

REHABILITATION PLAN

Redwood National Park
California

November 1978

EXECUTIVE SUMMARY

The creation and later expansion of Redwood National Park resulted in the acquisition of approximately 48,000 acres of cutover timberlands. These lands, representing nearly 45% of the 106,000 acre National Park, were strongly modified by past logging, including the construction of approximately 300 miles of truck roads and 3,500 miles of tractor trails. In addition to direct alteration of the site - which includes soil compaction, loss of topsoil, loss of ground cover, and loss of shade - the logging activities produced cumulative downstream impacts. These include increased streamside slides, increased streambed elevation, increased bank erosion, increased streambed width, greater winter stream discharge, and lower summer discharge.

These problems were addressed directly in the legislation which expanded the Park. Section 101(6) of Public Law 95-250, March 27, 1978 authorized "....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....".

A later section of P.L. 95-250 (Section 105) authorized \$33 million to be appropriated effective October 1, 1978 to carry out the rehabilitation provisions of the Act.

As a result of this legislative mandate, a number of goals and objectives have been established for the rehabilitation program. The long-term goal of the program is to return the downstream National Park portion of the Redwood Creek stream system to a reasonable replica of its natural state, bearing in mind the continuing input of some man-induced erosion from socially-desirable upstream land practices. The immediate goal is to minimize continuing and future man-induced inputs of sediment to the Redwood Creek stream system and to manage the existing stream sediment load to mitigate its impact on the resources of Redwood National Park. There are three objectives in meeting the immediate goal of the rehabilitation program. The first is to minimize man-induced erosion in the National Park using labor-intensive (that is, primarily hand work, rather than using machines) methods while encouraging the return of a natural pattern of vegetation. The second objective is to minimize man-induced erosion upstream from the National Park in the park protection zone and stabilize natural erosion processes while fostering the productivity of commercial forest land in the protection zone. The third objective is to create local jobs and retain the rehabilitation money in the local area.

The first steps in meeting these goals and objectives have been to gain a knowledge of the magnitude and extent of the problem to be solved, while at the same time determining the best rehabilitation methods to apply in the watershed. One of the key problems is the lack of knowledge about

rehabilitation techniques that are applicable to the steep, unstable conditions found in the Redwood Creek watershed. Although four previous test projects have provided some information regarding methods, there is still a relative lack of previous research on the subject.

To develop a better understanding of the problem and possible solutions, the Natural Resources Division of Redwood National Park held a workshop in March, 1978 regarding "Techniques of Rehabilitation and Erosion Control in Recently Logged Watersheds". The workshop brought together many professionals who are working in rehabilitation and erosion control from throughout California and Oregon. Along with the workshop, aerial photo coverage of the lower basin was obtained during the summer, 1978 to help determine the priority areas for rehabilitation where sediment yield problems are most critical. An onsite survey of the roads within the basin has also been undertaken to determine ongoing maintenance needs and make preliminary judgments regarding the viability of certain roads.

In addition to these programs, the National Park Service has begun five projects in the Redwood Creek watershed to test and evaluate rehabilitation techniques. These test projects were chosen because they are representative of the logged-over portions of the watershed. In each area, thorough documentation was made of the conditions that existed prior to rehabilitation, and once the rehabilitation work is completed, the results will again be recorded. Each site will be carefully monitored throughout the winter and next summer to insure that the work has been effective. The evaluation of this year's test projects will provide vital information in determining succeeding years' programs.

This autumn, projects are being conducted on upper Miller Creek (80 acres), lower Weir Creek (80 acres), upper Bond Creek (85 acres), lower Bond Creek (7 acres), and on a landing along the C-line road (see map). The projects are designed to control further erosion by attempting to reestablish natural drainage patterns on tractor yarded clearcuts, remove failing stream crossings and culverts, reshape road surfaces, and plant exposed soil surfaces to control surface erosion. Planting will include mostly native grasses to assure a rapid recovery of ground cover along with the use of willow cuttings bundled into wattles that will sprout in the spring. Native conifer tree species will also be planted to assure the reestablishment of native forests. Brush thinning for tree release will also be done as needed.

