*, That any amount computed as provided by section 3(c)(1) of the Act of October 20, 1976, but not paid because of the limitation of subsection (c)(2) and subsection (d) of that section shall be carried forward and shall be applied to future years in which this portion of the total payment would not otherwise equal the amount of real property taxes assessed and levied on such property during the last full fiscal year before the fiscal year in which such land or interest was acquired for addition to Redwood National Park until such amount is exhausted.

(d) The Redwoods Community College District shall be considered as an affected school district for purpose of section 3(a) of the Act of October 20, 1976, as amended herein.

SEC. 107. The Secretary is further authorized, and the Congress specifically directs that it shall be a purpose of this Act, that the com-

General management plan, submittal to congressional committees.

Appropriation authorization.  
16 USC 79n.

Payments to local governments.  
16 USC 79o.

31 USC 1601.

31 USC 1602.

31 USC 1603.  
Payment carry forward.

31 USC 1602.

31 USC 1602.  
Redwoods United, Inc.,  
Manila, Cal.  
16 USC 79p.

munity services and employment opportunities provided by Redwoods United, Incorporated, a nonprofit corporation located in Manila, California, shall be maintained at the present rate of employment to the greatest degree practicable.

Just  
compensation.  
16 USC 79q.

SEC. 108. The Congress further acknowledges and directs that the full faith and credit of the United States is pledged to the prompt payment of just compensation as provided for by the fifth amendment to the Constitution of the United States for those lands and properties taken by this Act.

16 USC 79k note.

SEC. 109. Unless otherwise indicated hereinbefore, a reference to the Secretary will refer to the Secretary of the Department of the Interior, except in subsections 103(d) through 103(i), where a reference to the Secretary will refer to the Secretary of the Department of Labor.

Title II has not been reprinted.

## B: BACKGROUND OF THE REHABILITATION EFFORT

### Reports

Under PL 90-545 (the law that established Redwood National Park), a number of options were available, contingent upon congressional approval, to protect park resources from adjacent land use practices. Pursuant to section 3(e) of the act, the secretary of the Department of the Interior was authorized to enter into contracts and cooperative agreements that would entail the purchase of less-than-fee interests (for example, easements) and the acquisition of lands in fee title by either donation or purchase. (The secretary also had the option of taking land under eminent domain to provide satisfactory protection.) The land acquisition option was limited by legislative ceilings to 58,000 acres and \$92 million.

In response to this legislation, the National Park Service contracted with Stone and Associates (1969) to determine which lands should be acquired and which lands could continue to be harvested, given special restrictions. The firm was also to examine management concepts and techniques for lands surrounding the park to minimize any deleterious effects on park resources. The 1969 report discussed the dynamic nature of the redwood ecosystem, potentially destructive activities near the park, and ownership and management practices on adjacent land. It recommended that an 800-foot buffer zone be established around the perimeter of the park, within the Redwood Creek watershed. The concept of delineating buffers was based on the philosophy that timber harvesting was compatible with adjacent park values if proper intensive land use management was practiced. The report further stated that the major watershed management problems would continue in the Redwood Creek drainage upstream from the park and that the cost of stabilizing the watershed would be considerable.

Soon after the Stone report was published, the Sierra Club presented the Robinson report as a rebuttal (Robinson 1969). This report stated that the buffers recommended for the Redwood Creek corridor would be inadequate to protect the park resources, but that they would be satisfactory in most other areas surrounding the park. It suggested that some land in the Redwood Creek area be acquired, where ecologically safe logging could continue, with selective harvesting of redwoods and maximum 1-acre clearcuts of Douglas-fir.

Although both reports contained useful information, neither the recommendations of the Stone report nor those of the Robinson report were implemented. Several other reports were prepared before 1972, including a preliminary draft master plan for the park. In January 1972, a special task force of scientists again reviewed

the problems within the Redwood Creek watershed for the Department of the Interior. A concluding report, known as the Curry report, contained a series of recommendations (USDI 1973). One recommendation, fee acquisition of an 800-foot buffer zone around the Redwood Creek corridor, was not approved by the Office of Management and the Budget.

The Curry report outlined additional options to reduce upstream and upslope impacts on the park corridor. It remarked that the upstream impacts were a responsibility of those state agencies charged with regulating forest practices and maintaining water quality standards. Federal efforts along the main channel were to be limited to maintaining natural channel integrity and to minimizing bank undercutting and redirection of flow. Options dealing with upslope impacts were described in more detail, and they proposed a combination of fee or less-than-fee interest in the 800-foot buffer zone, additional tributary streams or slide prone areas, and the lands upslope of the hydrologic boundary. The purpose of these options was not to enlarge the park, but rather to provide existing park resources with adequate protection from damaging inputs from adjacent lands.

In May 1974 the Sierra Club initiated legal actions against the Department of the Interior to compel the secretary to discharge his duties in protecting the national park. The court found the secretary to have certain statutory and fiduciary duties with respect to the park (8 ERC 1013). The evidence presented during the case clearly established damage to park resources directly related to logging activities in the Redwood Creek watershed upstream from the parklands. The department was directed to take those steps required by law to protect timber, soil, and streams within Redwood National Park from adverse consequences of logging on adjacent lands.

In July 1976, the court found the Department of the Interior to have made a good faith attempt to protect the park (8 ERC 2196). In a report to Congress, the department identified several possible alternatives for protecting park resources.

### Early Rehabilitation Efforts

In 1977, in anticipation of the congressional authorization to rehabilitate cutover timberlands, four test plots for potential rehabilitation methods were established on park lands. In March 1978, the National Park Service met with erosion control and forest rehabilitation experts from state and federal agencies, the academic community, and the local timber industry. Presentations included studies and methods from areas throughout the Northwest.

In the summer and fall of 1978 the Park Service began five additional pilot rehabilitation projects on recently tractor-logged slopes within the newly acquired park area. Site prescriptions were developed after reviewing the methods utilized and the results of treatments previously used on rehabilitated test sites. The projects incorporated 80 acres in upper Miller Creek, 80 acres in lower Emerald Creek, 85 acres in upper Bond Creek, 7 acres in lower Bond Creek, and 2 acres in lower Miller Creek. Heavy-equipment work, supervised by park staff, was carried out in September under rental agreements with local contractors; labor-intensive erosion-control contracts were issued and successfully completed on all units.

In 1979, additional techniques were tested on four pilot sites: Airstrip Creek basin (160 acres), Copper Creek (640 acres), Bond Creek (60 acres), and Bridge Creek (80 acres). A total of 9.4 miles of road were ripped and/or outsloped, and 1,000 acres of slope were affected by rehabilitation efforts. Also, approximately 200,000 trees were planted on understocked and rehabilitated land during the winter of 1979-1980.

The prescription for each site varied and included a combination of heavy-equipment and labor-intensive work. For example at the Bridge Creek site, approximately 2 miles of road was "pulled." This road segment contained four major stream channel crossings that were failing and delivering sediment directly to perennial/intermittent streams. Each of these stream crossings required the removal of 2,000 to 3,200 cubic yards of road fill material. The channels were rocked or check dammed, and slopes were planted, seeded, and/or mulched. In the Copper Creek unit, however, the gullies resulting from tractor yarding in the late 1960s and early 1970s were so deep that diversion of water to the original water channels was considered infeasible in some cases. Therefore, gullies were stabilized by excavating, recontouring, and revegetating over-steepened gully banks.

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