The majority of the work is being carried out by local persons under contract with the National Park Service and supervised by the Natural Resources Division staff of the Park.

Land rehabilitation is only one part of the effort to restore the Park to near pre-logging conditions. Thinning dense stands of young, second-growth

trees will also be undertaken. The objective is to return the stand to a more natural composition that existed prior to logging and reforestation. The thinning will stimulate growth of the remaining trees, reduce fuel loads for wildfires, and eliminate exotic species. This summer and fall, approximately 220 acres of park land on the west side of Holter Ridge (see map) are being thinned by park crews hired locally and by local contractors.

The Natural Resources Division staff is continuing to monitor timber harvesting in the park protection zone by reviewing timber harvest plans with the respective timber companies. The reviews allow the National Park Service to suggest methods the companies can use to reduce the potential for erosion while still allowing the timber to be harvested.

Although the forests of the park have received the majority of attention so far, the Natural Resources Division staff will also begin investigating ways to control gullying in the prairies of Redwood National Park. The prairie soils tend to erode easily when their grass cover is removed and they are subject to concentrated runoff from winter storms. The problem is most pronounced along the Bald Hills road.

The overall rehabilitation and thinning program will be expanded greatly in succeeding years, as more knowledge of techniques for rehabilitation is gained through evaluation of this year's program. No single, set plan has yet been written to guide the rehabilitation effort; rather, the formative stages of the plan will consist of the application of a variety of techniques to appropriate sites, followed by long-term monitoring. It is expected that annual revisions will occur and that future actions will be based on the success or failure of previous years' program.

INTRODUCTION

Redwood National Park was established in Northern California by the act of October 2, 1968, to preserve significant examples of the primeval coastal redwood forests and the streams and seashores with which they are associated (16 USC 79a). The law establishing the park included fusing of three existing state parks and forming a 50 mile long national park by adding about 28,000 acres of private lands. The act authorized the Secretary of the Interior to exercise his authority in protecting park resources from possible damage caused by private land uses along the parks periphery (16 USC 79c).

From the moment of the new park's creation, timber harvest and associated activities posed imminent threats of substantial damage to valued park resources. A major area of concern was the Redwood Creek watershed, where national parklands encompassed portions of the lower Redwood Creek basin near Orick, California.

Redwood Creek drains a 280 square mile watershed in the mountainous, coastal region of Northern California. The creek rises near elevations of 5,000 feet and flows 55 miles north-northwest to the Pacific Ocean near Orick, California. In its historic, pristine condition, the Redwood Creek basin was extensively forested. In 1963, the world's tallest measured tree, along with several others nearly as tall, was found in a redwood grove on alluvial soils of the lower Redwood Creek basin. In addition to the other lands, the 1968 Redwood National Park Act set aside 32 square miles of the lower Redwood Creek basin in protected status including the tall trees grove.

Following World War II, timber harvest became the dominant land use in the Redwood Creek basin on lands upstream from the park which was to be created in 1968. Logging activities reached their peak during the 1960's. Presently, about 90% of the forests in the Redwood Creek basin have been harvested.

Streams of the region are subject to frequent winter flooding. Many soils of the Redwood Creek basin are naturally unstable and highly erodible. Landslides and earthflows are widespread and common. Even under natural conditions, therefore, streams swelled by winter flooding transport large volumes of sediment from the basin into the sea.

Logging practices have greatly accelerated the erosional process. Logging road construction and timber harvest practices (e.g. log skid trails, layouts, slash burning, etc.) have dramatically increased the suspended sediment load to streams in drainage basins that were heavily logged, as opposed to unlogged areas. Studies undertaken for the National Park Service have revealed systemic changes occurring in the Redwood Creek watershed as a direct result of these land use practices. Such changes include increased and accelerated runoff, a general modification of the of the natural hydrologic regime, increased sediment yield and accumulating sand and silt deposits in major stream channels.

Landsliding, filling and widening of stream beds, erosion of stream banks, damage of stream side vegetation and overall degradation of natural aquatic ecosystems were documented. The primary causes of these harmful changes were (1) vegetation removal, (2) pervasive alteration of hillside drainages, (3) development of an extensive logging road network, and (4) construction of thousands of miles of tractor log skidding trails. National parklands, located as they are at the bottom of the watershed, were exposed to the impacts of timber harvest in the upstream, 240 square miles of the Redwood Creek basin which remained open to logging.

In July, 1975, 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 (8 ERC 1013). The court found the Secretary to have certain statutory and fiduciary duties with respect to the park. The evidence presented during the case, clearly established damage to park resources which was directly related to logging activities in the watershed located above parklands. The Department was directed to take those steps required by law to afford protection for timber, soil, and streams within Redwood National Park from adverse consequences of logging on adjacent lands.

One year later, July, 1976, the Department of the Interior was found to have made a good faith attempt to protect the park (8 ERC 2196). Interior, in a report to the Congress, identified several possible alternative means of providing protection for park resources.

The Congress, in establishing park boundaries in the 1968 act, had not anticipated the magnitude of adverse impacts that ultimately occurred as a result of continued logging in the watershed upstream from parklands (Senate Report No. 95-528, 95th Congress, 1st Session, October 21, 1977). To rectify this oversight, the Congress, in 1978, amended the Redwood National Park Act (PL 92-250, March 27, 1978; 92 Stat. 163) to enlarge the park by 48,000 acres (75 sq. mi.), and provided for a 33,000 acre park protection zone.

In addition, the 1978 act ^{authorized} ~~mandated~~ a watershed rehabilitation program which would include Redwood Creek, to undertake and publish the results of erosion and sedimentation studies, and to evaluate, in concert with other Federal Departments, means of mitigating adverse economic impacts caused by the 1978 park expansion.

The Secretary was given certain responsibilities under the 1978 act, these included assuring that logging in the park protection zone does not have adverse effects upon park resources, and a reiteration of the Secretary's duty to protect the park from adverse activities located beyond park boundaries. The 1978 act identified a number of reports and plans to be submitted to the Congress documenting the progress of

park development, the rehabilitation program, and the mitigation of economic impacts, etc. Authorized by the act was \$33 million for land rehabilitation, and a number of permanent and temporary positions for the land rehabilitation program, park management, and for hiring of state park personnel upon donation of these state parklands to the national park.

THE REHABILITATION PROGRAM

This report deals with the planning and development of the cut-over lands rehabilitation program and the proposed implementation of this plan over the next 10 to 15 years. Certain initial phases of the proposed restoration program have begun. The experiences gained thus far have aided the preparation of this report. A short description of accomplishments to date has been included.

Before an effective land rehabilitation program can be properly implemented, the National Park Service must first accomplish a series of prerequisite tasks. First among these tasks is the acquisition and analysis of existing information on restoration of disturbed land elsewhere in this and other countries. Since few existing techniques have been applied in areas such as those found in Redwood National Park, a testing and evaluation program will be necessary. The research and development of new techniques to supplement known and proven methods will also require consideration.

An evaluation of existing and newly developed rehabilitation methods, coupled with an analysis of relevant information will, of necessity, precede a full scale rehabilitation program by several years. Field application of selected techniques, such as thinning of trees and elimination of exotic vegetation, the development of logistical support, in terms of equipment, materials, supplies and services, and requisite park staffing, will be achieved during the first three (3) years of the program (1978-80). During this period, a longer range, more specific and detailed program plan of action will be developed, tested, and refined. Information needs, methods development and evaluation, and environmental monitoring are being undertaken presently by a research and monitoring team. The planning and development of logistical support, providing for equipment needs, supplies, etc., and the overall conduct and supervision of the rehabilitation and natural resource management program at Redwood National Park will be the responsibility of a resources management team.

PROGRAM GOALS

Rehabilitation of the Redwood Creek basin will be a multifaced program designed to protect the resources of the park and to restore the altered

terrestrial and aquatic ecosystems to more nearly natural conditions for the enjoyment of future generations. The objectives of the program include:

1. Reduction of man accelerated erosion rates on lands within Redwood National Park.
2. Revegetation of recently cut-over lands both within and outside of the park. Included would be the elimination, when feasible, of exotic vegetation and thinning of new growth stands.
3. Maintenance of the usable road system in the park until park development plans are formulated, and "put to bed" or remove the balance of the old road system. In particular, to rehabilitate those areas where the roadbed is contributing to massive erosional problems.
4. Protection of riparian and aquatic resources in the tributaries and along the main channel of Redwood Creek within the park.
5. Rehabilitate areas in the Redwood Creek watershed upstream of Redwood National Park concentrating on those sites, such as roads and stream side slides, that are major producers of sediment.
6. Protection of cultural resource locations recently identified within the project area, particularly near haul roads, prairie lands, and margins of watercourses.

THE PROGRAM

The land rehabilitation program will consist of six interrelated projects aimed at achieving the goals and objectives listed above. These include:

1. Watershed rehabilitation: Rehabilitation of logged hillslopes, prairies and ephemeral and intermittent stream channels. This will be accomplished by gully, rill and slope erosion control, reestablishing streams in the natural, pre-logging channels and stabilizing mass movement features. This work will be primarily labor intensive.
2. Vegetation management: Second growth management, vegetation restoration on cut-over land, thinning of trees, elimination of exotic vegetation, use of vegetation for erosion control, restoration of disturbed prairie vegetation and riparian vegetation management. This work will be labor intensive.

3. Road maintenance and rehabilitation: Maintenance of several hundred miles of logging roads (until access is no longer needed) followed by obliterating most of the road system. Roads will be "removed" to prevent their future failure at stream crossing sites and other points of slope instability.
4. Tributary rehabilitation: Consists of an inventory of erosional features along perennial tributaries to Redwood Creek and an assessment of stored sediment within the channels. Erosion control activities will be carried out on features which lend themselves to treatment. Biological conditions will be evaluated and restoration measures such as restoring anadromous (salmon and steelhead) runs will be initiated as required.
5. Main channel rehabilitation: Consists of studies and activities in rehabilitation/erosion control along the main channel of Redwood Creek including the physical protection of riparian vegetation and redwood groves, gravel extraction from the main channel (if deemed appropriate) and protection or restoration of the aquatic ecosystems of the watershed.
6. Evaluation of land rehabilitation: Monitoring of rehabilitation activities and determining the success or failure of each of the first five (5) projects listed above.

SPECIFIC REHABILITATION NEEDS

Rehabilitation needs within Redwood National Park include the following:

1. Erosion control measures on logged slopes.
2. Maintenance or removal of logging haul roads.
3. Revegetation of recently disturbed areas or areas with severely disturbed or compacted soils.
4. Erosion control and resource management along major watercourses.
 - a) The main stem of Redwood Creek.
 - b) The major tributaries.
5. Control of gullying and vegetation management on the prairie lands.
6. Immediate elimination of major exotics such as Monterey pine and thinning of second growth stands.
7. Monitoring of the effectiveness of the rehabilitation program.

1. Erosion Control Measures on Logged Slopes

The primary aim of erosion control on logged slopes is to direct the flow of surface water into stable channels that will minimize active erosion and to revegetate disturbed, bare soil areas. Waterbars are troughs constructed to direct runoff into natural channels or onto less erosive slope areas. Check dams are small dams constructed in gullies or small tributary streams to trap sediment which in turn prevents down cutting and bank erosion. Check dams create a stable substrate for planting. Water ladders are ladder type structures built in a watercourse which serve to convey water over a channel that otherwise would be subject to down cutting and bank erosion. Other measures to stabilize eroding hillslopes will be applied on a site specific basis.

2. Maintenance or Removal of Logging Haul Roads

Major logging haul roads in Redwood National Park must either be maintained or eliminated as potential erosion hazards. If the road is a persistent maintenance problem, and not important as a transportation artery, the road will be eliminated as soon as possible. Elimination of logging roads entails the use of heavy equipment to pull out all culverts, open all natural drainage ways across the road alignment, and remove fill materials from the outside edge of the road and the relocation of this material on the inside stable road bench. Material replaced on the inside of the road will fill in and obliterate the inboard road ditch. The roadbed (in cross section) will then be "outsloped" such that any surface runoff travels directly across the road rather than along the former road alignment.

3. Revegetation of Recently Disturbed Areas or Areas with Severely Disturbed or Compacted Soils

Revegetation for erosion control is a critical aspect of the rehabilitation plan. All areas where soils are disturbed by rehabilitation measures, such as "pulled" log landings and former road alignments, must be seeded and/or planted. In addition, soils laid bare by landsliding must be planted. Compacted soils or slopes where surface soils have been scraped away by bulldozers are also sites where special revegetation techniques may be applied. Revegetation techniques include, but are not limited to the following: Willow wattling, stem plantings, planting protected log barriers or "planter boxes", seeding with grass and hardwood species, and containerized planting of coniferous trees (redwood, Douglas-fir, spruce, grand fir, hemlock).

4. Erosion Control and Resource Management along Major Watercourses

a) Main stem of Redwood Creek: In the past two decades, significant aggradation has occurred in the Redwood Creek channel as a result of the combined effects of severe storms and flooding and upstream land uses, most notably logging and associated road building. Aggradation of Redwood Creek within the national park results in a number of changes which affect stream bank stability and stream side vegetation. Attempts will be made to further understand the dynamics of sediment transport along Redwood Creek and to investigate the feasibility of physically removing gravel from an upstream portion of Redwood Creek to minimize this stream bed elevation within the park. In order to protect the virgin redwood alluvial groves from bank erosion, various methods of stabilizing stream banks will be investigated.

b) Major tributaries of Redwood Creek within the park: The physical condition and aquatic habitat along major tributaries will be surveyed to determine if active management can improve those stream reaches adversely affected by logging. In some streams, excessive organic debris has been introduced to the channel; and in other tributaries, removal of commercial logs from the streams has reduced habitat diversity and reduced the resident fish populations. Each tributary will be surveyed on a site specific basis; organic debris removal or introduction of logs to a channel are both options depending on stream condition. Restoration of shade canopy on wide stream reaches with little riparian vegetation is another possible rehabilitation measure.

5. Management of Prairie Vegetation and Treatment of Gullies on Prairies

Prairies are one of the valuable assets of the recent park expansion. Many prairies are deeply gullied where roads have concentrated runoff onto the prairie. Proper dispersion of road runoff will require removal of unnecessary roads which traverse prairies, and installation of check dams and/or water ladders to stop gully down cutting and stabilize gully banks for revegetation are all measures which can eliminate excessive prairie erosion.

Because of grazing pressure during the last century, the native, perennial prairie grasses have been in large part replaced by non-native annual grasses. A management program, perhaps including prescribed burning, may be instituted to reestablish native perennial grasses to a dominant role on the prairie slopes. Vegetation conversion to native species on prairies will be thoroughly studied and tested prior to a broad scale revegetation commitment on all the prairie lands.

6. Management of Park Lands with Second Growth Vegetation

Extensive pre-park timber harvesting operations have left approximately 50,000 acres of park land in second-growth vegetation ranging from 1 to

50 years since logging. These areas support second-growth forests of native tree species, however, non-native trees primarily Monterey pine (Pinus radiata) have been planted on some lands in addition to the native Douglas-fir (Pseudotsuga menziesii) and redwood (Sequoia sempervirens). Second-growth stands are extremely dense with large number of stems (1,500-2,500/acre) in comparison with 30-60/acre found in virgin stands. Growth of all trees in these second-growth stands is slowed by competition. Over several decades, the density of living trees decline toward the number found in natural stands as a result of competition, however, Douglas-fir numbers will be greater than natural for centuries.

In a few locations where slash burning produced a very hot fire, tree production, especially redwood, may be greatly reduced and extensive stands of brush (Ceanothus sp.) established. Selective manual brush removal followed by appropriate tree planting will be carried out.

It is our intention to rehabilitate the second-growth vegetation by removing exotic trees and plants, thinning, and planting when necessary to speed the reestablishment of a more nearly natural-appearing forest. Thinning will accelerate natural successional processes in the stand by several decades and will provide an opportunity to adjust the proportions of native trees and remove exotics in one operation. Thinning will be accomplished near prospective visitor-use areas including roads and trails and on other lands as appropriate.

7. Monitoring of the Effectiveness of Rehabilitation Measures

All rehabilitation and erosion control techniques used in the Redwood Creek watershed will be thoroughly monitored to determine effectiveness and relative benefits for the costs. Standard monitoring techniques will be used where appropriate, and undoubtedly, new techniques must be developed to monitor some experimental erosion control methods. There is a limit beyond which active erosion control work may accrue more harm than good in areas that have started to heal naturally, and the monitoring program will address the question of what are the effective limits of a sound rehabilitation effort.

The U.S. Geological Survey (USGS) has laid a base of physical measurements in the Redwood Creek Basin, which if continued, will provide a substantial measure of success of our rehabilitation. We propose that the USGS continue this cooperative effort with the National Park Service for data collection and interpretation. This is of particular value because of the USGS's reputation for independence in its scientific work and because much of the work is standardized and conducted by the USGS in nationwide programs.

PROGRAM OVERVIEW

The cut-over lands rehabilitation program involves a number of specific tasks.

Survey, Inventory, and Mapping

Detailed surveys and mapping using both aerial photo interpretation and field surveying will be employed to compile and inventory resource problem areas. Priority selection of areas for erosion control treatment will arise from this inventory. This information will form the basis for the design of sub-drainage rehabilitation projects.

Areas of critical concern, those areas having the greatest erosion and landslide potential, and those areas found to be most affected by storm events will be given highest priority for emergency treatment, stabilization, and restoration during the first, second, and third years of the program. Initial emergency treatment during storm events, for example, will be followed by more effective and lasting control measures applied during fair weather.

Development of Techniques, Testing, and Field Crew Training

The National Park Service has planned for test rehabilitation projects to be undertaken on 50 to 100 acre cut-over areas. These tests may be implemented either by park hired labor, or through contract with private concerns. Test restoration projects will enable N.P.S. to evaluate the effectiveness of new and innovative rehabilitation techniques. These trial projects can serve effectively for the training of field crews derived, in part, from the local affected labor force, who will be given special hiring consideration.

A wide variety of vegetative and physical erosion control techniques will be given trial use. These projects will establish basic information on effective methods, materials and logistics, and may result in the development of manpower training programs. The projects will also sound the available, affected labor force for involvement in the rehabilitation program. It is anticipated that park interpretive programs will benefit from these projects.

This phase of the project will encompass the second and third years of the program (1979-1980).

Sub-drainage Contract Work

Year four (1981) of the program will begin routine letting of larger scale, complete sub-basin restoration contracts. Contract work will

be derived directly from land rehabilitation guidelines which provide site specific, prescriptive erosion control measures delineated by the National Park Service professional staff. Invited proposals for innovative erosion control will likewise be solicited. By the fourth, fifth, and sixth year (1981-83) of the program, satellite industries are expected to have become established to provide the trained labor force, transportation, light and heavy earth moving equipment, tools, pack animals, mulch, seed, seedlings, and other supplies and services required to support the rehabilitation work. It is anticipated these satellite industries will respond to the demand for raw materials, needs for services and equipment, and will absorb significant portions of the unemployed local labor pool.

Land rehabilitation activities, once well established with the park, will be expanded into the park protection zone, and the remainder of the Redwood Creek basin. This expansion of work will be accomplished through cooperative agreements with landowners, private industry, local, state, other Federal agencies, and other interests.

Monitoring and Maintenance of Completed Rehabilitation Work and Road Network

Field survey crews will monitor the quality and effectiveness of completed rehabilitation work. Ineffective or incomplete rehabilitation will be remedied where possible. This maintenance will be carried out by a combination of contract and park staff work.

Maintenance will include summer routine upkeep of ditches, culverts and the road surface, and winter maintenance to clear ditches and culverts, and confront erosional problems as they occur.

Post-Rehabilitation Maintenance and Follow-up Work

Once active phases of the cut-over land rehabilitation programs have been completed, a routine resource maintenance program will be undertaken. Reestablished forests may require selective thinning to acquire the composition, growth rate, and aesthetic attractiveness desired for long term park objectives. The ultimate objective will be the restoration of a naturally functioning ecosystem that will maintain itself unaided by active resource manipulation. It is not known at this time how much active resource management will be required following completion of the 10-15 year rehabilitation program, or how long active resource manipulation will be required. This uncertainty is compounded by the unknown consequences of continued timber harvest in the upper Redwood Creek basin, and other land use changes, such as residential development, that has begun in the upper reaches of the watershed.

PROGRAM SCHEDULE AND DURATION

Based on staff experience with ground surface conditions, erosional processes and vegetation patterns in the Redwood Creek watershed, and in light of the anticipated rehabilitation needs, the following outline suggests tentative timing of rehabilitation activities (also refer to Figure 1):

1. The total rehabilitation program is expected to last approximately 15 years.
2. In the first 4 years (1978-81) activity is anticipated to rapidly escalate in scope and level of expenditure of funds.
3. A broad peak in activity will occur from year 5 through year 11 (1982-1988) as the major, labor intensive rehabilitation work is in full progress. All critical areas will be addressed prior to 1984.
4. Once rehabilitation projects are well underway on parklands, the emphasis on new work will shift to the park protection zone. Once the park protection zone program has become established, efforts will be directed toward the remaining upper Redwood Creek watershed. It is expected that by year 6 or 7, the parklands program will be well established. Less time will be required to implement succeeding areas programs once initial start up problems have been overcome.
5. Operations will shift gradually from construction to maintenance of erosion control structures. Overall rehabilitation will shift slightly towards road removal and vegetation rehabilitation activities in about year 7 or 8 (1984 or 1985) on parklands.
6. Following year 9 or 10 (1986 or 1987), a small staff will be needed for follow-up work, road maintenance, tree thinning, treatment of erosion problems as they arise and for the continuing assessment of the results of the rehabilitation program on parkland additions.

PROGRAM FUNDING

Techniques in the Redwood Creek basin rehabilitation comprise a variety of erosion control and road engineering techniques, some of which are novel. Others have been employed before on small, isolated sites, but none have been employed on a large scale such as that anticipated. Previous experience provides little information on costs of instituting and maintaining a rehabilitation program on this magnitude. Anticipated costs for the program, are itemized in Table 1.

REHABILITATION WORK PLAN

FY-80 - Major Program Start Up

Execution of first large scale vegetation and watershed rehabilitation projects, inventory of tributary erosional problems, determination of sediment transport rates in main channel, inventory of road erosional problems and commencement of evaluation program including the establishment of pretreatment conditions.

FY-82 - Escalation of Activity

Watershed and vegetation rehabilitation continues, tributary erosion control starts, completion of main channel sediment transport determinations and initiation of rehabilitation in the main channel, (if necessary) continuing road maintenance and minor road removal. Evaluation of program continues: Continuing interaction between evaluation effort and work supervision. (Note - The General Management Plan for RNP will be finished January 1, 1980, and will guide subsequent rehabilitation decisions, especially with regard to retained roads.)

FY-83-88 - Peak Activity of Program

All aspects of program in actual implementation phase except for roads, evaluation program proceeding at full scale. Road rehabilitation or removal increases as the need for road access terminates and the roads are no longer needed.

FY-89 - Activity Decreases

All critical watershed units in the basin have been treated, tributary and main channel Redwood Creek rehabilitation work now mostly completed, vegetation management and maintenance of erosion control structures continues, road rehabilitation (road removal becomes a major activity, the evaluation program proceeds).

FY-90 - Activity Levels Out at Relatively Low Cost

Evaluation program proceeds with preliminary conclusions starting to emerge, vegetation management proceeds, minor maintenance of erosion control structures continues, end of major road removal program, attention to erosional problems as they arise. Rehabilitation lands are now in a maintenance program.

PROGRAM ACCOMPLISHMENTS

Pilot Projects

Anticipating congressional action to expand Redwood National Park, the National Park Service initiated several pilot projects which were the beginning of cut-over land rehabilitation within the boundary of the original park as established in 1968. Four separate pilot rehabilitation projects were initiated during October, 1977. These original four projects were accomplished by three different contractors, employing a combination of several erosion control measures. Monitoring to evaluate the effectiveness of these initial four projects has been carried out for one year. Studies will be continued throughout the upcoming winter season.

To obtain a better appreciation and understanding of the problems and possible solutions that will be encountered in carrying out the rehabilitation program, the National Park Service convened a workshop in March, 1978. The workshop brought together professionals knowledgeable in erosion control and forest rehabilitation throughout the Northwest. Numerous scientists and technicians from State and Federal agencies as well as individuals from the academic community and the local timber industry provided oral presentations on various tested and untested methods of land and stream rehabilitation.

Thereafter, the National Park Service began five pilot rehabilitation projects on recently tractor-logged lands within the newly expanded park. These are serving as larger scale test sites on which various erosion control and restoration techniques are applied and evaluated in terms of the cost and effectiveness of the various procedures outlined above. The projects begun this fall (1978) incorporate 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 rehabilitation erosion control contracts were issued and successfully completed on all five units. Cost analysis of these projects as well as quantitative evaluations of the effectiveness of the prescribed measures will help direct future rehabilitation planning, prescription, and implementation.

Other trial efforts to restore disturbed parklands to pre-timber harvest conditions include thinning of dense stands of young, second growth trees. The objective of this tree thinning is to hasten the development of more nearly natural vegetation on the cut-over lands. Thinning will stimulate growth of remaining trees, adjust species composition, and eliminate exotic species of trees and shrubs. About 250 acres of thick second growth stands are currently being thinned on four test sites by both contract and by NPS employment of affected woods workers.

To afford protection of park resources from timber harvest activities in upstream reaches of the Redwood Creek drainage, park staff currently review logging plans within the park protection zone and other upstream areas. Similarly, Redwood National Park will act in assuring restoration of cut-over lands following timber harvest in the park protection zone and will monitor streams to detect potential harm to park values.

Stream monitoring, begun in 1973 for the national park by the U.S. Geological Survey, has continued to date. This monitoring program will proceed during and following the active rehabilitation program. Stream study refinements have been made annually to keep abreast of changing events and new discoveries within the Redwood Creek basin. These studies are funded by the National Park Service and park staff and work closely in support of and in cooperation with the USGS on this program.

Environmental Compliance

Environmental documentation has been prepared for two pilot projects: The Watershed Rehabilitation Program and the Second-Growth Forest Thinning. Negative declarations were signed August 15, 1978. To continue environmental evaluation of the 10-year Rehabilitation Program, an environmental assessment will be developed during 1979 and 1980 along with the more detailed plan of action. An environmental specialist will be added to the staff to determine effects of the program and to ensure that no sensitive resources, such as threatened or endangered species, and cultural resources, will be adversely affected by the proposed actions.

Staffing

During FY-77, 78, two full time, permanent scientists, and a permanent less than full time geologist were added to the park technical staff. A number of seasonal employees were added to assist with specific project activities. Recruitment for four key full time positions was initiated.

The National Park Service soon recognized the magnitude of technical and other problems faced in successfully implementing the rehabilitation program mandated by the 1978 Redwood National Park Act. In response, NPS instituted a reorganization and restaffing program at Redwood National Park consistent with the recognized need.

A new park superintendent possessing strong capabilities in natural resource management and program organization was assigned to Redwood National Park. An environmental scientist from the Washington, D.C. office of NPS was assigned to the park as an associate superintendent to organize and implement the rehabilitation program. A new park office was established in Arcata, California, to house the rehabilitation program